ACT PREPARATION, SOCIOECONOMIC STATUS, AND RACE/ETHNICITY: A QUANTITATIVE STUDY ON DIFFERENCES IN ACT SCORES

By

Kimberly Denise Herndon

A Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Education in Educational Leadership

Austin Peay State University
August 2021

Dissertation Committee:

Dr. John McConnell, Committee Chair

Dr. Thomas Buttery

Dr. Zachary Barnes

Dr. Schanda Doughty

August, 2021

To the College of Graduate Studies:

We are submitting a dissertation written by Kimberly Denise Herndon entitled "ACT PREPARATION, SOCIOECONOMIC STATUS, AND RACE/ETHNICITY: A QUANTITATIVE STUDY ON DIFFERENCES IN ACT SCORES." We have examined the final copy of this dissertation for form and content. We recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Education, Educational Leadership.

DocuSigned by:
Dr. John McConnell 7/23/2021 | 1:16 PM

Dr. John McConnell, Committee Chair

DocuSigned by:
Dr. Thomas J. Buttery 7/26/2021 | 12:49 PM

Dr. Thomas Buttery, Committee Member

DocuSigned by:
Zachary Barnes 7/26/2021 | 12:52 PM

Dr. Zachary Barnes, Committee Member

DocuSigned by:
Schanda Doughty 7/26/2021 | 9:01 PM

Dr. Schanda Doughty, Committee Member

Accepted for the Graduate and Research Council

DocuSigned by:
Dr. Chad Brooks 7/27/2021 | 9:49 AM CDT

Dean

College of Graduate Studies

Statement of Permission to Use

In presenting this dissertation in partial fulfillment of the requirements for the Doctor of Education degree at Austin Peay State University, I agree that the library shall make it available to borrowers under the rules of the library. Brief quotations from this dissertation are allowable without special permission, provided that accurate acknowledgement of the source is made. Permissions for extensive quotation or reproduction of this dissertation may be granted by my major professor, or in his/her absence, by the Head of the Interlibrary Services when, in the opinion of either, the proposed use of the material is for scholarly purposes. Any copying or use of the material in this dissertation for financial gain shall not be allowed without my written permission.

Kimberly Denise Herndon 07/13/2021

DEDICATION

I would like to dedicate this work to five of the most important people in my life, who have always showed me unfailing love and support throughout all my endeavors. First, my husband, Daniel, who always encourages me to pursue my dreams and loves, guides, and supports me throughout the process. Next, my precious daughter, Ella, who has shown me a kind of love that I never knew existed until she came along. She has given me countless hugs and words of encouragement that helped me keep going on my doctoral journey. I pray that she always has a heart full of love as she travels through life. My mom, Elaine, who has always been my go-to person and sacrificed her time to help me achieve the many things I always wished to do. I would not be who I am today without her. My dad, Noah, who was always so proud of me and who I know is smiling down on me from heaven. Finally, my brother, Noah, who has always had my back. We may be complete opposites, but we always make the best team. I love you all more than words can say.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank my Lord and Savior, Jesus Christ, who makes all things possible. I would also like to thank my dissertation chair, Dr. John McConnell, who was invaluable throughout this process. His constant encouragement, motivation for me to explore new ideas on my own, and willingness to answer my questions when needed helped push me to the end of this dissertation. He is everything one could ask for in a dissertation chair. To my other committee members, Dr. Thomas Buttery, Dr. Zachary Barnes, and Dr. Schanda Doughty, I appreciate your actionable feedback in pushing me to consider ideas I might otherwise not have realized. Thank you for devoting your knowledge and time into helping me grow as a researcher.

ABSTRACT

This study examined differences in participation or nonparticipation in an ACT preparation course, race/ethnicity, and socioeconomic status on ACT scores. Practice ACT scores were used as a covariate to control for individual differences in student scores. Participants consisted of 264 students from one graduating class at a large high school in Middle Tennessee. Five separate Analysis of Covariance tests were run to determine differences on composite scores and scores for each subtest of the ACT (English, math, reading, and science). Results indicated no statistically significant interaction effects between any group combinations of ACT preparation participation, race/ethnicity, and socioeconomic status. Results also yielded no statistically significant differences for ACT preparation participation or race/ethnicity, with no statistically significant differences existing between students who participated in an ACT preparation course and those who did not or between students of the majority and minority racial/ethnic groups. A statistically significant difference was found for socioeconomic status on English, mathematics, and science subtest scores but not for composite or reading scores.

Keywords: ACT, college admissions tests, test preparation, socioeconomic status

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter I

Introduction

"The SAT is not perfect. We all know smart, knowledgeable people who do badly on standardized tests. But neither is it useless. SAT scores do measure both specific knowledge and valuable thinking skills" (Postrel, 2001, para. 5). Although referring to the SAT, this quote could be generalized to represent the conflicting opinions surrounding standardized testing. Perceived benefits of standardized testing include identifying student strengths and weaknesses, selecting students for academic placement, predicting success, and improving academic achievement (Phelps, 2005). Criticisms of standardized testing include that these assessments only provide a superficial examination of student knowledge, are biased against certain groups, and restrict student learning (Worthen & Spandel, 1991). Despite the mixed opinions concerning standardized testing, the increased prevalence of these assessments in recent years produces data that are used in multiple ways.

One well-known use of standardized testing is as a component of the college admissions process. Most colleges and universities in the United States now have college admissions requirements that include standardized test scores, particularly those of the ACT, formerly known as the American College Test, or SAT, formerly known as the Scholastic Aptitude Test (What Works Clearinghouse, 2016). Universities typically set certain scores that students must meet in order to gain admittance. With schools that are highly selective, higher college admissions test scores can increase the likelihood a student will be accepted. Not only are these scores important to determining whether students are eligible for admission, but they are also important in determining eligibility for scholarships. As a result, test preparation programs that can assist students in raising scores on admissions tests are becoming increasingly popular.

In Tennessee, one of the most widely known scholarships is the HOPE lottery scholarship, which is part of the Tennessee Education Lottery Scholarship program. This scholarship provides up to $2,250 per semester to students who graduate from eligible Tennessee high schools and attend select in-state colleges (Tennessee Higher Education Commission & Student Assistance Corporation, 2020). One of the requirements for receiving this scholarship is that students earn a 21 or higher on the ACT. This scholarship is particularly lucrative to students due to its non-competitive nature. Rather than competing against other students to receive these funds, all students who meet the requirements are eligible to receive the HOPE scholarship. As a result, high schools in Tennessee can help students earn money for college by instituting test preparation programs that are effective in helping students earn the required score of 21 or higher on the ACT.

The importance of the ACT became even more significant with the passage of the Every Student Succeeds Act (ESSA). Despite including non-academic factors into school accountability measures, schools still face pressure to narrow curricula, teach to tests, and raise test scores (Saultz et al., 2019). As a result of ESSA, school districts implemented measures to increase the percentage of high school students who are considered Ready Graduates. Students can achieve Ready Graduate status by meeting certain requirements, which can include achieving a score of 21 or higher on the ACT, earning industry certifications, completing early postsecondary courses, and receiving qualifying scores on the Armed Services Vocational Aptitude Battery Armed Forces Qualifying Test (Tennessee Department of Education, 2018). Additionally, the ESSA requirements mandate that individual schools be held accountable for their performance on a Ready Graduate indicator, which involves either reaching a target percentage of Ready Graduate students or improving on a prior percentage by a predetermined

amount. This Ready Graduate indicator accounts for 20% of a school's overall score. Schools that do not meet overall scores required under ESSA are labeled as Focus Schools in need of targeted support. In order to improve their score on the Ready Graduate indicator and avoid becoming a Focus School, schools in Tennessee have placed an increasing importance on helping students achieve a score of 21 or higher on the ACT.

Problem Statement

Due to the importance placed on college admissions test scores across several contexts, schools have a significant interest in how students perform on these exams (Allen & Mattern, 2019). Performance on college admissions tests can factor into students' chances of acceptance into college, particularly at more selective schools, in addition to determining eligibility for merit aid (What Works Clearinghouse, 2016). Furthermore, many high schools and colleges use measures of students' ability to meet college readiness benchmarks, which are established by ACT, to identify students who are adequately prepared for college versus those who need remedial coursework (Allen & Radunzel, 2017). Due, in part, to the increasing number of states utilizing state funds to require high school students to participate in college admissions tests (Klasik, 2013), the percent of graduates who took the ACT increased from 38% in 1995 to 52% in 2018 (National Center for Education Statistics, 2019a). Despite this increase in the number of test-takers, the average national ACT composite score remains basically unchanged over the past 25 years, remaining at approximately 20.8 (ACT, 2019a; National Center for Education Statistics, 2019a). Several states use the ACT for federal accountability purposes (Camara & Westrick, 2017), which makes the implementation of effective strategies to increase these scores crucial for school leaders (Xi & Liu, 2016).

Purpose of the Study

This purpose of this study was to examine the differences in participation or nonparticipation in an ACT preparation (ACT Prep) course, socioeconomic status (SES), and race/ethnicity on ACT scores at one public high school in Middle Tennessee. Of the 1,854 students within this school, data was examined for a graduating 12th-grade class of 420 students. Students in this grade level participated in a practice ACT to determine baseline scores during their first semester of high school, and these scores served as a covariate for this study. Throughout their four years of high school, some students elected to take an ACT Prep course, which utilized ePrep test preparation software, while other students did not. All students were required to participate in at least one official ACT administration prior to graduating high school. Of the 420 students in this grade level, 264 students possessed all necessary data for inclusion in this study.

Significance of the Study

Test preparation can help students achieve score gains (Briggs, 2009). However, not all forms of test preparation result in equal outcomes. ACT Prep courses exist in many high schools, but there is no set format for how these preparation courses are taught. As a result, research describing the effectiveness of one preparation course is not generally transferable to all preparation courses. In order to determine the effectiveness of an ACT Prep course, the individual aspects of the program should be considered.

The ACT Prep course in this study utilized ePrep, which is a computer-based preparation program, throughout the one-semester course. Each section of the ACT received approximately four weeks of focus. Prior to preparing for each section, students completed a pretest within the ePrep program. Based on these results, the ePrep program provided students with individualized

feedback and instructional videos on skills with which they needed improvement. Teachers of the ACT Prep course provided students with additional preparation activities and progress tracking materials to promote student engagement. At the end of each four-week section, students completed a posttest from that subject area to determine growth before continuing to the next section of the ACT. Students could then have chosen to take additional quizzes or revisit prior material throughout the course.

Briggs (2009) acknowledged the rapid corporate growth in computer-based coaching programs accessed via the internet. Although some of these programs claim to result in significant score gains, actual score growth is typically much smaller and only guaranteed if specific conditions are followed. Additionally, these companies often report results using measurements of their own creation, which can be misleading. This particular study extended the knowledge base by examining differences in ACT scores for students from different SES and racial/ethnic backgrounds who either did or did not participate in the ACT Prep program, which used the computer-based ePrep program.

In addition to being significant to school leaders within this particular high school, findings from this study are relevant to other high schools within the district, all of which also incorporate the ePrep program within their ACT Prep courses. Although these ACT Prep courses have been offered within the district for several years, no statistical analyses had been conducted to examine differences in student ACT scores prior to this point. Results from this study will guide future research in determining which aspects of these courses assist or undermine student ACT scores and whether it could be beneficial to institute courses that use this program at other schools.

Chapter II

Review of Literature

Theoretical Framework

Cognitive information processing theory, which focuses on learning as occurring from changes with learners (Shuell, 1986), provides the basis for the theoretical framework of this study. Cognitive theory became prominent in the mid-1900s and represented a significant shift from the prior tenets of behavioral theory. Prior to the introduction of cognitive theory, early theorists described learning as occurring from behavioral approaches in which learning is impacted by environment, such as providing positive or negative reinforcement for responses (Shuell, 1986). From a behavioral approach known as response strengthening, teachers can be viewed as dispensers of rewards and punishments for which students are the recipients based on correct or incorrect responses (Mayer, 1996). Drill and practice is often considered an associated response strengthening strategy. The learner reacts to environmental conditions but is not an active participant in the discovery process (Ertmer & Newby, 1993). One criticism of behavioral approaches is that they aid in retention but do not allow for transfer of understanding to other concepts (Mayer, 1996). These types of strategies can have implications for learners, who may recall information in one setting but not be able to transfer this information to questions that are posed differently on standardized tests.

As opposed to behavioral theory, cognitive theory focuses on changes within learners, such as through the use of effective learning strategies (Shuell, 1986). Rather than reacting passively to environmental factors, learning is an active process that relies on the mental functions of the learner. Within this framework, emphasis is placed on how learners mentally process environmental events, code and relate new information with prior knowledge, and store

and retrieve knowledge as needed. In this manner, information processing theory compares mental processes to those of a computer in terms of receiving, storing, and retrieving information (Schunk, 2012).

Information processing theory acknowledges that cognitive processes occur in stages (Schunk, 2012). Miller (1956) researched limits on the capacity of memory, determining that memory is severely limited in its ability to immediately receive, interpret, and recall information. Atkinson and Shiffrin (1968) determined that human memory consists of sensory memory, short-term memory, and long-term memory. Information first enters the sensory memory for a brief moment before being lost. Short-term memory receives information from the sensory and long-term memories. Although information is only retained for approximately 30 seconds in short-term memory, rehearsal can allow individuals to maintain limited information for longer lengths of time. Information that reaches long-term memory can be stored indefinitely. Since standardized tests examine students' ability to recall prior knowledge, information that never reached the long-term memory stage may not be recalled. As a result, strategies that ensure transfer of information into long-term memory become crucial to successful student performance on standardized tests.

Examination of information processing theories naturally leads to investigation of strategies that can improve learning. Miller (1956) described chunking as one strategy that can improve memory capacity. When material is well-learned, individuals can recall large amounts of information in the form of a single chunk and relate parts of this chunk to other chunks (Winne, 2001). Slate and Charlesworth (1988) outlined several information processing strategies that can be incorporated into the educational setting, including maintaining students' attention, encouraging students to be active learners, and utilizing advance organizers and memory aids.

Information should be communicated to learners in meaningful ways that allow them to connect new information to prior knowledge (Schunk, 2012). Information processing strategies can be beneficial in preparing students to effectively store and recall information for standardized tests.

Standardized Testing

Before the 1850s, school-level testing mainly consisted of oral examinations (Gallagher, 2003). Due to the efforts of Horace Mann, written examinations were introduced into Boston schools and quickly spread to other locations. The goals of these written exams were to provide objective data about instruction, learning, and comparisons across schools and teachers. These tests were followed by the introduction of intelligence tests to help determine students' mental abilities and educational placement (Haney, 1981). The Army Alpha Test, which was a written multiple-choice assessment given to large groups of soldiers, became a model for subsequent standardized testing. Social factors compelled schools to increasingly rely on test results to describe student performance (Gallagher, 2003). The University of Iowa created the first tests that could be administered statewide, and the SAT and ACT were developed to set standards for the college admissions process.

As standardized tests were increasingly used, the need for standard administration procedures became evident (Gallagher, 2003). In order to compare results, these procedures included isolated test settings, standardized instructions, nationally endorsed questions vetted by test publishers, and outside-entity test scoring (Hanson, 1993). As testing increased, scores were increasingly used to determine student advancement, placement in special education programs, and academic honors (Gallagher, 2003).

Legislation has played a significant role in the fate of standardized testing in the United States. The Elementary and Secondary Education Act of 1965 aimed to provide equitable

opportunities to underprivileged children and changed the face of standardized testing by requiring schools to participate in standardized testing and present results in order to qualify for federal funding (Thomas & Brady, 2005). In 1969, the National Assessment of Educational Progress began testing samples of students from all states in order to gauge the state of student performance both nationally and internationally (Gallagher, 2003). Standardized testing was more firmly established through the publication of *A Nation at Risk* by the National Commission on Excellence in Education (1983). This report, which raised concerns about the declining state of education in America, identified problems and recommended improvements in several areas, including more rigorous standards and expectations. Specifically, the report encouraged standardized testing to certify students' credentials, identify areas in need of remediation, and identify opportunities for advanced work. The result of this report was an increased focus on educational reform which included more stringent standardized testing (Gallagher, 2003). Statewide testing was expanded in nearly every state. Average test scores in each state shed light on growing concerns of inequity in educational opportunities.

Several other major reform efforts have attempted to address inequity in education. The No Child Left Behind Act of 2001 required public schools to implement annual standardized tests in order to determine whether schools were making adequate yearly progress toward student proficiency (Dee & Jacob, 2011). Schools were subject to sanctions and rewards each year based on their progress, which was intended to increase focus and productivity. Over time, the mandates of No Child Left Behind became increasingly difficult for schools (U.S. Department of Education, 2021). As a result, in a reauthorization of the Elementary and Secondary Education Act, ESSA was passed in 2015. ESSA allows states more flexibility regarding requirements but

continues to focus on closing achievement gaps and increasing equity, quality of instruction, and outcomes for all students.

Despite the purported purpose of providing educational opportunities for all students through objective and equitable assessments, standardized testing has often been criticized (Gallagher, 2003). One common concern of standardized testing is that of teaching to the test, in which educators focus on drill strategies instead of the promotion of higher-order thinking (Lazarín, 2014). In a study that investigated teacher perceptions of testing effects, teachers reported feeling pressured to teach to the test, which hindered their ability to teach a balanced curriculum and detracted from a responsive learning environment (Thompson, 2013). Rather than such a focus on standardized testing, some educators favor a more learner-centered approach that utilizes diverse measurements of student progress (Gallagher, 2003).

Other concerns surrounding standardized testing are the overtesting of students, student test anxiety, and student motivation. Testing should be limited to the number of tests and time on tests needed to produce adequate information about student learning (Lazarín, 2014). Additionally, tests should be developed with quality in mind and should not interfere with meaningful classroom learning time. An additional concern of overtesting is that it can reflect poorly on students who already suffer from test anxiety. Individuals experiencing test anxiety view evaluations as threatening and experience strong emotional responses (Spielberger et al., 2015). The worry responses exhibited by these individuals can take their attention off the task at hand and interfere with effective performance. Finally, not all students are motivated to perform well on tests. Poor performance on standardized tests may not result in personal consequences to the students who take the tests (Brown, 2015). However, some states have instituted teacher evaluation systems in which student performance on tests is used to evaluate teacher

performance (Rutkowski & Wild, 2015). Additionally, school districts are subject to sanctions resulting from poor student performance, such as decreased funding, corrective actions, and school restructuring (Brown, 2015).

The next sections will focus on college admissions tests, which are another form of standardized testing. Students' ability to recall internalized information in order to perform well on these tests can be crucial to achieving successful scores.

College Admissions Tests

The process for college admissions varied greatly throughout the 1900s. Prior to World War I, students who desired to attend college typically sat for an interview and/or completed an exam administered by the specific college they wished to attend (National Association for College Admission Counseling [NACAC], 2008). The first College Board exams were curriculum-based and assessed students' knowledge of college preparatory subjects (Atkinson & Geiser, 2009). The face of college admissions tests was significantly altered with the introduction of the SAT and ACT. Although both of these assessments have introduced changes over the years, they remain renowned forms of college admissions tests.

SAT

At its inception, the SAT was believed to share common assumptions with the popular intelligence quotient (IQ) tests of the time, which were thought to measure a person's intelligence while assuming that one's intelligence did not change over the course of a lifetime (Atkinson & Geiser, 2009). The test has evolved from its original purpose of measuring students' aptitude. The current claim is that the SAT focuses on skills that are most important for readiness and success in college (College Board, 2021). The test contains four sections, which include Reading, Writing and Language, Math, and an optional essay, for a possible score of 1600

points. In all iterations, the SAT has remained stringent about claiming to measure students' general analytic ability instead of focusing on mastery of subject area content (Atkinson & Geiser, 2009).

From the outset, The SAT marked a distinct effort toward standardization. The test could be given easily to large groups of students, allowing comparisons to be made between students in a manner that grades from different high schools could not do (Atkinson & Geiser, 2009). The SAT also simplified the college admissions process for students who wanted to apply to more than one college (What Works Clearinghouse, 2016). The ease and cost effectiveness of use allowed students from disadvantaged backgrounds to participate in SAT testing, thus increasing their chances of receiving a college education and improving equity in the college admissions process (Atkinson & Geiser, 2009). Additionally, colleges used the SAT to help predict which students were likely to perform well if accepted.

ACT

Originally branded the American College Test, the ACT became a direct competitor to the SAT (Atkinson & Geiser, 2009). The ACT was founded upon the belief that college admissions should depend on students' achievement and not on their inherent abilities. Rather than focusing on the ability to memorize and recall facts, founders of the ACT believed that achievement tests should allow students to demonstrate their reasoning ability developed from participating in high school curriculum. The ACT was revised in 1988 to reflect a scale score of 1-36 (Camara & Harris, 2015). The scores from a nationally representative sample of over 100,000 students were used to create this scale. The introduction of calculators on the math test required that section to be rescaled in 1996. ACT has conducted stability and validity studies throughout the years to prove scale scores are consistent and ensure that scores are predictive of

student outcomes. ACT acknowledges that changes are important to keeping the ACT relevant. However, changes are introduced incrementally and incorporate feedback from comprehensive surveys of educators. Introducing changes in this manner helps maintain consistent interpretation of scale scores across years and groups of students.

In recent years, the ACT has slightly overtaken the SAT in number of participants annually. In 2019, 52% of graduating seniors across the nation had participated in the ACT at some point during their high school experience (ACT, 2019a). The composite average for the national graduating class of 2019 was 20.7, down from 20.8 the previous year, out of a possible score of 36. The current version of the ACT consists of four multiple-choice tests in English, mathematics, reading, and science (ACT, 2019b). Students may also choose to complete an optional writing section. Each multiple-choice question consists of either four or five answer choices, each with only one correct response. Total test time, without the optional writing or test break included, is 2 hours and 55 minutes. The following sections outline details about each section of the test.

English

The English section of the ACT consists of 45 multiple-choice questions that students must answer within 45 minutes (ACT, 2019b). Students are given five passages from different genres. Questions require students to select correct answers concerning edits and revisions to the text. Students receive an overall score for the English section in addition to separate scores in the areas of Production of Writing, Knowledge of Language, and Conventions of Standard English. The Conventions of Standard English questions, incorporating sentence structure and formation, usage, and punctuation, account for 51-56% of the total English score. The Production of Writing questions examine students' understanding of topic development and cohesion of text

and account for 29-32% of the English score. The final 13-19% of the English score is derived from Knowledge of Language, which requires students to demonstrate precision with word choice and consistency in style.

Mathematics

The mathematics section consists of 60 multiple-choice questions that must be answered within 60 minutes (ACT, 2019b). Students are allowed to use a calculator from an approved list on this section of the test. Content is designed to include math topics students have covered in the years prior to 12th-grade that are considered prerequisites to entry-level college mathematics courses. Students receive an overall mathematics score in addition to scores for eight subcategories. Preparing for Higher Mathematics accounts for 57-60% of the overall math score and includes questions concerning number and quantity, algebra, functions, geometry, and statistics and probability. The remaining 40-43% of the math score originates from Integrating Essential Skills through applying skills to more complex problems. Questions from each reporting category also require students to demonstrate modeling skills across the various mathematical topics.

Reading

The reading section of the test consists of 40 multiple-choice questions with a time limit of 35 minutes (ACT, 2019b). Students receive an overall reading score and four subscores. Divided into four sections, the first three sections each contain one long prose passage, with the fourth section containing two shorter prose passages. These passages are representative of what students will encounter during a first year of college. Passages encompass a variety of topics with which students must read closely, reason while citing evidence, and amalgamate multiple sources. Key Ideas and Details comprise 55-60% of the reading score and require students to

determine themes, summarize information, and make inferences. Craft and Structure, which accounts for 25-30% of the Reading score, asks students to determine meaning and author's purpose through analysis of text. Integration of Knowledge and Ideas, with which students must distinguish fact from opinion and form connections between multiple texts, is the final 13-18% of the score.

Science

The science portion of the test, similar to the reading test, is 40 multiple-choice questions with a time limit of 35 minutes (ACT, 2019b). In addition to the overall science score, students receive three subscores. Questions within this section surround specific scientific scenarios provided to the students. Background knowledge in Biology, Chemistry, Earth, and space sciences could help students answer these questions, but advanced knowledge of these subjects is not necessary. Instead, students must have the ability to examine, draw conclusions, and make associations about the information provided, which appears in the form of data representation, research summaries, and conflicting viewpoints. Interpreting Data, accounting for 45-55% of the score, requires students to analyze data presented in different scientific forms. Scientific Investigation is 20-30% of the score, and students must understand experimental designs and form conclusions. The final part of the score, Evaluation of Models, Inferences, and Experimental Results, is 25-35% and expects students to judge validity and form predictions based on their conclusions.

Writing

If opted to take, the writing portion of the test is completed after the four multiple-choice sections (ACT, 2019b). The test is comprised solely of composing one essay within 40 minutes. Four domain scores are averaged to create an overall score on a scale of 2-12. The four domain

scores are Ideas and Analysis, Development and Support, Organization, and Language Use and Conventions. The essay should incorporate skills learned throughout high school English courses and be similar to those of first-year college courses. Students are given a complex issue writing prompt with three varying points of view. Students must then explain their perspective in relation to those given.

State-Mandated Testing

In 2019, the majority of graduates in 26 states completed the ACT, with nearly 100% participation in 17 of those states due mostly to state-funded testing (ACT, 2019a). State-funded testing is thought to reduce barriers for students and increase the number of students who enroll in post-secondary education (Klasik, 2013). State-funded testing has also led to state-mandated admissions test participation in many states. Prior to state-mandated testing, some students chose not to take college admissions tests and were therefore uninformed of results that might have demonstrated their ability to be successful in college. NACAC (2008) agreed that incorporating the SAT or ACT as part of high school coursework could encourage students not to underestimate their abilities while also exposing them to a wide range of colleges to which they qualify for admittance. Prior to state-mandated stating, some students simply chose not to register for tests due to the extra effort required in order to register (Klasik, 2013). State-mandated testing makes it easier for students to participate without extra burden and move one step closer to college enrollment. Tennessee is currently one of the states that requires students to take the ACT as a condition of graduation and provides state funding to cover the cost of these tests.

As the number of states requiring students to participate in a college admissions test as a condition for graduation increased, a study was conducted concerning the effects of such a

requirement in Colorado, Illinois, and Maine (Klasik, 2013). This study sought to determine whether participating in a college admissions assessment changed students' college choices. The study discovered that requiring students to take a college admissions test changed the distribution of college types in which students enrolled. For example, Illinois observed an increase in admissions to four-year colleges. In addition, both Illinois and Maine saw decreased enrollment in two-year institutions. Colorado enrollment increased in private and selective colleges. These results lend credibility to the idea that state-mandated testing can increase college enrollment.

Admissions Test Score Use by Colleges

The role of college admissions test scores has been highly debated over the years. A What Works Clearinghouse Intervention Report (2016) identified three ways in which high stakes admissions tests can be used. These scores can be factored into admissions decisions made by colleges, can increase students' chances of being admitted to selective schools or limit their college choices, and can determine eligibility for merit aid. Ideally, students who improve their scores on college admissions tests should likewise improve their chances of college acceptance (Briggs, 2009). However, some universities are able to rely on other factors independent of standardized test scores, such as students' high school grades, to help determine student success (NACAC, 2008).

Some schools rely heavily on standardized tests as a means of predicting students' success in college (NACAC, 2008). A survey conducted by NACAC attempted to determine how much college admissions test scores factored into four-year colleges' acceptance decisions (Briggs, 2009). Although 78% of universities indicated that test scores were only used holistically, test scores were still rated as important, with only curriculum strength and student grades receiving higher rankings. On a scale of no/limited/moderate/considerable importance,

58% of respondents indicated that test scores rated considerable importance, with the average rating between moderate and considerable. In a survey of whether an average score increase on a college admissions test could increase a student's likelihood for admission if all other factors remained constant, results showed that nearly one-third of surveyed institutions indicated that, in certain cases, the score increase could benefit the student's chance of admission.

In addition to admissions decisions, ACT scores can be used to predict success in college. Westrick et al. (2015) found that ACT composite score and high school grade point average (GPA) were highly correlated with performance during the first year of college. Additionally, ACT composite score and high school GPA continued to be effective predictors of performance through the beginning of the third year of college. The best predictor of continued retention during the second and third years of college was first-year performance. Williams et al. (2018) recommended using a combination of cognitive factors as predictors of college retention rate. Specifically, the collective use of high school GPA, first-year college GPA, ACT or SAT score, and academic major produced statistically significant results.

College Readiness

A highly debated topic in recent years has concerned whether students are adequately prepared for college coursework upon leaving high school. The National Center for Education Statistics reported that, in 2016, 30.9% of public students at four-year institutions and 55.5% of students at two-year institutions reported having to take at least one remedial course upon entering college (Campbell & Wescott, 2019). Hoyt and Sorenson (2001) noted an alarming rate of students who passed high school English and math courses but still needed remediation for these courses at the college level. These results could be interpreted as either a lack of rigor in course content or lack of student retention at the high school level.

ACT Benchmarks

ACT, Inc. has established college readiness benchmarks to help determine students' reasonable chance of success during first-year college coursework. Specifically, "students who meet an ACT Benchmark have at least a 50% chance of earning a B or higher grade and approximately a 75-80% chance of earning a C or higher in the corresponding college course or courses" (Allen & Radunzel, 2017, p. 2). Benchmark scores were established by ACT after examining first-year college work of students from a wide range of institutions (Allen & Radunzel, 2017). ACT recommends that benchmark scores be used for identifying college students who are adequately prepared for coursework or who need additional remediation. Additionally, secondary schools can use benchmarks to evaluate whether students are ready for college and monitor improvement over time.

The current benchmarks for each ACT subtest are an 18 in English, 22 in math, 22 in reading, and 23 in science (Allen & Radunzel, 2017). In 2019, the percentage of students who demonstrated readiness for college coursework by meeting at least three of the four ACT college readiness benchmarks was 37%, which had declined 1% from 2018. Additionally, college readiness, as assessed by benchmark scores, has decreased in all subject areas since 2015 (ACT, 2019a).

Although less than ideal, student backgrounds are often associated with their performance on tests. Additionally, students' differentiated backgrounds can affect their access to strategies that could improve their ability to process information and perform successfully on tests.

Student Background

Studies have indicated that students from different subgroups exhibit significant differences in ACT scores (NACAC, 2008). When too much emphasis is placed on admissions

test scores, colleges could be increasing the disproportion of underrepresented students. Although admissions tests are standardized to purportedly level the playing field, test scores have shown high correlations with personal and family characteristics over which students had no choice.

Students considered underserved in terms of the ACT can fall into three categories (ACT, 2019a). The first category is identification with a minority group, specifically African American, American Indian, Hispanic, or Pacific Islander. The second category is having a family income that is less than $36,000 per year. The final category consists of the highest parental education level being a high school diploma or less. Recently, more than 40% of students who participated in the ACT fell into at least one of these categories (ACT, 2019a). Students who identified with one underserved category demonstrated lower levels of college readiness than students who belonged to neither category. When compounded by identification with multiple categories, the levels of college readiness became progressively lower. Of the students in 2019 who fell into all three categories, only 9% demonstrated college readiness by meeting three or more of the ACT benchmarks.

SES

SES has long been a societal concern. SES can affect individuals' physical and mental health (American Psychological Association, 2021). Additionally, factors associated with SES, such as poverty, poor health conditions, and lower educational achievement can have a direct impact on society. Individuals from lower SES backgrounds often experience lower levels of educational attainment, thus affecting their earning levels as adults (Rouse & Barrow, 2006).

Although it is commonly thought that SES is significantly linked to academic achievement, results have been mixed (Chen et al., 2018). Studies have shown that family

background accounts for most of the variance in academic achievement (Berkowitz et al., 2017; Lawson & Farah, 2017). A meta-analysis of approximately 200 studies corroborated this positive correlation (White, 1982). When examining a group of 20,000 students over a six-year period, Rouse and Barrow (2006) separated students into four quartiles based on family income. Students in the highest quartile demonstrated the highest test scores, were less likely to be held back a grade, and were more likely to earn a high school diploma. Sirin (2005) conducted a meta-analysis that indicated the relationship between SES and academic achievement was not as high as previously concluded by White (1982). This finding could be attributed to the use of more precise measurements of SES, social and policy changes, and/or increased access to educational materials in the years following White's (1982) study. Additionally, an increased focus on economic desegregation could have contributed to a lower correlation. Other studies have found no significant correlation between SES and academic achievement (Ripple & Luthar, 2000; Seyfried, 1998).

School conditions play a role in student success. Without access to quality schools, the chance of transmission of low SES from parent to child is often heightened (Rouse & Barrow, 2006). Students with low SES who attend experience higher academic achievement than those who attend low-quality schools (Lim et al., 2014). When considering school quality as separate from student-level variables, high-quality schools exhibit strong academic orientation, have lower teacher-student ratios, and have greater access to resources (Gemici et al. 2013). Additionally, low SES students who attend high-quality schools are more likely to complete school, attend college, and experience higher earnings (Chetty et al., 2011). Brown et al. (2016) determined that students from low SES backgrounds have unequal access to information about higher education. In many cases, these students rely on internet resources for information but

need help in understanding this material. African American and Latino students with high aspirations in high-poverty areas of Chicago were found to have to rely on their schools for information about the ACT and higher education resources (Deil-Amen & Tevis, 2010). Much of this information proved to be faulty, as students remained unaware of preparation opportunities.

Maintaining quality schools for disadvantaged students is a difficult task. Based on school zoning, students from similar SES backgrounds typically attend the same schools, thus overwhelming schools who are struggling to meet the needs of disadvantaged students (Aikens & Barbarin, 2008; Rouse & Barrow, 2006). Maintaining smaller class sizes and improving teacher quality are two effective strategies for improving school quality for disadvantaged students (Rouse & Barrow, 2006). Students who experience small classes are also significantly more likely to attend college (Chetty et al., 2011). However, despite legislative efforts to equalize school quality for all students, affluent families can still counteract these efforts due to their ability to pay for more educational opportunities outside the school setting (Rouse & Barrow, 2006). Efforts to improve school quality in underprivileged areas should include a focus on teaching and learning, effective leadership, positive school culture, learning communities, professional development, parent involvement, and external resources (Muijs et al., 2004).

Teacher quality is yet another factor to be considered with SES. In many cases, the highest achieving students are taught by higher quality teachers (Clotfelter et al., 2006). Experience and licensure test scores have been shown to be positively correlated with student achievement. In addition to years of experience, quality of teacher preparation has been linked with academic achievement (Gimbert et al., 2007). When higher quality teachers are paired with higher achieving students, test scores in math are positively impacted (Clotfelter et al., 2006). However, the social effects of these pairings deserve further consideration.

In further examining the meta-analyses of White (1982) and Sirin (2005), it was determined that other factors can temper the relationship of SES and academic achievement. Personal characteristics of students, such as age and race/ethnicity, can be important variables (Chen et al., 2018). Furthermore, the manner in which SES and academic achievement are measured can play a vital role. For example, parental education level, which can be used as a measure of SES, has been found to be correlated with academic achievement (Ludeke et al., 2021; Pishghadam & Zabihi, 2011; Scarr & Weinberg, 1978). When deciding how to measure academic achievement, a number of measures could be selected, such as IQ, GPA, or specific subject area scores (Chen et al., 2018). The use of different variables can contribute to mixed results when attempting to relate SES and academic achievement.

Studies have shown that SES can affect student literacy gaps even before students enter the school setting (American Psychological Association, 2021). Family characteristics, including home literacy environment, number of books owned, parent distress, and receipt of center-based care, are significant to reading outcomes (Aikens & Barbarin, 2008). These factors have been shown to be most influential during the initial stage of kindergarten. This finding implies that the adverse effects of SES prior to kindergarten can be overcome with proper literacy interventions. Family factors have less of a significance from kindergarten through third grade, when school and neighborhood factors play more of a significant role in continuing students' reading progress.

Students from low SES backgrounds can perform differently on tests depending on how the test is perceived (Croizet & Dutrévis, 2008). When described as a test of intellectual ability, low SES students performed lower than high SES students. However, when described as non-diagnostic of intellectual ability, low SES students performed as well as their high SES

counterparts on the same test. Additionally, low SES students' motivation to persist academically is greater if they believe socioeconomic mobility is possible in their society and lower if they do not believe mobility is possible (Browman et al., 2017). When examining students' learning motivation, consisting of challenge, engagement, and intrinsic and extrinsic motivation, Chen et al. (2018) determined that the effect of SES on reading ability differs based on students' motivation.

When examining ACT scores, Marchetti et al. (2016) found that students from low SES backgrounds had statistically lower ACT reading and math scores and were less likely to meet benchmarks in both of these areas than students who were considered more affluent. Students from low SES backgrounds who met both benchmarks were more likely to be involved in extracurricular activities. Surprisingly, students from low SES backgrounds who met the reading benchmark were found less likely to have two employed parents.

Using National Education Longitudinal Study (NELS) data, Buchmann et al. (2010) examined the relationship between family background and SAT scores. This study indicated that family income and parental education level had large and significant effects on SAT scores. When examining five-year ACT score trends from 2012-2016, the achievement gap between high-income and low-income students increased slightly (Mattern et al., 2016). In 2016, students who reported a family income higher than $80,000 scored an average composite score of 23.6 as opposed to a score of 19.5 for students with family income lower than $80,000.

SES concerns have contributed to the controversy surrounding the use of college admissions test scores in selection criteria (Alvero et al., 2021). One criticism of using college admissions scores in the selection process is that these scores are simply reflections of students' SES backgrounds (Colvin, 1997). However, SES has been shown to be a weak predictor of both

academic performance and retention, with ACT composite scores and high school GPA showing stronger relationships (Sackett et al., 2009; Westrick et al., 2015). Alvero et al. (2021) recommend considering how SAT information is encoded in non-numerical analyses of selection criteria, specifically the use of student essays. These researchers found that essay responses reflected a higher correlation with household income than did SAT scores. Efforts to equalize the college admissions process should consider how social class is incorporated into these essays.

Race/Ethnicity

The ethnic distribution of students in the United States has changed in the past decade. The population of White students in the United States decreased from 62% in 2000 to 51% in 2017 (de Brey et al., 2019). The African American student population also decreased, though by a smaller margin with a change from 15% to 14%. The percentage of Hispanic students increased from 16% to 25%, and the Asian student population increased from 3% to 5%.

Research has typically shown that African American students exhibit lower academic achievement than White students (Battle & Lewis, 2008). Research has also drawn attention to the gaps that exist between White and Hispanic students, with White students typically outscoring their Hispanic peers (Paschall et al., 2018). These gaps tend to get wider as students progress through school, and efforts to reduce the effects of inequality are not widely successful. In a 25-year span, the achievement gap between White and African American students narrowed slightly in both reading and math for fourth-grade students (de Brey et al., 2019). However, gaps in these subjects at the eighth-grade level were still the same as 25 years ago. Between White and Hispanic students, the achievement gap closed slightly for eighth-grade students in reading but remained the same in other areas.

Students are often members of both minority and low SES groups. In 2016, the percentage of children living in poverty was highest for African American students at 31%. The percentage of Hispanic students in poverty was 26%, while only 10% each of White and Asian children were reported as living in poverty (de Brey et al., 2019). While it is possible that these associations place these students at additional disadvantages, SES has been found to be more than three times more important than race when determining student outcomes. Additionally, when SES is controlled, African American students have been shown to outperform White students (Battle & Lewis, 2008). When examining data in math and reading achievement from three age groups of students across 20 years, the gap between poor White and poor Black and Hispanic students grew (Paschall et al., 2018). However, the gap between non-poor White and non-poor Hispanics lessened, indicating that poverty and race/ethnicity should both be considered rather than separated as two separate entities.

Students who attend schools with high-minority populations demonstrate lower gains, even when controlling for SES, than those who attend culturally diverse schools (Ready & Silander, 2011). Despite this finding, segregation of minority groups based upon location, often in high-poverty urban areas, is still prevalent and places students' academic achievement at risk (Presidential Task Force on Educational Disparities, 2012). Additionally, high-minority schools tend to have less access to resources, larger class sizes, and teachers with less credentials.

Although treating all students the same can be viewed as synonymous with equaling the playing field, this act can be detrimental when taking cultural considerations into account (Morgan, 2010). In order to promote academic success for minority students, teachers should adjust teaching styles to account for different learning and communication styles of racial and ethnic groups. Some cultural recommendations include recognizing the significance of culture in

instructional settings, preventing stereotypes, resolving cultural conflicts within schools, integrating home and school cultures, and promoting communication concerning the instructional process (Trueba, 1988). The faculty of schools often does not accurately represent the diversity of the student population (Jenkins, 2018). In order to meet the needs of all students, teachers must examine their own levels of cultural competency and strive to become culturally responsive educators. A culturally responsive approach to teaching helps all students obtain information about cultural diversity and uses cultural heritage and experiences as instructional tools (Gay, 2015). Although some level of resistance to culturally responsive teaching can be expected, maintaining positive attitudes can produce better teaching and learning for culturally diverse students.

Focus has also been placed on strategies that can close achievement gaps among groups of students. Within the classroom, teachers should promote student engagement, elaboration of student responses, classroom discourse, and practice teacher responsiveness (Presidential Task Force on Educational Disparities, 2012). Teachers should be exposed to more effective professional development. School leaders must encompass administrative, instructional, and human relations leadership roles. Academic support programs should help students improve in areas where they are behind and enrich them in others. Partnerships should exist between schools, families, and the community to support student success (Henderson & Mapp, 2002).

Parental involvement can also make a difference in achievement for students (Zhang et al., 2015). Statistically significant differences exist between parental involvement and student achievement based on students' race/ethnicity (Desimone, 2010). Zhang et al. (2015) found that African American parents showed lower rates of participation in school activities than White parents and were less likely to talk about school experiences with children at home. Although

parent participation in school activities was not significantly linked to student achievement, talking to students about school showed a positive link with student achievement. Epstein et al. (1997) have recommended several types of parent involvement toward improving student outcomes. These include providing a home environment conducive to learning, communication with schools about student achievement, volunteering at school events, participating in academic activities at home, participating in school decision-making processes, and engaging in community activities that promote learning.

Average ACT composite scores further demonstrate differences between racial/ethnic subgroups. In 2018, students in the Asian category scored highest with an average of 24.5, followed by White with 22.2, Hispanic/Latino with 18.8, Native Hawaiian/Other Pacific Islander with 18.2, American Indian/Alaskan Native with 17.3, and Black/African American with 16.9 (ACT, 2018). College readiness, as assessed by meeting benchmark scores on the ACT, has increased from 59% to 62% for Asian students in 2019. However, college readiness percentages have decreased for all other racial/ethnic subgroups (ACT, 2019a).

When considering SAT scores provided through NELS data, Buchmann et al. (2010) discovered that Asian students scored approximately 35 points higher on the test than White students, while African American students scored 40 points lower than White students. Other minority groups did not score significantly different than White students. According to the National Center for Education Statistics (2019b), Asian Americans scored highest on the SAT in 2018, scoring an average of 1223 out of a possible 1600. White students were 100 points lower with a score of 1123, followed by Hispanics with 990 and Black students with 946.

Although often praised for their ability to compare students' performance objectively, college admissions tests can place students who struggle to recall information quickly at a

disadvantage. The following sections will examine the associations between different methods of test preparation and test performance.

Test Preparation

The goal of test preparation activities is to improve performance on a test as compared to what otherwise would have been achieved (Briggs, 2009). At a minimum, test preparation should provide students with test-taking strategies and familiarity with content (Park & Becks, 2015). The ACT is designed to measure students' knowledge and skills obtained throughout their high school courses. This design aligns with a recommendation from NACAC (2008) that test preparation programs should align with college preparatory coursework. In addition to normal preparatory coursework, some students pursue additional forms of test preparation. One form of individual test preparation is evidenced by students who choose to purchase test preparation books in order to review and practice. Overviews of test preparation and practice problems are usually available on test companies' websites (Briggs, 2009). The ACT, Inc. (2021) website contains access to test preparation materials, both free and for purchase, that students can use to help prepare for the test. These materials include study books, online programs, and access to practice tests and questions. Other students choose to pursue more formal coaching opportunities (Briggs, 2009). Test preparation can be termed coaching when activities are led by an instructor rather than structured by the student. Examples of coaching activities include classroom-based courses, online coaching, and individual or small group tutoring.

Due to the long-term skills being measured by the test, ACT, Inc. advises against expecting cram sessions to produce better score results (ACT, 2019b). If short-term test preparation had the ability to boost test scores significantly, then college admissions tests as valid and reliable measures of college readiness would be doubtful (Briggs, 2001). However,

ACT, Inc. does encourage certain test preparation tactics, including becoming familiar with test content, updating knowledge in each content area, and studying unfamiliar content areas (ACT, 2019b). NACAC (2008) also advised becoming familiar with the format and administration procedures of the test, in addition to incorporating basic study skills. Content review, item practice, and familiarization of test format are all typical components of test preparation (Briggs, 2009).

Preferred Methods of Test Preparation

Briggs (2009) examined the types of test preparation activities chosen by high school seniors. Percentages of students who participated through high school test preparation courses, commercial coaching, individual or small group tutoring, and printed study books had remained approximately the same as previous years. However, a sizable increase of approximately 20% was noted in the use of computerized preparation by students due to an increase in internet usage. Students who participated in coaching were more likely to have also participated in other forms of test preparation, such as using study books and practice tests (Powers & Rock, 1998).

Students who attended larger high schools and schools with more Advanced Placement (AP) course offerings were more likely to have participated in more elite forms of test preparation, such as private tutoring (Park & Becks, 2015). Students who talked only with school counselors were found more likely to participate in private tutoring forms of test preparation, whereas students who talked with both counselors and teachers were found more likely to participate in all forms of test preparation. Talking with a parent also contributed to participation in test preparation (Buchmann et al., 2010; Parks & Becks, 2015).

Using a sample of students who registered for the SAT I test, Powers and Rock (1998) discovered that only 12% of registered students sought coaching outside of their high school

setting. This discovery stresses the importance of having accessible and effective test preparation courses in high schools. The coached students in the Powers and Rock (1998) study differed from uncoached students in several ways, including ethnicity, parental education, and parental income. Coached students were more likely to be Asian, have parents with formal education, and come from more affluent families.

Results of Preparation on Test Scores

Briggs (2009), commissioned by NACAC, authored a report intended to advance knowledge surrounding test preparation. In this report, Briggs noted a considerable lack of research had been published on the effects of test preparation since the year 2000, with only two studies being conducted concerning the effects of test preparation on ACT performance. After reviewing these studies, Briggs concluded that test preparation yielded a small positive effect on college admissions test scores. However, the results of these studies could be misleading for several reasons. First, these studies did not consider the varying quality, setting, and duration of coaching. Additionally, coaching results could be more or less effective for different types of students. Additional studies conducted on a larger scale would be useful in examining the effects of different types of test preparation.

In an attempt to address the need for more reliable research discussed by Briggs (2009) and using data from studies by Schiel and Valiga (2014a; 2014b), a study by Moore et al. (2018) examined the relationships between test preparation and score gains. Students who participated in test preparation prior to taking the ACT for a second time showed a growth of .71 scale score points when compared to the score growth of students who did no preparation. The effects of test preparation were not different depending on race/ethnicity, gender, or family income. These results indicated that test preparation is equally effective for minority versus majority

racial/ethnic groups, males versus females, and low-income versus high-income students. However, this study indicated that more research is needed concerning family income and effectiveness of test preparation method due to the small number of low-income and middle-income students who utilized private tutors.

Individual Preparation

Using NELS data, Briggs and Domingue (2009) found that using study books had a .60 effect on the English section of the ACT. This same study showed the use of study books had a small significant effect of seven points on the math section of the SAT for students who took the test without having previously taken the PSAT, which is a precursor to the SAT. However, a study of different NELS data concerning SAT scores showed that using books, videos, or computer software while utilizing no other forms of test preparation did not produce significant score gains (Buchmann et al., 2010). Another study determined that rate of SAT homework completion and completion of more practice tests led to higher score increases (Appelrouth et al., 2017). Additionally, students who participated in official SAT administrations showed greater gains than students who took only unofficial practice tests.

Coaching Preparation

Briggs (2002) found that the only forms of test preparation resulting in a significant effect on SAT scores were use of a private tutor and participation in a commercial coaching class. The commercial coaching effect was 15 points on the math section of the SAT and eight points on the verbal section. However, these scores did not control for SES, academic background, or motivation. These results were supported by a later study that reported private tutoring showed a gain of 15 points on SAT math scores with participation in commercial coaching resulting in a gain of 13 points (Briggs & Domingue, 2009). Although the effects of these results were

significant, the magnitude was considered small. Buchmann et al. (2010) also concluded that private courses and private tutors produced significant results, producing score gains of 30 and 37 points on the SAT, respectively. Byun and Park (2012), however, found that only private commercial courses had an effect on SAT scores, and this effect only proved true for East Asian Americans.

Domingue and Briggs (2009) used propensity matching on SAT scores, which compared comparable samples of coached and uncoached students. The results of this study were similar to previous studies of coaching effects. For students who took both the PSAT and SAT, coaching resulted in gains of 11 to 15 points on the math section and 6 to 9 points on the verbal section, although only the math results were statistically significant.

When considering the ACT, Briggs (2002) reported no evidence of a coaching effect on the math section, a small positive coaching effect of .55 on English scores, and a slight negative coaching effect of -.66 on the reading section. Briggs and Domingue (2009) reported that private tutoring resulted in an effect of .43 on the math section of the ACT. When considering students who took the ACT for a second time, working with a private tutor or consultant had a statistically significant effect on retest scores (Moore et al., 2018). Similar results were found in another study in which students took the SAT a second time, with the addition that individual tutoring produced greater increases in SAT scores than group tutoring sessions (Appelrouth et al., 2017). These results received support from an expanded study by Appelrouth et al. (2018) that also recommended high school test preparation courses consider incorporating methods deemed to be successful, such as starting preparation earlier, timed practice tests, spacing sessions over time, providing sufficient instruction, and encouraging students to test multiple times.

The results of participating in a high school preparation course vary across studies. In a study of students who took the SAT without previously taking the PSAT, participation in a high school preparation course resulted in a negative effect of 10 points on SAT verbal scores (Briggs & Domingue, 2009). However, this study also discovered that no forms of test preparation had significant positive effects on SAT verbal scores. A separate study of NELS data on SAT scores showed taking a high school preparation course produced a significant gain of 26 points on the SAT (Buchmann et al., 2010).

In a study of junior-level students in the suburban Midwest, a group of 52 students volunteered to participate in an ACT coaching program in 2011 (Moss et al., 2012). This coaching took place over four weeks and comprised 20 hours of study, with half of the time spent on math and science and half on reading and English. Coaches were experienced teachers from a private learning center that offered test preparation. Students were divided into two groups based on skill level derived from prior ACT scores. Instruction for the two groups was differentiated to address target skills for each score range. Test preparation activities included reviews of ACT content, test-taking strategies, and practice tests. Results showed that students who participated in the coaching class increased their ACT composite scores by an average of 1.50 points, which was a statistically significant result. The 55 students who did not participate in coaching increased their scores by .65 points. The coached group also demonstrated higher growth on each of the ACT subtests. These results indicated that coaching and test preparation does improve ACT scores. However, the small number of participants was a limitation in this study. A program in Minneapolis and St. Paul that provided randomly selected students with two years of college preparatory work determined that the program did not have a significant effect on ACT scores as compared to students who did not participate in the program (Avery, 2013).

Computerized Test Preparation

McClain (1999) conducted a randomized controlled trial in order to determine the effects of two computerized test preparation programs, *The Standard Study Guide for the SAT* and *Your Personal Trainer for the SAT*. Both programs covered both math and verbal sections and used drill items and a diagnostic feature. The results of students in these programs were compared with the results of students who received no testing preparation. No statistically significant difference existed between either of the groups using the computer programs and the group who received no preparation. One limitation of this study was its sample size of only 60 participants. However, the What Works Clearinghouse (2016) deemed the study to meet its standards of design. When examining students who participated in both a PSAT and SAT administration, Briggs and Domingue (2009) reported that using a computer program resulted in a small, negative effect of seven points on SAT math scores.

In recent years, computerized test preparation has become increasingly popular (Briggs, 2009). A number of companies, such as Kaplan, Princeton Review, Prep Scholar, etc., boast websites advertising their various test preparation services. ePrep, which is the test preparation program used within the current study being researched, is one such form of online test preparation. This program was introduced by ePrep, Inc. in 2007 and provides services for both the ACT and SAT (ePrep, 2021). This program offers students online practice, full-length practice tests, and practice quizzes. ePrep's basic methodology involves taking and grading a practice test, reviewing video explanations, and repeating the process multiple times. Students begin by selecting either a full-length practice test or a shorter quiz to complete. Answers to the assessments are entered online and graded to provide feedback. Every question is accompanied by a video from a master teacher who gives an explanation of the answer. After reviewing the

explanation videos, students are advised to repeat the process by selecting a new test or quiz on which to apply the skills they have learned in order to further their practice.

The ePrep platform provides several features designed to make the test preparation experience more efficient for students (ePrep, 2021). Students are provided with information about their current scores and target scores to help determine progress toward goal achievement. Once students have completed a test, they are provided access to a video explanation of each question and additional videos providing related subject-area content and test-taking strategies. Areas of weakness are diagnosed for each student based on the results of their practice tests. Based on these diagnoses, specific content or strategy videos are recommended for review. A separate quiz section provides access to shorter assessments that are focused on a particular area. Students can select quizzes based on their diagnosed weaknesses in order to focus on just those content areas.

Race/Ethnicity, SES, and Preparation

African American students have been found more likely to take advantage of test preparation opportunities than White students from comparable backgrounds (Buchmann et al., 2010). Park and Becks (2015) corroborated these results for African American students and reported a similar finding for Asian students. When African American students participated in more test preparation activities than White students, the score gap decreased (Buchmann et al., 2010).

Ellis and Ryan (2003) examined test score disparities in a group of 170 undergraduates. The first result of this study determined that White students scored higher on a cognitive ability test than African American students. However, the study also concluded that a significant difference existed between the two groups when measuring the use of ineffective test strategies.

These ineffective test strategies proved to be a predictor of students' performance on the cognitive ability test. When considering race alone, race accounted for 21% of the variance in test scores. However, when ineffective test strategies were included, race accountability dropped to only an incremental 11% of the variance, suggesting that appropriate test-taking skills could reduce the score gap between White and African American students. In an attempt to generalize the results of this study to other samples and measures of performance, Dollinger and Clark (2012) corroborated these results using a convenience sample of students from one academic college course over several years. Additionally, results showed that younger students were more likely to use ineffective test strategies than their older counterparts.

Access to test preparation is often differentiated based on family income or availability of resources within high schools (NACAC, 2008). Students without the financial means or access to test preparation could be penalized by earning lower test scores than students who were able to access these resources. Buchmann et al. (2010) also attempted to discover if family income and parental education contributed to students' choice of test preparation. Results determined that students from low-income backgrounds and lower parental education levels were more likely to complete no test preparation or only use the most affordable types, such as books, videos, or computer software. Students from higher-income backgrounds were more likely to use the most expensive types of test preparation, such as private tutors or private courses compared to no preparation. Park and Becks (2015) found that having a parent with an advanced degree contributed to a higher chance of participation in private tutoring or preparation courses, and having a parent who attended college was related to participation in a high school or private course. Domingue and Briggs (2009) determined that coaching is more effective from students with high SES backgrounds and who have completed more rigorous coursework.

False Claims of Score Gains

It is difficult to determine an exact number of points an individual can raise a test score through test preparation (NACAC, 2008). Although commercial test preparation providers often make claims that their programs can raise test scores by a significant number of points, research has shown that average gains are much more modest (Briggs, 2009; Powers & Rock, 1998). For example, research has shown that the typical gain on the SAT is between 20 and 30 points, despite claims of test preparation strategies that can raise SAT scores 100 points or more (Buchmann et al., 2010; NACAC, 2008). A study by Powers and Rock (1998) determined that students who received coaching were only somewhat more likely to exhibit large score gains. On the verbal section of the SAT I, 12% of coached students raised their SAT scores by more than 100 points as compared to 8% of uncoached students. On the math section, 16% of coached students showed gains of 100 or more points compared to 8% of uncoached students. In addition to these findings, students in both coached and uncoached groups were found more likely to show no score gains or decreased scores instead of large score gains.

The discrepancy in score gains is often accentuated by commercial test preparation companies who only survey past customers to determine score changes (Powers & Rock, 1998). True experimental research that compares score gains from coached students and non-coached students, who may also exhibit score gains even without coaching, would be the best method for verifying such results. Commercial services that boast guaranteed score gains can mislead students in other ways as well (Briggs, 2009). If an initial test intended to provide a baseline score is purposely made too difficult, it can appear that students earned score gains on a subsequent test that is actually easier. Coaching companies have little incentive for examining their programs under controlled experimental conditions likely to produce more accurate results.

When considering test preparation opportunities, it is important that students and families receive objective information about the success of the programs in question (NACAC, 2008).

Time Spent on Test Preparation

Research has shown that the amount of time spent preparing for tests affects the outcome. Of 9,654 students who took the ACT twice, students who studied more than 20 hours for the second test raised their scores an average .70 points more than students who only studied 3-6 hours (Schiel & Valiga, 2014b). Additionally, the average score for students who studied more than 20 hours for the second test was .90 points higher overall than for students who studied 3-6 hours. Students who studied for both tests, regardless of the amount of time spent, showed little change in composite scores. In a separate study, students who spent more than 11 hours working with a private tutor demonstrated significantly higher scores when taking the ACT for a second time when compared with students who spent no time with a tutor (Moore et al., 2018). In a study of students who prepared for the SAT, time on task had a significant effect on SAT score increases. Students who started preparing for the test earlier in their 11th-grade year and spread their tutoring sessions more throughout the year showed the greatest increases (Appelrouth et al., 2017).

Students' Self-perception of Test Preparation

When considering students who took the ACT more than once, students' self-perception of their preparation was a significant predictor of how well they performed on the second test. Students who reported feeling inadequately prepared for a retest scored .32 scale score points lower than students who reported feeling prepared (Moore et al., 2018). Powers and Rock (1998) found that students who had participated in coaching activities were more likely to feel that their previous test scores were underestimates of their ability to perform well. This group was also

more likely to be anxious about testing and place more importance on obtaining good scores. Students who did not participate in coaching believed their prior test scores to be accurate representations of their abilities (Powers & Rock, 1998).

Retesting

Not all score increases can be attributed to targeted test preparation. Students who receive no coaching typically experience score gains simply from retesting (Briggs, 2009). As a result, the estimated effect of coaching is less than observed due to the effects that retesting also contributes to gains in score. Schiel and Valiga (2014a) examined the test preparation activities and ACT composite scores of students who took the ACT twice. Results showed that students who participated in no test preparation activities between the first and second test scored an average of .80 points higher on the second test. Students who reported participating in some form of preparation scored an average of 1.40 points higher on the second test. Students who prepared only for the first test received notably smaller score gains than students who prepared for either both or neither of the tests.

AP Tests and ACT Scores

With the many factors that could affect students' performance on the ACT, it is interesting to note the relationship between taking AP courses and ACT scores. One study determined that taking AP mathematics greatly increased students' chances of meeting all ACT benchmark scores and achieving a composite score of 19 or more (Mo et al., 2011). Taking an AP English course did not affect students' chances of meeting the ACT English benchmark, but it did affect obtaining a composite score of 19. Surprisingly, AP social studies courses helped students meet the ACT mathematics benchmark, but AP social studies and AP science courses had no other effects. Males were more likely to meet ACT math and science benchmarks than

females. Additionally, taking a greater number of AP courses increased the likelihood of meeting ACT benchmarks and achieving a composite score of at least 19.

Acknowledging the results of the previous study by Mo et al. (2011) and that the study did not account for confounding variables, Warne et al. (2015) examined the effect of taking AP English and calculus courses on ACT scores. Results found that participating in AP English raised ACT composite scores 2.8-4.1 points. Participating in AP calculus resulted in composite score gains of 1.00-2.70 points. However, simply enrolling in the courses was not beneficial to students and only raised composite scores by approximately one point. Benefits were greater if students completed the AP exam, particularly if earning a score of three, four, or five.

Instructional strategies used within the various types of test preparation can influence how students process and retain information. Additionally, depth of memory and the ability to recall information can depend on the amount of time spent actively learning material.

Gaps in the Literature

Briggs (2009) conducted a comprehensive analysis of prior research related to the effects of test preparation on college admission tests. His findings indicated that although more than 30 studies referenced test preparation for the SAT, only two studies were conducted to determine the effects of coaching on ACT scores. Additionally, this analysis noted the dramatic increase in computerized test preparation options. Many companies have developed test preparation materials that claim to help students improve ACT scores by significant point values, but little is known about the efficacy of such programs. More studies were recommended to evaluate the effectiveness of these online programs.

Although studies have examined taking a high school preparation course when considering student ACT scores, these studies have shown both positive (Buchmann et al., 2010)

and negative (Briggs & Domingue, 2009) results. The variability of programs and strategies used within high school preparation courses likely contributed to these results, thus reducing generalizability. Additional studies on ACT preparation courses, the methods incorporated within these courses, and the resulting differences in ACT scores could assist schools in developing or refining preparation courses to benefit specific student populations.

Present Study

When high schools incorporate test preparation courses, it is important to determine if these courses actually result in benefits for students. A critical step is examining test results of students who participated in the course to determine if scores improved from what they otherwise would have been. The present study examined differences in participation/nonparticipation in a high school ACT Prep course, SES, and race/ethnicity on ACT scores. Practice ACT scores from a prior year were used to establish baselines for growth. Statistical analyses first determined if an interaction existed between any combination of the above-mentioned independent variables. Based on these results, analyses of the main effects of each independent variable were conducted.

The present study added to existing research by examining ACT score differences from an ACT Prep course that used the ePrep online program. This study addressed recommendations from Briggs (2009) that more research be conducted concerning test preparation for the ACT and the efficacy of computerized test preparation. This study could be important to other schools that might consider spending substantial funds on utilizing the ePrep program. Results of this study could lead the school or district to conduct further research to determine which specific aspects, if any, of the ACT Prep course and ePrep program are beneficial to students.

Research Questions

RQ1: Is there an interaction between participation/nonparticipation in an ACT Prep course, SES, and race/ethnicity related to ACT scores when using practice ACT scores as a covariate?

RQ2: Is there an interaction between participation/nonparticipation in an ACT Prep course and SES related to ACT scores when using practice ACT scores as a covariate?

RQ3: Is there an interaction between participation/nonparticipation in an ACT Prep course and race/ethnicity related to ACT scores when using practice ACT scores as a covariate?

RQ4: Is there an interaction between SES and race/ethnicity related to ACT scores when using practice ACT scores as a covariate?

RQ5: Is there a difference in ACT scores of students who participate in an ACT Prep course versus those who do not when using practice ACT scores as a covariate?

RQ6: Is there a difference in students' ACT scores based on SES when using practice ACT scores as a covariate?

RQ7: Is there a difference in students' ACT scores based on race/ethnicity when using practice ACT scores as a covariate?

Research Hypotheses

H1: There is an interaction between participation/nonparticipation in an ACT Prep course, SES, and race/ethnicity related to ACT scores when using practice ACT scores as a covariate.

H2: There is an interaction between participation/nonparticipation in an ACT Prep course and SES related to ACT scores when using practice ACT scores as a covariate.

H3: There is an interaction between participation/nonparticipation in an ACT Prep course and race/ethnicity related to ACT scores when using practice ACT scores as a covariate.

H4: There is an interaction between SES and race/ethnicity related to ACT scores when using practice ACT scores as a covariate.

H5: There is a difference in ACT scores for students who take an ACT Prep course and those who do not when using practice ACT scores as a covariate.

H6: There is a difference in ACT scores based on SES when using practice ACT scores as a covariate.

H7: There is a difference in ACT scores based on race/ethnicity when using practice ACT scores as a covariate.

Chapter III

Methodology

This study examined the differences in participation or nonparticipation in an ACT Prep course, SES, and race/ethnicity on ACT scores. Data was collected from a graduating class of 12th-grade students within a large high school in Middle Tennessee. Students within this graduating class were given a practice ACT assessment early during their first year of high school that provided baseline data from which to determine growth. Some students then elected to complete an ACT Prep course, which used ePrep computer software, during a semester of their choice during their four years of high school, while other students did not. Students participated in an official ACT administration prior to graduating from high school.

This research study incorporated a quantitative, causal-comparative design. Causal-comparative research designs attempt "to identify cause-and-effect relationships by forming groups of individuals in whom the independent variable is present or absent – or present at several levels – and then determining whether the groups differ on the dependent variable" (Gall et al., 2007, p. 306). Independent variables in a causal-comparative design are categorical (Gall et al., 2007). Participation or nonparticipation in an ACT Prep course, SES, and race/ethnicity are categorical independent variables that were examined for differences on ACT scores measured on an interval scale. A causal-comparative design was appropriate for this study due to its nonexperimental nature, including lack of random assignment (Gall et al., 2007). The data used for this study were preexisting, which did not allow for manipulation of independent variables.

Participants

The sample for this research consisted of data from 264 12th-grade students. This sample is considered a convenience sample. Participants in this study were not randomly selected but chosen based on preexisting data that fit the purpose of the study (Gall et al., 2007). This particular group of senior students was chosen based on having completed an ACT practice test, consisting of questions provided by ACT, under standard time conditions during the first semester of their ninth-grade year and the official ACT prior to graduating from high school. A summary of gender, SES, and race/ethnicity for the population and sample can be found in Table 1. Of the 264 students in this sample, 122 students participated in an ACT Prep course, and 142 students did not participate in an ACT Prep course.

Instrumentation

The instrumentation for this study included practice ACT scores and official ACT scores. ACT regularly evaluates test scores for reliability. "Test reliability refers to the consistency, stability, and precision of test scores" (Gall et al., 2007, p. 151). Using operational data from seven test forms during the 2018-19 academic year, ACT (2020) reported median reliability scores of 0.93 in English, 0.92 in mathematics, 0.87 in reading, 0.85 in science, and 0.97 for composite scores, which demonstrate a high level of reliability. The median standard error of measurement (*SEM*) was 1.69 in English, 1.52 in mathematics, 2.31 in reading, 2.00 in science, and 0.97 for composite scores. These reliability estimates are high with reasonably consistent *SEM* values across test forms.

In addition to reliability, ACT considers validity for each assessment. "Test validity refers to the appropriateness, meaningfulness, and usefulness of specific inferences made from test scores" (Gall et al., 2007, p. 151). ACT offers authorized accommodations and supports to

Table 1

Summary of Participants' Gender, SES, and Race/Ethnicity

Variable	Sample		Population	
	n	%	*N*	%
Gender				
Male	101	38	900	49
Female	163	62	954	51
SES				
Free/reduced lunch	53	20	558	30
No free/reduced lunch	211	80	1296	70
Race/Ethnicity				
White	178	67	1127	61
Black or African American	45	17	396	21
Hispanic	20	8	212	11
Asian	19	7	86	5
American Indian or Alaskan Native	0	0	21	1
Pacific Islander or Native Hawaiian	2	1	12	1
Total	264		1854	

ensure all students receive equal benefits, resulting in valid and reportable scores, for each test administration (ACT, 2020). Acknowledging the diversity for which ACT scores can be used, ACT (2020) examines content, construct, or criterion validity evidence in support of the five most recognized uses of ACT scores, which include measuring educational achievement, making college admissions choices, determining course placement selections, evaluating chances of success in college, and assisting with program evaluation.

The practice test given during the first semester of students' ninth-grade year was an official released practice test from ACT, thus meeting ACT's standards for reliability and

validity, consisting of multiple-choice questions in each of the four ACT subtest areas: English, mathematics, reading, and science. Student responses were scored for accuracy and converted to ACT's score range of 1-36. Scores were given for each subtest and then averaged to determine a composite score. The practice test was administered by the school under standard time conditions.

The official ACT administration in which students participated also included all four subtests and a score range of 1-36. Subtest scores and overall composite score for each student were calculated and reported by ACT. The test was administered under standard time conditions with the exception of students with Individualized Education Plans (IEPs) or 504 plans who received ACT-approved accommodations or non-college reportable supports for extended time and/or oral testing.

Variables

The three independent variables in this study were participation or nonparticipation in an ACT Prep course, SES as determined by free/reduced lunch or full-pay lunch status, and race/ethnicity classified as majority for White students and minority for the combined group of African American, Hispanic, Asian, and Pacific Islander students. The covariate in this study was practice ACT scores. The dependent variable was official ACT scores.

As discussed in a previous section, the one-semester ACT Prep course in this study utilized ePrep test preparation software. Students prepared for each subtest in the order in which the subtests appeared on the ACT, with each subtest receiving approximately four weeks of focus. When using the program, students completed online practice quizzes. Students received immediate feedback from ePrep upon completion of each quiz. In addition to receiving the correct answers, students had access to video explanations for each question. The program

diagnosed areas of weakness for each student. Students then completed additional practice questions and instructional videos in order to improve their skills. Extra quizzes and tests were taken to monitor student growth. In addition to the tracking features of ePrep, teachers provided students with additional resources to track their activity and progress on a daily basis. When large groups of students appeared to demonstrate weakness in similar areas, teachers provided instruction and/or additional resources to support students on these topics.

Data Collection

The researcher conducting this study completed the web-based Study Staff, Social/Behavioral Research course learner group of the larger Human Research curriculum group through the Collaborative Institutional Training Initiative (see Appendix A). Permission to conduct this research was obtained from Austin Peay State University's Institutional Review Board (see Appendix B) and from the Middle Tennessee school district (see Appendix C) and high school principal prior to beginning data collection for the study.

This study utilized data from the graduating class of 2020. As a result, all data were already in existence. Data collection included practice ACT composite and subtest scores from the fall semester of students' first year of high school. Additionally, students' highest ACT composite and subtest scores from official ACT administrations were collected. No data with both pieces of information were excluded.

All data pertinent to this study was recorded using an Excel spreadsheet. Data included each student's highest composite and subtest scores for the official ACT. Official ACT scores were reported to the school directly from ACT, and these scores were previously entered into the school system's database by school counselors. Additionally, each student's practice test scores, participation or nonparticipation in an ACT Prep course, SES, and race/ethnicity were recorded.

Students' practice scores and participation or nonparticipation in an ACT Prep course were copied from an existing Excel spreadsheet. All other data was provided by the school district's accountability team. All identifying student information from the Excel spreadsheet was replaced with anonymous participant numbers. A summary matrix for this study can be found in Appendix D.

Data Analysis

In the case of this study, it was not possible for the researcher to assign students randomly to complete an ACT Prep course or not. In cases where experimental control is not possible, statistical control can allow the researcher to control for an extraneous variable in addition to independent variables (Hinkle et al., 2003). A three-way Analysis of Covariance (ANCOVA) was used to address the research questions within this study. ANCOVA tests are helpful when researchers cannot choose comparison groups that are similar based on all variables except the dependent variable (Gall et al., 2007). Using an ANCOVA can control for these original discrepancies between groups before any statistical comparisons are made, thus making the groups equitable concerning control variables.

As stated in a prior section, independent variables of the ANCOVA were participation or nonparticipation in the ACT Prep course, SES, and race/ethnicity. The sample size for a causal-comparative study is recommended to contain at least 15 participants in each group (Gall et al., 2007). As a result, the researcher combined the African American, Hispanic, Asian, and Pacific Islander groups into one subgroup. The covariate of the ANCOVA was students' practice ACT scores. The dependent variable was students' scores on an official ACT assessment. In cases where students had more than one official ACT score available, the highest composite and subtest scores were used.

The Statistical Package for the Social Sciences (SPSS), version 28, was used to perform statistical analysis. The researcher assessed and resolved all assumptions for the ANCOVA. The researcher also reported and analyzed results of the ANCOVA. All data within this study was evaluated at the .05 level of significance, first formally recognized by Ronald Fisher (Cowles & Davis, 1982), which is typical of educational research (Gall et al., 2007). Although composite results are useful, more often educators need disaggregated subtest data in order to make instructional decisions on areas of strength and weakness for students. As a result, separate ANCOVA tests were conducted on composite scores and scores for each subtest (i.e., English, mathematics, reading, and/or science). Since research has shown that Asian students typically score higher than White students while African American and Hispanic students typically score lower (ACT, 2018; Battle & Lewis, 2008; National Center for Education Statistics, 2019b; Paschall et al., 2018), additional ANCOVA tests were conducted on composite and subtest scores without the inclusion of Asian students' data. These extra tests were incorporated in an effort to guard against misleading results of combining typically higher-scoring subgroups with lower-scoring subgroups. Results that included and excluded the Asian student data were then compared and any differences were reported.

Assumptions, Limitations, and Delimitations

Several assumptions were considered as part of the ANCOVA test. The assumptions of a continuous dependent variable, categorical independent variables, and a continuous covariate (Hinkle et al., 2003) were already met based on the data and design used for this study. Other assumptions that were tested as part of the ANCOVA included independent samples, normality, homogeneity of variance, linearity, homoscedasticity, and homogeneity of regression (Hinkle et

al., 2003). Where appropriate, the statistical capabilities of SPSS were used to assist in the evaluation of each assumption.

In addition to the assumptions that were considered as part of the ANCOVA test, the main assumption in this study was that all student data was reported accurately to the researcher. All student data, to include participation or nonparticipation in an ACT Prep course, SES, race/ethnicity, and ACT composite and subtest scores were assumed to be recorded accurately in the district's PowerSchool system. Once a report of student data was downloaded from PowerSchool, it was assumed that practice score data was matched accurately to the appropriate students.

The convenience sample used within this study was one limitation. Convenience sampling can threaten external validity, thus limiting generalizability, by providing samples that are not representative of larger populations (Gall et al., 2007). Another issue with this convenience sample was the selection process used for participation in the ACT Prep course. Self-selection was the main process by which students enrolled. Self-selection into an ACT Prep course could imply that these students were more motivated to perform well on the assessment, thus creating the potential for a confounding variable and making it more likely that a score difference would be detected. Additionally, data from practice tests conducted during students' 10th-grade year provided a basis for recommending some students to take the ACT Prep course, with students scoring an 18, 19, or 20 on the practice assessment being encouraged to participate. As a result, there were potentially a greater number of students with these previous practice scores who were enrolled in the course than students with lower or higher scores.

An additional limitation involved the disparity in which semester students completed the ACT Prep course. Students who chose to take the ACT Prep course were also allowed to select

the year in which they took the course. As a result, some students took the ACT Prep course early in their high school years, thus allowing them an early start to preparation but also more time in which to lose the effects of the course. Other students took the ACT Prep course closer to the time in which they participated in the official ACT, which allowed the material to be fresher in their minds but provided a shorter amount of overall preparation time.

A final limitation is that the sample of students only represented one high school in one school district in Middle Tennessee due to SES data only being available to the researcher for this one particular school. Additionally, not all high schools in this district choose to administer a practice ACT, which was needed for covariate data, to students during their first year of high school. Of the seven high schools in this district, the school in this study exhibits similar demographics to one other school. Other schools in this area exhibit higher percentages of minority and/or low SES students. Additionally, this school consistently maintains the highest average ACT score in the district, with an average score of approximately 22.0 for the past three years.

One delimitation of this study was that the researcher only examined differences in ACT scores based on participation or nonparticipation in a school-based ACT Prep course, SES, and race/ethnicity. The researcher did not consider other factors that could represent confounding variables, such as additional ACT preparation activities in which students may have participated, rigor of academic coursework, or level of student effort put forth during test preparation activities or official test administrations. Data concerning these factors were not available for the current study but could guide future research in building upon results.

Chapter IV

Results

The purpose of this study was to determine differences in students' ACT scores across participation or nonparticipation in an ACT Prep course, race/ethnicity, and SES when controlling for students' practice ACT scores. These differences were examined in consideration of students' highest official ACT composite scores then again with their highest scores on each subtest of the ACT.

Composite Scores

Assumptions

In order for the results of the ANCOVA to be valid, assumptions of the analysis were examined for violations. These included the following assumptions: (a) independence, (b) linearity, (c) homogeneity of regression slopes, (d) homoscedasticity, (e) homogeneity of variances, and (f) normality. Unusual points, such as outliers, leverage points, and influential points were also considered.

Independence

In an ANCOVA, observations should consist of random and independent samples from the population (Hinkle et al., 2003). In this case, participants belonged to different groups with no participant being in more than one group. For example, if a participant identified as a minority, low SES, and completing an ACT Prep course, then that participant did not belong to any other groups.

Linearity

The covariate of practice ACT composite scores should be linearly related to the dependent variable of official ACT composite scores, which would demonstrate that practice

ACT composite scores are appropriate to use as a covariate. There was a linear relationship between practice ACT composite scores and official ACT composite scores for every combination of groups of the three independent variables, as assessed by visual inspection of each scatterplot (see Figure 1). This inspection suggested that the covariate of practice ACT composite scores was good for consideration at this point in the analysis.

Homogeneity of Regression Slopes

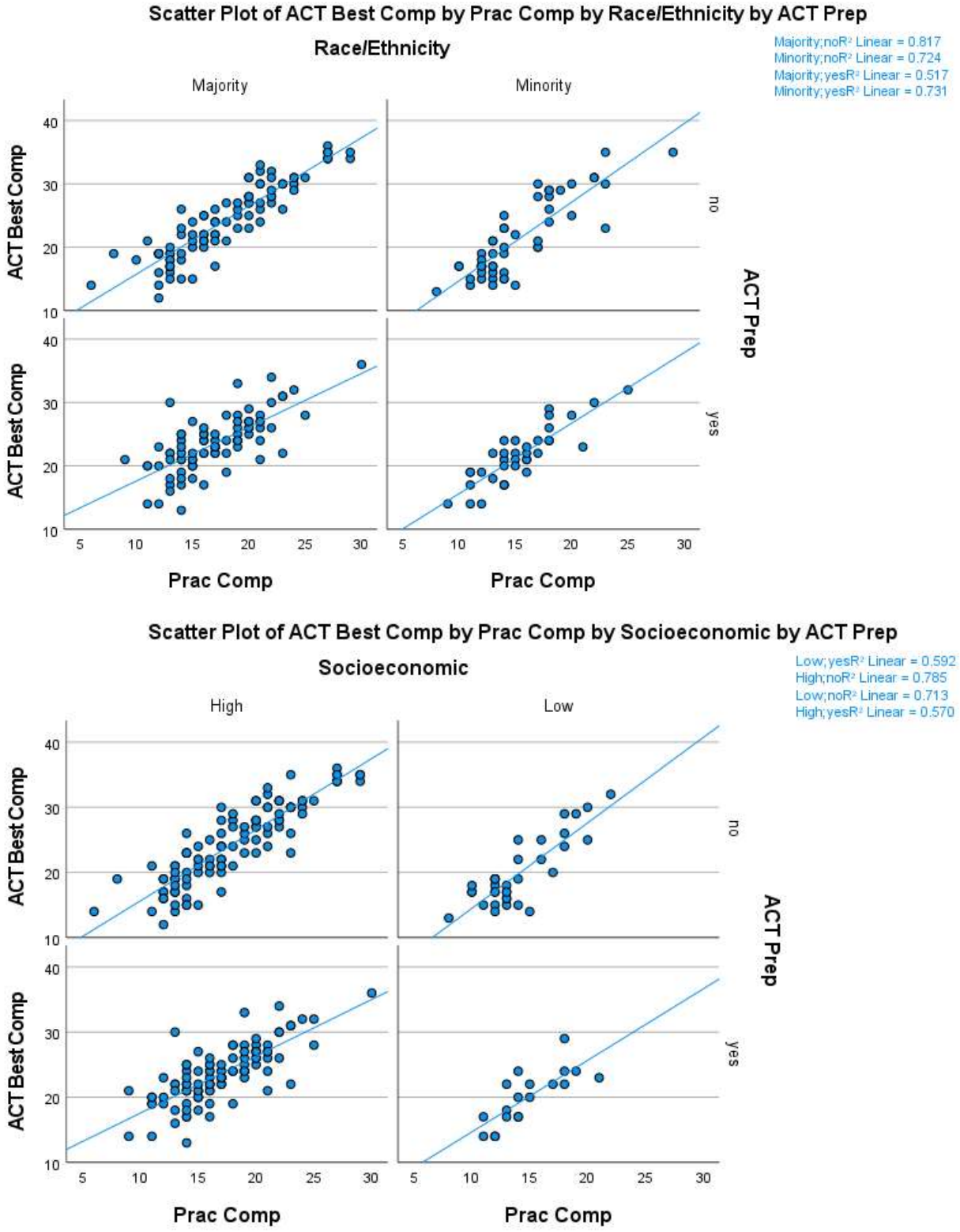
Another assumption of the ANCOVA is that of homogeneity of regression slopes. To achieve homogeneity of regression slopes, the slope of the relationship of the covariate and dependent variable should be the same for all group combinations of independent variables. Although it has already been established that a linear relationship exists between practice ACT scores and official ACT scores for all independent variable group combinations, homogeneity of regression slopes will determine whether the slopes are the same. A comparison between the three-way ANCOVA model with and without interaction terms did not discover a statistically significant interaction, $F(7, 248) = 1.737$, $p = .101$ (see Table 2). Since no statistically significant interaction was found, the assumption of homogeneity of regression slopes was met.

Homoscedasticity

Homoscedasticity of error variances should exist within each combination of groups of independent variables. Homoscedasticity within groups is evident if studentized residuals are randomly scattered across predicted values for each combination of groups. Homoscedasticity existed within each combination of groups of the three independent variables, as assessed by visual inspection of the studentized residuals plotted against the predicted values for each group (see Figure 2).

Figure 1

Scatterplots of Practice and Official Composite Scores for Independent Variable Groups



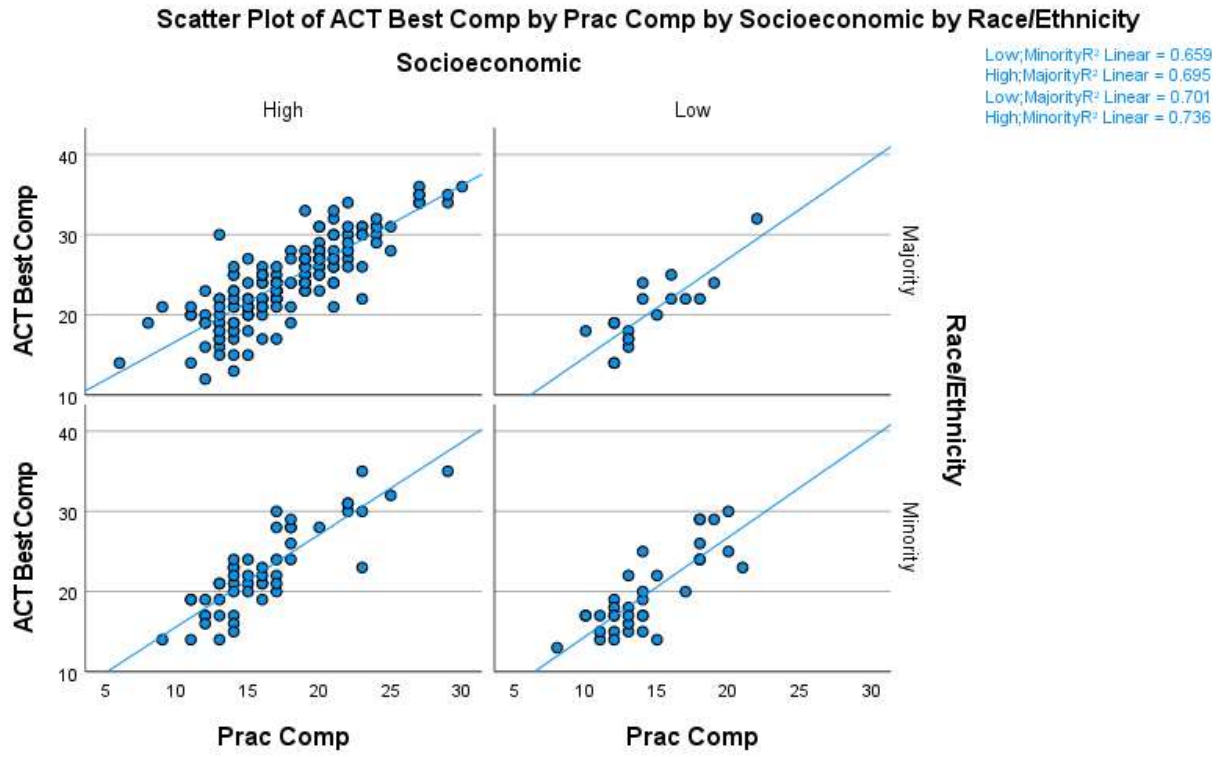


Table 2

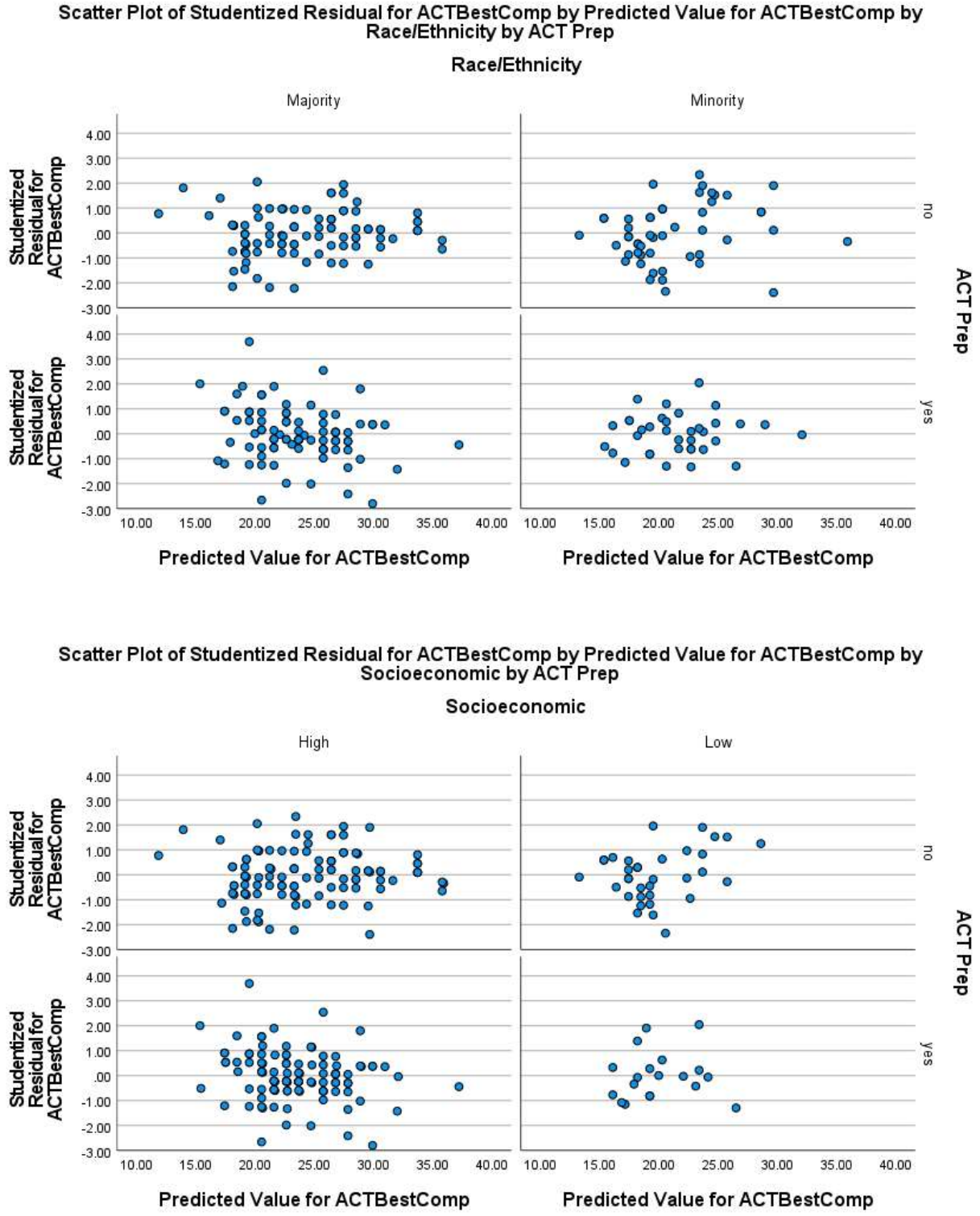
Tests of Between-Subjects Effects with and without Interaction Terms for Composite Scores

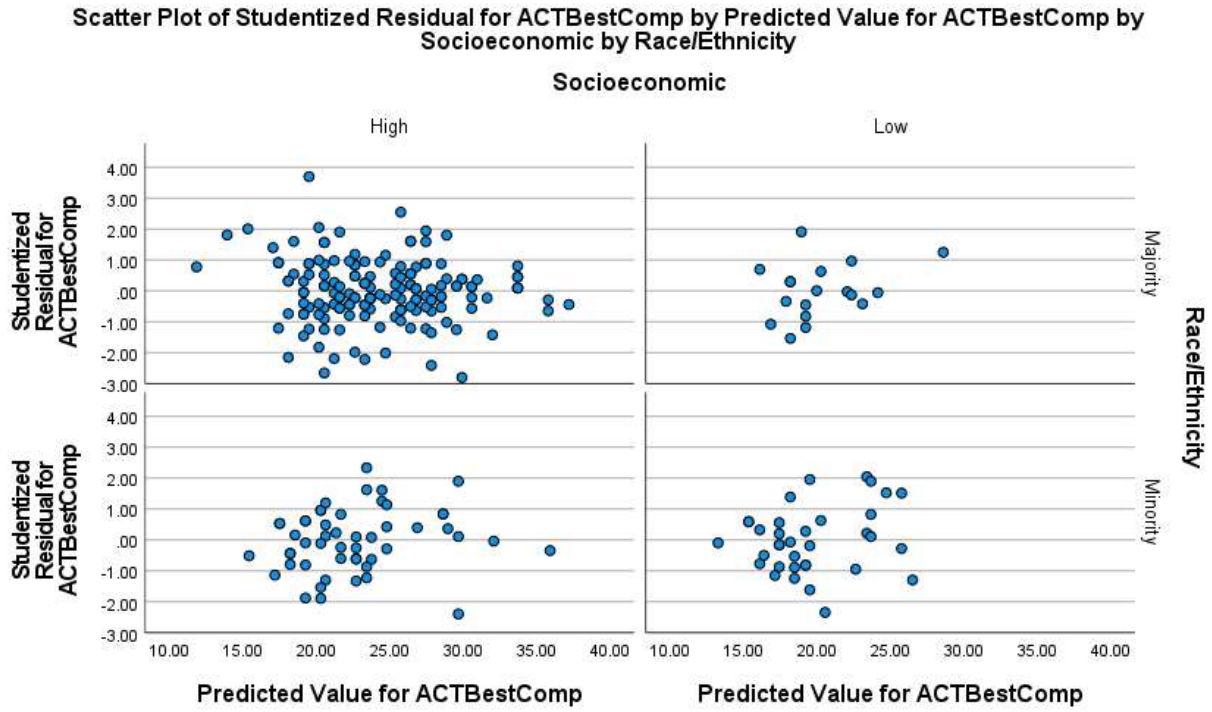
Source	*SS*	*df*	*MS*	*F*	*p*
Groups	109.394	7	15.628	1.947	.063
Practice Composite	1501.994	1	1501.994	187.167*	< .001
Groups x Practice Composite	97.595	7	13.942	1.737	.101
Error	1990.170	248	8.025		
Total	149276.000	264			

* $p < .05$

Figure 2

Scatterplots of Studentized Residuals across Predicted Values for Composite Scores





Homogeneity of Variances

To meet the assumption of homogeneity of variances for an ANCOVA, the distribution of scores on the dependent variable should all have equal variances. Unequal variances could affect the Type I error rate. Levene's test of homogeneity of variances yielded no statistically significant difference, $F(7, 256) = 1.620$, $p = .130$ (see Table 3). The assumption of homogeneity of variances was met.

Table 3

Levene's Test of Homogeneity of Variances for Composite Scores

F	df_1	df_2	*P*
1.620	7	256	.130

* $p < .05$

Normality

The dependent variable should be approximately normally distributed for each combination of groups of the three independent variables. Examination of normal Q-Q plots determined the data points were close to a diagonal line (see Figure 3), which demonstrates the data are approximately normally distributed.

Unusual Points

Outliers, leverage points, and influential points are types of points that may be detrimental to statistical inferences in an ANCOVA. Each of these points is examined further in the following sections.

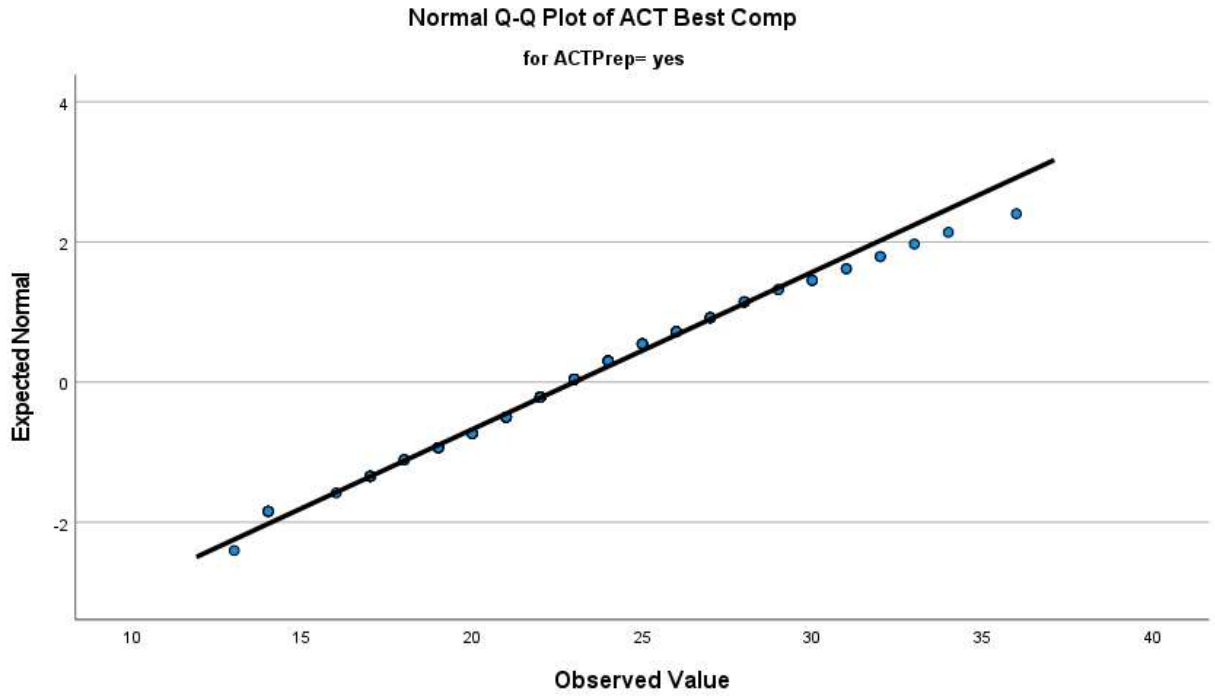
Outliers. An assessment of studentized residuals determined one outlier greater than ±3 standard deviations. A comparison of the three-way ANCOVA results with and without the outlier determined that conclusions were not significantly affected by inclusion of the outlier. As a result, the decision was made to keep the outlier in the data for reporting purposes.

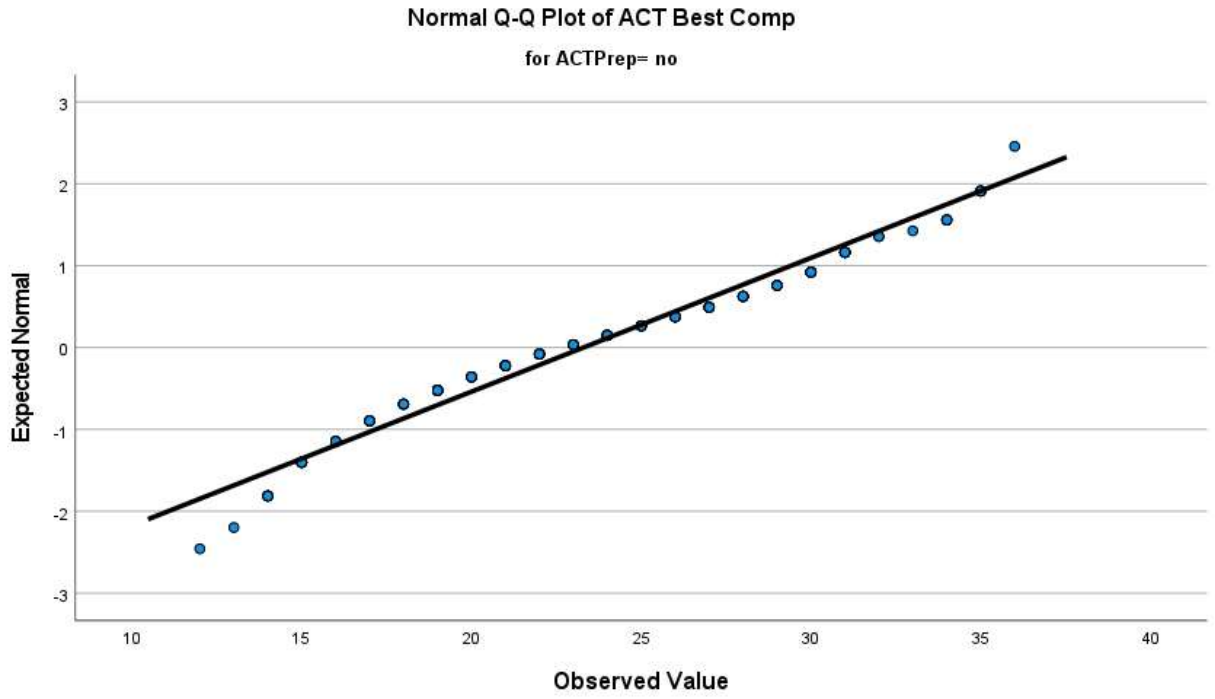
Leverage Points. Data points should be examined to determine if any point exhibits high leverage. An examination of leverage values in the data determined that all leverage values were less than 0.2, which made all datapoints safe to include in the dataset.

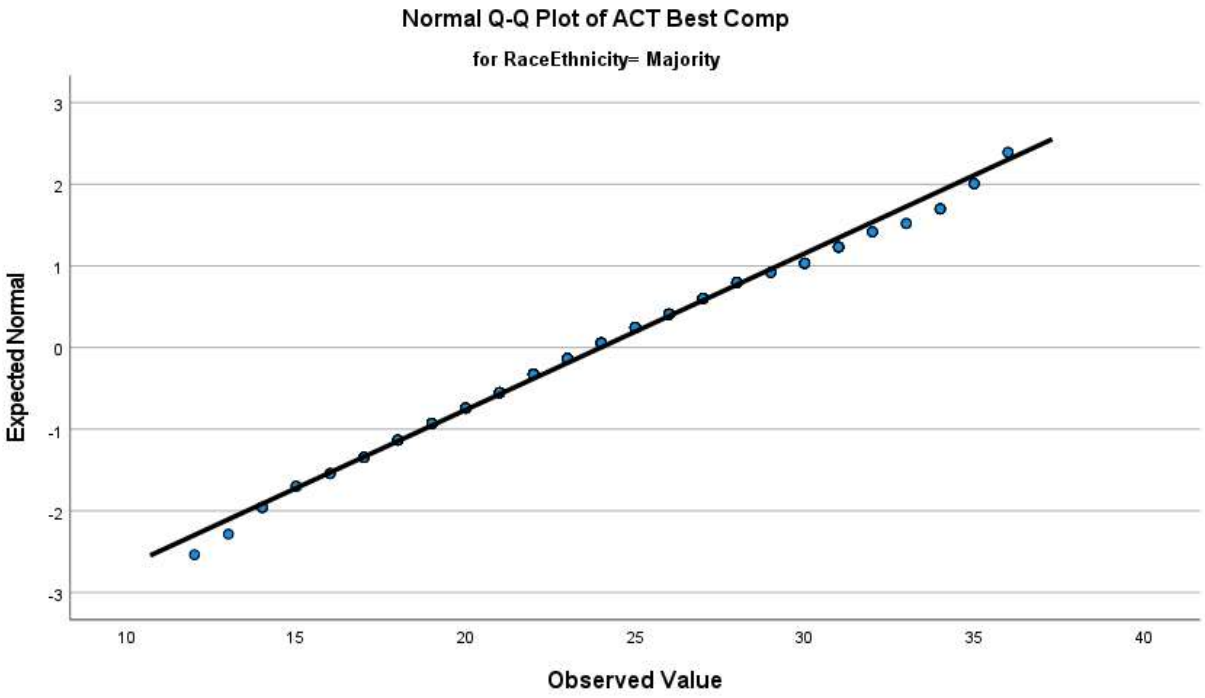
Influential Points. Cook's distance values can be used to measure the influence of each datapoint. Cook's distance values higher than 1 indicate that a particular datapoint is influential. An examination of Cook's distance values determined that all values were lower than 1, which means there were no influential points.

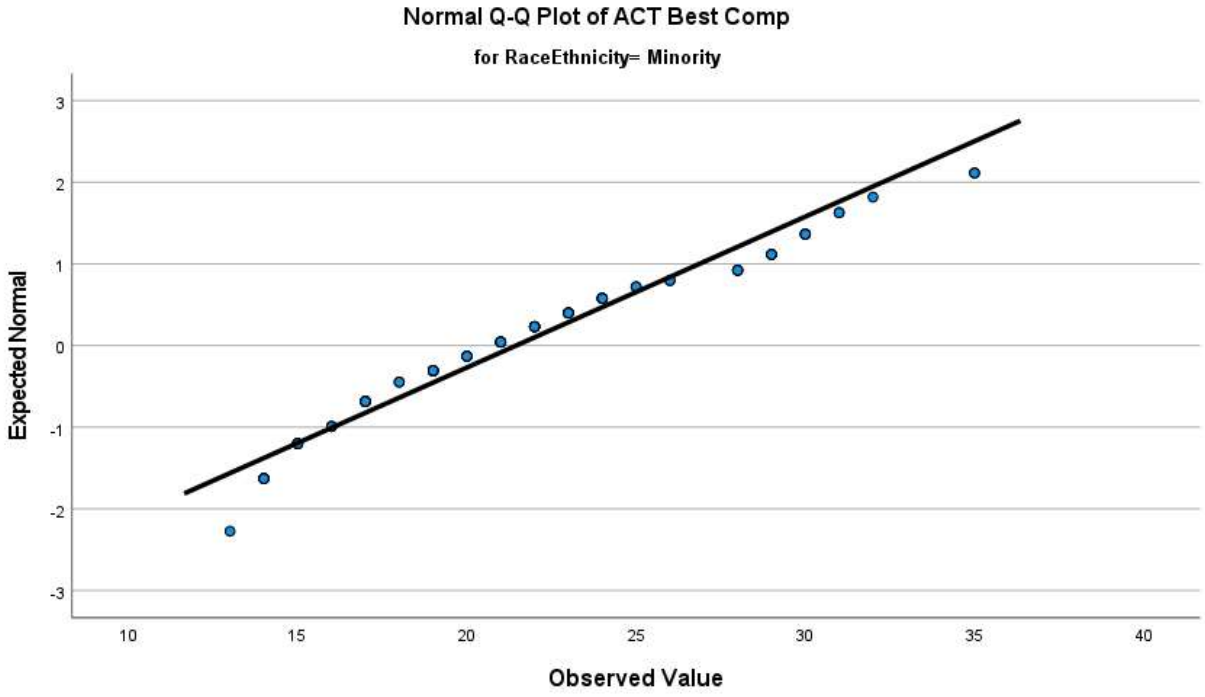
Figure 3

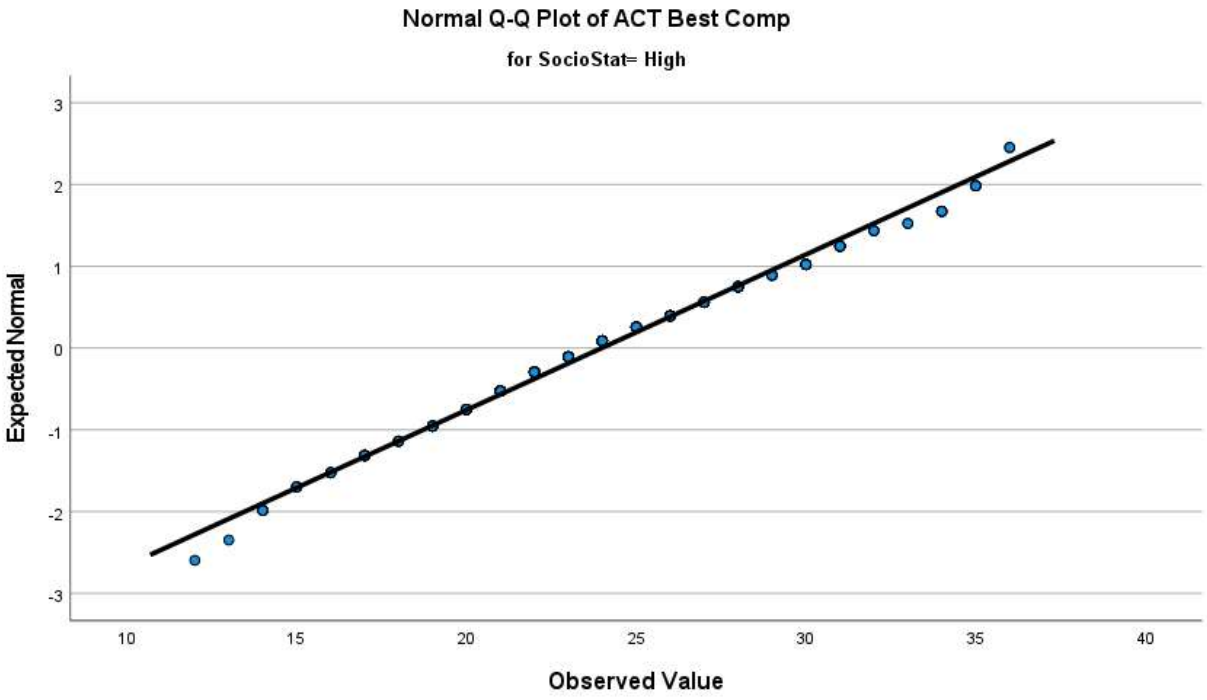
Normal Q-Q Plots for ACT Prep, Race/Ethnicity, and SES for Composite Scores

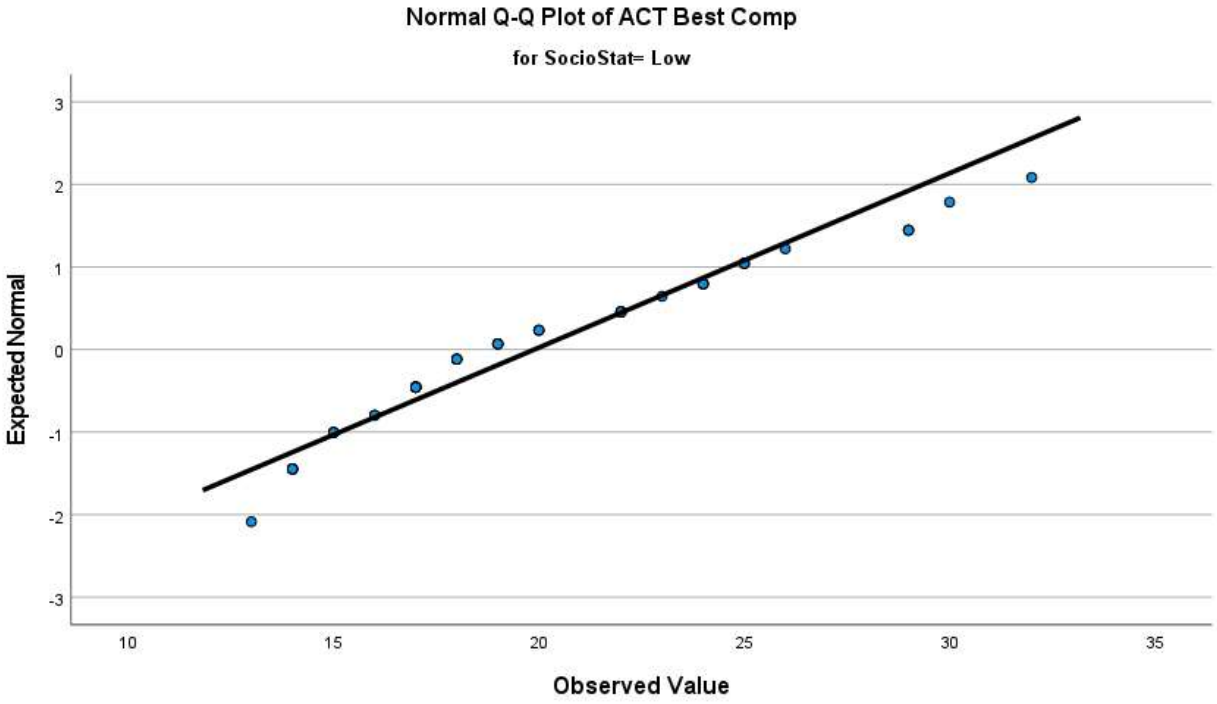





Normal Q-Q Plot of ACT Best Comp
for RaceEthnicity= Majority
Expected Normal
Observed Value
3
2
1
0
-1
-2
-3
10
15
20
25
30
35
40


Normal Q-Q Plot of ACT Best Comp
for RaceEthnicity= Minority
Expected Normal
Observed Value
3
2
1
0
-1
-2
-3
10
15
20
25
30
35
40


Normal Q-Q Plot of ACT Best Comp
for SocioStat= High
Expected Normal
Observed Value
3
2
1
0
-1
-2
-3
10
15
20
25
30
35
40


Normal Q-Q Plot of ACT Best Comp
for SocioStat= Low
Expected Normal
Observed Value
3
2
1
0
-1
-2
-3
10
15
20
25
30
35

Substantive Results of the ANCOVA

A 2 x 2 x 2 between-groups ANCOVA was conducted to examine the differences across students' participation or lack of participation in an ACT Prep course, race/ethnicity, and SES, after controlling for practice ACT composite scores, on their official ACT composite scores. The independent variables were participation or lack of participation in the ACT Prep course, race/ethnicity, and SES, while the dependent variable was official ACT composite scores. Students' practice ACT composite scores were used as a covariate to control for individual differences in scores.

Assumptions of the ANCOVA were considered to ensure there were no violations of independence, linearity, homogeneity of regression slopes, homoscedasticity, homogeneity of variances, and normality. After adjusting students' official ACT composite scores based on their practice ACT composite scores, there was no significant interaction effect between any combination of the three independent variables. The interaction effect between participation or nonparticipation in an ACT Prep course, race/ethnicity, and SES was not significant, $F(1, 255) = .314$, $p = .576$, $\eta_p^2 = .001$. Additionally, no significant interactions were found between participation or nonparticipation in an ACT Prep course and race/ethnicity, $F(1, 255) = .266$, $p = .606$, $\eta_p^2 = .001$, participation or nonparticipation in an ACT Prep course and SES, $F(1, 255) = 1.409$, $p = .236$, $\eta_p^2 = .005$, or race/ethnicity and SES, $F(1, 255) = .122$, $p = .727$, $\eta_p^2 = .000$. ANCOVA results (see Table 4) indicated no significant main effect for participation or nonparticipation in an ACT Prep course, $F(1, 255) = .226$, $p = .635$, $\eta_p^2 = .001$, race/ethnicity, $F(1, 255) = .017$, $p = .895$, $\eta_p^2 = .000$, or SES, $F(1, 255) = 3.435$, $p = .065$, $\eta_p^2 = .013$. Students' practice ACT composite scores, used as a covariate, significantly influenced their official ACT composite scores, $F(1, 255) = 576.289$, $p < .001$, $\eta_p^2 = .693$.

Table 4

ANCOVA Summary Table for Composite Scores

Source	*SS*	*df*	*MS*	*F*	*p*	η_p^2
Practice ACT Scores	4718.256	1	4718.256	576.289*	< .001	.693
ACT Prep	1.851	1	1.851	.226	.635	.001
Race/Ethnicity	.143	1	.143	.017	.895	.000
SES	28.120	1	28.120	3.435	.065	.013
ACT Prep x Race/Ethnicity	2.181	1	2.181	.266	.606	.001
ACT Prep x SES	11.535	1	11.535	1.409	.236	.005
Race/Ethnicity x SES	1.001	1	1.001	.122	.727	.000
ACT Prep x Race/Ethnicity x SES	2.571	1	2.571	.314	.576	.001
Error	2087.765	255	8.187			
Total	149276.000	264				

* $p < .05$

Table 5 presents the adjusted means for all the combinant groups of participation or nonparticipation in an ACT Prep course, race/ethnicity, and SES. The adjusted means indicate that the average official ACT composite score was higher for students who did not complete an ACT Prep course (M_{adj} = 23.015) than for students who completed an ACT Prep course (M_{adj} = 22.783), higher for students in the majority racial/ethnic group (M_{adj} = 22.931) than the minority racial/ethnic group (M_{adj} = 22.867), and higher for students who were in the higher SES group (M_{adj} = 23.362) than students who were in the low SES group (M_{adj} = 22.436).

Table 5

Means, Adjusted Means, Standard Deviations, and Standard Errors for ACT Prep, Race/Ethnicity, and SES for Composite Scores

	ACT Prep				No ACT Prep			
	Majority Race/Ethnicity		Minority Race/Ethnicity		Majority Race/Ethnicity		Minority Race/Ethnicity	
	High SES	Low SES	High SES	Low SES	High SES	Low SES	High SES	Low SES
n	79	7	24	12	81	11	27	23
M	23.87	20.43	22.50	19.75	24.91	20.18	22.81	19.65
(SD)	(4.333)	(3.735)	(4.149)	(4.434)	(5.816)	(4.976)	(6.439)	(5.280)
M_{adj}	23.494	21.885	23.578	22.175	23.123	23.223	23.251	22.462
(SE)	(.322)	(1.083)	(.586)	(.832)	(.327)	(.872)	(.551)	(.608)

Note. $N = 264$.

English Subtest Scores

Assumptions

The assumptions of the ANCOVA, as well as unusual points, were checked for English subtest scores.

Independence

Participants belonged to different groups with no participant being in more than one group. For example, if a participant identified as a minority, low SES, and completing an ACT Prep course, then that participant did not belong to any other groups.

Linearity

There was a linear relationship between practice ACT English scores and official ACT English scores for every combination of groups of the three independent variables, as assessed by visual inspection of each scatterplot (see Figure 4). This inspection suggested that the covariate of practice ACT English scores was good for consideration at this point in the analysis.

Homogeneity of Regression Slopes

Using the covariate of practice ACT English scores and dependent variable of official ACT English scores, a comparison between the three-way ANCOVA model with and without interaction terms did not discover a statistically significant interaction, $F(7, 248) = 1.388$, $p = .211$ (see Table 6). Since no statistically significant interaction was found, the assumption of homogeneity of regression slopes was met.

Homoscedasticity

Homoscedasticity existed within each combination of groups of the three independent variables, as assessed by visual inspection of the studentized residuals plotted against the predicted values for each group (see Figure 5).

Homogeneity of Variances

Levene's test of homogeneity of variances yielded no statistically significant difference, $F(7, 256) = .989$, $p = .440$ (see Table 7). The assumption of homogeneity of variances was met.

Normality

Examination of normal Q-Q plots determined the data points were close to a diagonal line (see Figure 6), which demonstrates the data are approximately normally distributed.

Unusual Points

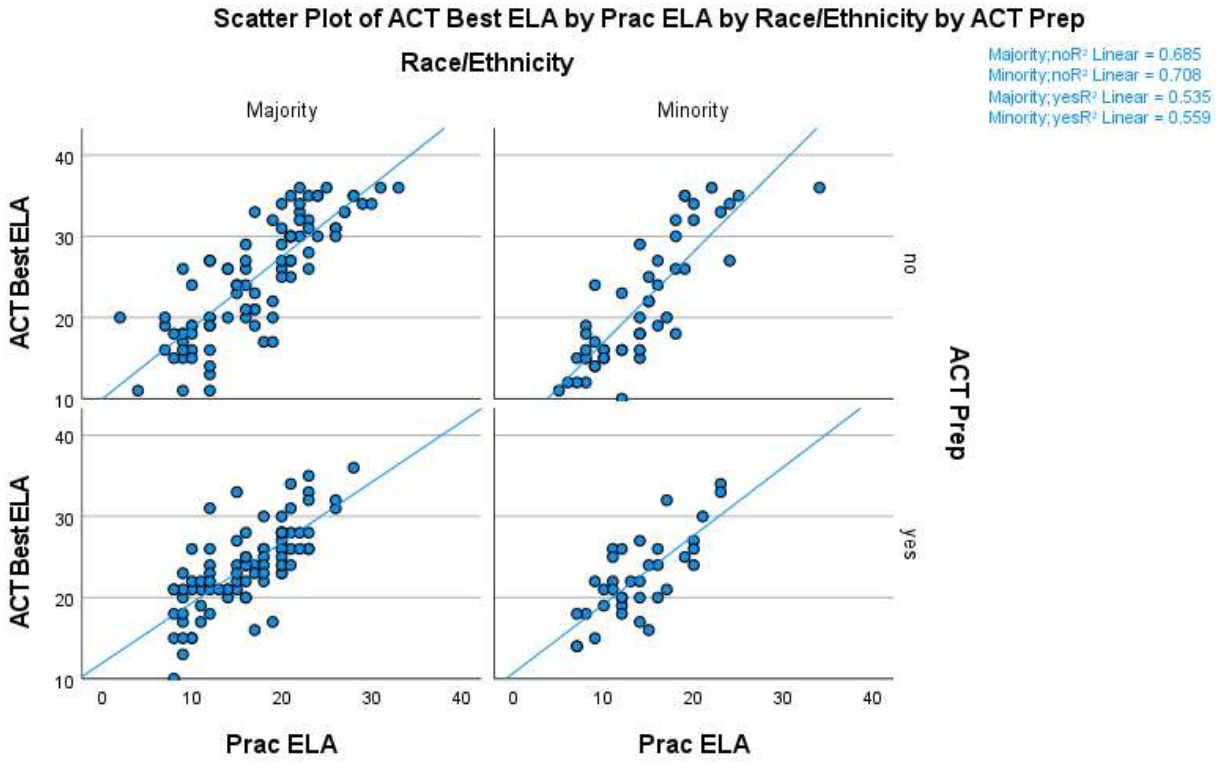
Outliers. An assessment of studentized residuals determined no outliers greater than ±3 standard deviations.

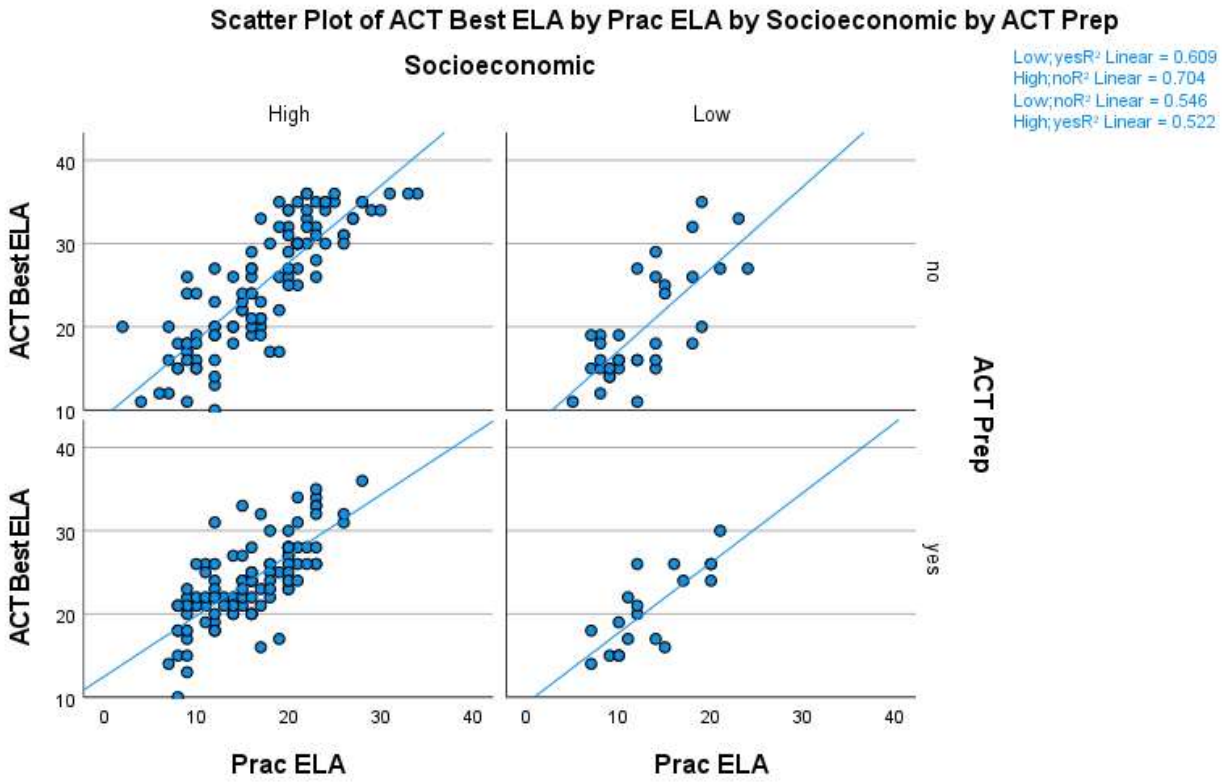
Leverage Points. An examination of leverage values in the data determined that all leverage values were less than 0.2, which made all datapoints safe to include in the dataset.

Influential Points. An examination of Cook's distance values determined that all values were lower than 1, which means there were no influential points.

Figure 4

Scatterplots of Practice and Official English Scores for Independent Variable Groups




Scatter Plot of ACT Best ELA by Prac ELA by Socioeconomic by ACT Prep
Socioeconomic
High
Low
Low;yesR² Linear = 0.609
High;noR² Linear = 0.704
Low;noR² Linear = 0.546
High;yesR² Linear = 0.522
ACT Best ELA
Prac ELA
ACT Prep
no
yes
10
20
30
40
0

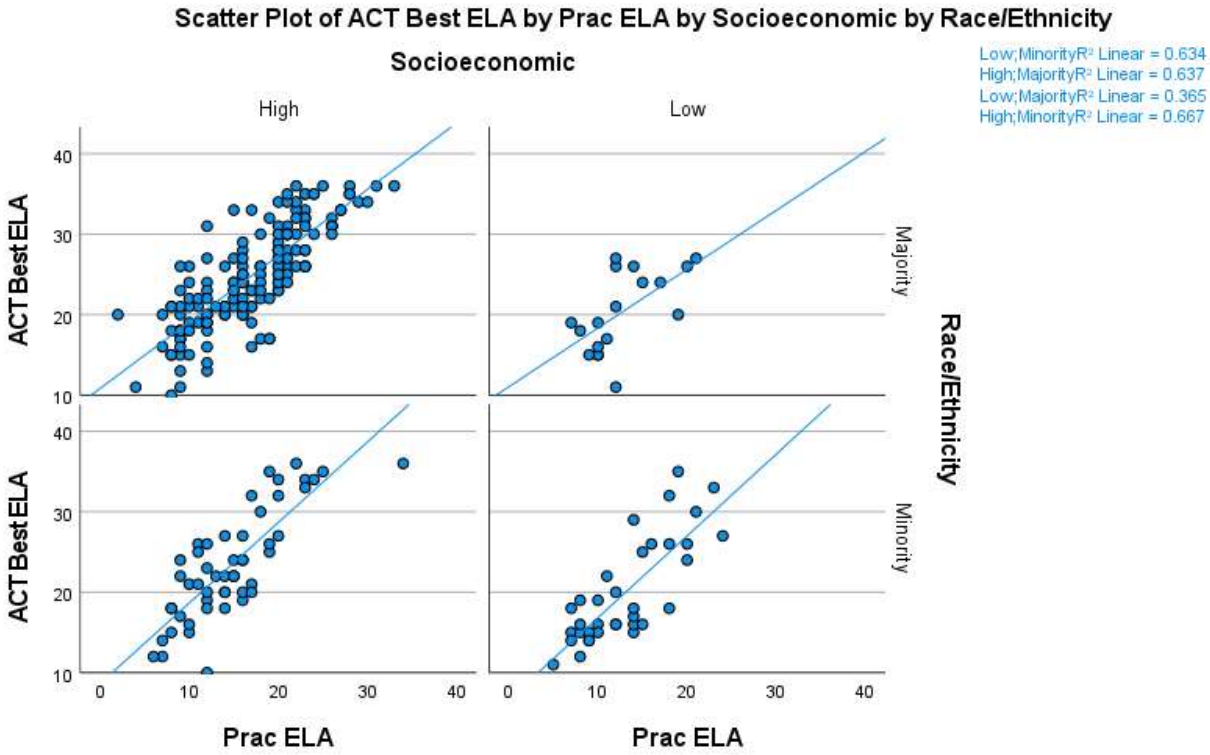

Scatter Plot of ACT Best ELA by Prac ELA by Socioeconomic by Race/Ethnicity
Socioeconomic
High
Low
Low;MinorityR² Linear = 0.634
High;MajorityR² Linear = 0.637
Low;MajorityR² Linear = 0.365
High;MinorityR² Linear = 0.667
ACT Best ELA
Prac ELA
Race/Ethnicity
Majority
Minority
10
20
30
40
0

Table 6

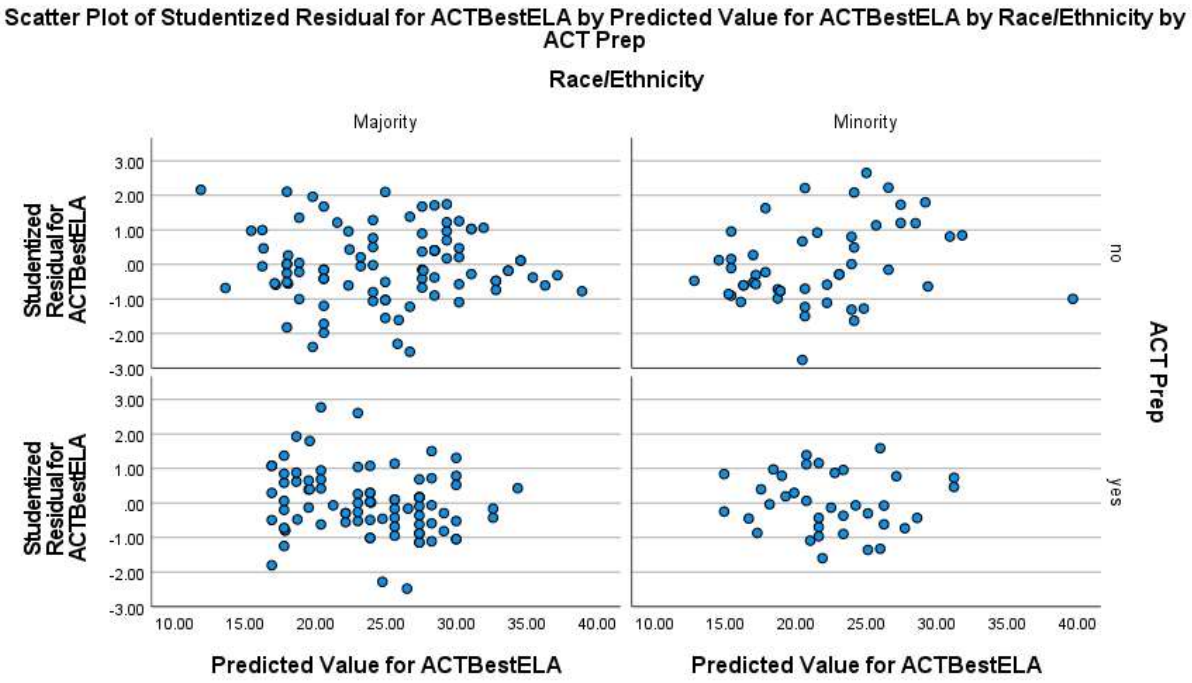
Tests of Between-Subjects Effects with and without Interaction Terms for English Scores

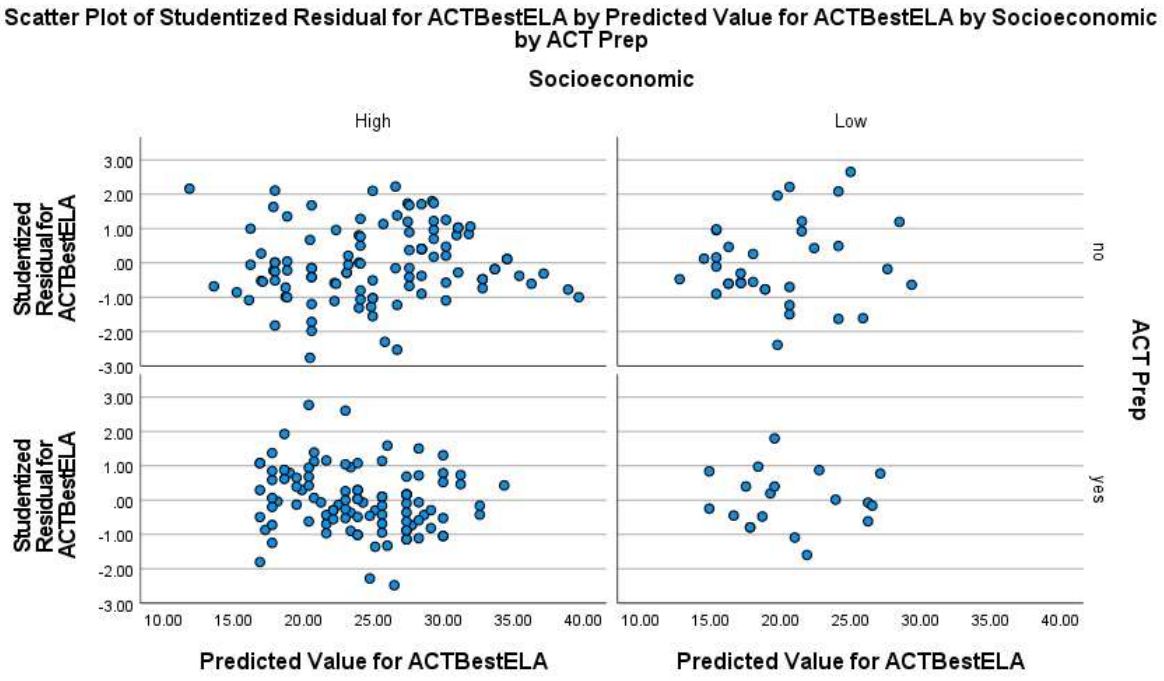
Source	*SS*	*df*	*MS*	*F*	*p*
Groups	159.679	7	22.811	1.548	.152
Practice English	1930.731	1	1930.731	131.038*	< .001
Groups x Practice English	143.158	7	20.451	1.388	.211
Error	3654.064	248	14.734		
Total	159106.000	264			

* $p < .05$

Figure 5

Scatterplots of Studentized Residuals across Predicted Values for English Scores





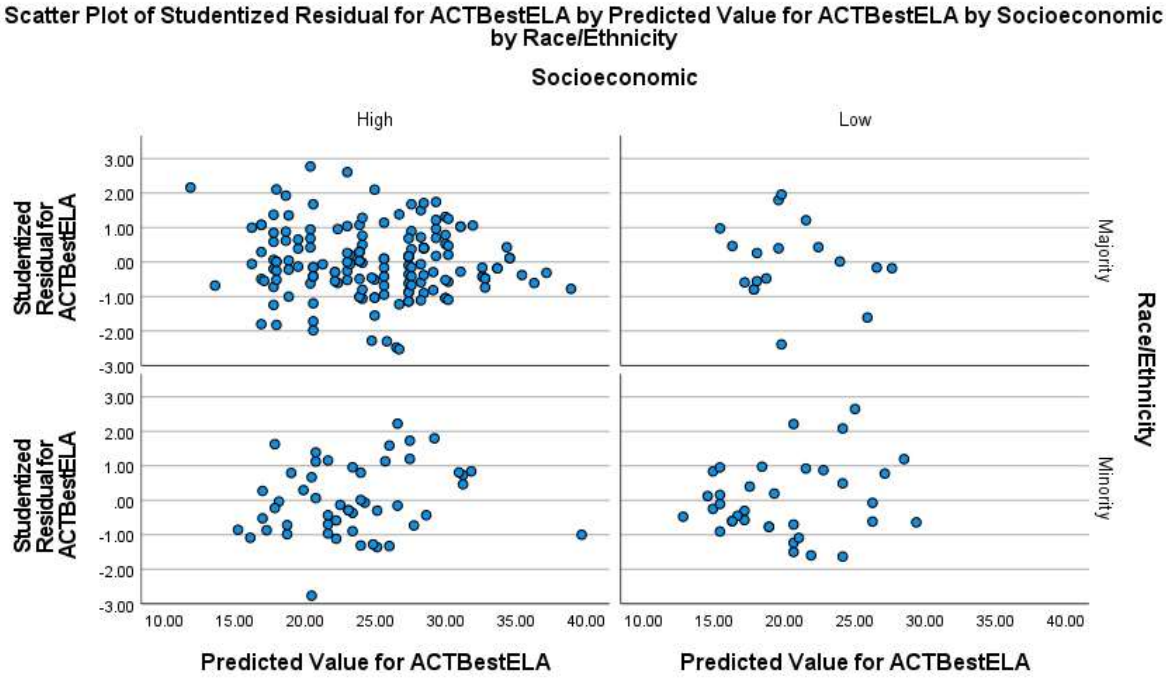


Table 7

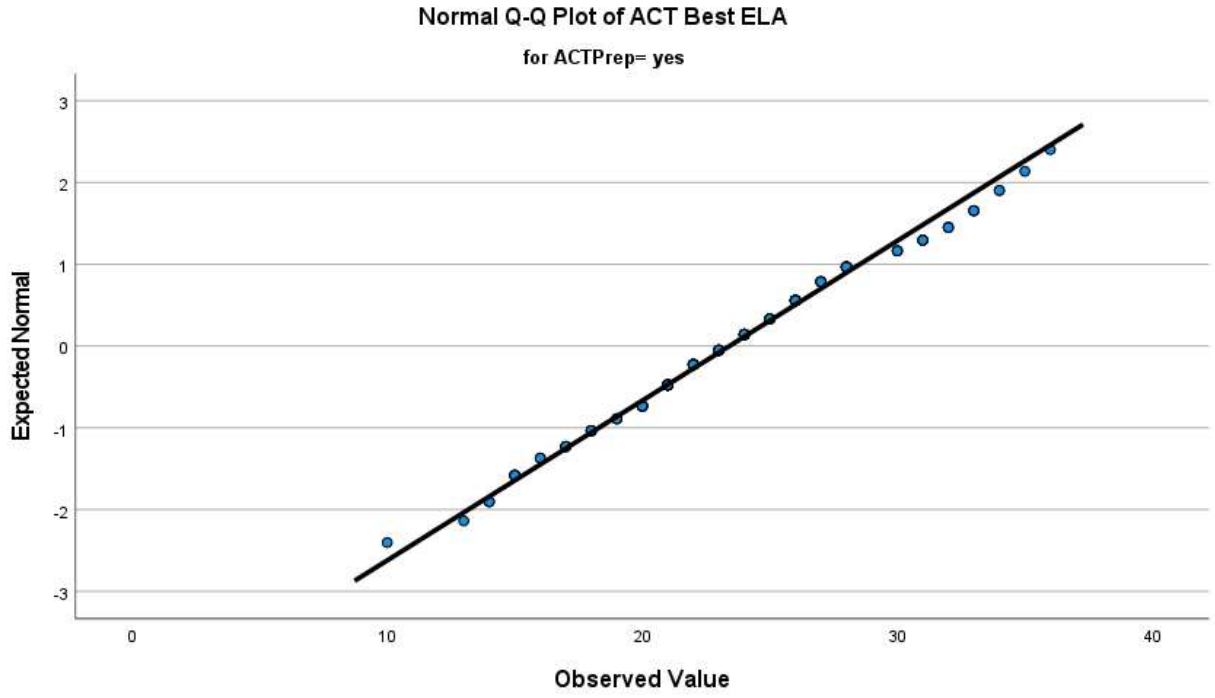
Levene's Test of Homogeneity of Variances for English Scores

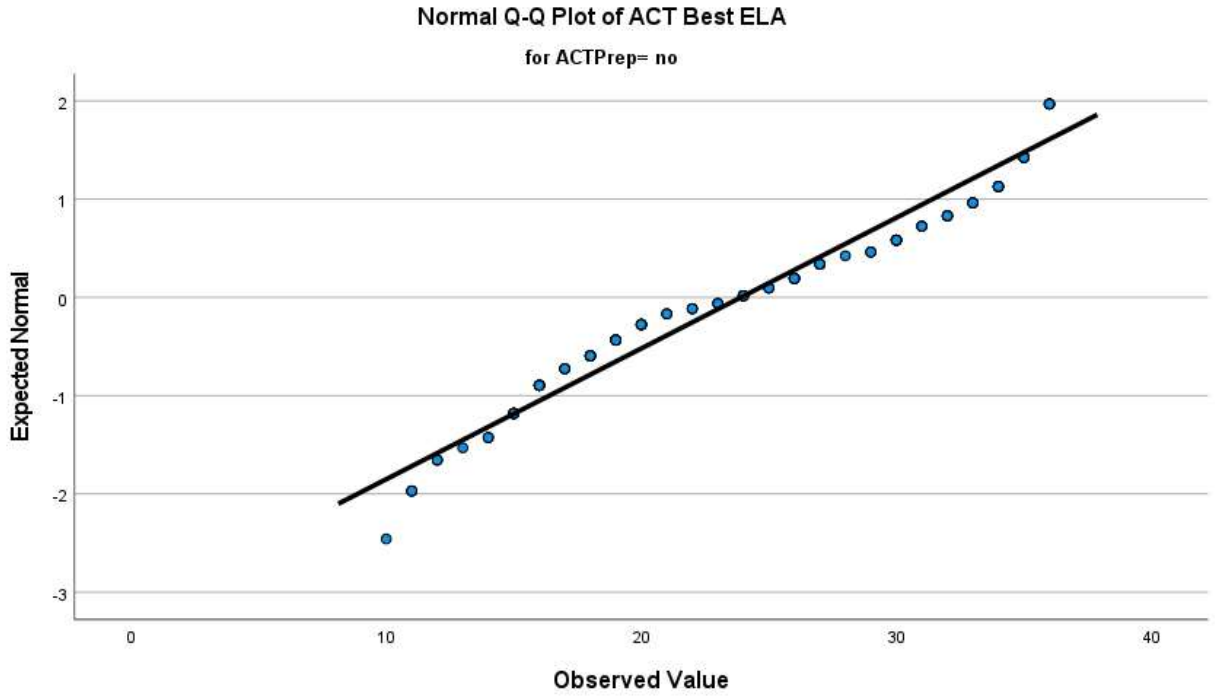
F	df_1	df_2	*P*
.989	7	256	.440

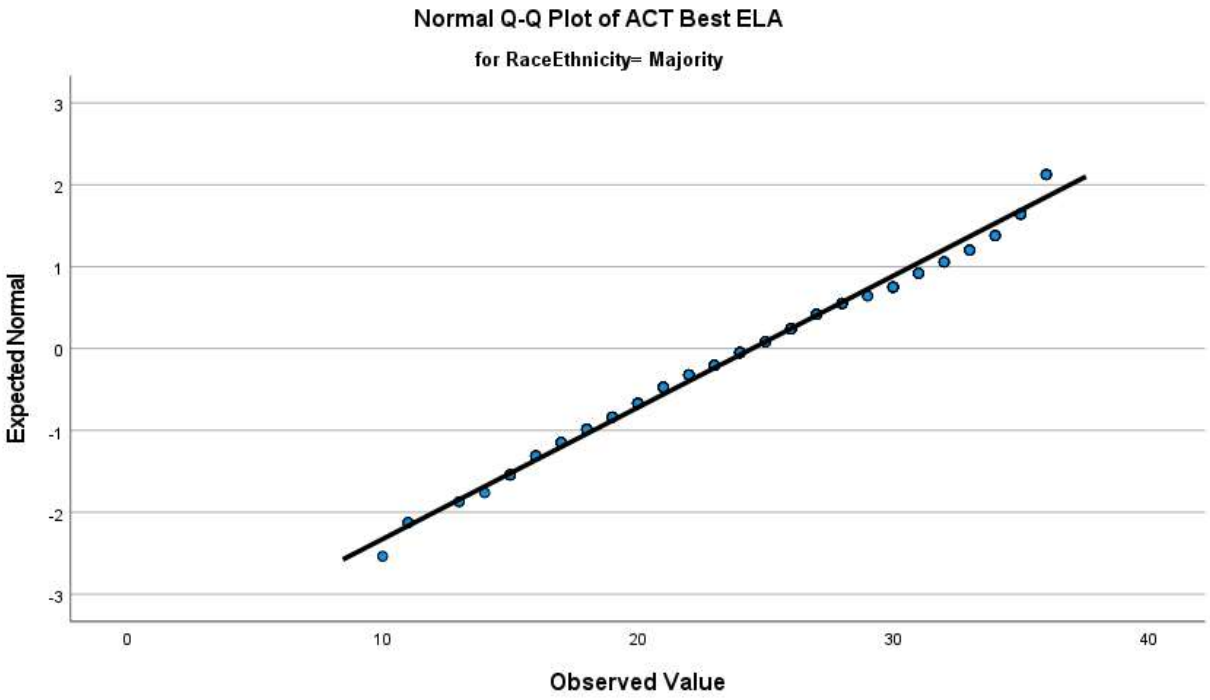
* $p < .05$

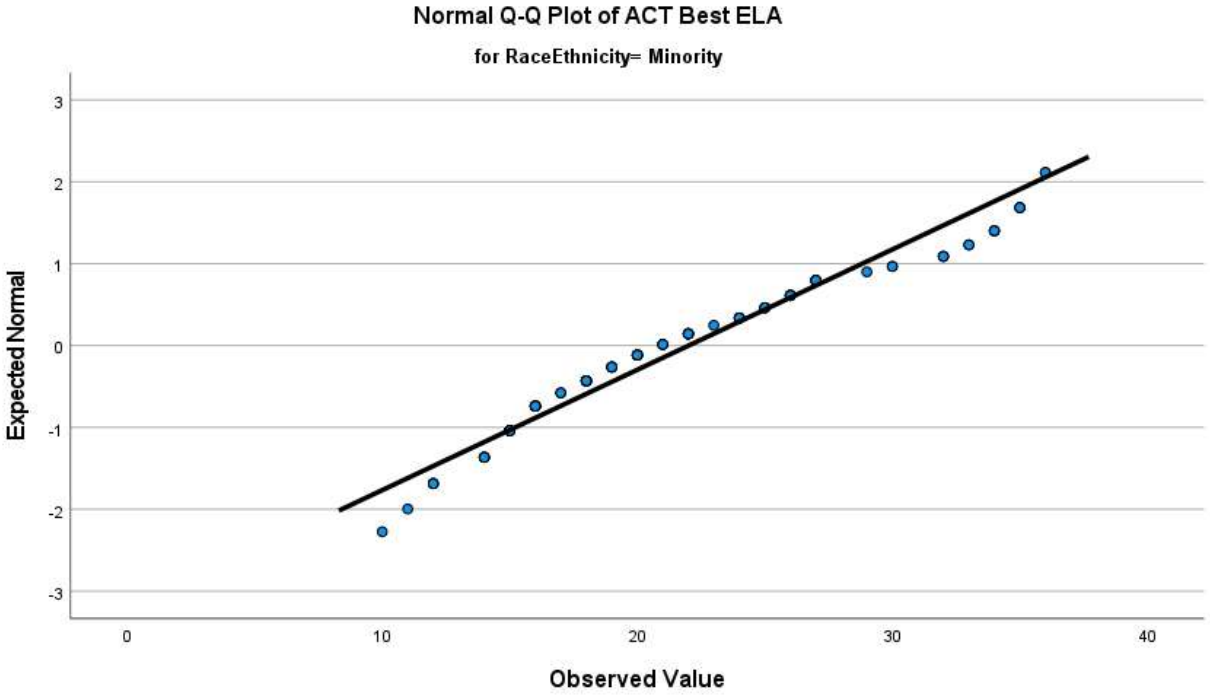
Figure 6

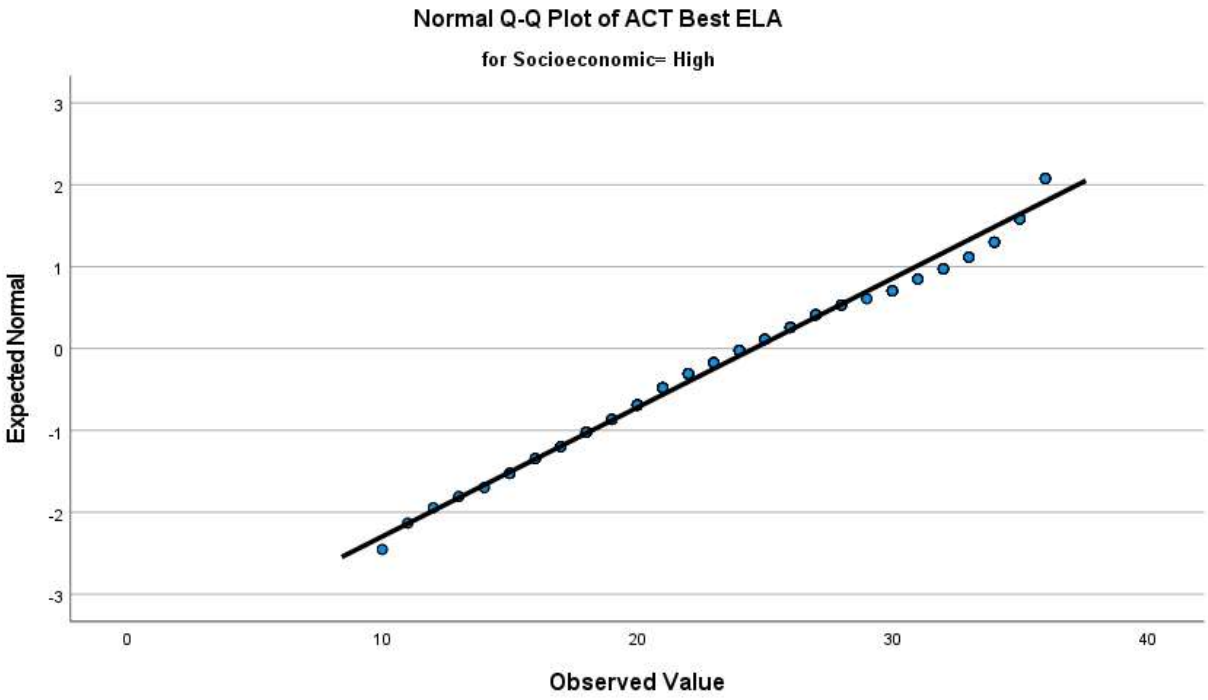
Normal Q-Q Plots for ACT Prep, Race/Ethnicity, and SES for English Scores

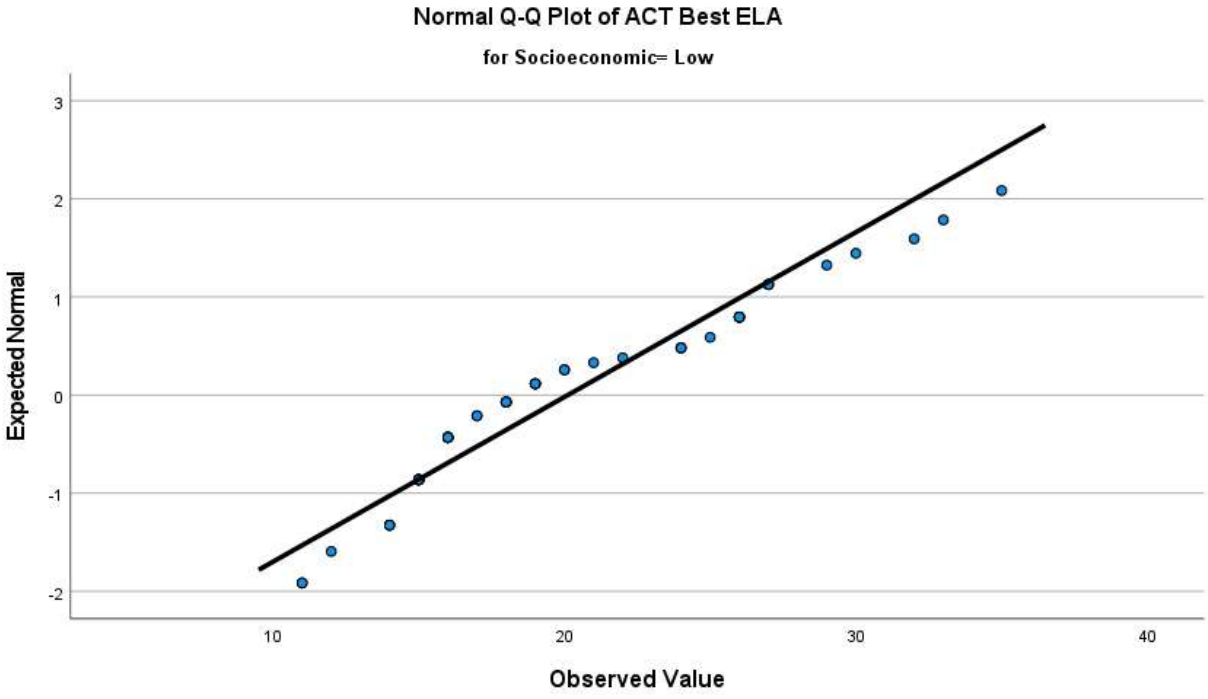





Normal Q-Q Plot of ACT Best ELA
for RaceEthnicity= Majority
Expected Normal
Observed Value
3
2
1
0
-1
-2
-3
0
10
20
30
40


Normal Q-Q Plot of ACT Best ELA
for RaceEthnicity= Minority
Expected Normal
Observed Value
3
2
1
0
-1
-2
-3
0
10
20
30
40


Normal Q-Q Plot of ACT Best ELA
for Socioeconomic= High
Expected Normal
Observed Value
3
2
1
0
-1
-2
-3
0
10
20
30
40


Normal Q-Q Plot of ACT Best ELA
for Socioeconomic= Low
Expected Normal
Observed Value
3
2
1
0
-1
-2
10
20
30
40

Substantive Results of the ANCOVA

A 2 x 2 x 2 between-groups ANCOVA was conducted to examine the differences across students' participation or lack of participation in an ACT Prep course, race/ethnicity, and SES, after controlling for practice ACT English scores, on their official ACT English scores. The independent variables were participation or lack of participation in the ACT Prep course, race/ethnicity, and SES, while the dependent variable was official ACT English scores. Students' practice ACT English scores were used as a covariate to control for individual differences in scores.

Assumptions of the ANCOVA were considered to ensure there were no violations of independence, linearity, homogeneity of regression slopes, homoscedasticity, homogeneity of variances, and normality. After adjusting students' official ACT English scores based on their practice ACT English scores, there was no significant interaction effect between any combination of the three independent variables. The interaction effect between participation or nonparticipation in an ACT Prep course, race/ethnicity, and SES was not significant, $F(1, 255) = .088$, $p = .767$, $\eta_p^2 = .000$. Additionally, no significant interactions were found between participation or nonparticipation in an ACT Prep course and race/ethnicity, $F(1, 255) = .552$, $p = .458$, $\eta_p^2 = .002$, participation or nonparticipation in an ACT Prep course and SES, $F(1, 255) = .092$, $p = .762$, $\eta_p^2 = .000$, or race/ethnicity and SES, $F(1, 255) = .777$, $p = .379$, $\eta_p^2 = .003$. ANCOVA results (see Table 8) indicated no significant main effect for participation or nonparticipation in an ACT Prep course, $F(1, 255) = .183$, $p = .669$, $\eta_p^2 = .001$ or race/ethnicity, $F(1, 255) = .000$, $p = .986$, $\eta_p^2 = .000$. Results indicated a significant main effect for SES, $F(1, 255) = 4.241$, $p = .040$, $\eta_p^2 = .016$. However, when Asian students' data were removed from the analysis, the main effect of SES was not significant for English, $F(1, 236) = 2.495$, $p = .116$, η_p^2

= .010. The significance of all other results in this study remained the same regardless of whether Asian students' data were included or excluded, so all reported results include these students' data. Students' practice ACT English scores, used as a covariate, significantly influenced their official ACT English scores, $F(1, 255) = 422.521$, $p < .001$, $\eta_p^2 = .624$.

Table 8

ANCOVA Summary Table for English Scores

Source	*SS*	*df*	*MS*	*F*	*p*	η_p^2
Practice ACT Scores	6291.791	1	6291.791	422.521*	< .001	.624
ACT Prep	2.727	1	2.727	.183	.669	.001
Race/Ethnicity	.005	1	.005	.000	.986	.000
SES	63.153	1	63.153	4.241*	.040	.016
ACT Prep x Race/Ethnicity	8.227	1	8.227	.552	.458	.002
ACT Prep x SES	1.374	1	1.374	.092	.762	.000
Race/Ethnicity x SES	11.577	1	11.577	.777	.379	.003
ACT Prep x Race/Ethnicity x SES	1.314	1	1.314	.088	.767	.000
Error	3797.222	255	14.891			
Total	159106.000	264				

* $p < .05$

Table 9 presents the adjusted means for all the combinant groups of participation or nonparticipation in an ACT Prep course, race/ethnicity, and SES. The adjusted means indicate that the average official ACT English score was higher for students who completed an ACT Prep course ($M_{adj} = 23.552$) than for students who did not complete an ACT Prep course ($M_{adj} = 23.270$), higher for students in the majority racial/ethnic group ($M_{adj} = 23.417$) than the minority racial/ethnic group ($M_{adj} = 23.405$), and higher for students who were in the higher SES group ($M_{adj} = 24.100$) than students who were in the low SES group ($M_{adj} = 22.722$).

Table 9

Means, Adjusted Means, Standard Deviations, and Standard Errors for ACT Prep, Race/Ethnicity, and SES for English Scores

	ACT Prep				No ACT Prep			
	Majority Race/Ethnicity		Minority Race/Ethnicity		Majority Race/Ethnicity		Minority Race/Ethnicity	
	High SES	Low SES	High SES	Low SES	High SES	Low SES	High SES	Low SES
n	79	7	24	12	81	11	27	23
M	24.10	20.57	23.38	20.58	25.77	20.18	23.41	19.70
(SD)	(5.070)	(4.928)	(4.880)	(5.035)	(7.045)	(5.269)	(8.158)	(7.176)
M_{adj}	23.713	22.913	24.968	22.613	23.916	23.125	23.802	22.238
(SE)	(.435)	(1.463)	(.791)	(1.118)	(.438)	(1.172)	(.743)	(.814)

Note. $N = 264$.

Math Subtest Scores

Assumptions

The assumptions of the ANCOVA, as well as unusual points, were checked for math subtest scores.

Independence

Participants belonged to different groups with no participant being in more than one group. For example, if a participant identified as a minority, low SES, and completing an ACT Prep course, then that participant did not belong to any other groups.

Linearity

There was a linear relationship between practice ACT math scores and official ACT math scores for every combination of groups of the three independent variables, as assessed by visual inspection of each scatterplot (see Figure 7). This inspection suggested that the covariate of practice ACT math scores was good for consideration at this point in the analysis.

Homogeneity of Regression Slopes

Using the covariate of practice ACT math scores and dependent variable of official ACT math scores, a comparison between the three-way ANCOVA model with and without interaction terms did not discover a statistically significant interaction, $F(7, 248) = 1.724$, $p = .104$ (see Table 10). Since no statistically significant interaction was found, the assumption of homogeneity of regression slopes was met.

Homoscedasticity

Homoscedasticity existed within each combination of groups of the three independent variables, as assessed by visual inspection of the studentized residuals plotted against the predicted values for each group (see Figure 8).

Homogeneity of Variances

Levene's test of homogeneity of variances yielded no statistically significant difference, $F(7, 256) = 1.202$, $p = .302$ (see Table 11). The assumption of homogeneity of variances was met.

Normality

Examination of normal Q-Q plots determined the data points were close to a diagonal line (see Figure 9), which demonstrates the data are approximately normally distributed.

Unusual Points

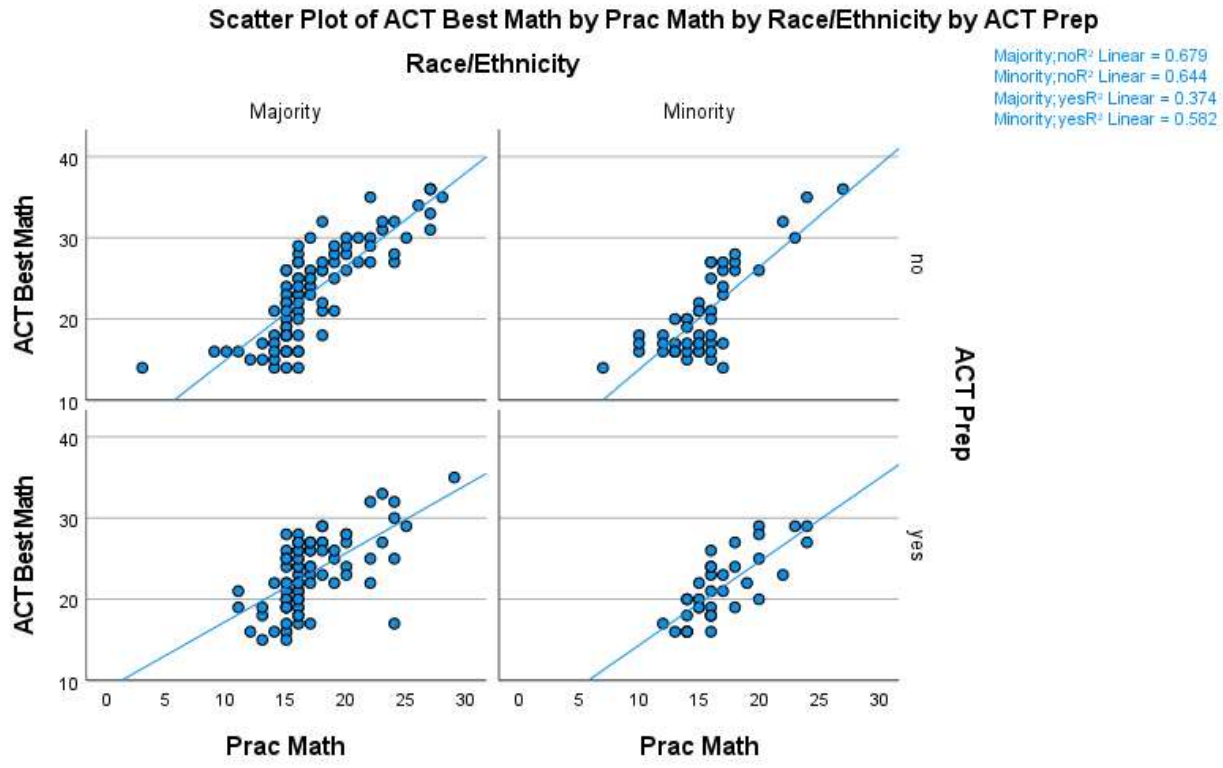
Outliers. An assessment of studentized residuals determined one outlier greater than ±3 standard deviations. A comparison of the three-way ANCOVA results with and without the outlier determined that conclusions were not significantly affected by inclusion of the outlier. As a result, the decision was made to keep the outlier in the data for reporting purposes.

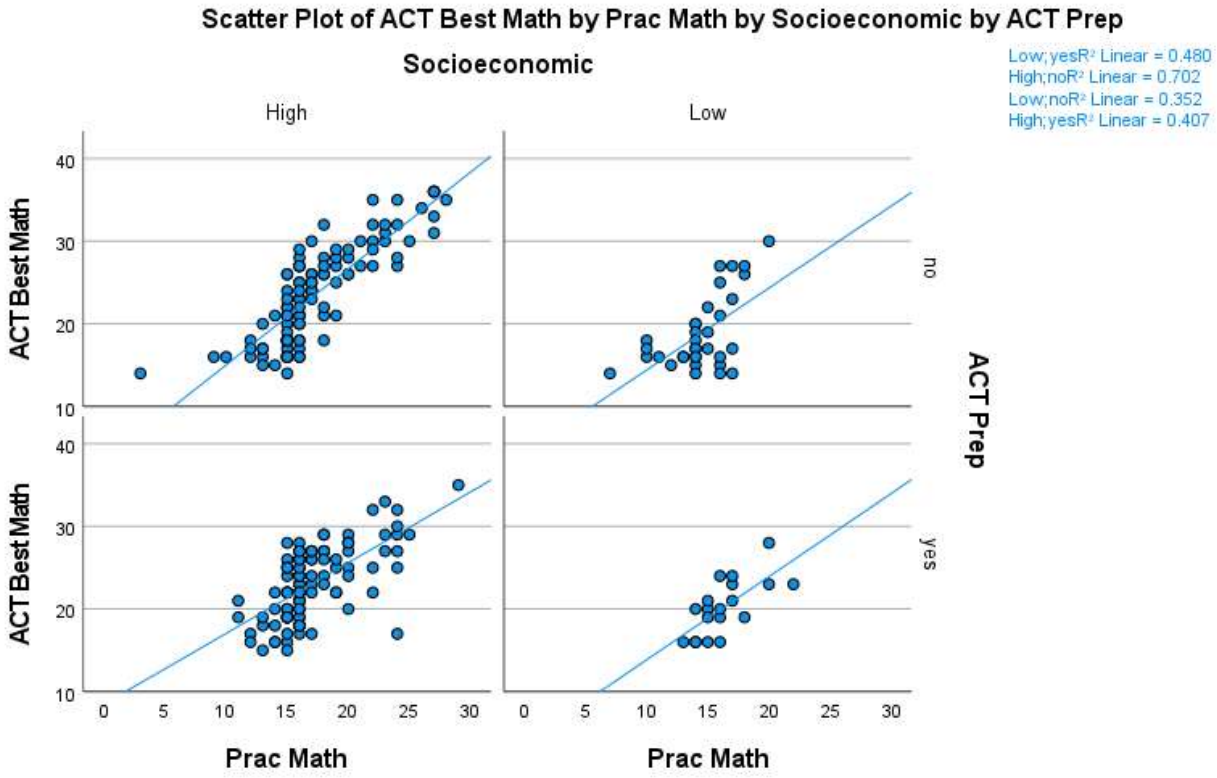
Leverage Points. An examination of leverage values in the data determined that all leverage values were less than 0.2, which made all datapoints safe to include in the dataset.

Influential Points. An examination of Cook's distance values determined that all values were lower than 1, which means there were no influential points.

Figure 7

Scatterplots of Practice and Official Math Scores for Independent Variable Groups




Scatter Plot of ACT Best Math by Prac Math by Socioeconomic by ACT Prep
Socioeconomic
High
Low
Low;yesR² Linear = 0.480
High;noR² Linear = 0.702
Low;noR² Linear = 0.352
High;yesR² Linear = 0.407
ACT Best Math
Prac Math
ACT Prep
no
yes
10
20
30
40
0
5
10
15
20
25
30

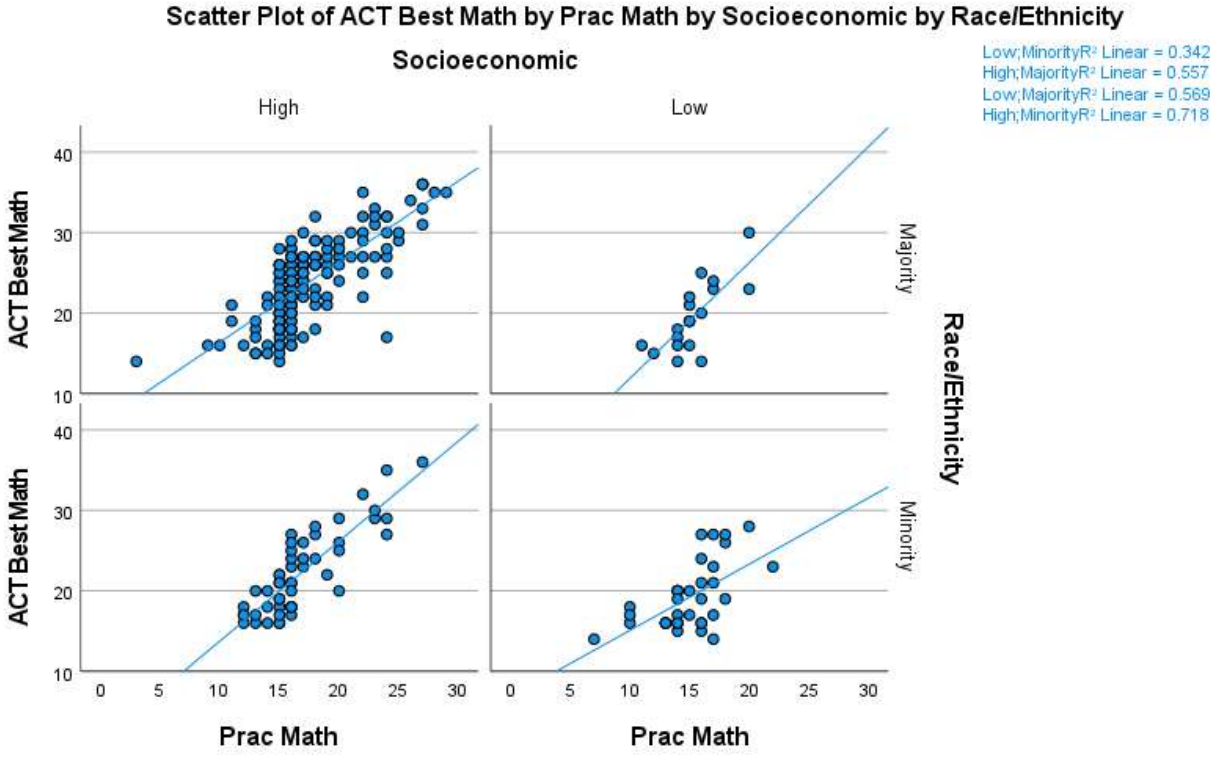

Scatter Plot of ACT Best Math by Prac Math by Socioeconomic by Race/Ethnicity
Socioeconomic
High
Low
Low;MinorityR² Linear = 0.342
High;MajorityR² Linear = 0.557
Low;MajorityR² Linear = 0.569
High;MinorityR² Linear = 0.718
ACT Best Math
Prac Math
Race/Ethnicity
Majority
Minority
10
20
30
40
0
5
10
15
20
25
30

Table 10

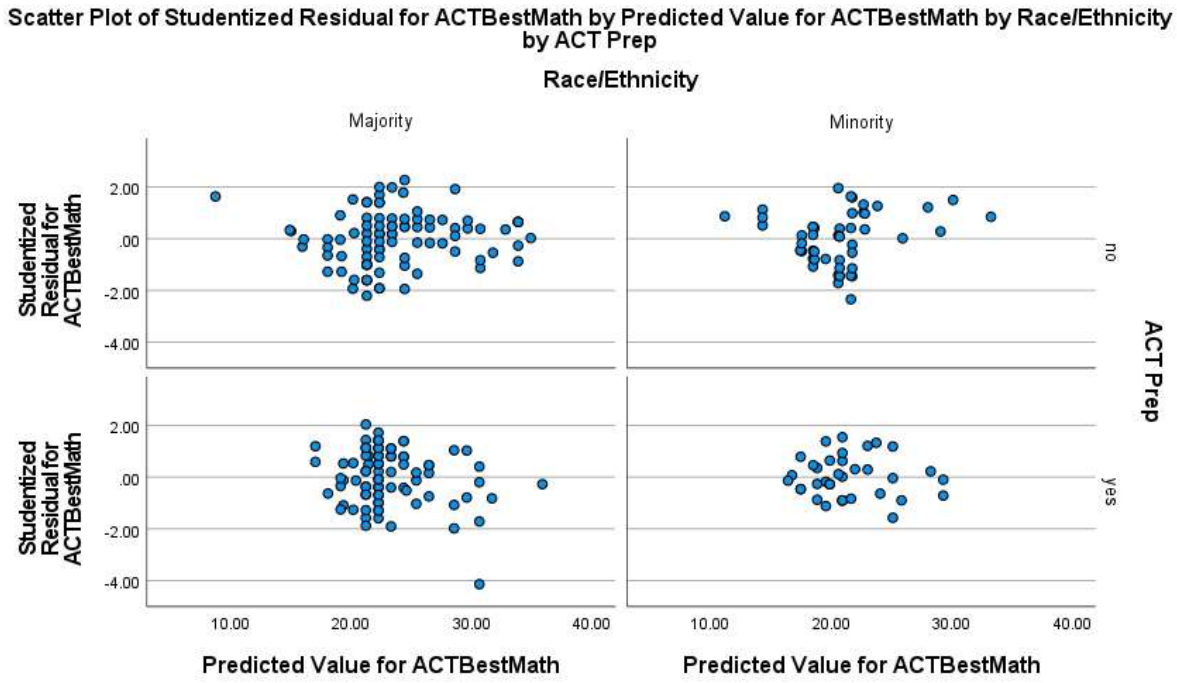
Tests of Between-Subjects Effects with and without Interaction Terms for Math Scores

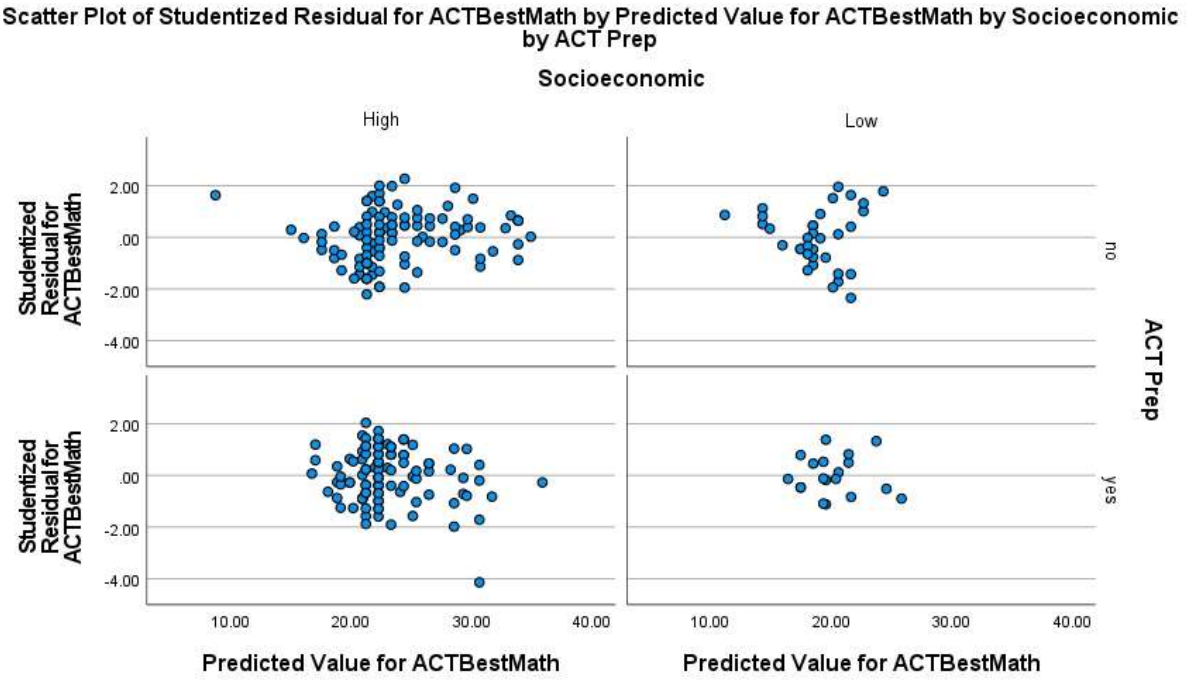
Source	*SS*	*df*	*MS*	*F*	*p*
Groups	136.952	7	19.565	1.785	.091
Practice Math	808.655	1	808.655	73.785*	< .001
Groups x Practice Math	132.267	7	18.895	1.724	.104
Error	2717.967	248	10.960		
Total	142956.000	264			

* $p < .05$

Figure 8

Scatterplots of Studentized Residuals across Predicted Values for Math Scores





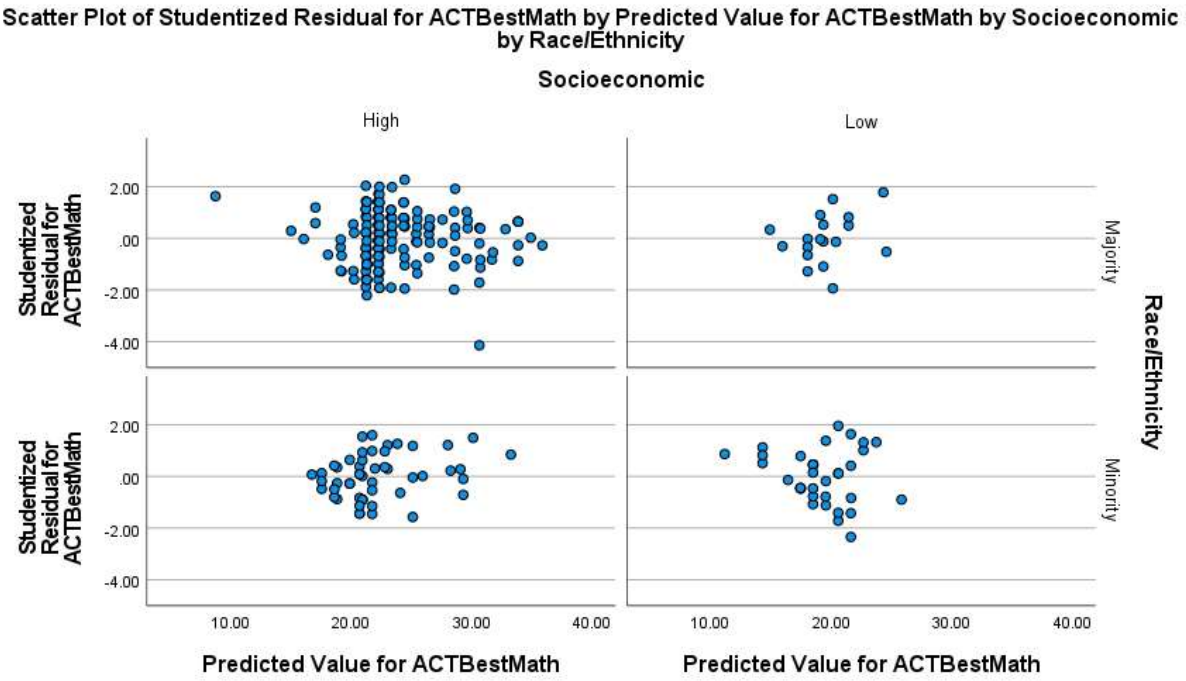


Table 11

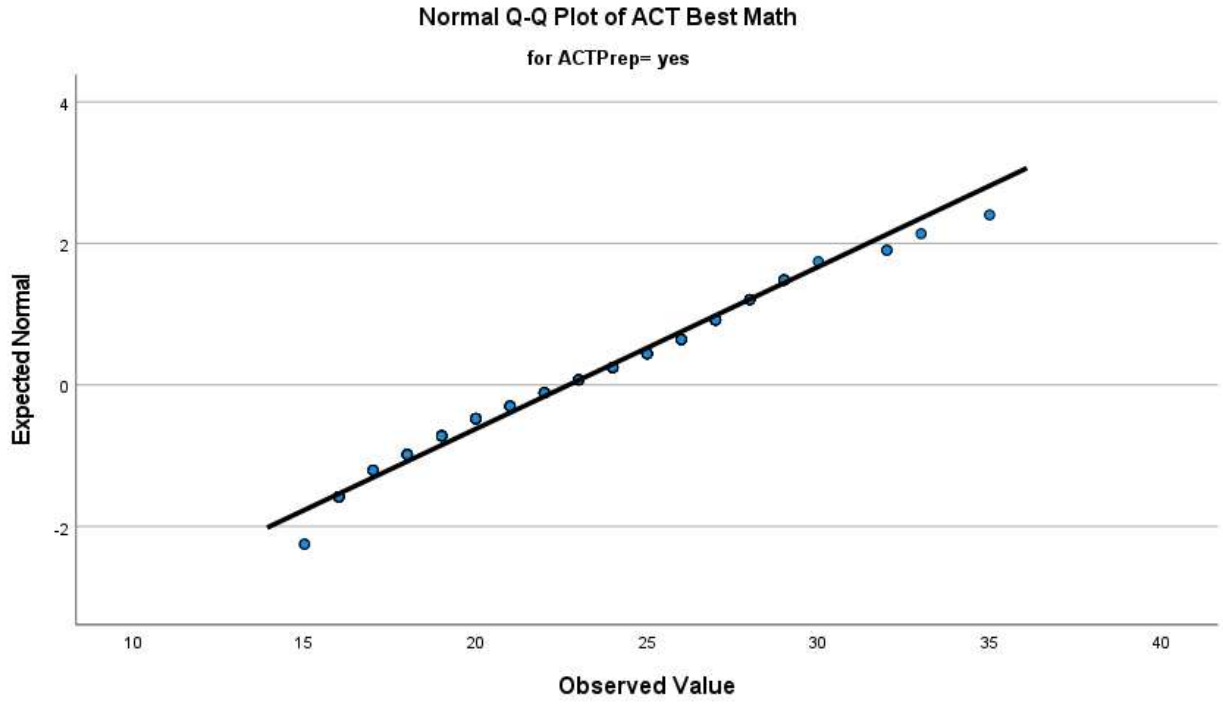
Levene's Test of Homogeneity of Variances for Math Scores

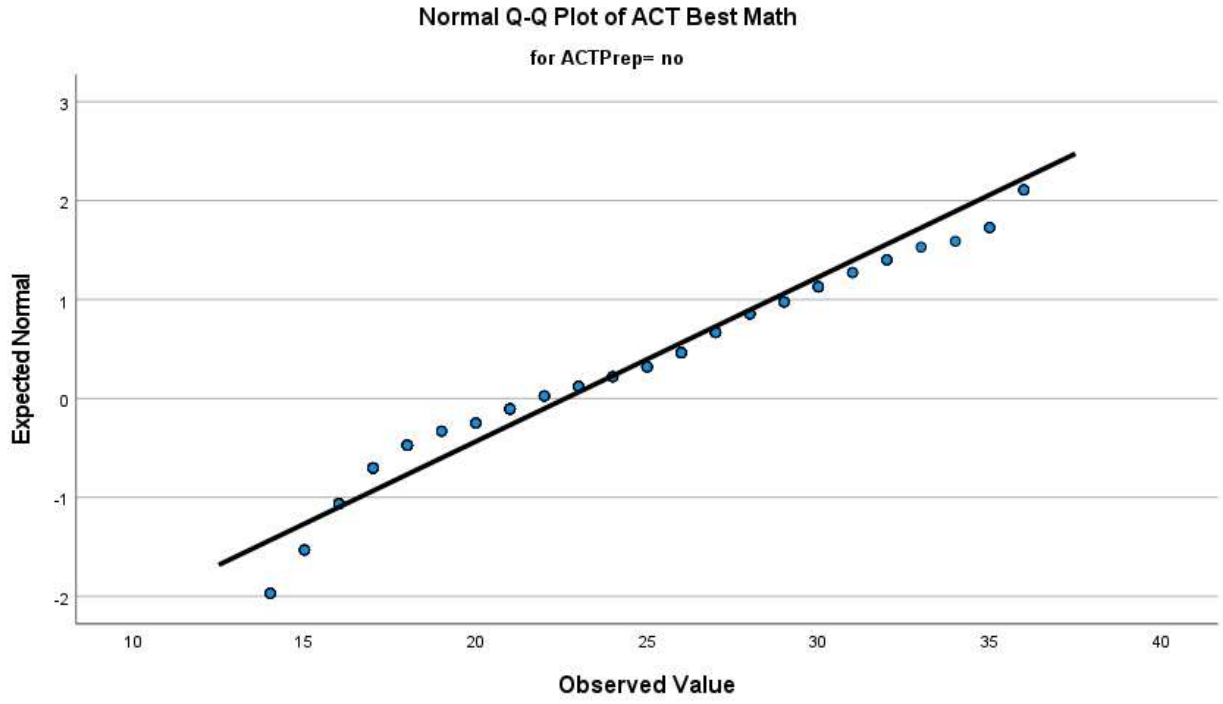
F	df_1	df_2	*P*
1.202	7	256	.302

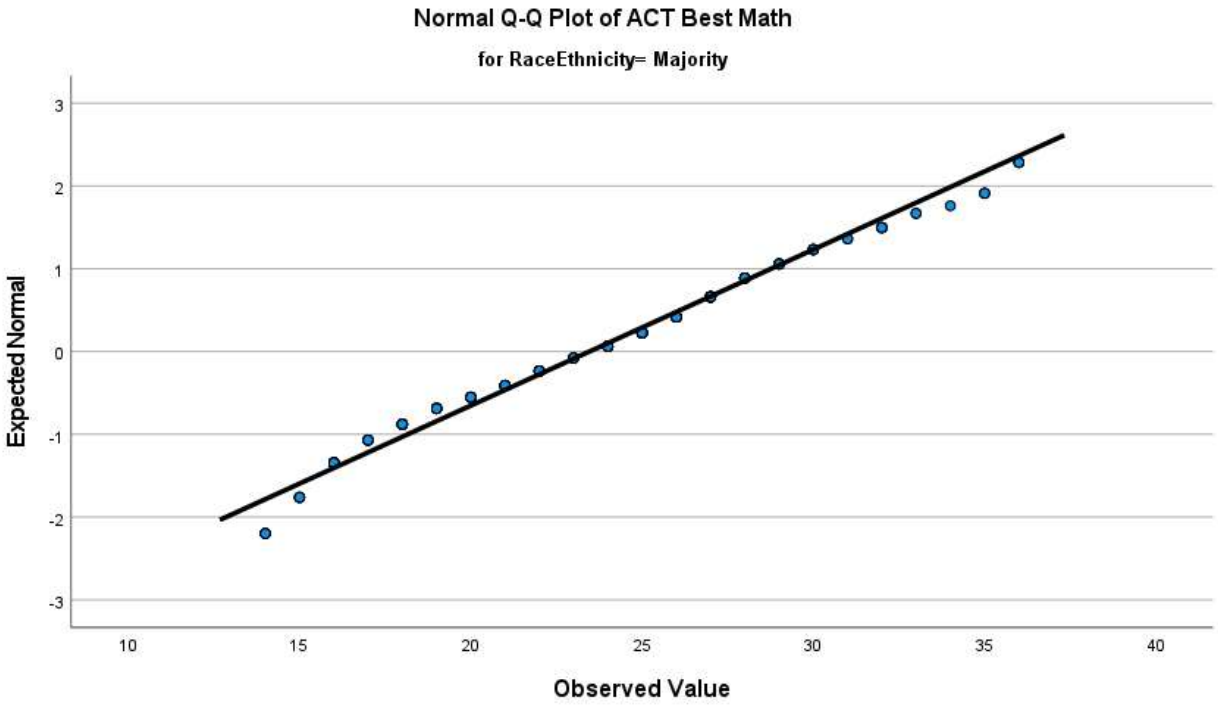
* $p < .05$

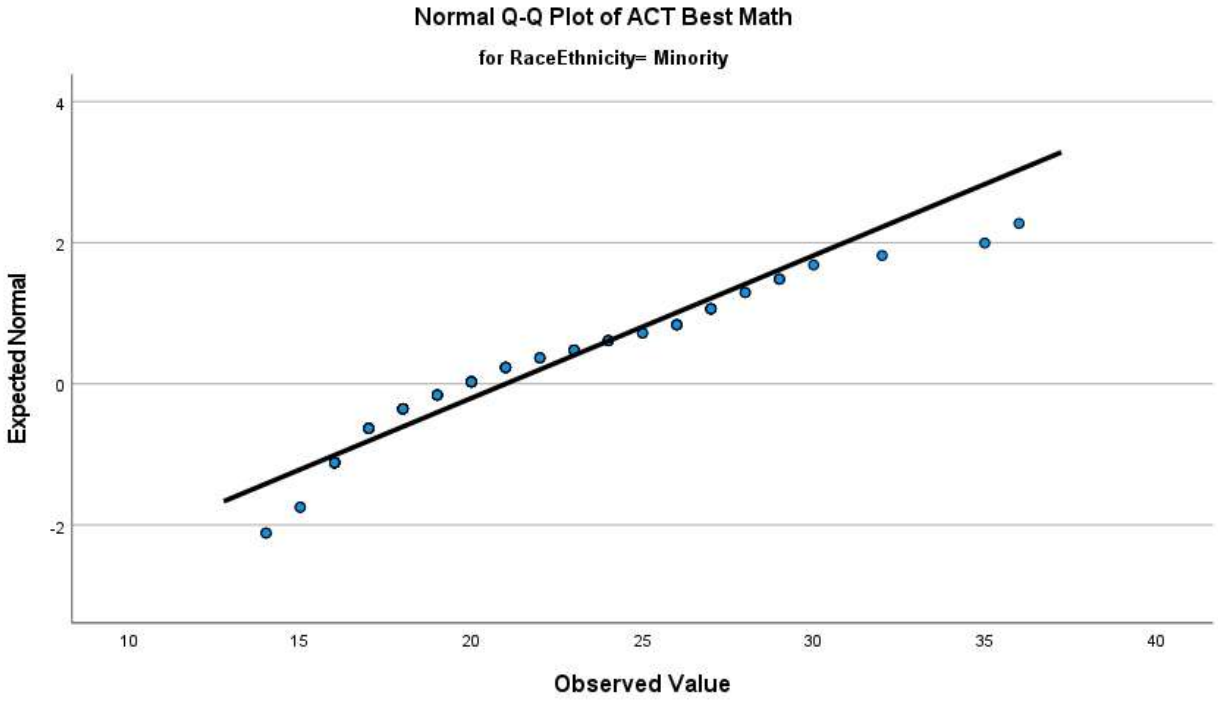
Figure 9

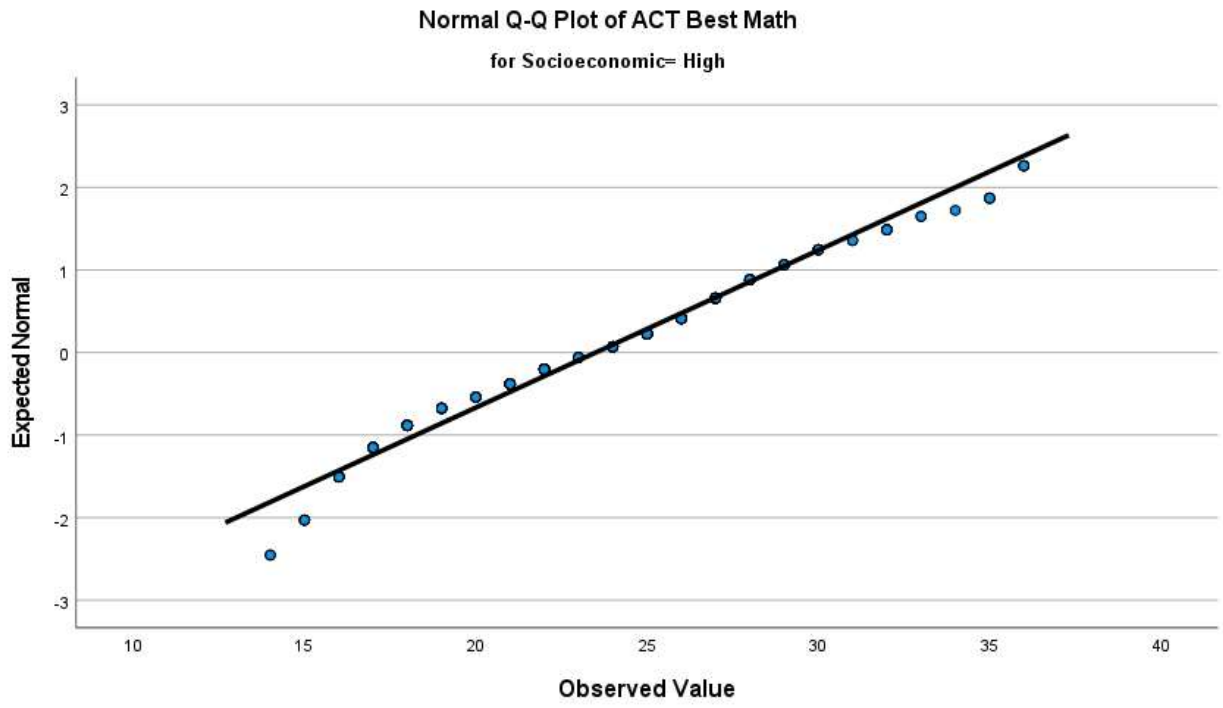
Normal Q-Q Plots for ACT Prep, Race/Ethnicity, and SES for Math Scores

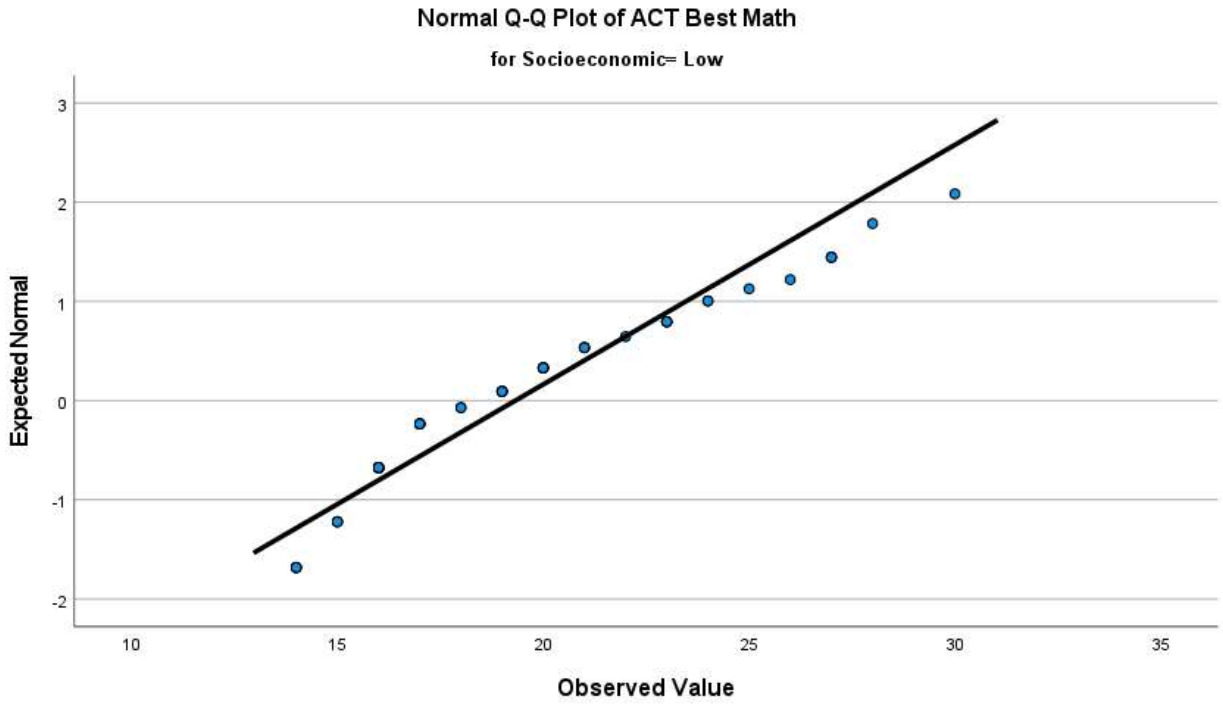





Normal Q-Q Plot of ACT Best Math
for RaceEthnicity= Majority
Expected Normal
3
2
1
0
-1
-2
-3
10
15
20
25
30
35
40
Observed Value


Normal Q-Q Plot of ACT Best Math
for RaceEthnicity= Minority
Expected Normal
4
2
0
-2
10
15
20
25
30
35
40
Observed Value


Normal Q-Q Plot of ACT Best Math
for Socioeconomic= High
Expected Normal
3
2
1
0
-1
-2
-3
10
15
20
25
30
35
40
Observed Value


Normal Q-Q Plot of ACT Best Math
for Socioeconomic= Low
Expected Normal
3
2
1
0
-1
-2
10
15
20
25
30
35
Observed Value

Substantive Results of the ANCOVA

A 2 x 2 x 2 between-groups ANCOVA was conducted to examine the differences across students' participation or lack of participation in an ACT Prep course, race/ethnicity, and SES, after controlling for practice ACT math scores, on their official ACT math scores. The independent variables were participation or lack of participation in the ACT Prep course, race/ethnicity, and SES, while the dependent variable was official ACT math scores. Students' practice ACT math scores were used as a covariate to control for individual differences in scores.

Assumptions of the ANCOVA were considered to ensure there were no violations of independence, linearity, homogeneity of regression slopes, homoscedasticity, homogeneity of variances, and normality. After adjusting students' official ACT math scores based on their practice ACT math scores, there was no significant interaction effect between any combination of the three independent variables. The interaction effect between participation or nonparticipation in an ACT Prep course, race/ethnicity, and SES was not significant, $F(1, 255) = .057$, $p = .811$, $\eta_p^2 = .000$. Additionally, no significant interactions were found between participation or nonparticipation in an ACT Prep course and race/ethnicity, $F(1, 255) = .782$, $p = .377$, $\eta_p^2 = .003$, participation or nonparticipation in an ACT Prep course and SES, $F(1, 255) = .003$, $p = .957$, $\eta_p^2 = .000$, or race/ethnicity and SES, $F(1, 255) = .458$, $p = .499$, $\eta_p^2 = .002$. ANCOVA results (see Table 12) indicated no significant main effect for participation or nonparticipation in an ACT Prep course, $F(1, 255) = .531$, $p = .467$, $\eta_p^2 = .002$ or race/ethnicity, $F(1, 255) = 1.042$, $p = .308$, $\eta_p^2 = .004$. Results indicated a significant main effect for SES, $F(1, 255) = 8.134$, $p = .005$, $\eta_p^2 = .031$. Students' practice ACT math scores, used as a covariate, significantly influenced their official ACT math scores, $F(1, 255) = 326.896$, $p < .001$, $\eta_p^2 = .562$.

Table 12

ANCOVA Summary Table for Math Scores

Source	*SS*	*df*	*MS*	*F*	*p*	η_p^2
Practice ACT Scores	3653.842	1	3653.842	326.896*	< .001	.562
ACT Prep	5.931	1	5.931	.531	.467	.002
Race/Ethnicity	11.643	1	11.643	1.042	.308	.004
SES	90.922	1	90.922	8.134*	.005	.031
ACT Prep x Race/Ethnicity	8.740	1	8.740	.782	.377	.003
ACT Prep x SES	.032	1	.032	.003	.957	.000
Race/Ethnicity x SES	5.118	1	5.118	.458	.499	.002
ACT Prep x Race/Ethnicity x SES	.642	1	.642	.057	.811	.000
Error	2850.234	255	11.177			
Total	142956.000	264				

* $p < .05$

Table 13 presents the adjusted means for all the combinant groups of participation or nonparticipation in an ACT Prep course, race/ethnicity, and SES. The adjusted means indicate that the average official ACT math score was higher for students who did not complete an ACT Prep course (M_{adj} = 22.156) than for students who completed an ACT Prep course (M_{adj} = 21.739), higher for students in the majority racial/ethnic group (M_{adj} = 22.238) than the minority racial/ethnic group (M_{adj} = 21.657), and higher for students who were in the higher SES group (M_{adj} = 22.773) than students who were in the low SES group (M_{adj} = 21.122).

Table 13

Means, Adjusted Means, Standard Deviations, and Standard Errors for ACT Prep, Race/Ethnicity, and SES for Math Scores

	ACT Prep				No ACT Prep			
	Majority Race/Ethnicity		Minority Race/Ethnicity		Majority Race/Ethnicity		Minority Race/Ethnicity	
	High SES	Low SES	High SES	Low SES	High SES	Low SES	High SES	Low SES
n	79	7	24	12	81	11	27	23
M	23.46	20.86	22.25	19.83	24.33	18.73	22.22	18.87
(SD)	(4.454)	(2.795)	(4.078)	(3.762)	(5.889)	(5.042)	(6.002)	(4.299)
M_{adj}	23.216	21.348	21.881	20.511	23.296	21.093	22.696	21.538
(SE)	(.376)	(1.264)	(.683)	(.966)	(.376)	(1.016)	(.644)	(.713)

Note. $N = 264$.

Reading Subtest Scores

Assumptions

The assumptions of the ANCOVA, as well as unusual points, were checked for reading subtest scores.

Independence

Participants belonged to different groups with no participant being in more than one group. For example, if a participant identified as a minority, low SES, and completing an ACT Prep course, then that participant did not belong to any other groups.

Linearity

There was a linear relationship between practice ACT reading scores and official ACT reading scores for every combination of groups of the three independent variables, as assessed by visual inspection of each scatterplot (see Figure 10). This inspection suggested that the covariate of practice ACT reading scores was good for consideration at this point in the analysis.

Homogeneity of Regression Slopes

Using the covariate of practice ACT reading scores and dependent variable of official ACT reading scores, a comparison between the three-way ANCOVA model with and without interaction terms did not discover a statistically significant interaction, $F(7, 248) = .895$, $p = .511$ (see Table 14). Since no statistically significant interaction was found, the assumption of homogeneity of regression slopes was met.

Homoscedasticity

Homoscedasticity existed within each combination of groups of the three independent variables, as assessed by visual inspection of the studentized residuals plotted against the predicted values for each group (see Figure 11).

Homogeneity of Variances

Levene's test of homogeneity of variances yielded no statistically significant difference, $F(7, 256) = 1.419$, $p = .198$ (see Table 15). The assumption of homogeneity of variances was met.

Normality

Examination of normal Q-Q plots determined the data points were close to a diagonal line (see Figure 12), which demonstrates the data are approximately normally distributed.

Unusual Points

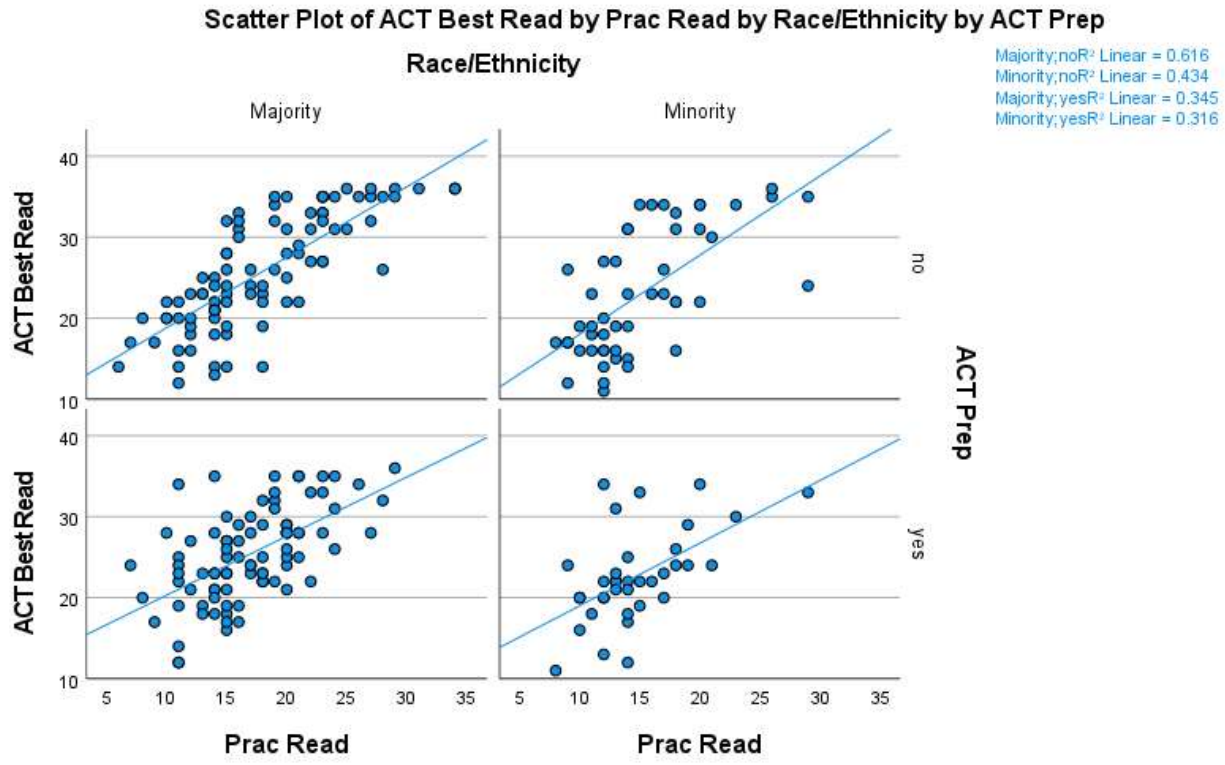
Outliers. An assessment of studentized residuals determined no outliers greater than ±3 standard deviations.

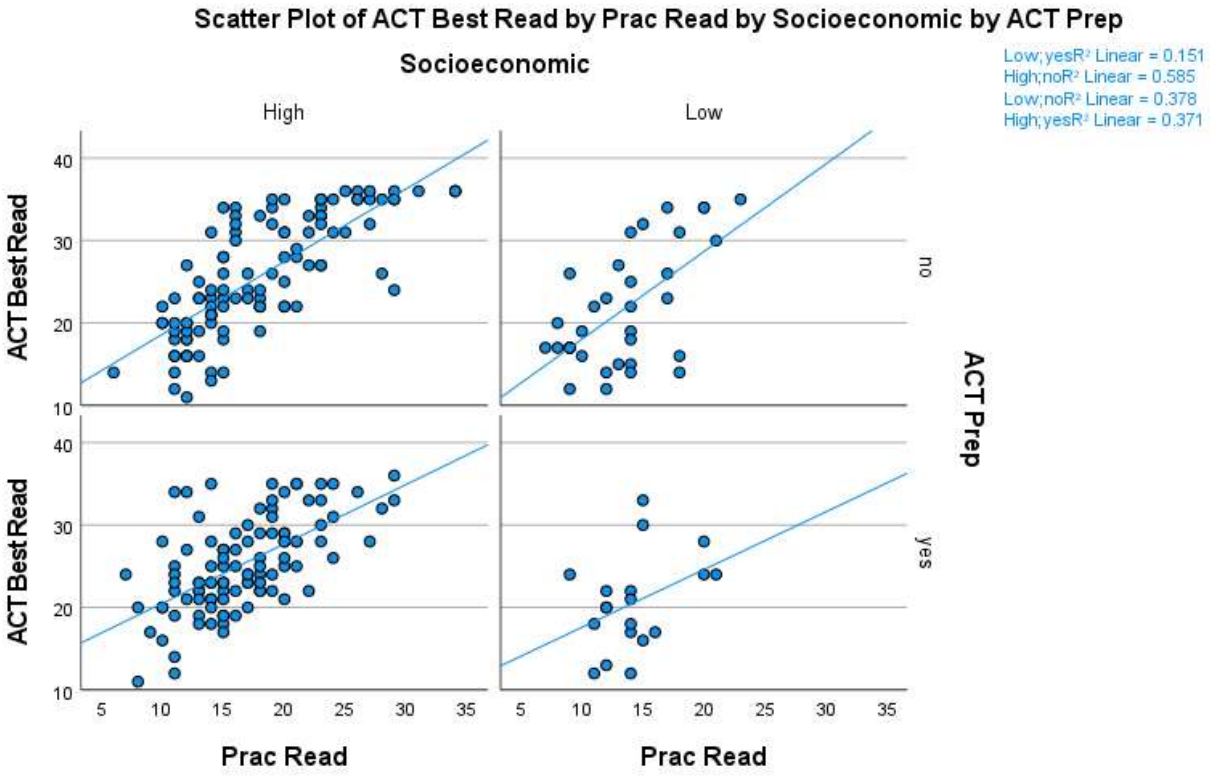
Leverage Points. An examination of leverage values in the data determined that all leverage values were less than 0.2, which made all datapoints safe to include in the dataset.

Influential Points. An examination of Cook's distance values determined that all values were lower than 1, which means there were no influential points.

Figure 10

Scatterplots of Practice and Official Reading Scores for Independent Variable Groups




Scatter Plot of ACT Best Read by Prac Read by Socioeconomic by ACT Prep
Socioeconomic
High
Low
Low;yesR² Linear = 0.151
High;noR² Linear = 0.585
Low;noR² Linear = 0.378
High;yesR² Linear = 0.371
ACT Best Read
Prac Read
ACT Prep
no
yes
10
20
30
40
5
10
15
20
25
30
35

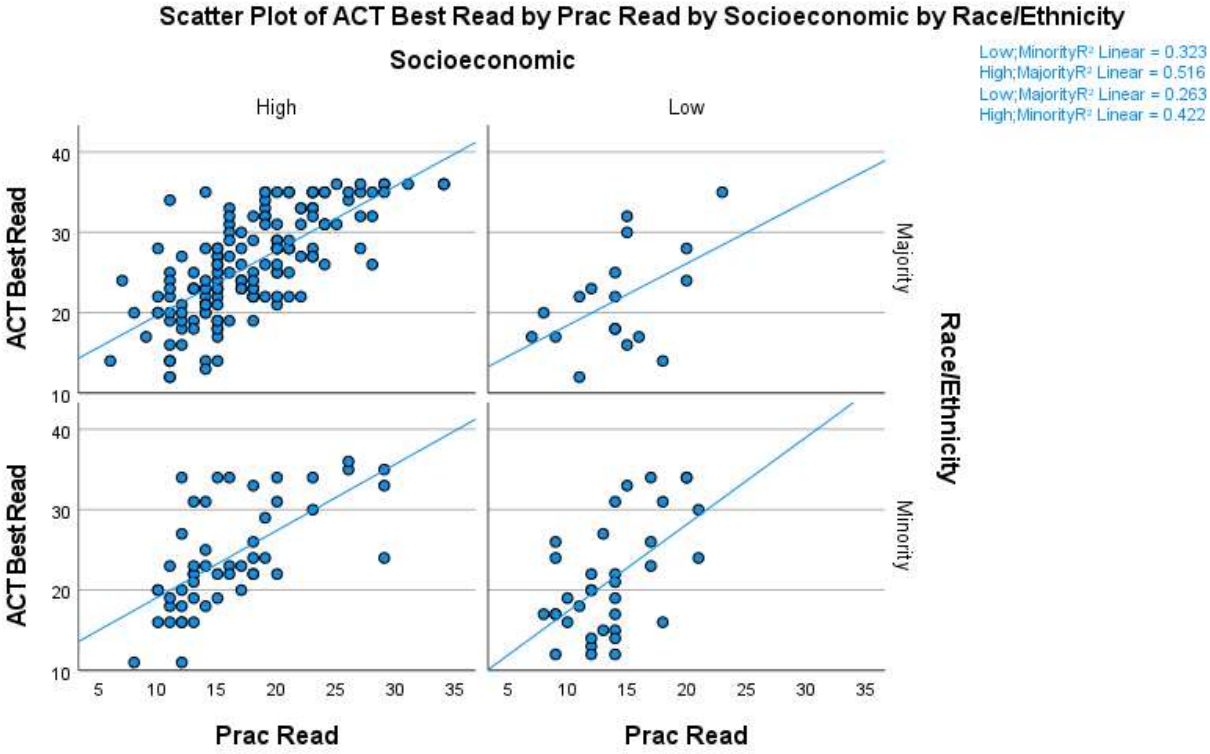

Scatter Plot of ACT Best Read by Prac Read by Socioeconomic by Race/Ethnicity
Socioeconomic
High
Low
Low;MinorityR² Linear = 0.323
High;MajorityR² Linear = 0.516
Low;MajorityR² Linear = 0.263
High;MinorityR² Linear = 0.422
ACT Best Read
Prac Read
Race/Ethnicity
Majority
Minority
10
20
30
40
5
10
15
20
25
30
35

Table 14

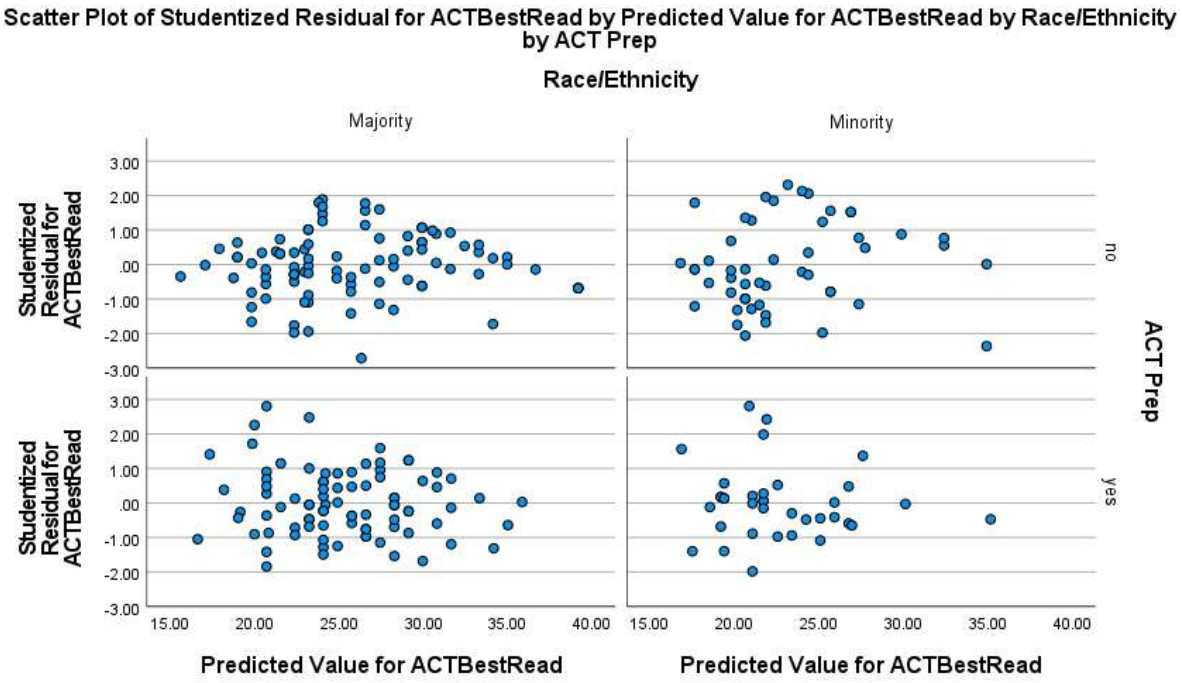
Tests of Between-Subjects Effects with and without Interaction Terms for Reading Scores

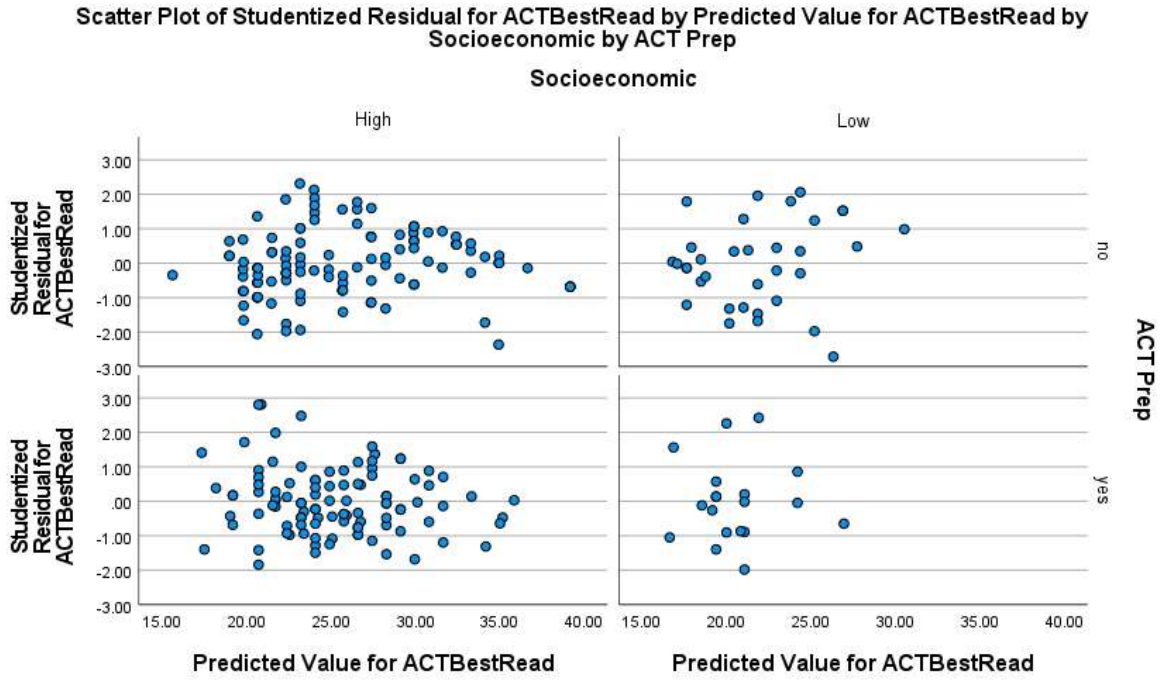
Source	*SS*	*df*	*MS*	*F*	*p*
Groups	185.052	7	26.436	1.155	.329
Practice Reading	1311.516	1	1311.516	57.304*	< .001
Groups x Practice Reading	143.311	7	20.473	.895	.511
Error	5675.961	248	22.887		
Total	173163.000	264			

* $p < .05$

Figure 11

Scatterplots of Studentized Residuals across Predicted Values for Reading Scores





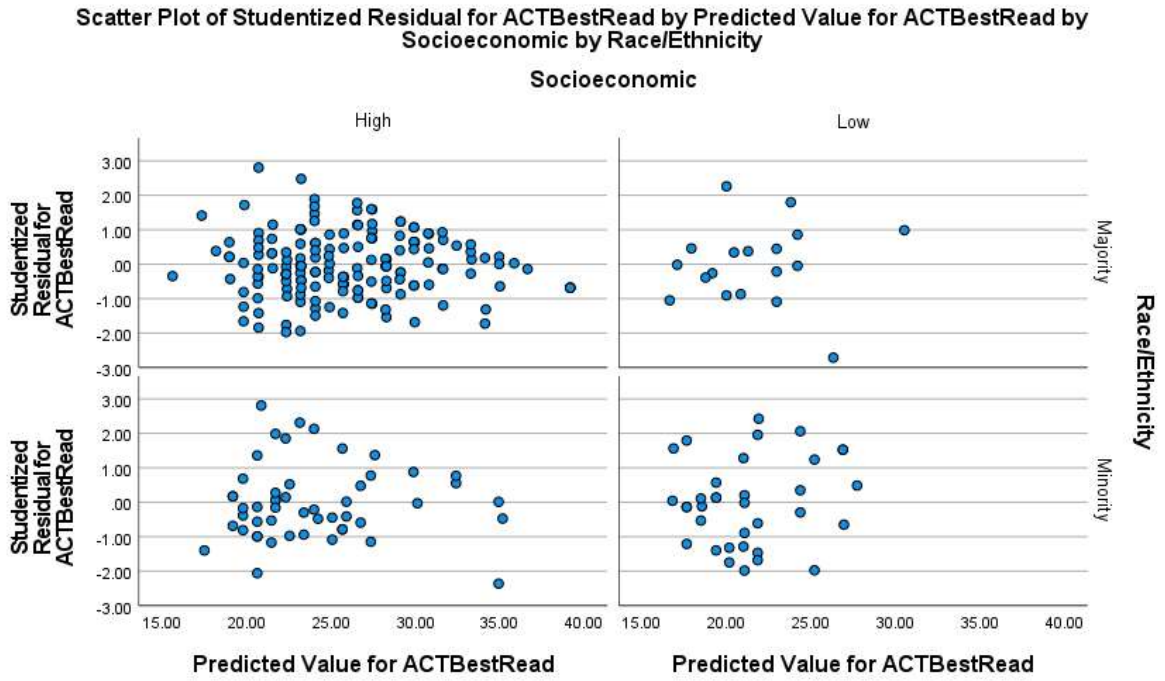


Table 15

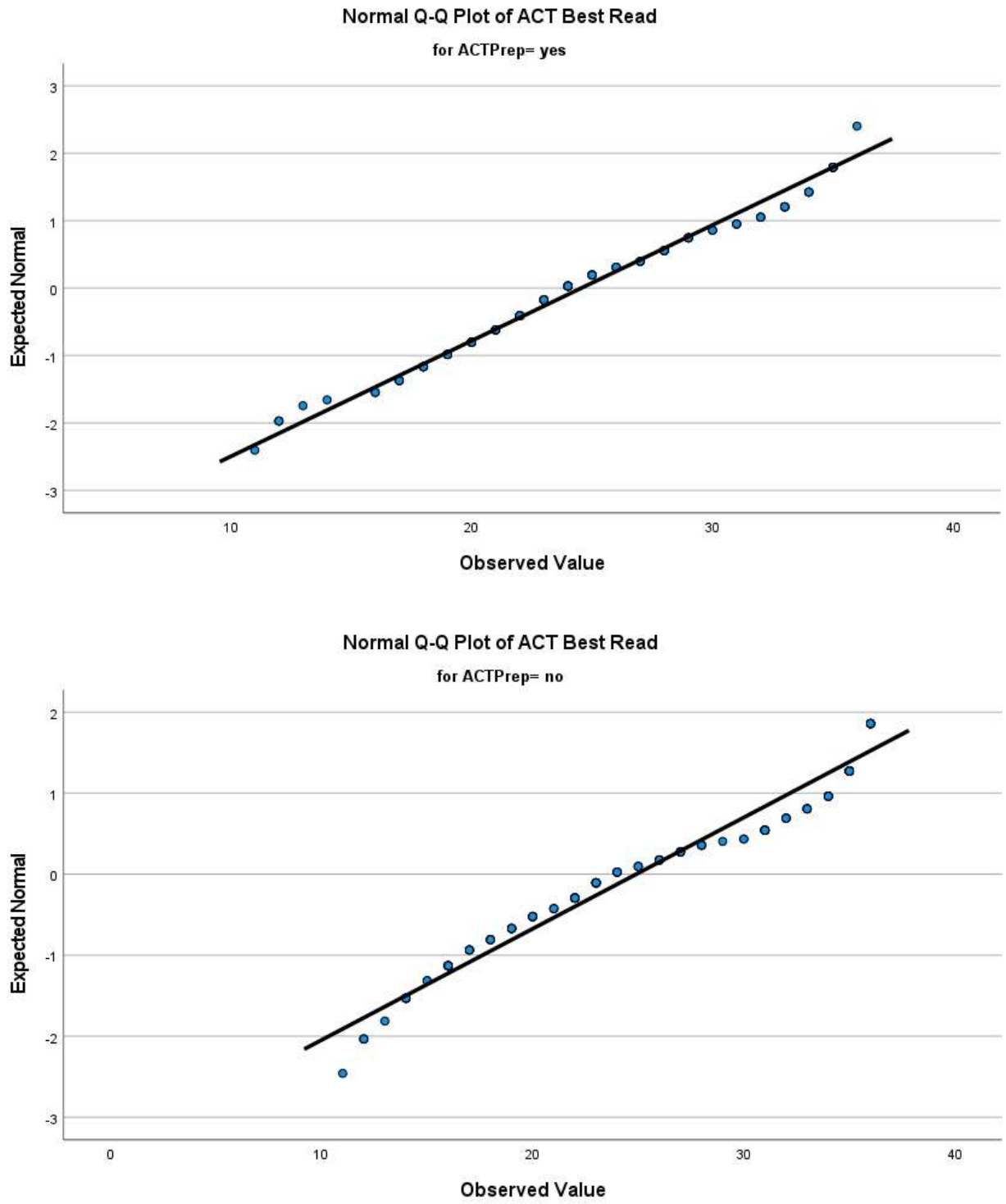
Levene's Test of Homogeneity of Variances for Reading Scores

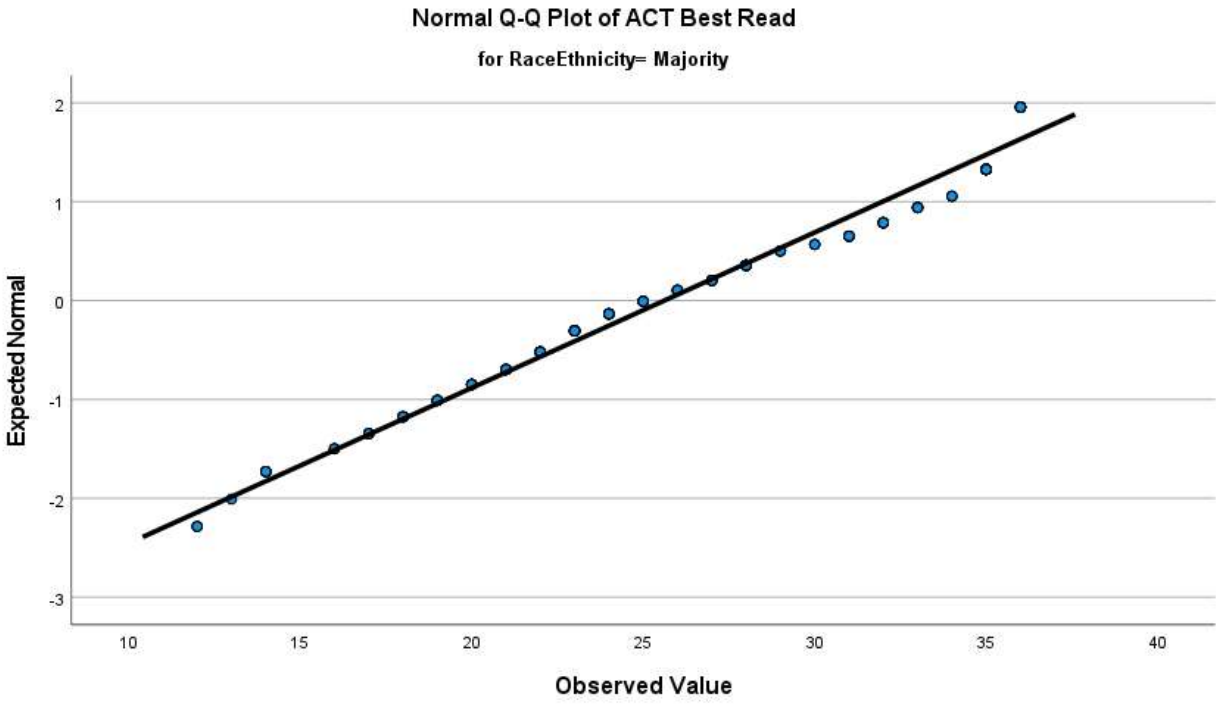
F	df_1	df_2	*P*
1.419	7	256	.198

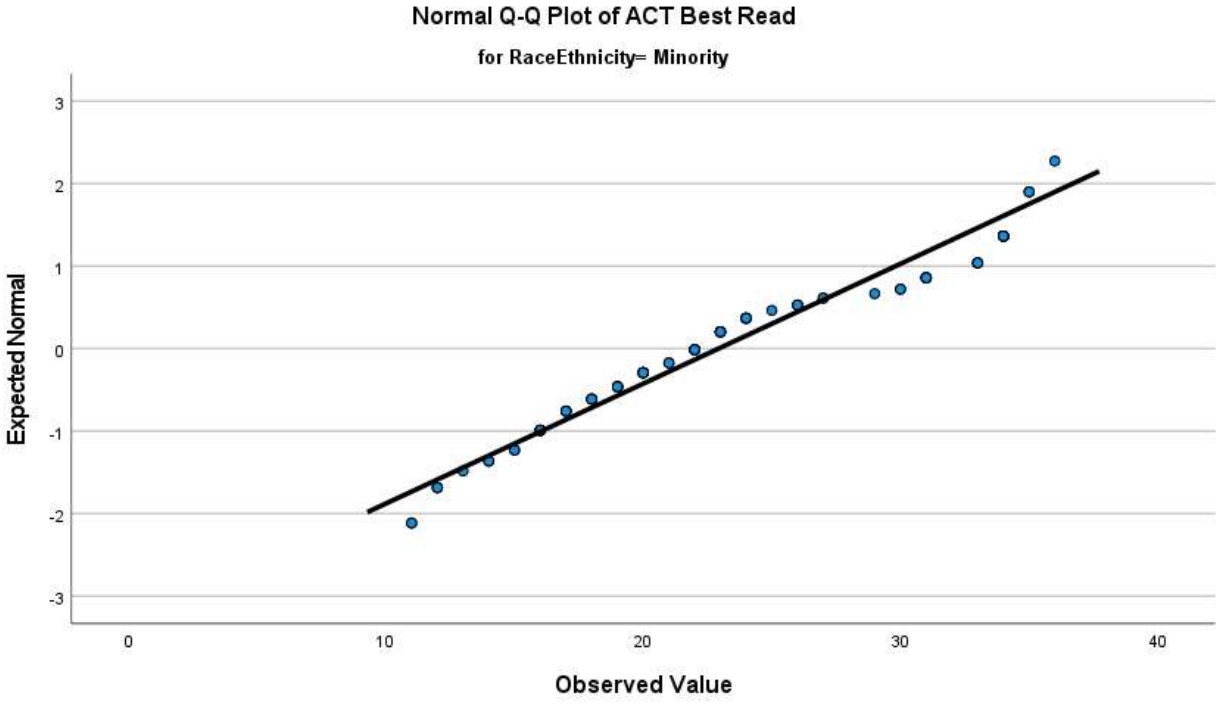
* $p < .05$

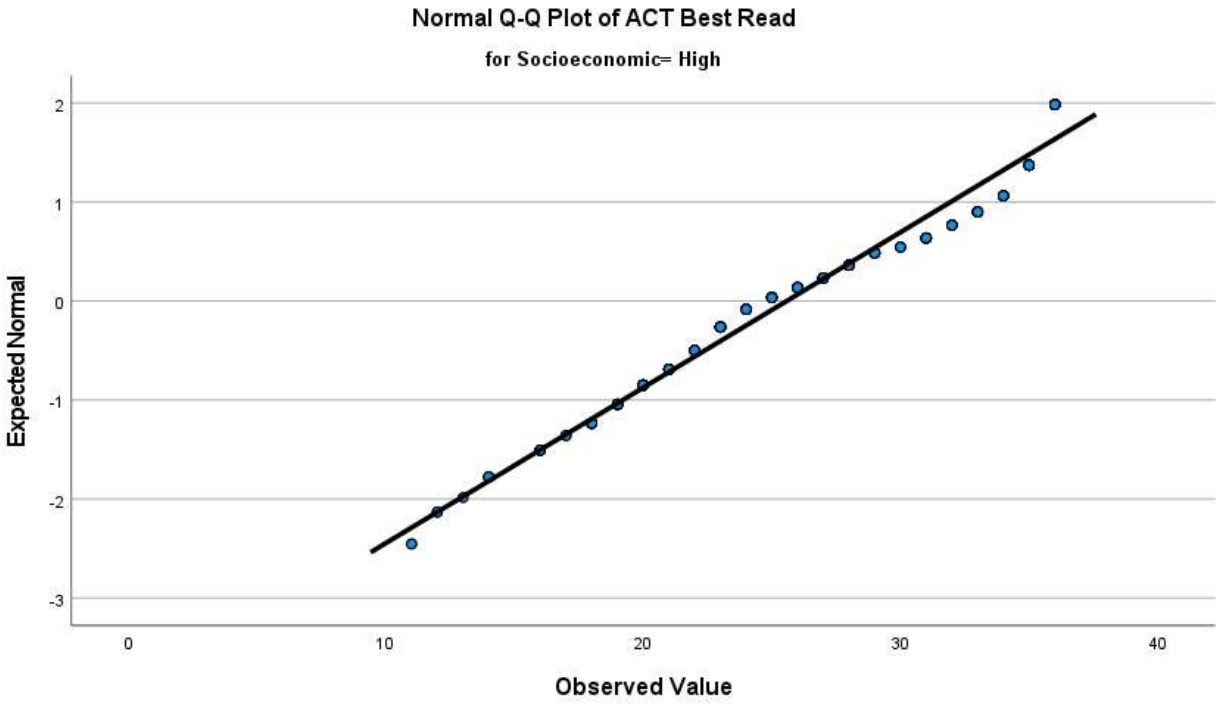
Figure 12

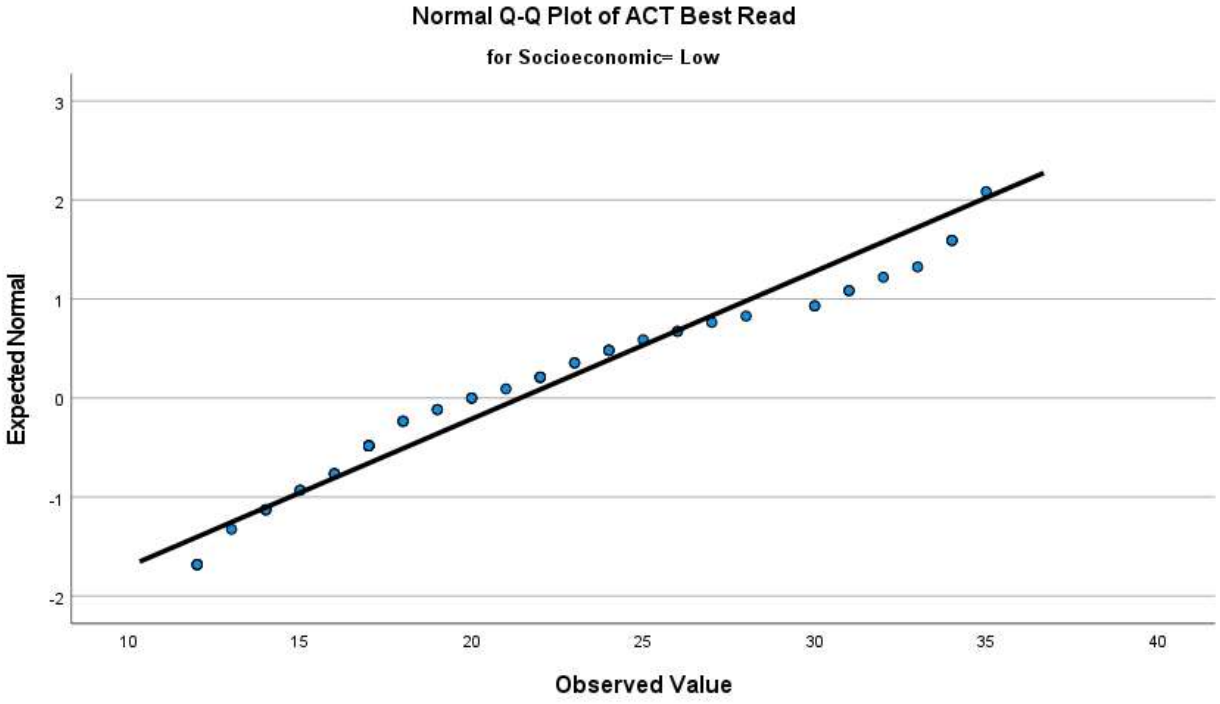
Normal Q-Q Plots for ACT Prep, Race/Ethnicity, and SES for Reading Scores




Normal Q-Q Plot of ACT Best Read
for RaceEthnicity= Majority
Expected Normal
Observed Value
2
1
0
-1
-2
-3
10
15
20
25
30
35
40


Normal Q-Q Plot of ACT Best Read
for RaceEthnicity= Minority
Expected Normal
Observed Value
3
2
1
0
-1
-2
-3
0
10
20
30
40


Normal Q-Q Plot of ACT Best Read
for Socioeconomic= High
Expected Normal
Observed Value
2
1
0
-1
-2
-3
0
10
20
30
40


Normal Q-Q Plot of ACT Best Read
for Socioeconomic= Low
Expected Normal
Observed Value
3
2
1
0
-1
-2
10
15
20
25
30
35
40

Substantive Results of the ANCOVA

A 2 x 2 x 2 between-groups ANCOVA was conducted to examine the differences across students' participation or lack of participation in an ACT Prep course, race/ethnicity, and SES, after controlling for practice ACT reading scores, on their official ACT reading scores. The independent variables were participation or lack of participation in the ACT Prep course, race/ethnicity, and SES, while the dependent variable was official ACT reading scores. Students' practice ACT reading scores were used as a covariate to control for individual differences in scores.

Assumptions of the ANCOVA were considered to ensure there were no violations of independence, linearity, homogeneity of regression slopes, homoscedasticity, homogeneity of variances, and normality. After adjusting students' official ACT reading scores based on their practice ACT reading scores, there was no significant interaction effect between any combination of the three independent variables. The interaction effect between participation or nonparticipation in an ACT Prep course, race/ethnicity, and SES was not significant, $F(1, 255) = 1.272$, $p = .260$, $\eta_p^2 = .005$. Additionally, no significant interactions were found between participation or nonparticipation in an ACT Prep course and race/ethnicity, $F(1, 255) = .532$, $p = .466$, $\eta_p^2 = .002$, participation or nonparticipation in an ACT Prep course and SES, $F(1, 255) = 3.061$, $p = .081$, $\eta_p^2 = .012$, or race/ethnicity and SES, $F(1, 255) = .214$, $p = .644$, $\eta_p^2 = .001$. ANCOVA results (see Table 16) indicated no significant main effect for participation or nonparticipation in an ACT Prep course, $F(1, 255) = 1.132$, $p = .288$, $\eta_p^2 = .004$, race/ethnicity, $F(1, 255) = .001$, $p = .982$, $\eta_p^2 = .000$, or SES, $F(1, 255) = 2.674$, $p = .103$, $\eta_p^2 = .010$. Students' practice ACT reading scores, used as a covariate, significantly influenced their official ACT reading scores, $F(1, 255) = 212.361$, $p < .001$, $\eta_p^2 = .454$.

Table 16

ANCOVA Summary Table for Reading Scores

Source	*SS*	*df*	*MS*	*F*	*p*	η_p^2
Practice ACT Scores	4846.214	1	4846.214	212.361*	< .001	.454
ACT Prep	25.838	1	25.838	1.132	.288	.004
Race/Ethnicity	.012	1	.012	.001	.982	.000
SES	61.019	1	61.019	2.674	.103	.010
ACT Prep x Race/Ethnicity	12.152	1	12.152	.532	.466	.002
ACT Prep x SES	69.862	1	69.862	3.061	.081	.012
Race/Ethnicity x SES	4.882	1	4.882	.214	.644	.001
ACT Prep x Race/Ethnicity x SES	29.030	1	29.030	1.272	.260	.005
Error	5819.272	255	22.821			
Total	173163.000	264				

* $p < .05$

Table 17 presents the adjusted means for all the combinant groups of participation or nonparticipation in an ACT Prep course, race/ethnicity, and SES. The adjusted means indicate that the average official ACT reading score was higher for students who did not complete an ACT Prep course (M_{adj} = 24.638) than for students who completed an ACT Prep course (M_{adj} = 23.772), higher for students in the minority racial/ethnic group (M_{adj} = 24.215) than the majority racial/ethnic group (M_{adj} = 24.196), and higher for students who were in the higher SES group (M_{adj} = 24.884) than students who were in the low SES group (M_{adj} = 23.527).

Table 17

Means, Adjusted Means, Standard Deviations, and Standard Errors for ACT Prep, Race/Ethnicity, and SES for Reading Scores

	ACT Prep				No ACT Prep			
	Majority Race/Ethnicity		Minority Race/Ethnicity		Majority Race/Ethnicity		Minority Race/Ethnicity	
	High SES	Low SES	High SES	Low SES	High SES	Low SES	High SES	Low SES
n	79	7	24	12	81	11	27	23
M	25.76	20.71	23.71	20.50	26.35	22.27	24.37	21.70
(SD)	(5.445)	(6.701)	(5.760)	(5.502)	(6.912)	(6.420)	(7.463)	(7.701)
M_{adj}	25.508	21.424	24.824	23.334	24.619	25.234	24.586	24.115
(SE)	(.538)	(1.806)	(.978)	(1.393)	(.544)	(1.455)	(.919)	(1.010)

Note. $N = 264$.

Science Subtest Scores

Assumptions

The assumptions of the ANCOVA, as well as unusual points, were checked for science subtest scores.

Independence

Participants belonged to different groups with no participant being in more than one group. For example, if a participant identified as a minority, low SES, and completing an ACT Prep course, then that participant did not belong to any other groups.

Linearity

There was a linear relationship between practice ACT science scores and official ACT science scores for every combination of groups of the three independent variables, as assessed by visual inspection of each scatterplot (see Figure 13). This inspection suggested that the covariate of practice ACT science scores was good for consideration at this point in the analysis.

Homogeneity of Regression Slopes

Using the covariate of practice ACT science scores and dependent variable of official ACT science scores, a comparison between the three-way ANCOVA model with and without interaction terms did not discover a statistically significant interaction, $F(7, 248) = 1.835$, $p = .081$ (see Table 18). Since no statistically significant interaction was found, the assumption of homogeneity of regression slopes was met.

Homoscedasticity

Homoscedasticity existed within each combination of groups of the three independent variables, as assessed by visual inspection of the studentized residuals plotted against the predicted values for each group (see Figure 14).

Homogeneity of Variances

Levene's test of homogeneity of variances yielded no statistically significant difference, $F(7, 256) = 1.133$, $p = .343$ (see Table 19). The assumption of homogeneity of variances was met.

Normality

Examination of normal Q-Q plots determined the data points were close to a diagonal line (see Figure 15), which demonstrates the data are approximately normally distributed.

Unusual Points

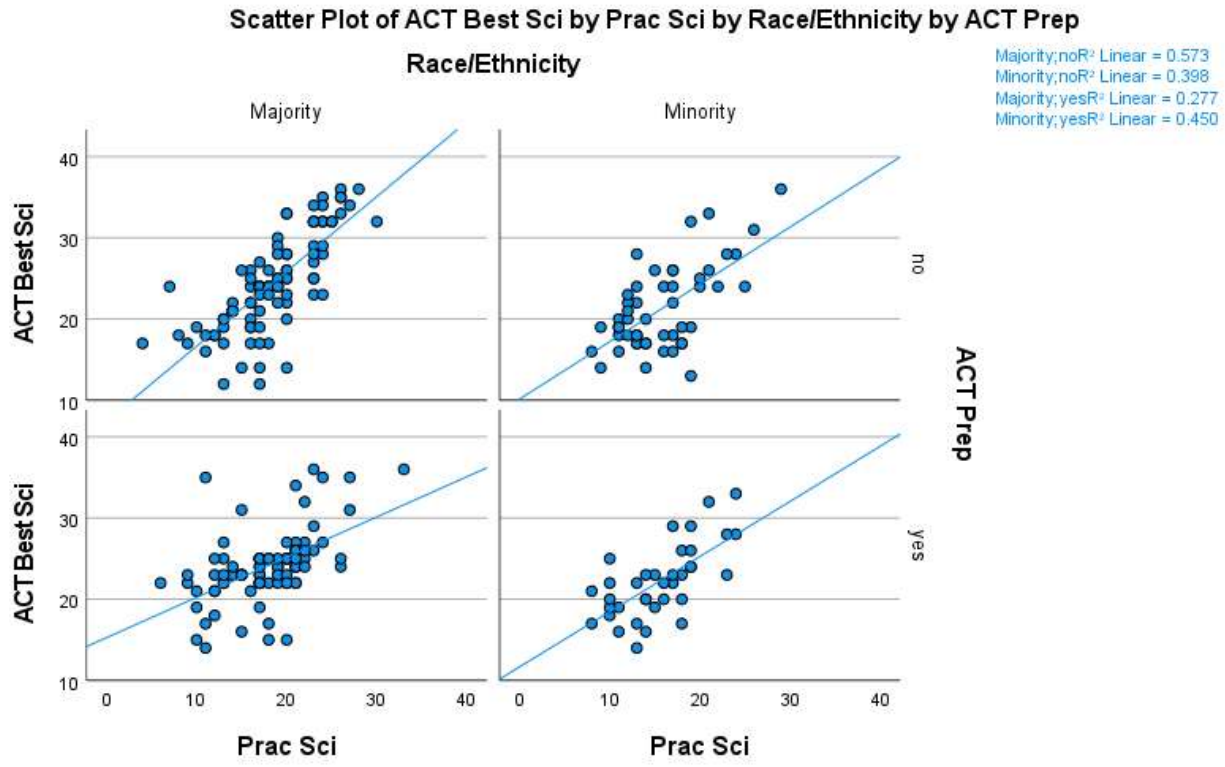
Outliers. An assessment of studentized residuals determined two outliers greater than ±3 standard deviations. A comparison of the three-way ANCOVA results with and without the outliers determined that conclusions were not significantly affected by inclusion of the outliers. As a result, the decision was made to keep the outliers in the data for reporting purposes.

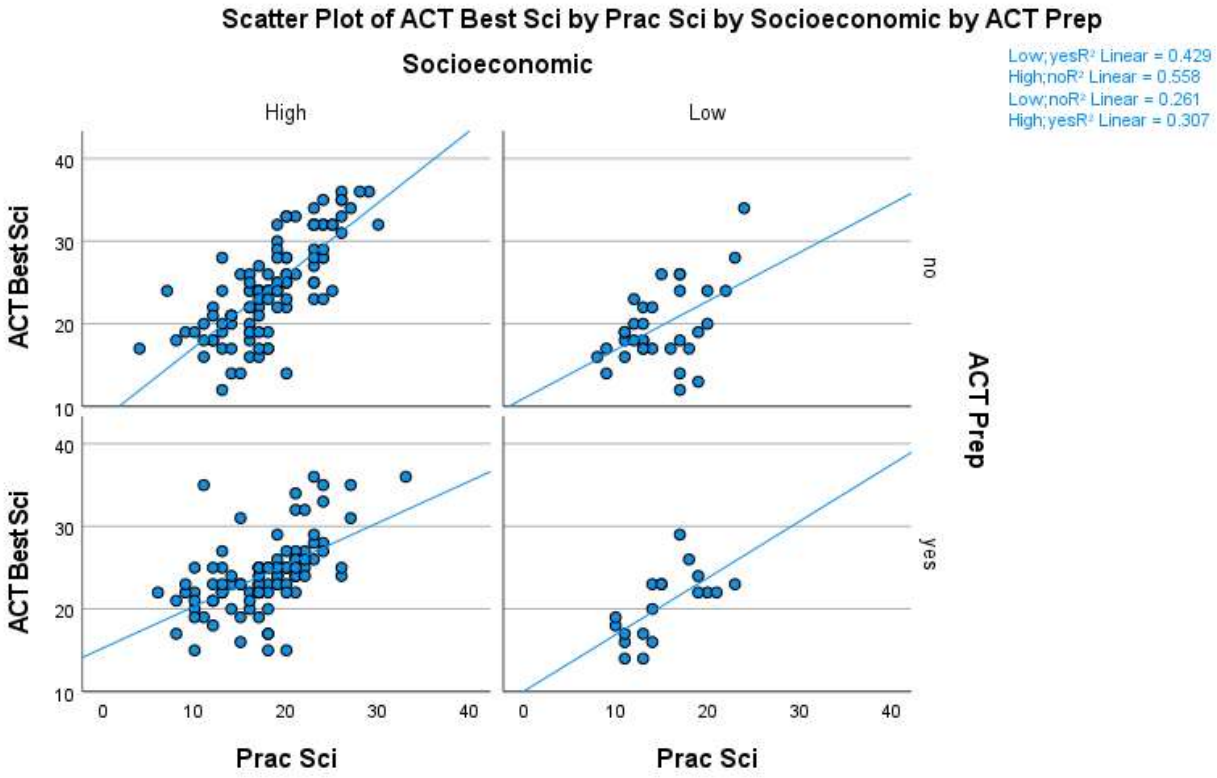
Leverage Points. An examination of leverage values in the data determined that all leverage values were less than 0.2, which made all datapoints safe to include in the dataset.

Influential Points. An examination of Cook's distance values determined that all values were lower than 1, which means there were no influential points.

Figure 13

Scatterplots of Practice and Official Science Scores for Independent Variable Groups




Scatter Plot of ACT Best Sci by Prac Sci by Socioeconomic by ACT Prep
Socioeconomic
High
Low
Low;yesR² Linear = 0.429
High;noR² Linear = 0.558
Low;noR² Linear = 0.261
High;yesR² Linear = 0.307
ACT Best Sci
Prac Sci
ACT Prep
no
yes
10
20
30
40
0

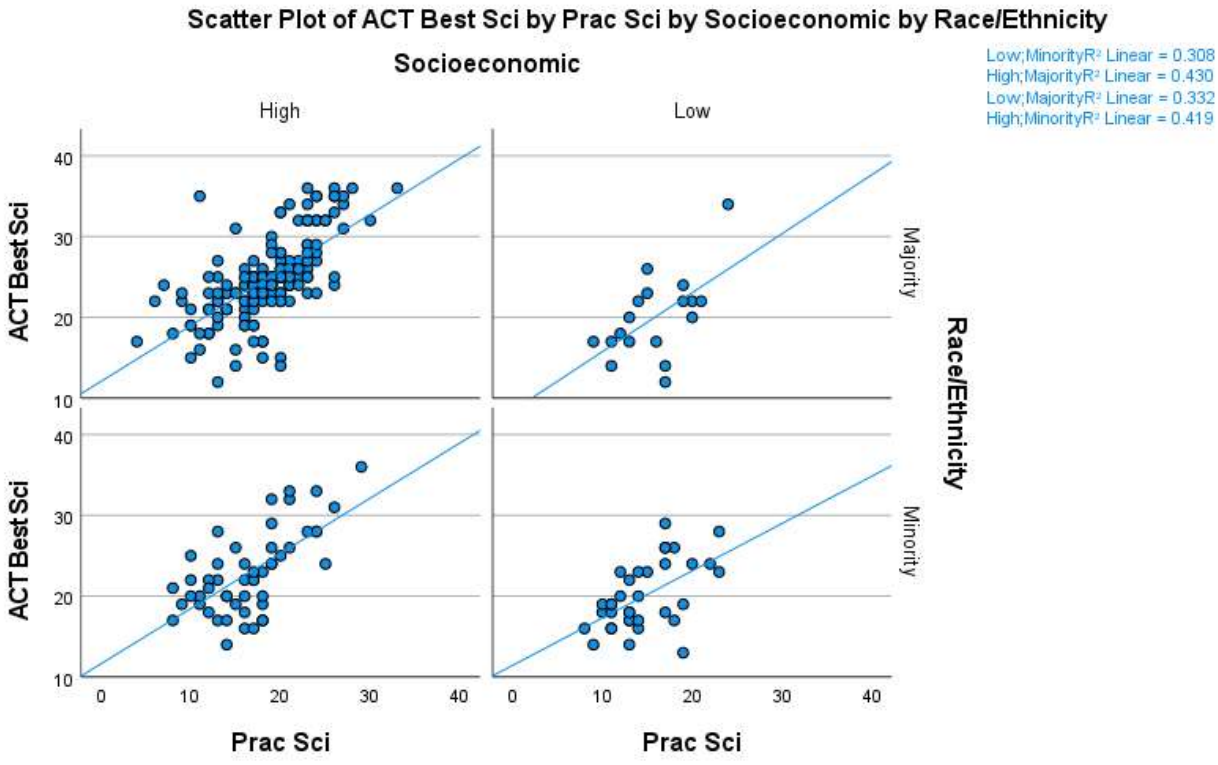

Scatter Plot of ACT Best Sci by Prac Sci by Socioeconomic by Race/Ethnicity
Socioeconomic
High
Low
Low;MinorityR² Linear = 0.308
High;MajorityR² Linear = 0.430
Low;MajorityR² Linear = 0.332
High;MinorityR² Linear = 0.419
ACT Best Sci
Prac Sci
Race/Ethnicity
Majority
Minority
10
20
30
40
0

Table 18

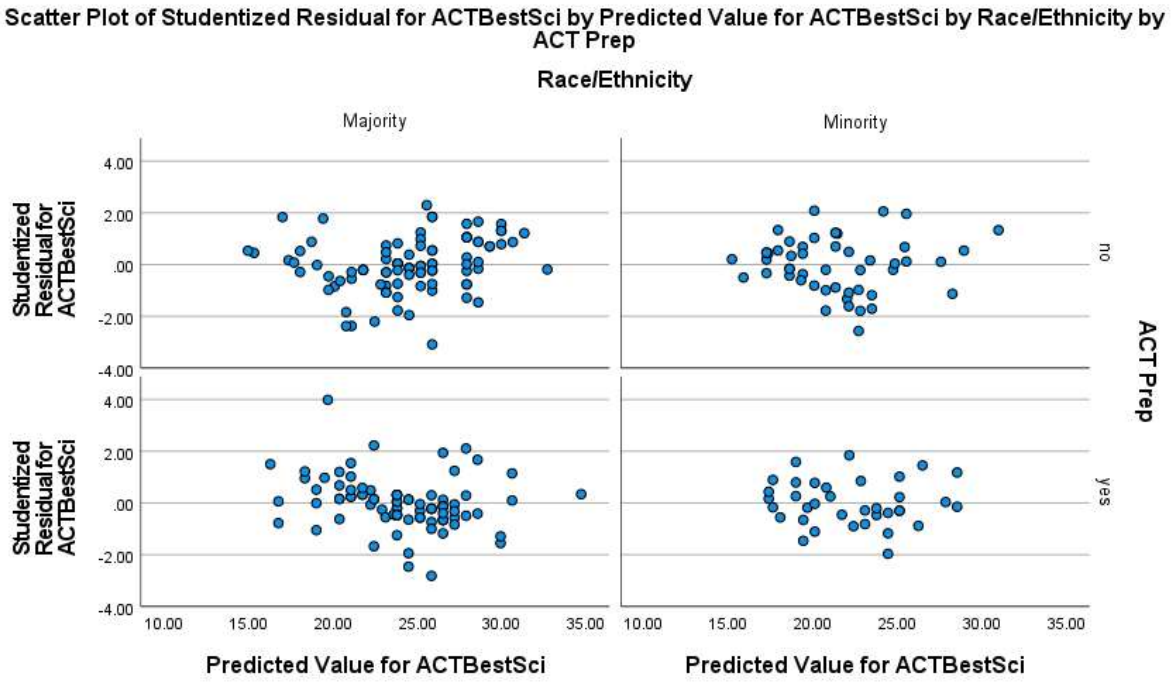
Tests of Between-Subjects Effects with and without Interaction Terms for Science Scores

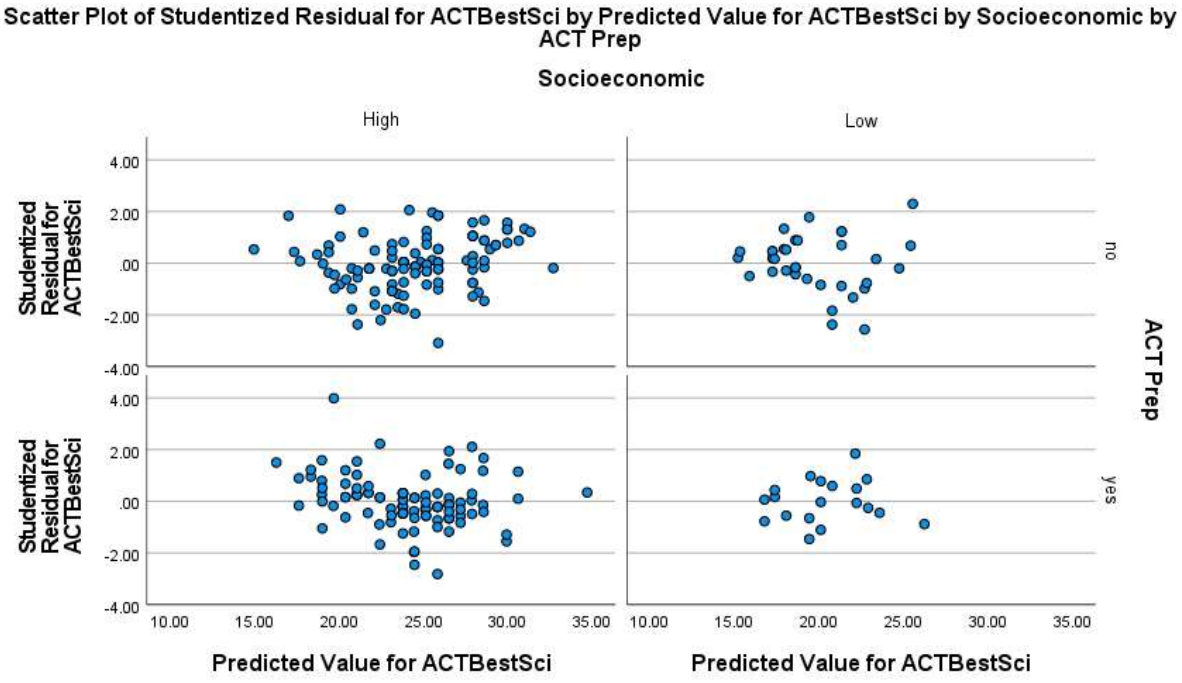
Source	*SS*	*df*	*MS*	*F*	*p*
Groups	186.972	7	26.710	1.817	.084
Practice Science	1023.679	1	1023.679	69.646*	< .001
Groups x Practice Science	188.771	7	26.967	1.835	.081
Error	3645.187	248	14.698		
Total	152713.000	264			

* $p < .05$

Figure 14

Scatterplots of Studentized Residuals across Predicted Values for Science Scores





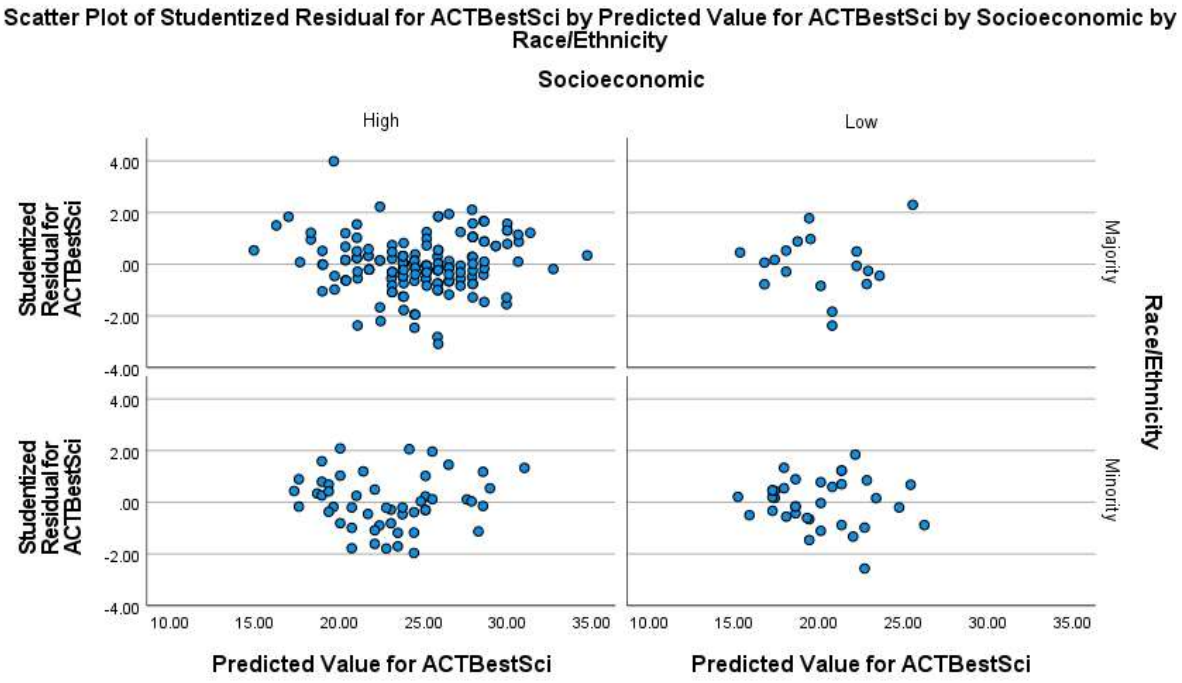


Table 19

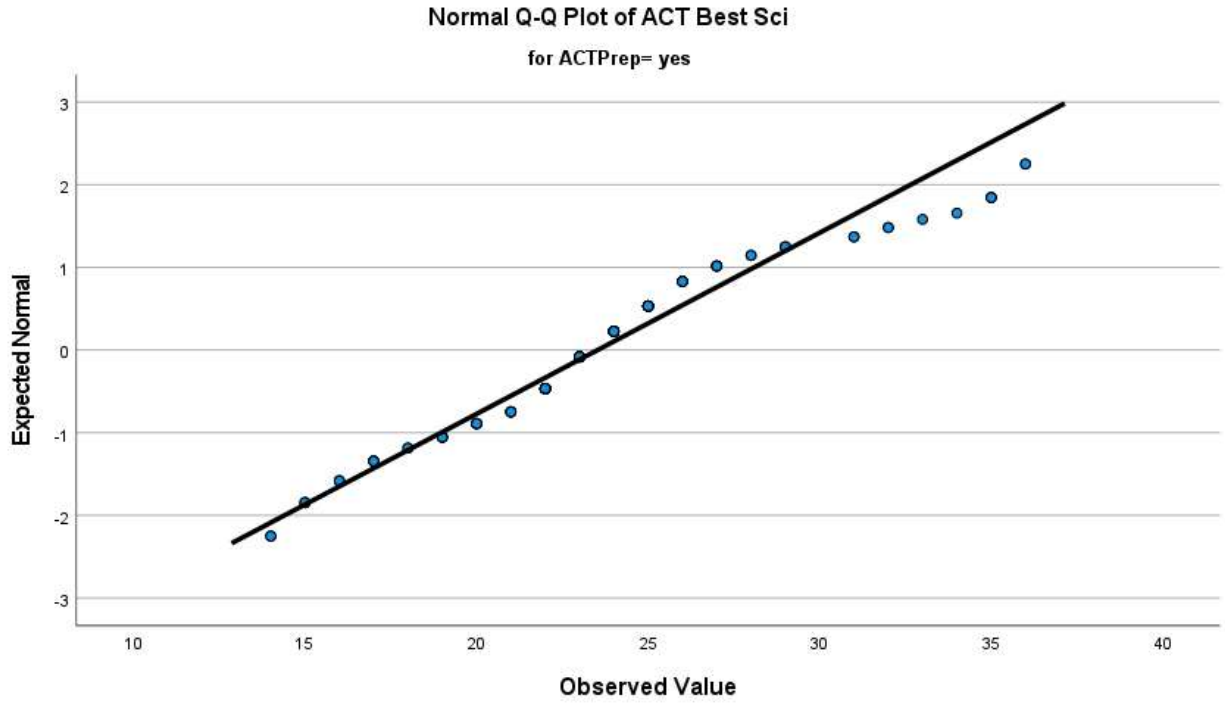
Levene's Test of Homogeneity of Variances for Science Scores

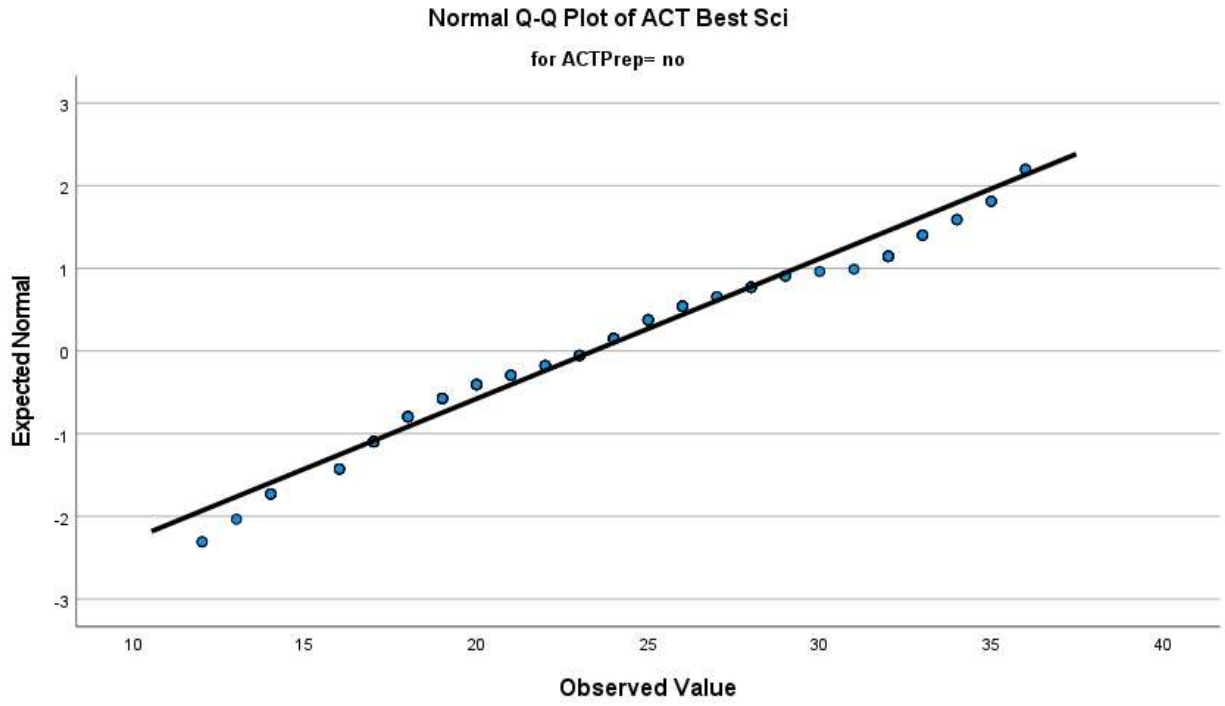
F	df_1	df_2	*P*
1.133	7	256	.343

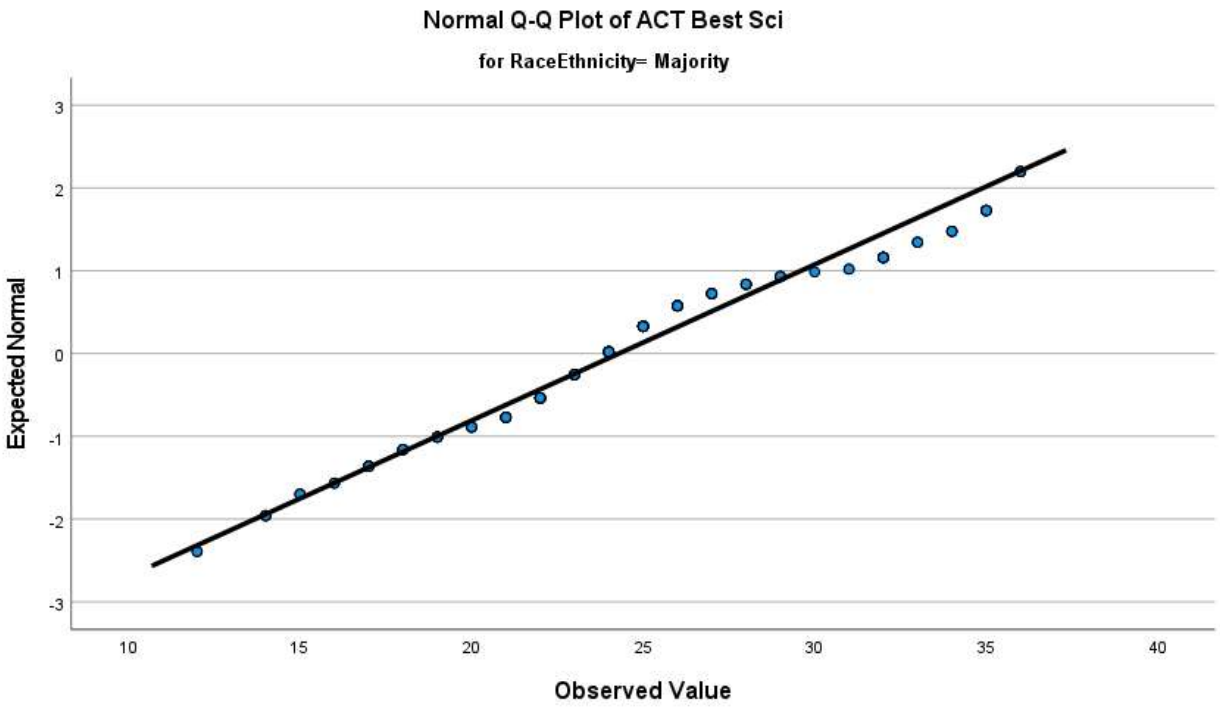
* $p < .05$

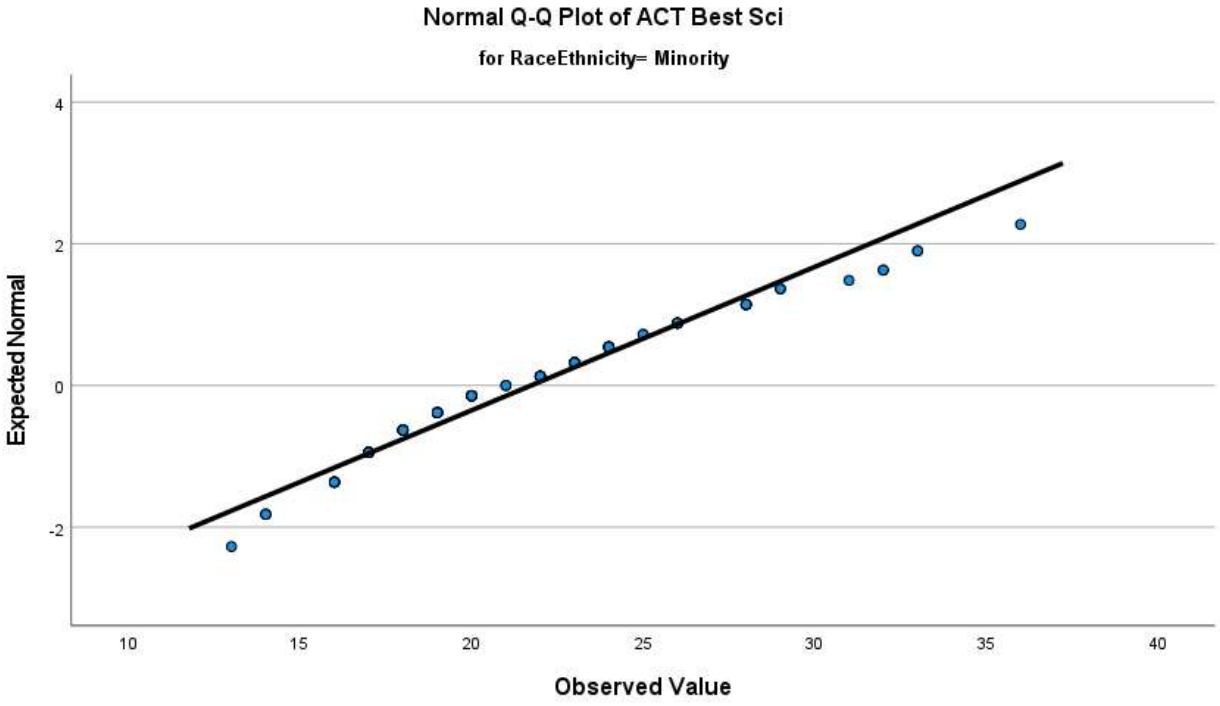
Figure 15

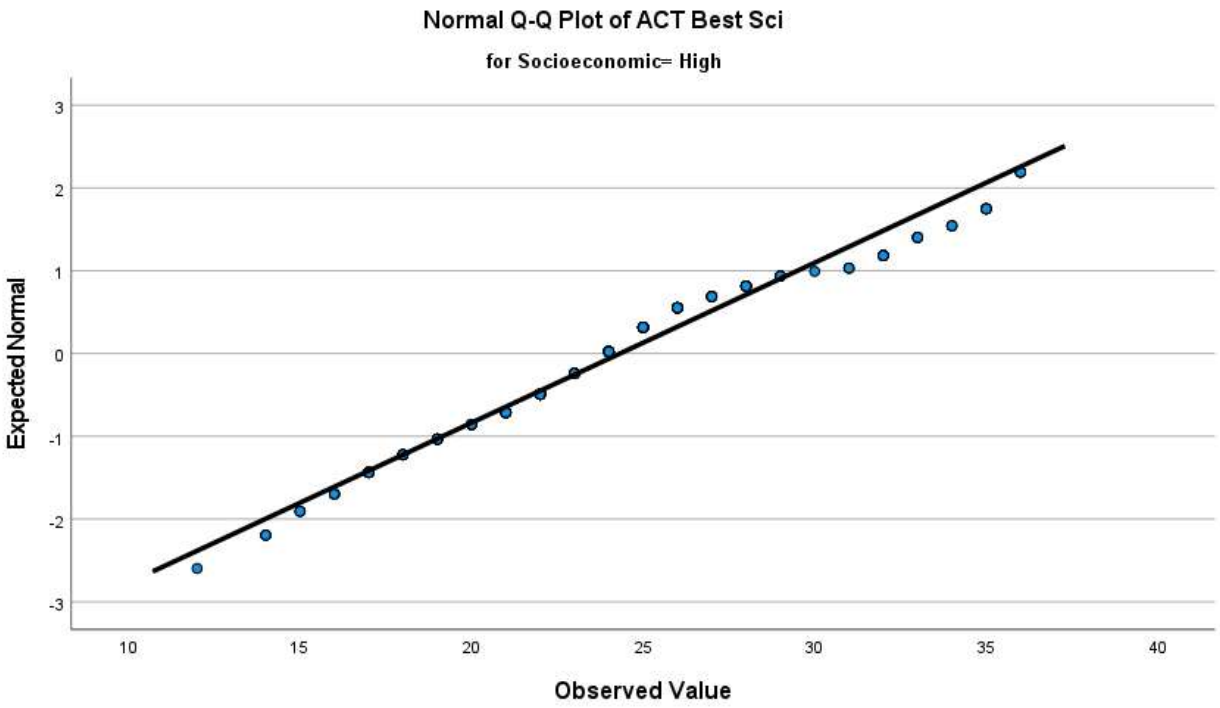
Normal Q-Q Plots for ACT Prep, Race/Ethnicity, and SES for Science Scores

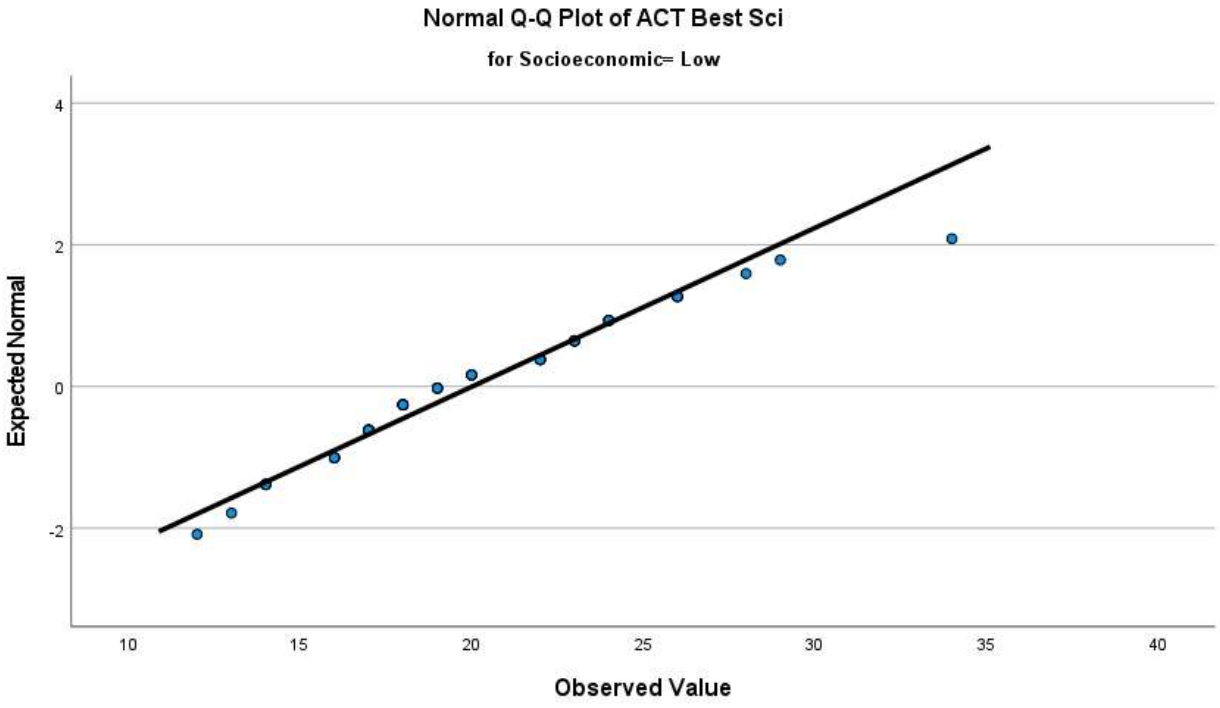





Normal Q-Q Plot of ACT Best Sci
for RaceEthnicity= Majority
Expected Normal
3
2
1
0
-1
-2
-3
10
15
20
25
30
35
40
Observed Value


Normal Q-Q Plot of ACT Best Sci
for RaceEthnicity= Minority
Expected Normal
4
2
0
-2
10
15
20
25
30
35
40
Observed Value


Normal Q-Q Plot of ACT Best Sci
for Socioeconomic= High
Expected Normal
3
2
1
0
-1
-2
-3
10
15
20
25
30
35
40
Observed Value


Normal Q-Q Plot of ACT Best Sci
for Socioeconomic= Low
Expected Normal
4
2
0
-2
10
15
20
25
30
35
40
Observed Value

Substantive Results of the ANCOVA

A 2 x 2 x 2 between-groups ANCOVA was conducted to examine the differences across students' participation or lack of participation in an ACT Prep course, race/ethnicity, and SES, after controlling for practice ACT science scores, on their official ACT science scores. The independent variables were participation or lack of participation in the ACT Prep course, race/ethnicity, and SES, while the dependent variable was official ACT science scores. Students' practice ACT science scores were used as a covariate to control for individual differences in scores.

Assumptions of the ANCOVA were considered to ensure there were no violations of independence, linearity, homogeneity of regression slopes, homoscedasticity, homogeneity of variances, and normality. After adjusting students' official ACT science scores based on their practice ACT science scores, there was no significant interaction effect between any combination of the three independent variables. The interaction effect between participation or nonparticipation in an ACT Prep course, race/ethnicity, and SES was not significant, $F(1, 255) = .010$, $p = .919$, $\eta_p^2 = .000$. Additionally, no significant interactions were found between participation or nonparticipation in an ACT Prep course and race/ethnicity, $F(1, 255) = .430$, $p = .513$, $\eta_p^2 = .002$, participation or nonparticipation in an ACT Prep course and SES, $F(1, 255) = .000$, $p = .994$, $\eta_p^2 = .000$, or race/ethnicity and SES, $F(1, 255) = 1.208$, $p = .273$, $\eta_p^2 = .005$. ANCOVA results (see Table 20) indicated no significant main effect for participation or nonparticipation in an ACT Prep course, $F(1, 255) = .471$, $p = .493$, $\eta_p^2 = .002$ or race/ethnicity, $F(1, 255) = .088$, $p = .768$, $\eta_p^2 = .000$. Results indicated a significant main effect for SES, $F(1, 255) = 11.431$, $p < .001$, $\eta_p^2 = .043$. Students' practice ACT science scores, used as a covariate,

significantly influenced their official ACT science scores, $F(1, 255) = 176.500$, $p < .001$, $\eta_p^2 = .409$.

Table 20

ANCOVA Summary Table for Science Scores

Source	*SS*	*df*	*MS*	*F*	*p*	η_p^2
Practice ACT Scores	2653.703	1	2653.703	176.500*	< .001	.409
ACT Prep	7.078	1	7.078	.471	.493	.002
Race/Ethnicity	1.316	1	1.316	.088	.768	.000
SES	171.869	1	171.869	11.431*	< .001	.043
ACT Prep x Race/Ethnicity	6.459	1	6.459	.430	.513	.002
ACT Prep x SES	.001	1	.001	.000	.994	.000
Race/Ethnicity x SES	18.162	1	18.162	1.208	.273	.005
ACT Prep x Race/Ethnicity x SES	.155	1	.155	.010	.919	.000
Error	3833.957	255	15.035			
Total	152713.000	264				

* $p < .05$

Table 21 presents the adjusted means for all the combinant groups of participation or nonparticipation in an ACT Prep course, race/ethnicity, and SES. The adjusted means indicate that the average official ACT science score was higher for students who completed an ACT Prep course ($M_{adj} = 22.891$) than for students who did not complete an ACT Prep course ($M_{adj} = 22.438$), higher for students in the minority racial/ethnic group ($M_{adj} = 22.763$) than the majority racial/ethnic group ($M_{adj} = 22.566$), and higher for students who were in the higher SES group ($M_{adj} = 23.797$) than students who were in the low SES group ($M_{adj} = 21.532$).

Table 21

Means, Adjusted Means, Standard Deviations, and Standard Errors for ACT Prep, Race/Ethnicity, and SES for Science Scores

	ACT Prep				No ACT Prep			
	Majority Race/Ethnicity		Minority Race/Ethnicity		Majority Race/Ethnicity		Minority Race/Ethnicity	
	High SES	Low SES	High SES	Low SES	High SES	Low SES	High SES	Low SES
n	79	7	24	12	81	11	27	23
M	24.38	20.57	23.17	20.33	25.15	19.73	22.70	19.83
(SD)	(4.444)	(3.645)	(4.320)	(4.519)	(5.710)	(6.051)	(5.817)	(4.041)
M_{adj}	24.041	21.112	24.012	22.401	24.082	21.030	23.053	21.587
(SE)	(.437)	(1.466)	(.794)	(1.130)	(.438)	(1.173)	(.747)	(.819)

Note. $N = 264$.

Chapter V

Discussion

To determine differences in participation or nonparticipation in an ACT Prep course, race/ethnicity, and SES on ACT scores when controlling for practice ACT scores, this study considered the following seven research questions:

RQ1: Is there an interaction between participation/nonparticipation in an ACT Prep course, SES, and race/ethnicity related to ACT scores when using practice ACT scores as a covariate?

RQ2: Is there an interaction between participation/nonparticipation in an ACT Prep course and SES related to ACT scores when using practice ACT scores as a covariate?

RQ3: Is there an interaction between participation/nonparticipation in an ACT Prep course and race/ethnicity related to ACT scores when using practice ACT scores as a covariate?

RQ4: Is there an interaction between SES and race/ethnicity related to ACT scores when using practice ACT scores as a covariate?

RQ5: Is there a difference in ACT scores of students who participate in an ACT Prep course versus those who do not when using practice ACT scores as a covariate?

RQ6: Is there a difference in students' ACT scores based on SES when using practice ACT scores as a covariate?

RQ7: Is there a difference in students' ACT scores based on race/ethnicity when using practice ACT scores as a covariate?

Conclusions

ACT Prep

For RQ5, no statistically significant differences were found on composite or subtest ACT scores for students who participated in an ACT Prep course versus students who did not. For

RQ1, RQ2, and RQ3, results indicated that differences in participation or nonparticipation in an ACT Prep course had no statistically significant interaction with race/ethnicity or SES on composite or subtest scores of the ACT. In other words, the effect of participating or not participating in an ACT Prep course, after controlling for practice ACT scores, had no statistically significant effect on adjusted mean ACT scores when considering each racial/ethnic and SES group. This result aligned with the finding of Moore et al. (2018), who determined that the effects of test preparation were not different depending on race/ethnicity or family income.

Although test preparation is generally thought to help students, results in this area have been mixed. Research has shown that test preparation has positive effects on test scores (Briggs, 2009; Buchmann et al., 2010; Moore et al., 2018; Moss et al., 2012). However, other studies have indicated that test preparation has little to no effect or is only effective on certain subject areas of a test (Briggs, 2002; Briggs & Domingue, 2009; Domingue & Briggs, 2009). The conclusions of the current study coincide more with the latter. In this study, participating in an ACT Prep course was not shown to have a statistical significance on performance on the official ACT. However, these results do not definitively lead to a conclusion that participation in an ACT Prep course does not increase student scores, only that the results in this case were not significant. Students who participated in an ACT Prep course showed a higher adjusted mean on the English and science subtests of the ACT than students who did not participate. These results indicate that differences in ACT scores likely do exist within the population when considering whether or not students completed an ACT Prep course, but there is no evidence to support that these differences are significant.

As noted by Briggs (2009), the purpose of test preparation is to improve student scores over what they would normally have been. If this goal is not being met, it becomes the task of

school administrators to determine why. It is possible that students who gave their best effort on the practice test received scores that were more truly accurate of their abilities, ultimately leaving themselves less room to demonstrate growth on the official ACT. Students who did not evince effort into the practice test likely received scores that underrated their true abilities, which could have made their official ACT scores appear more significant if they then tried their best. Since students who were unwilling to try on the practice test were likely among the same group of students who refrained from ACT Prep, the potential for growth from these students provides one possible explanation for why students who did not participate in ACT Prep showed higher scores in certain areas.

Another possible reason for lack of differences in scores for students who completed ACT Prep is lack of quality and/or fidelity in program implementation, which this study did not investigate. Although teachers and students were provided with the ePrep program for use during the ACT Prep course, the study did not examine how the program was used or if these methods were considered effective. Varied use of the program could lead to different results and explain a lack of higher scores from students who took ACT Prep. Additionally, teacher effect could be a contributing factor. Teacher experience can have a positive impact on student achievement (Clotfelter et al., 2007). The ACT Prep course within this high school is typically taught by multiple teachers each year, and these teachers change from year to year, resulting in students having different teachers depending on when they took the course. If some teachers were more or less effective than others, this could have led to a difference in overall scores. School culture could also have played a role, as schools with healthy learning environments tend to have students who score higher on standardized tests (MacNeil et al., 2009).

Race/Ethnicity

For RQ1, RQ3, and RQ4, the independent variable of race/ethnicity showed no statistically significant interaction with other independent variables on ACT scores. No statistically significant differences existed in adjusted mean scores of composite or subtest ACT scores between levels of SES or participation or nonparticipation in an ACT Prep course. For RQ7, without considering SES or ACT Prep participation, there was no statistically significant difference between majority and minority students on ACT composite or subtest scores.

Research has primarily shown that African American and Hispanic students perform lower on standardized tests than White students or Asian students (ACT, 2018; Battle & Lewis, 2008; National Center for Education Statistics, 2019b; Paschall et al., 2018). However, researchers have found that when separated from SES, students from African American and Hispanic backgrounds are capable of closing achievement gaps and/or outscoring White students (Battle & Lewis, 2008; Paschall et al., 2018). The lack of a statistically significant difference between majority and minority ACT scores in the current study supported the idea that minority students are capable of performing at a level similar to that of majority students. This result is further supported by minority students exhibiting a higher adjusted mean on the reading and science portions of the ACT than their majority counterparts. Additionally, the lack of a statistically significant interaction indicated that race/ethnicity is not dependent upon level of SES. It can be concluded that in this particular population, while one racial/ethnic group is not significantly outperforming the other, the minority group is not necessarily at a deficit when it comes to performance on the ACT.

One possible explanation for a lack of difference in scores between racial/ethnic groups is the school's focus on preparing all students to perform successfully on tests. With a schoolwide

focus on improving ACT scores, all students, regardless of race/ethnicity, have access to preparation activities. These efforts could help ensure that one racial/ethnic group is not left behind the others. Another possible explanation could be in the test design of this study. In order to promote adequate sample sizes, the minority subgroup consisted of a combination of the typically higher-achieving Asian subgroup with the typically lower-achieving subgroups of African American and Hispanic students (ACT, 2018; Battle & Lewis, 2008; National Center for Education Statistics, 2019b; Paschall et al., 2018). This combination could have contributed to a balancing effect, in which the true achievement of each group was masked.

SES

SES was the only independent variable to demonstrate a statistically significant result in this study. Although, for RQ1, RQ2, and RQ4, SES showed no statistically significant interaction with other independent variables, SES did exhibit a statistically significant difference on ACT scores for RQ6. Specifically, a statistically significance difference existed on the English, math, and science subtests of the ACT, with students from the higher SES group significantly outscoring students from the low SES group. On the reading subtest score and overall composite score, students from the higher SES group still outperformed the low SES group in terms of the adjusted mean, but these results were not statistically significant.

SES has been acknowledged to make a difference in standardized test scores (Berkowitz et al., 2017; Lawson & Farah, 2017; Rouse & Barrow, 2006; White, 1982). However, other researchers have found that SES has no correlation with academic achievement (Ripple & Luthar, 2000; Seyfried, 1998; Sirin, 2005). This study added credibility to studies that have shown SES made a difference in achievement. Although only statistically significant on certain portions of the ACT, students from a higher SES background outperformed low SES students in

all areas. The conclusion in this case is that SES tends to make a difference in ACT scores within this population.

Several possibilities could exist as to why lower SES students did not perform as well as their higher SES counterparts. In some cases, students from lower SES backgrounds have unequal access to higher education information (Brown et al., 2016), and students from lower SES backgrounds have been found to perform differently depending on their perception of tests (Croizet & Dutrévis, 2008). If students are unaware of the benefits of attending college or earning scholarships, or otherwise do not have interest in pursuing higher education, then it is unlikely they perceive the value in performing well on a test such as the ACT. Another possible explanation is lack of access to effective test preparation. This study already determined that students who completed the ACT Prep course did not perform significantly higher than students who did not. Additionally, low SES students are often limited from access to other test preparation opportunities based on family income (NACAC, 2008). Buchmann et al. (2010) determined that students from low SES backgrounds are more likely to complete no test preparation or only use the most affordable types, such as books, videos, or computer software, which were not shown to have an effect on score gains. Other students may have responsibilities at home, such as caring for younger siblings or working outside jobs to earn money, that limit their ability to prepare adequately for the ACT.

Implications

One significant implication of this study is the need for further examination of ACT Prep courses in this school, district, and possibly others that use the ePrep program. The lack of evidence to support differences in ACT scores is concerning for the school and district in question, particularly considering that district funds are used to purchase the ePrep program.

ACT scores at the school in this study have stagnated between 21 and 22 for the past several years. Students are encouraged to take the ACT Prep course with the hope of improving their scores to a level that makes them competitive for scholarships. With no results to justify that the ACT Prep course is serving its intended purpose, the course should certainly bear greater scrutiny.

Although results showed no evidence of differences for this particular school, it is possible that the ACT Prep course is making a difference in other schools with varied demographics, which is an area for future research. Within this district, district leaders mandate that high schools use the ePrep program as part of their ACT Prep courses. If ePrep is proven successful in some schools and not in others, principals should be given the autonomy to either continue to use the current program or select one that is more effective for their populations.

Administrators in this school should take action in relation to the results of this study. An important first step is a deeper examination into ACT Prep courses. Administrators should not operate under the idea that preparation courses produce significant results simply because they are offered. In the case of the current study, in which significant differences were not found between students who completed ACT Prep and those who did not, administrators should examine additional data to determine if this is an ongoing issue or an issue that only affected this sample. Additional research with larger sample sizes encompassing multiple years could shed light on this issue.

Administrators should also examine the quality and fidelity of ACT Prep courses. This process could include examination of curriculum and lesson plans, review of assessment data, classroom observations, and evaluation of student engagement. Conversations with teachers can provide additional information concerning strengths and weaknesses of the program.

Additionally, student feedback should be sought to determine level of student effort and perceptions of program effectiveness. If fidelity issues are discovered, teachers could need professional development to assist with those issues. If determined that the program in question, such as the ePrep program in the current study, is being implemented with fidelity and not producing positive results, administrators should consider seeking a more effective option. Examination of programs that have proved effective for similar populations could lead to adoption of a new program and/or effective strategies and resources that could be shared with teachers.

A second implication involves the consideration of SES. This study has shown that this particular school is not immune to the SES concerns that have been found in other studies (Berkowitz et al., 2017; Lawson & Farah, 2017; Rouse & Barrow, 2006; White, 1982), with low SES students performing lower than their higher SES peers. Not effectively addressing this issue can compound SES factors by failing to narrow the achievement gap between these students and others. Lower ACT scores can limit students' opportunities for college admissions or scholarships in order to further their education, thus perpetuating the cycle of poverty within communities, which include lower lifetime earnings (Rouse & Barrow, 2006).

In order to ensure that low SES students are aware of higher education opportunities, which has been identified as an issue in the literature (Brown et al., 2016), administrators should implement strategies to ensure resources are shared with these students. Students from low SES backgrounds, unfamiliar with higher education opportunities, might be less likely to inquire for information about these resources due to a lack of general knowledge. Administrators, teachers, and school counselors can all play an influential role in this process by identifying these students and speaking with them individually about career goals and higher education opportunities and

funding. Students should also be informed of affordable test preparation opportunities. Awareness of these opportunities could play a critical role in student effort and performance on the ACT.

Limitations of the Study

This study was limited by its small sample size and the use of a convenience sample. Although the demographics of this graduating class closely matched the demographics of the school, practice test data was not available for many students, resulting in an even smaller sample of usable data. The result of this limited sample is that rather than examining each racial/ethnic group on its own, the minority group was combined to form 86 African American, Hispanic, Asian, and Pacific Islander students and was still outnumbered by the majority group of 178 White students. A similar issue was present for SES with 211 students in the higher SES group and only 53 students in the low SES group. When the low SES group was further divided based on race/ethnicity and ACT Prep, group numbers were further diminished to sizes of 7, 11, 12, and 23 students.

Additionally, the sample within this study only consisted of participants from one high school within the school district, and this high school consistently has the highest average ACT scores in the district. Although other schools in the district use the same ACT Prep program, these schools did not have data immediately available for inclusion in this study. It remains unclear whether a school in this district that exhibits lower average ACT scores and varied demographics would produce similar results. The use of only one school, combined with the small sample size, limits the generalizability of results to other populations.

A final limitation is that of confounding variables. As mentioned previously, this study did not consider the influence of other variables, such as additional ACT preparation, rigor of

coursework, or level of student effort. However, the study did use students' practice test scores in an attempt to control for baseline scores for each individual student. Although results showed that the use of practice scores was a significant choice of covariate on ACT scores, the study did not consider the influence of student effort on practice scores.

Recommendations for Future Research

The topics within this study would benefit from future research. For this particular school, it would be helpful to include a larger sample containing multiple years of data to either support or refute the findings of this study. The inclusion of other high schools in the district would also give a clearer picture of the differences being investigated since these schools use the same ACT Prep program with varied demographics. Ultimately, the current study was unable to lead to conclusive evidence of the ePrep program being effective or noneffective as an ACT preparation tool, and further research would be beneficial, particularly considering the increased use of commercial test preparation programs and the limited research that has been conducted concerning score gains in this area (Briggs, 2009).

Also deserving of further examination is the fidelity of courses implementing the ePrep program within ACT Prep courses. With this course being taught by multiple teachers in different schools within this school district, it leads to the belief that fidelity of program implementation should be examined. Lack of evidence of differences in ACT scores between students who do or do not complete the ACT Prep course does not necessarily imply that the program itself is not effective. A qualitative approach, including classroom observations and interviews with students and teachers who participate with the program, could lead to further conclusions concerning the program's effectiveness.

In an ideal situation, true experimental research would be utilized to determine the effectiveness of the ePrep program as a component of ACT Prep courses. Since true experimental research is often not possible within an educational setting, it could be beneficial for future researchers to select participants that allow for as similar samples as possible for comparison purposes, which could be achieved through propensity score matching. Another analysis that could be used is a multivariate analysis of covariance (MANCOVA), which would eliminate the need to run separate ANCOVA tests for composite and subtest scores, thus decreasing the Type I error rate (Hinkle et al., 2003). Although the current study also indicated that using students' practice ACT scores is an appropriate use of a covariate, further studies could introduce additional covariates to control for other confounding variables, such as GPA, IQ, grades, academic rigor, or participation in other forms of test preparation.

References

ACT, Inc. (2018). *ACT national profile report: Graduating class of 2018*. https://www.act.org/content/dam/act/unsecured/documents/cccr2018/P_99_999999_N_S_N00_ACT-GCPR_National.pdf

ACT, Inc. (2019a). *The condition of college and career readiness 2019.* https://www.act.org/content/dam/act/unsecured/documents/National-CCCR-2019.pdf

ACT, Inc. (2019b). *Preparing for the ACT test.* http://www.act.org/content/dam/act/unsecured/documents/Preparing-for-the-ACT.pdf

ACT, Inc. (2020). *The ACT technical manual*. http://www.act.org/content/dam/act/unsecured/documents/ACT_Technical_Manual.pdf

ACT, Inc. (2021, January 21). *ACT test prep*. http://www.act.org/content/act/en/products-and-services/the-act/test-preparation.html

Aikens, N. L., & Barbarin, O. (2008). Socioeconomic differences in reading trajectories: The contribution of family, neighborhood, and school contexts. *Journal of Educational Psychology, 100*(2), 235-251. https://doi.org/10.1037/0022-0663.100.2.235

Allen, J. M., & Mattern, K. (2019). *Validity considerations for 10th-grade ACT state and district testing* (ACT Insights in Education and Work, R1758). ACT, Inc. https://www.act.org/content/dam/act/unsecured/documents/R1758-act-grade10-validity-2019-06.pdf

Allen, J., & Radunzel, J. (2017). *What are the ACT college readiness benchmarks?* (Issue Brief R1670). ACT, Inc. https://www.act.org/content/dam/act/unsecured/documents/pdfs/R1670-college-readiness-benchmarks-2017-11.pdf

Alvero, A. J., Giebel, S., Gebre-Medhin, B., Antonio, A. L., Stevens, M. L., & Domingue, B. W. (2021). *Essay content is strongly related to household income and SAT scores: Evidence*

from 60,000 undergraduate applications (CEPA Working Paper No. 21-03). Stanford Center for Education Policy Analysis. https://cepa.stanford.edu/sites/default/files/wp21-03-v042021.pdf

American Psychological Association. (2021, June 1). *Education and socioeconomic status*. https://www.apa.org/pi/ses/resources/publications/education

Appelrouth, J. I., Moore, D., Zabrucky, K. M., & Cheung, J. H. (2018). Preparing for high-stakes admissions tests: A moderation mediation analysis. *International Research in Higher Education, 3*(3), 32-50. https://doi.org/10.5430/irhe.v3n3p32

Appelrouth, J. I., Zabrucky, K. M., & Moore, D. (2017). Preparing students for college admissions tests. *Assessment in Education: Principles, Policy & Practice, 24*(1), 78-95. https://doi.org/10.1080/0969594X.2015.1075958

Atkinson, R. C., & Geiser, S. (2009). Reflections on a century of college admissions tests. *Educational Researcher, 38*(9), 665-676. https://doi.org/10.3102/0013189X09351981

Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: A proposed system and its control processes. In K. W. Spence & J. T. Spence (Eds.), *Psychology of learning and motivation* (Vol. 2, pp. 89-195). Academic Press. https://doi.org/10.1016/S0079-7421(08)60422-3

Avery, C. (2013). Evaluation of the College Possible program: Results from a randomized controlled trial (Working Paper 19562). National Bureau of Economic Research. https://doi.org/10.3386/w19562

Battle, J., & Lewis, M. (2008). The increasing significance of class: The relative effects of race and socioeconomic status on academic achievement. *Journal of Poverty, 6*(2), 21-35. https://doi.org/10.1300/J134v06n02_02

Berkowitz, R., Moore, H., Astor, R. A., & Benbenishty, R. (2017). A research synthesis of the associations between socioeconomic background, inequality, school climate, and academic achievement. *Review of Educational Research, 87*(2), 425-469. https://doi.org/10.3102/0034654316669821

Briggs, D. C. (2001). The effect of admissions test preparation: Evidence from NELS:88. *Chance, 14*(1), 10-21. https://doi.org/10.1080/09332480.2001.10542245

Briggs, D. C. (2002). *SAT coaching, bias and causal inference* (DAI-A 64/12, 4433, UMI No. 3115515) [Doctoral dissertation, University of California, Berkeley]. Dissertation Abstracts International. https://nepc.colorado.edu/publication/sat-coaching-bias-and-causal-inference

Briggs, D. C. (2009). *Preparation for college admission exams* [2009 NACAC Discussion Paper]. National Association for College Admission Counseling. https://files.eric.ed.gov/fulltext/ED505529.pdf

Briggs, D. C., & Domingue, B. W. (2009). *The effect of admissions test preparation: New evidence from ELS:02* [Unpublished Working Paper]. www.colorado.edu/education/faculty/derekbriggs/publications.html

Browman, A. S., Destin, M., Carswell, K. L., & Svoboda, R. C. (2017). Perceptions of socioeconomic mobility influence academic persistence among low socioeconomic students. *Journal of Experimental Social Psychology, 72*, 45-52. https://doi.org/10.1016/j.jesp.2017.03.006

Brown, M. G., Wohn, D. Y., & Ellison, N. (2016). Without a map: College access and the online practices of youth from low-income communities. *Computers & Education, 92-93*, 104-116. https://doi.org/10.1016/j.compedu.2015.10.001

Brown, S. L. (2015). Motivating high school students to score proficient on state tests. *Journal of Education and Training Studies, 3*(3), 45-50. http://doi.org/10.11114/jets.v3i3.700

Buchmann, C., Condron, D. J., & Roscigno, V. J. (2010). Shadow education, American style: Test preparation, the SAT and college enrollment. *Social Forces, 89*(2), 435-461. https://doi.org/10.1353/sof.2010.0105

Byun, S., & Park, H. (2012). The academic success of East Asian American youth: The role of shadow education. *Sociology of Education, 85*(1), 40-60. https://doi.org/10.1177/0038040711417009

Camara, W. J., & Harris, D. J. (2015). *Why scores on the ACT are scores you can trust*. ACT, Inc. http://www.act.org/content/dam/act/unsecured/documents/Scores-You-Can-Trust.pdf

Camara, W. J., & Westrick, P. (2017). *USA: Perspectives on admissions & admissions testing* (R1653). ACT, Inc. https://www.act.org/content/dam/act/unsecured/documents/R1653-usa-admission-perspectives-2017-09.pdf

Campbell, T., & Wescott, J. (2019). *Profile of undergraduate students: Attendance, distance and remedial education, degree program and field of study, demographics, financial aid, financial literacy, employment, and military status: 2015–16* (NCES 2019-467). U. S. Department of Education, National Center for Education Statistics. https://nces.ed.gov/pubs2019/2019467.pdf

Chen, Q., Kong, Y., Gao, W., & Mo, L. (2018). Effects of socioeconomic status, parent-child relationship, and learning motivation on reading ability. *Frontiers in Psychology, 9*, Article 1297. https://doi.org/10.3389/fpsyg.2018.01297

Chetty, R., Friedman, J. N., Hilger, N., Saez, E., Schanzenbach, D. W., & Yagan, D. (2011). How does your kindergarten classroom affect your earnings? Evidence from Project

STAR. *The Quarterly Journal of Economics, 126*(4), 1593-1660. https://doi.org/10.1093/qje/qjr041

Clotfelter, C. T., Ladd, H. F., & Vigdor, J. L. (2006). Teacher-student matching and the assessment of teacher effectiveness. *Journal of Human Resources, 41*(4), 778-820. https://doi.org/10.2307/40057291

Clotfelter, C. T., Ladd, H. F., & Vigdor, J. L. (2007). Teacher credentials and student achievement: Longitudinal analysis with student fixed effects. *Economics of Education Review, 26*(6), 673-682. https://doi.org/10.1016/j.econedurev.2007.10.002

College Board. (2021, January 21). *Key content features*. https://collegereadiness.collegeboard.org/sat/inside-the-test/key-features

Colvin, R. L. (1997, October 1). *Q & A: Should UC do away with the SAT?* Los Angeles Times. https://www.latimes.com/archives/la-xpm-1997-oct-01-me-38061-story.html

Cowles, M., & Davis, C. (1982). On the origins of the .05 level of statistical significance. *American Psychologist, 37*(5), 553-558. https://doi.org/10.1037/0003-066X.37.5.553

Croizet, J., & Dutrévis, M. (2008). Socioeconomic status and intelligence: Why test scores do not equal merit. *Journal of Poverty, 8*(3), 91-107. https://doi.org/10.1300/J134v08n03_05

de Brey, C., Musu, L., McFarland, J., Wilkinson-Flicker, S., Diliberti, M., Zhang, A., Branstetter, C., & Wang, X. (2019). *Status and trends in the education of racial and ethnic groups 2018* (NCES 2019-038). U. S. Department of Education. https://nces.ed.gov/pubs2019/2019038.pdf

Dee, T. S., & Jacob, B. (2011). The impact of No Child Left Behind on student achievement. *Journal of Policy Analysis and Management, 30*(3), 418-446. https://doi.org/10.1002/pam.20586

Deil-Amen, R., & Tevis, T. L. (2010). Circumscribed agency: The relevance of standardized college entrance exams for low SES high school students. *Review of Higher Education, 33*(2), 141-175. https://doi.org/10.1353/rhe.0.0125

Desimone, L. (2010). Linking parent involvement with student achievement: Do race and income matter? *Journal of Educational Research, 93*(1), 11-30. https://doi.org/10.1080/00220679909597625

Dollinger, S. J., & Clark, M. H. (2012). Test-taking strategy as a mediator between race and academic performance. *Learning and Individual Differences, 22*(4), 511-517. https://doi.org/10.1016/j.lindif.2012.03.010

Domingue, B. W., & Briggs, D. (2009). Using linear regression and propensity score matching to estimate the effect of coaching on the SAT. *Multiple Linear Regression Viewpoints, 35*(1), 12-29. https://www.researchgate.net/publication/228337033_Using_Linear_Regression_and_Propensity_Score_Matching_to_Estimate_the_Effect_of_Coaching_on_the_SAT

Ellis, A. P., & Ryan, A. M. (2003). Race and cognitive-ability test performance: The mediating effects of test preparation, test-taking strategy use and self-efficacy. *Journal of Applied Social Psychology, 33*(12), 2607-2629. https://doi.org/10.1111/j.1559-1816.2003.tb02783.x

ePrep, Inc. (2021, January 31). *Features*. https://www.eprep.com

Epstein, J. L., Coates, L., Salinas, K. C., Sanders, M. G., & Simon, B. S. (1997). *School, family, and community partnerships: Your handbook for action.* Corwin Press.

Ertmer, P. A., & Newby, T. J. (1993). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly, 6*(4), 50-72. https://doi.org/10.1111/j.1937-8327.1993.tb00605.x

Gall, M. D., Gall, J. P., & Borg, W. R. (2007). *Educational research: An introduction* (8th ed.). Pearson.

Gallagher, C. J. (2003). Reconciling a tradition of testing with a new learning paradigm. *Educational Psychology Review, 15*(1), 83-99. https://doi.org/10.1023/A:1021323509290

Gay, G. (2015). Teaching to and through cultural diversity. *Curriculum Inquiry, 43*(1), 48-70. https://doi.org/10.1111/curi.12002

Gemici, S., Lim, P., & Karmel, T. (2013). *The impact of schools on young people's transition to university* (Research Report 61). National Centre for Vocational Education Research. https://files.eric.ed.gov/fulltext/ED541754.pdf

Gimbert, B., Bol, L., & Wallace, D. (2007). The influence of teacher preparation on student achievement and the application of national standards by teachers of mathematics in urban secondary schools. *Education and Urban Society, 40*(1), 91-117. https://doi.org/10.1177/0013124507303993

Haney, W. (1981). Validity, vaudeville, and values: A short history of social concerns over standardized testing. *American Psychologist, 36*(10), 1021-1034. https://doi.org/10.1037/0003-066X.36.10.1021

Hanson, F. A. (1993). *Testing testing: Social consequences of the examined life*. University of California Press.

Henderson, A., & Mapp, K. (2002). *A new wave of evidence: The impact of school, family, and community connections on student achievement.* Southwest Educational Development Lab, Institute of Education Sciences. https://files.eric.ed.gov/fulltext/ED474521.pdf

Hinkle, D. E., Wiersma, W., & Jurs, S. G. (2003). *Applied statistics for the behavioral sciences* (5th ed.). Houghton Mifflin.

Hoyt, J. E., & Sorenson, C. T. (2001). High school preparation, placement testing, and college remediation. *Journal of Developmental Education, 25*(2), 26-34.

Jenkins, C. M. (2018). Educators, question your level of cultural responsiveness. *Journal on Empowering Teaching Excellence, 2*(2), 15-23. https://doi.org/10.26077/kttj-v296

Klasik, D. (2013). The ACT of enrollment: The college enrollment effects of state-required college entrance exam testing. *Educational Researcher, 42*(3), 151-160. https://doi.org/10.3102/0013189X12474065

Lawson, G. M., & Farah, M. J. (2017). Executive function as a mediator between SES and academic achievement throughout childhood. *International Journal of Behavioral Development, 41*(1), 94-104. https://doi.org/10.1177/0165025415603489

Lazarín, M. (2014). *Testing overload in America's schools*. Center for American Progress. https://files.eric.ed.gov/fulltext/ED561097.pdf

Lim, P., Gemici, S., & Karmel, T. (2014). The impact of school academic quality on low socioeconomic status students. *The Australian Economic Review, 47*(1), 100-106. https://doi.org/10.1111/1467-8462.12055

Ludeke, S. G., Gensowski, M., Junge, S. Y., Kirkpatrick, R. M., John, O. P., & Anderson, S. C. (2021). Does parental education influence child educational outcomes? A developmental

analysis in a full-population sample and adoptee design. *Journal of Personality and Social Psychology, 120*(4), 1074-1090. https://doi.org/10.1037/pspp0000314

MacNeil, A. J., Prater, D. L., & Busch, S. (2009). The effects of school culture and climate on student achievement. *International Journal of Leadership in Education, 12*(1), 73-84. https://doi.org/10.1080/13603120701576241

Marchetti, R., Wilson, R. H., & Dunham, M. (2016). Academic achievement and extracurricular school activities of at-risk high school students. *Educational Research Quarterly, 39*(4), 3-20.

Mattern, K., Radunzel, J., & Harmston, M. (2016). *ACT composite score by family income* (Data Byte No. 2016-14). ACT, Inc. https://www.act.org/content/dam/act/unsecured/documents/R1604-ACT-Composite-Score-by-Family-Income.pdf

Mayer, R. E. (1996). Learners as information processors: Legacies and limitations of educational psychology's second metaphor. *Educational Psychologist, 31*(3/4), 151-161. https://doi.org/10.1080/00461520.1996.9653263

McClain, T. B. (1999). *The impact of computer-assisted coaching on the elevation of twelfth-grade students' SAT scores* (UMI No. 9945906) [Doctoral dissertation, Morgan State University]. ProQuest Dissertations Publishing.

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological Review, 63*(2), 81-97. https://doi.org/10.1037/h0043158

Mo, L., Yang, F., Hu, X., Calaway, F., & Nickey, J. (2011). ACT test performance by Advanced Placement students in Memphis City Schools. *Journal of Educational Research, 104*(5), 354-359. https://doi.org/10.1080/00220671.2010.486810

Moore, R., Sanchez, E., & San Pedro, M. O. (2018). Investigating test prep impact on score gains using quasi-experimental propensity score matching (Working Paper R1710). ACT, Inc. https://www.act.org/content/dam/act/unsecured/documents/R1710-investigating-test-prep-impact-2018-07.pdf

Morgan, H. (2010). Improving schooling for cultural minorities: The right teaching styles can make a big difference. *Educational Horizons, 88*(2), 114-120.

Moss, G. L., Chippendale, E. K., Mershon, C. W., & Carney, T. (2012). Effects of a coaching class on the ACT scores of students at a large midwest high school. *Journal of College Admission, 217*, 16-23. https://files.eric.ed.gov/fulltext/EJ992994.pdf

Muijs, D., Harris, A., Chapman, C., Stoll, L., & Russ, J. (2004). Improving schools in socioeconomically disadvantaged areas: A review of research evidence. *School Effectiveness and School Improvement, 15*(2), 149-175. https://doi.org/10.1076/sesi.15.2.149.30433

National Association for College Admission Counseling. (2008). *Report of the commission on the use of standardized tests in undergraduate admission.* https://files.eric.ed.gov/fulltext/ED502721.pdf

National Center for Education Statistics. (2019a). *Fast facts: ACT scores* (Digest of Education Statistics, 2018, NCES 2020-009, Table 226.50). U. S. Department of Education. https://nces.ed.gov/fastfacts/display.asp?id=897

National Center for Education Statistics. (2019b). *Fast facts: SAT scores* (Digest of Education Statistics, 2018, NCES 2020-009, Table 226.10). U. S. Department of Education. https://nces.ed.gov/fastfacts/display.asp?id=171

National Commission on Excellence in Education. (1983). *A nation at risk: The imperative for educational reform*. https://files.eric.ed.gov/fulltext/ED226006.pdf

Park, J. J., & Becks, A. H. (2015). Who benefits from SAT prep?: An examination of high school context and race/ethnicity. *Review of High Education, 39*(1), 1-23. https://doi.org/10.1353/rhe.2015.0038

Paschall, K. W., Gershoff, E. T., & Kuhfeld, M. (2018). A two decade examination of historical race/ethnicity disparities in academic achievement by poverty status. *Journal of Youth and Adolescence, 47*(6), 1164-1177. https://doi.org/10.1007/s10964-017-0800-7

Phelps, R. (2005). *Defending standardized testing*. Lawrence Erlbaum Associates.

Pishghadam, R., & Zabihi, R. (2011). Parental education and social and cultural capital in academic achievement. *International Journal of English, 1*(2), 50-57. https://doi.org/10.5539/ijel.v1n2p50

Postrel, V. (2001, February 25). *Dropping the SATs is an excuse to drop standards*. Los Angeles Times. https://www.latimes.com/archives/la-xpm-2001-feb-25-op-29979-story.html

Powers, D. E., & Rock, D. A. (1998). Effects of coaching on SAT I: Reasoning scores. *Journal of Educational Measurement, 36*(2), 93-118. https://doi.org/10.1111/j.1745-3984.1999.tb00549.x

Presidential Task Force on Educational Disparities. (2012). *Ethnic and racial disparities in education: Psychology's contributions to understanding and reducing disparities*. American Psychological Association. https://www.apa.org/ed/resources/racial-disparities.pdf

Ready, D., & Silander, M. (2011). School racial and ethnic composition and young children's cognitive development. In E. Frankenberg & E. DeBray (Eds.), *Integrating schools in a*

changing society: New policies and legal options for a multiracial generation (pp. 91-113). University of North Carolina Press. https://doi.org/10.5149/9780807869208_frankenberg

Ripple, C. H., & Luthar, S. S. (2000). Academic risk among inner-city adolescents: The role of personal attributes. *Journal of School Psychology, 38*(3), 277-298. https://doi.org/10.1016/S0022-4405(00)00032-7

Rouse, C. E., & Barrow, L. (2006). U. S. elementary and secondary schools: Equalizing opportunity or replicating the status quo? *The Future of Children, 16*(2), 99-123. https://doi.org/10.1353/foc.2006.0018

Rutkowski, D. & Wild, J. (2015). Stakes matter: Student motivation and the validity of student assessments for teacher evaluation. *Educational Assessment, 20*(3), 165-179. https://doi.org/10.1080/10627197.2015.1059273

Sackett, P. R., Kuncel, N. R., Arneson, J. J., Cooper, S. R., & Waters, S. D. (2009). Does socioeconomic status explain the relationship between admission tests and post-secondary academic performance? *Psychological Bulletin, 135*(1), 1–22. https://doi.org/10.1037/a0013978

Saultz, A., Schneider, J., & McGovern, K. (2019). Why ESSA has been reform without repair. *Phi Delta Kappan, 101*(2), 18-21. https://doi.org/10.1177/0031721719879149

Scarr, S., & Weinberg, R. A. (1978). The influence of "family background" on intellectual attainment. *American Sociological Review, 43*(5), 674-692. https://doi.org/10.2307/2094543

Schunk, D. H. (2012). *Learning theories: An educational perspective* (6th ed.). Pearson.

Schiel, J. L., & Valiga, M. J. (2014a). *How ACT scores change with test preparation* (Information Brief 2014-6). ACT, Inc. https://www.act.org/content/dam/act/unsecured/documents/Info-Brief-2014-6.pdf

Schiel, J. L., & Valiga, M. J. (2014b). *How the amount of time spent on test preparation relates to ACT scores* (Information Brief 2014-7). ACT, Inc. http://www.act.org/content/dam/act/unsecured/documents/Info-Brief-2014-7-rev1.pdf

Seyfried, S. F. (1998). Academic achievement of African American preadolescents: The influence of teacher perceptions. *American Journal of Community Psychology, 26*(3), 381-402. https://doi.org/10.1023/A:1022107120472

Shuell, T. J. (1986). Cognitive conceptions of learning. *Review of Educational Research, 56*(4), 411-436. https://doi.org/10.2307/1170340

Sirin, S. R. (2005). Socioeconomic status and academic achievement: A meta-analytic review of research. *Review of Educational Research, 75*(3), 417-453. https://doi.org/10.3102/00346543075003417

Slate, J. R., & Charlesworth, J. R. (1988). *Information processing theory: Classroom applications* (ED293792). ERIC. https://files.eric.ed.gov/fulltext/ED293792.pdf

Spielberger, C. D., Anton, W. D., & Bedell, J. (2015). The nature and treatment of test anxiety. In M. Zuckerman & C. D. Spielberger (Eds.), *Emotions and anxiety: New concepts, methods, and applications* (pp. 317-346). Psychology Press. https://doi.org/10.4324/9781315744643

Tennessee Department of Education. (2018). *Every Student Succeeds Act: Building on success in Tennessee*. https://www.tn.gov/content/dam/tn/education/documents/TN_ESSA_State_Plan_Approved.pdf

Tennessee Higher Education Commission & Student Assistance Corporation. (2020, March 6). *Tennessee HOPE Scholarship*. https://www.tn.gov/collegepays/money-for-college/tn-education-lottery-programs/tennessee-hope-scholarship.html

Thomas, J. Y., & Brady, K. P. (2005). The Elementary and Secondary Education Act at 40: Equity, accountability, and the evolving federal role in public education. *Review of Research in Education, 29*(1), 51-67. https://doi.org/10.3102/0091732X029001051

Thompson, G. (2013). NAPLAN, MySchool, and Accountability: Teacher perceptions of the effects of testing. *International Education Journal: Comparative Perspectives, 12*(2), 62-84. https://files.eric.ed.gov/fulltext/EJ1017709.pdf

Trueba, H. T. (1988). Culturally based explanations of minority students' academic achievement. *Anthropology & Education Quarterly, 19*(3), 270-287. https://doi.org/10.1525/aeq.1988.19.3.05x1565e

U. S. Department of Education. (2021, January 23). *Every student succeeds act (ESSA).* https://www.ed.gov/essa?src=rn

Warne, R. T., Larsen, R., Anderson, B., & Odasso, A. J. (2015). The impact of participation in the Advanced Placement program on students' college admissions test scores. *The Journal of Educational Research, 108*(5), 400-416. https://doi.org/10.1080/00220671.2014.917253

Westrick, P. A., Le, H., Robbins, S. B., Radunzel, J., & Schmidt, F. L. (2015). College performance and retention: A meta-analysis of the predictive validities of ACT scores, high school grades, and SES. *Educational Assessment, 20*(1), 23-45. https://doi.org/10.1080/10627197.2015.997614

What Works Clearinghouse. (2016). *ACT/SAT test preparation and coaching programs* [Intervention Report]. U.S. Department of Education, Institute of Education Sciences. https://ies.ed.gov/ncee/wwc/Docs/InterventionReports/wwc_act_sat_100416.pdf

White, K. R. (1982). The relation between socioeconomic status and academic achievement. *Psychological Bulletin, 91*(3), 461-481. https://doi.org/10.1037/0033-2909.91.3.461

Williams, R., Smiley, E., Davis, R., & Lamb, T. (2018). The predictability of cognitive and non-cognitive factors on the retention rate among freshmen college students. *The Journal of Negro Education, 87*(3), 326-338. https://doi.org/10.7709/jnegroeducation.87.3.0326

Winne, P. H. (2001). Self-regulated learning viewed from models of information processing. In B. J. Zimmerman & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement: Theoretical perspectives* (2nd ed., pp. 145-178). Lawrence Erlbaum Associates.

Worthen, B. R., & Spandel, V. (1991). Putting the standardized test debate in perspective. *Educational Leadership, 48*(5), 65-69. http://www.ascd.org/ASCD/pdf/journals/ed_lead/el_199102_worthen.pdf

Xu, B., & Liu, D. (2016). Good instructional leadership: Principals' actions to increase composite ACT school scores. *International Education Studies, 9*(8), 120-126. https://doi.org/10.5539/ies.v9n8p120

Zhang, D., Hsu, H., Kwok, O., Benz, M., & Bowman-Perrott, L. (2011). The impact of basic-level parent engagements on student achievement: Patterns associated with race/ethnicity and socioeconomic status (SES). *Journal of Disability Policy Studies, 22*(1), 28-39. https://doi.org/10.1177/1044207310394447

Appendix A

Collaborative Institutional Training Initiative Certificate

Completion Date 16-Jun-2020
Expiration Date 16-Jun-2022
Record ID 37059463

This is to certify that:

Kimberly Herndon

Has completed the following CITI Program course:

Not valid for renewal of certification through CME. Do not use for TransCelerate mutual recognition (see Completion Report).

Human Research (Curriculum Group)
Study Staff, Social/Behavioral Research (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

Austin Peay State University

Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w7ce65a7c-3d92-4d4a-80f1-ca065715b7e6-37059463

Appendix B

Approval to Conduct Research from Austin Peay State University

Austin Peay State University
INSTITUTIONAL REVIEW BOARD

Date: 4/19/2021

Re 21-019: **ACT Preparation, Socioeconomic Status, and Race/Ethnicity: A Quantitative Study on Differences in ACT Scores**

Dear Dr. McConnell and Ms. Herndon,

We appreciate your cooperation with the human research review process. This letter is to inform you that study 21-019 the application has been reviewed on an expedited level. It is my pleasure to tell you that your application is approved.

This approval is subject to APSU Policies and Procedures governing human subject research. The IRB reserves the right to withdraw approval if unresolved issues are raised during the review period. Any changes or deviations from the approved protocol must be submitted in writing to the IRB for further review and approval before continuing.

This approval is for one calendar year and a closed study report or request for continuing review is required on or before the expiration date, 4/18/2022. If you have any questions or require further information, you can contact me by phone (931-221-7059) or email (youngh@apsu.edu).

Sincerely,

Harold A. Young, Ph. D. Chair, APIRB

Appendix C

Approval to Conduct Research from Clarksville-Montgomery County School System

cmcss The Defining Difference | Clarksville-Montgomery County School System

Dr. Kimi Sucharski
Accountability
Phone: 931.553.1142
Fax: 931.920.9813
Kimi.sucharski@cmcss.net

From: Dr. Kimi Sucharski
CMCSS Research Team

5.10.2021

To: Autumn Kirkland

Subject: Request to Conduct Research in CMCSS

The Clarksville Montgomery County School System Research Committee has met and approved your request to conduct research in the district at Rossview High School. This includes the collection of historical data as outlined in your request from the district accountability team and Rossview High School administration.

Dr. K L Sucharski

Dr. Kimi Sucharski
Director of Accountability
Kimi.Sucharski@cmcss.net

Appendix D

Summary Matrix

Research Question	Variables	Data Collection Source	Data Collection Tool	Frequency
1. Is there an interaction between participation or nonparticipation in an ACT Prep course, SES, and race/ethnicity related to ACT scores when using practice ACT scores as a covariate?	Independent: ACT Prep participation, SES, race/ethnicity Covariate: Practice ACT scores Dependent: Official ACT scores	ACT and practice ACT	Official ACT scores Practice ACT scores ACT Prep participation or nonparticipation, SES, race/ethnicity of each student	Once
2. Is there an interaction between participation or nonparticipation in an ACT Prep course and SES related to ACT scores when using practice ACT scores as a covariate?	Independent: ACT Prep participation, SES Covariate: Practice ACT scores Dependent: Official ACT scores	ACT and practice ACT	Official ACT scores Practice ACT scores ACT Prep participation or nonparticipation and SES of each student	Once
3. Is there an interaction between participation or nonparticipation in an ACT Prep course and race/ethnicity related to ACT scores when using practice ACT scores as a covariate?	Independent: ACT Prep participation, race/ethnicity Covariate: Practice ACT scores Dependent: Official ACT scores	ACT and practice ACT	Official ACT scores Practice ACT scores ACT Prep participation or nonparticipation and race/ethnicity of each student	Once

Research Question	Variables	Data Collection Source	Data Collection Tool	Frequency
4. Is there an interaction between SES and race/ethnicity related to ACT scores when using practice ACT scores as a covariate?	Independent: SES, race/ethnicity Covariate: Practice ACT scores Dependent: Official ACT scores	ACT and practice ACT	Official ACT scores Practice ACT scores SES and race/ethnicity of each student	Once
5. Is there a difference in ACT scores of students who participate in an ACT Prep course versus those who do not when using practice ACT scores as a covariate?	Independent: ACT Prep participation Covariate: Practice ACT scores Dependent: Official ACT scores	ACT and practice ACT	Official ACT scores Practice ACT scores ACT Prep participation or nonparticipation of each student	Once
6. Is there a difference in students' ACT scores based on SES when using practice ACT scores as a covariate?	Independent: SES Covariate: Practice ACT scores Dependent: Official ACT scores	ACT and practice ACT	Official ACT scores Practice ACT scores SES of each student	Once
7. Is there a difference in students' ACT scores based on race/ethnicity when using practice ACT scores as a covariate?	Independent: race/ethnicity Covariate: Practice ACT scores Dependent: Official ACT scores	ACT and practice ACT	Official ACT scores Practice ACT scores Race/ethnicity of each student	Once