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The Correlation Between Rural Oregon High School Students' SAT and ASVAB Scores with High School GPA, Gender, Race, and Ethnicity, and SES as Moderators

Kelly Garvin

THE CORRELATION BETWEEN RURAL OREGON HIGH SCHOOL STUDENTS' SAT AND ASVAB SCORES WITH HIGH SCHOOL GPA, GENDER, RACE, AND ETHNICITY, AND SES AS MODERATORS

by

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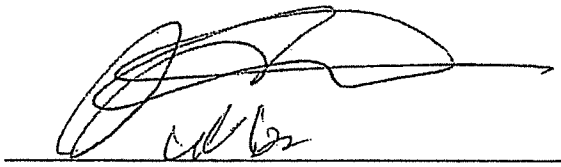
THE CORRELATION BETWEEN RURAL OREGON HIGH SCHOOL STUDENTS' SAT AND ASBAV SCORES WITH HSGPA, GENDER, RACE, AND ETHNICITY AND SES AS MODERATORS, a Doctoral research project prepared by KELLY GARVIN in partial fulfillment of the requirements for the Doctor of Education degree in Educational Leadership.

This dissertation has been approved and accepted by:



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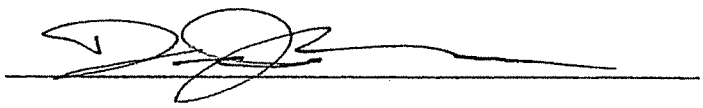

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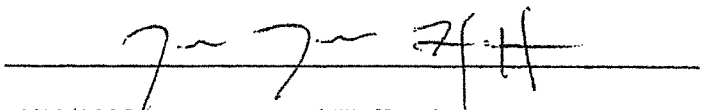

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Abstract

This study analyzed secondary standardized test score data for 11th grade students on the Scholastic Achievement Test (SAT) and the Armed Services Vocational Aptitude Battery (ASVAB) within a rural school district. Specifically, the study examined how each of the SAT and ASVAB's composite and subtest scores are distributed. This study also sought to examine how each of the tests' student scores correlated to each other and to high school grade point average (HSGPA). While most of the research pertaining to the SAT and ASVAB has been done internally by the College Board and Department of Defense, these studies have focused on large national samples to ensure that the SAT and ASVAB are valid and reliable predictors of a person's ability and aptitude. This study examined a single rural school district's test scores by using Tukey's Exploratory Data Analysis (EDA) and examining the associations between the students' test scores for the SAT and ASVAB test, and their HSGPAs by using a Pearson's r correlation test. Additionally, the study explored the test scores when HSGPA, gender, race and ethnicity, and socioeconomic status were moderators for the rural student sample using t-tests and a One-way ANOVA test. The analysis of the data revealed that students HSGPA was associated with tests that measured the academic learning domains of reading and mathematics. However, HSGPA had only a weak association with tests that measured the science and technology domains. Male students and students enrolled in a free and reduced lunch program also registered their highest scores on the tests measuring science and technology when gender and SES moderated. Understanding students' academic achievements, abilities, and aptitudes can assist educators in creating additional career and certification pathways. Additionally, the results of this study may provide additional insight for the district as to how they can better help students plan what they will do after high school.

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Chapter 1: Introduction

Educational policy, standards, and curriculum all use standardized tests to improve educational practices at national, state, and district levels. Many school districts administer scholastic aptitude and achievement tests to students annually. In recent years, the State of Oregon has also accepted test scores from the Scholastic Achievement Test (SAT) as a way for students to demonstrate the "essential skills" necessary for high school graduation. Test scores are also beneficial to students, parents, teachers, and counselors, informing them about students' cognitive abilities, aptitude, and achievement levels, and they are helpful for college and vocational planning (Drummond & Jones, 2006).

Aptitude is the capacity to acquire competence or skill through training; aptitude is also defined as any cognitive ability that could predict certain kinds of future success (Corsini, 2016). According to Snow et al. (2002), though the term "aptitude" is often used as a synonym of the term "ability," the terms are distinct. Ability comes in many different forms: reading comprehension, spatial ability, perceptual speed, knowledge of a subject or discipline, and physical coordination (Snow et al., 2002). According to Snow's 1980 definition of aptitude, "aptitudes are psychological constructs about individual differences in learning or performance in specified situations, and aptitude is both environmental and internal, signaling one's ability and readiness to learn" (Snow et al., 2002, p.3). *The Dictionary of Psychology,* by contrast, defines ability as "a present skill, such as being able to spell a word" (Corsini, 2016, p. 2). Aptitude and ability are similar in that one's present abilities are often the foundation for future success; hence, ability is often rightly linked with aptitude. However, what distinguishes the two is that ability is presently held, and aptitude is the capacity to gain what is not yet acquired. The

SAT and ASVAB are two standardized tests that reliably measure a student's aptitude and ability.

The SAT is one of the most reliable and widely used scholastic aptitude tests for measuring student academic achievement in critical reading, mathematical reasoning, and writing abilities (VandenBos, 2016). School districts also frequently provide students with the opportunity to take additional multi-factor aptitude tests that measure aptitudes beyond reading, writing, and mathematics. According to the American Psychological Association, these tests are "a battery of separate tests designed to measure a wide range of relatively independent functions and yield a profile of a person's abilities in different areas" (VandenBos, 2016). The Armed Services Vocational Aptitude Battery (ASVAB) is one of the most widely administered multi-aptitude tests. The ASVAB, like the SAT, is used in school districts for educational and vocational guidance purposes (Drummond & Jones, 2006). The test, administered by the Department of Defense (DOD), is designed for military entrance and career planning, though students only meet with armed services personnel for military enlistment purposes upon student request (Counselors and Educators: Asvab Subtests, 2021).

The purposes of the SAT and ASVAB are slightly different; however, they are both reliable measures of aptitude, ability, and academic achievement. The SAT focuses on the potential for academic readiness at the post-secondary level, while the ASVAB focuses on military and occupational success and performance after high school. In the latter half of the twentieth century, the United States Bureau of Labor and Statistics (BLS) extended the use of both tests beyond their original intent because of both tests' strong predictive natures towards academic and occupational success. That is, BLS uses the SAT and ASVAB for large-scale longitudinal studies aimed at predicting future labor and job markets. These studies included:

Project Talent 1960 (PT 60), National Youth Longitudinal Study 79 (NYLS 79), and National Youth Longitudinal Study 97 (NYLS 97). These studies not only provided a window into future job markets but also have established the national norms for the ASVAB (American Institute of Research, 2016; Bureau of Labor and Statistics, 2021).

Problem Statement

On January 1, 2011, Oregon lawmakers passed legislation to enact the 40-40-20 goal. The statewide legislation set a high marker for the state's educational achievement by the year 2025 using the following achievement markers:

- 40% of Oregonians will complete a four-year degree.
- 40% will complete a two-year degree or certificate.
- 20% will earn a high school diploma or the equivalent.

The intended purpose of the state's lofty education goal is to fill an estimated 300,000 projected jobs within the state that will require training beyond high school (Higher Education Coordinating Commission, 2018). The goal ideally puts 80% of Oregon's high school graduates into higher education settings.

The primary target group for achieving the 40-40-20 goal are Oregonians rising through the education system (Higher Education Coordinating Commission, 2018). The achievement markers apply to all of Oregon's citizens, and they are aligned to meet the state's upcoming job market and economic needs. The statewide goal does not mean that every graduating class from every school district in Oregon will be expected to perfectly mirror the percentages above. Still, high schools should be helping students target at least one of the achievement markers. In addition, given Oregon's high need for citizens to obtain post-secondary degrees, college

admissions counselors may need to find alternative data sources like the ASVAB to identify, recruit, and admit enough students to fulfill the post-secondary needs and goals of the state.

One Pacific Northwest high school, which uses the pseudonym Chinook Harbor High School, has loosely adopted the statewide 40-40-20 goal for its exiting graduating classes. According to the most recent data from the Chinook Harbor High School Counseling Office, thirty-five percent of Chinook Harbor High School graduates attend a two or four-year college after high school (with more graduates attending a two-year university). Three percent of its graduates join the military, ten percent enter a trade school, three percent start an apprenticeship, twenty-five percent join the workforce, and nineteen percent fall under a category of "other" (Chinook Harbor Counseling Department, 2021). Scores from the SAT and ASVAB may provide useful information for helping to filter the twenty-five percent of students who are immediately joining the workforce, and the nineteen percent who fall under the "other" category, into one of the achievement markers of the 40-40-20 goal.

Each year Chinook Harbor's students take the SAT in the spring and the ASVAB in the fall as part of the school's post-secondary planning program, with the intent to provide all students the opportunity to take the test for free and demonstrate essential skills to meet state graduation requirements. According to the Chinook Harbor counseling department and the Oregon Department of Education, student performance and test scores are typically low to average on the SAT and on Oregon's state standardized tests (Chinook Harbor Counseling Department, 2021). Oregon's school accountability report for the 2018-2019 school year reported Chinook Harbor High School's three-year state testing average as 34.2 percent in mathematics, and 45 percent in language arts, both of which met the state-wide benchmarks (Oregon Department of Education, 2019). Teachers reported that some students who performed

low on their standardized tests performed high in career and technical education (CTE) courses, music, art, and electives.

The Chinook Harbor School District has never used data from the SAT and ASVAB to look for generalized aptitude, ability, and achievement patterns in its student populations. Furthermore, the question of whether the practice of administering the SAT and ASVAB is actually necessary has never been studied. Understanding why a student may test poorly or well for certain aptitudes, and understanding how those test results relate to subsequent performance, could help the administration develop college and career pathways that meet the needs of all students. Nonetheless, the Chinook Harbor School District pays for the SAT, and provides the time and space for the Department of Defense (DOD) to administer the ASVAB and explain student scores on the ASVAB during regular class time, without a plan to use the information for administrative or counseling purposes.

Purpose Statement

This study had three main purposes. The first purpose was to look at SAT and ASVAB test score distributions for the Chinook Harbor School District. The second purpose was to correlate the composite and subtest scores for the SAT, ASVAB, and high school grade point average (HSGPA). Studying the associations between them would allow the Chinook Harbor School District to better understand its student population's strengths and abilities. The third purpose of the study was to examine how gender, socio-economic status, race, ethnicity, and HSGPA moderated the district’s student test scores.

Research Questions

This study compares the Armed Services Vocational Aptitude Battery (ASVAB) and Scholastic Assessment Test (SAT) using a quantitative, exploratory study of secondary data. This study will explore three research questions:

1. What are the distributions of composite and subtest SAT and ASVAB scores for high school students from a rural Oregon district?
2. To what extent do SAT and ASVAB composite and subtest scores correlate for high school students from a rural Oregon district?
3. To what extent are SAT and ASVAB composite and subtest scores moderated by gender, socio-economic status, race, and ethnicity for high school students from a rural Oregon district?

Significance Statement

District-wide, Chinook Harbor's counseling department and administration have expressed concerns regarding the number of students leaving high school without a post-secondary plan. The counseling department seeks to find additional ways to engage students in creating specific academic and career plans. With better data on student populations, these departments would be able to offer students more opportunities; specifically, the opportunities will prepare them for higher levels of education, apprenticeships, internships, and, ultimately, higher-paying careers.

In the Chinook Harbor district, administration of the ASVAB has been standard practice for over two decades. However, it was not until the 2018-2019 school year that the district began administering the SAT to every 11th grade student. This practice was primarily to give all students, specifically financially disadvantaged students, an equal opportunity to take the SAT

during school hours. It was hoped that this benefit would encourage more students to fill out college applications. The Chinook Harbor Counseling Department reports that this practice has not increased the number of students they are helping apply to college.

Aptitude tests might be another way to encourage students to enter post-secondary education based on the abilities and aptitudes where they have potential to be successful. Wai et al. (2020) suggest using tests to universally screen students for both academic levels and patterns of academic strengths. Using tests that measure aptitudes beyond reading, writing, and mathematics could potentially lead to discovering students who possess the capability to do well in post-secondary education, but may have low grades because of working, absenteeism, lack of effort, lack of interest in subject area, or other factors unrelated to aptitude. At the secondary level, the correlation of subtest and composite SAT and ASVAB scores and their subtests would help counseling departments encourage students early to consider academic and career options associated with their strengths, allowing these students extra time to develop post-secondary plans with the help of counselors and teachers.

Instead, many students from rural districts enter the workforce directly out of high school not believing they possess the requisite skills to be successful in college. This lack of belief is currently causing a disproportionate number of students to filter into the job force after high school in the Chinook Harbor School District instead of seeking the additional schooling or occupational training needed to meet the Oregon's 40-40-20 goal. To meet this goal, admissions counseling departments at universities should also consider broadening the measurement tools and scholastic aptitude data they typically use to assess students when admitting them to college. One potential way of doing this would be to use aptitude tests scores like those found on the

ASVAB to identify students who have the potential to be successful when considering admission into a specific university or college major.

Definitions of Terms

The following terms are related to this study:

Aptitude: The capacity to acquire competence or skill through training; any cognitive ability that is possibly predictive of certain kinds of future learning success (Carroll, 1993; Corsini, 2002).

Ability: A present skill, such as being able to spell a particular word, perform arithmetic, ride a bicycle, or recite a poem (Corsini, 2016).

Achievement: A specified level of proficiency in academic work in general or in a specific skill such as reading or arithmetic (Corsini, 2016).

Intelligence (g): Common factor and latent variable or general factor discovered by Charles Spearman (Spearman, 1927). For the purpose of this study, intelligence refers to the latent variable often referred to as "cognitive ability" or "general cognitive ability."

Rural: Defined by the NCES as any area with a population less than 2,500 residents; it is also defined as an urban area with populations ranging from 2,500 to 49,999 that are not part of larger labor market areas (metropolitan areas) (United States Department of Agriculture [USDA], 2021).

Socio-Economic Status (SES): There are a number of variables that are typically included in SES such as education level, income, and work experience. For the purpose of this study, socioeconomic status will be determined by eligibility in the Free and Reduced Lunch (FRL) program.

Summary

The results from this study have the potential to help the school district, high school staff, and high school counseling office better assist students in developing their post-secondary educational and vocational plans. The data obtained from this study could help inform the Chinook Harbor High School administration and counselors of potential career exploration programs that would be beneficial to its student population based on student aptitudes and strengths. For example, the district may be able to predict and set up internships and career pathways that match student aptitudes. In addition, the information is key to improving student post-secondary plans that better meet the individual needs of all its students. For example, students may need to retake one or both tests to achieve a better score based on their career goals, or students may be able to use their test data to recognize courses that align with their aptitudes and abilities, or careers they could pursue based on their results. Additionally, administrators could use the data to develop courses that more closely align with the likely career pathways of the student body.

Chapter 2: Literature Review

The purpose of this literature review is first to understand the SAT and ASVAB in terms of historical context, operationalization, and measurement. The second part of the review will examine how the demographic variables of gender, race, and ethnicity, and socio-economic status have typically moderated student academic performance and achievement. Finally, the last section will explore rural students' environmental and academic characteristics.

The Armed Services Vocational Aptitude Battery (ASVAB)

The United States Armed Services, in their desire to understand the aptitudes and abilities of their candidates and personnel, have a long history of employing tests to measure aptitude and ability. This practice began in World War I when soldiers were given either the Alpha test, which primarily measured verbal and numerical ability, or the Beta test, which measured the aptitude and ability of illiterate personnel (History of Military Testing, 2021; Sands & Waters, 2004). These tests were the predecessors of the cognitive ability and aptitude tests now administered by all United States Armed Services branches. This multi-aptitude test is one of the most well-researched aptitude tests used for military occupational screening and classification purposes. Since then, the ASVAB has undergone several evolutions and a shift to a computerized version that all military candidates take when being processed for military service. Scores determine general qualifications for each military service branch and classify enlistees for military occupations.

The Department of Defense has also developed a high school version of the test known as the ASVAB Career Exploration Program (CEP), formerly known as the Department of Defense Student Testing Program (DOD-STP) available to high schools nationwide. The ASVAB (CEP) was introduced as a career and counseling program during the 1968-1969 school year and has

been free for high schools to use ever since. The main difference between the ASVAB and ASVAB (CEP) test is the omittance of the assembling objects subtest. In addition to serving the Armed Services purposes, the ASVAB (CEP) is designed to serve as a career planning tool for high schools to use when helping students develop post-secondary educational and vocational plans.

The program, in its entirety, consists of students taking the ASVAB (CEP) and completing an interest-finder, based on Hollands Classifications Codes, used to cluster areas of interest to occupational career areas (Counselors and Educators: Asvab Subtests, 2021). Military personnel then visit the school to help students understand the meaning of test scores and interest inventories (Baker, 2002; Sands & Waters, 2004). Military personnel only meet with students regarding military enlistment if requested by the student (ASVAB Career Exploration Program, 2021). However, military personnel are always present to help students interpret their ASVAB test scores.

The ASVAB and Department of Defense use the National Youth Longitudinal Survey (NYLS 97) for norming and validity purposes. The Standards for Educational Psychological Testing has defined validity as “the degree to which accumulated evidence and theory support a specific interpretation of test scores for a given use of a test” (American Educational Research Association, 2014, p. 225). Validity, therefore, is the most fundamental consideration in developing and evaluating tests and their ability to predict outcomes accurately. The Department of Defense has conducted extensive research to determine the validity of the ASVAB through contracted and internal technical studies (Personnel Testing Division Defense Manpower Data Center [DMDC], 2012; Sands & Waters, 2004).

Welsh, et al. (1990) offered the most prominent study concerning the ASVAB's validity; this study is still being used today. The study examines the ASVAB's construct validity, how well the ASVAB measured the content or characteristic it is designed to measure, and content validity; the authors determined that the ASVAB is an evidence-based test that supports the intended interpretation of test scores for a given purpose (American Educational Research Association et al., 2014, p. 218). Much of the validity study examined criterion-related validity, and assessed whether the test could predict outcomes, especially those specific to enlistees and student performance in military and civilian occupations (Welsh, et al., 1990). The bulk of empirical done by Welsh, et al. and subsequent follow up technical reports by the Personnel Testing Division Defense Manpower Data Center [DMDC] (2012), have continued to demonstrate that the ASVAB is a reliable predictor of military and civilian occupational success.

The ASVAB currently uses item response theory (IRT) to develop its test forms. The shift to item response theory allows test scores to be placed on the same scale regardless of the combination of test items given (Personnel Testing Division Defense Manpower Data Center [DMDC], 2012). For example, the paper and pencil (P&P), computerized, and ASVAB (CEP) test results for an individual can be placed on the same scale regardless of the test version or form. IRT is ideal because the ASVAB (CEP) is currently only available in a P&P format, while the ASVAB given to military recruits at a military processing station (MEPS) is the computerized version. However, the Department of Defense is pushing to shift all ASVAB formats to a computerized format, which would further increase test reliability as it lowers the unsystematic and random variance from between-person administration and scoring.

The ASVAB's subtests measure four domains: verbal, math, science and technical, and spatial. However, the ASVAB (CEP) does not include the assembling objects subtest, which

measures a person's spatial domain ability. The assembling-objects test is given to military candidates at MEPS using the computer adaptive test (CAT-ASVAB) instead of the paper and pencil (P&P) version. All ASVAB subtest and composite scores are used to determine military occupations, but aptitude scores also predict non-military occupational success based on matching aptitudes to careers (Baker, 2002; Counselors and Educators: Asvab Subtests, 2021).

Scores are reported as raw scores, standard scores, percentile scores, and composite scores. Before 1980, ASVAB scores were normed using data from the male military personnel who were considered to be on active-duty status on December 31, 1944 (History of Military Testing, 2021; Sands & Waters, 2004). Since then, the Department of Defense and Department of Labor have jointly completed nationwide longitudinal studies to build their normative base (Bureau of Labor and Statistics, 2021; History of Military Testing, 2021). The ASVAB's subtests measure one of four learning domains except for the ASVAB CEP which omits the spatial domain. Figure 1 provides an overview of the ASVAB's subtests, content descriptions, and the learning domain measured (Counselors and Educators: Asvab Subtests, 2021).

Figure 1

ASVAB Sub-tests and Domains

Subtest	Description	Domain
General Science (GS)	Knowledge of physical and biological sciences	Science/Technical
Arithmetic Reasoning (AR)	Ability to solve Arithmetic word problems	Math
Word Knowledge (WK)	Ability to select the correct meaning of words presented in context and to identify the best synonym for a given word	Verbal
Paragraph Comprehension (PC)	Ability to obtain information from written passages	Verbal
Math Knowledge (MK)	Knowledge of high school mathematics principles	Math
Electronics Information (EI)	Knowledge of electricity and electronics	Science/Technical
* Auto Information (AI)	Knowledge of automobile technology	Science/Technical
* Shop Information (SI)	Knowledge of tools and shop terminology and practices	Science/Technical
Mechanical Comprehension (MC)	Knowledge of mechanical and physical principles	Science/Technical
Assembling Objects (AO)	Ability to determine how an object will look when its parts are put together	Spatial

**Only the paper-and-pencil version of the ASVAB is administered in the Career Exploration Program. In this version, AI and SI are combined into one single subtest (labeled AS) and Assembling Objects (AO) is not administered.*

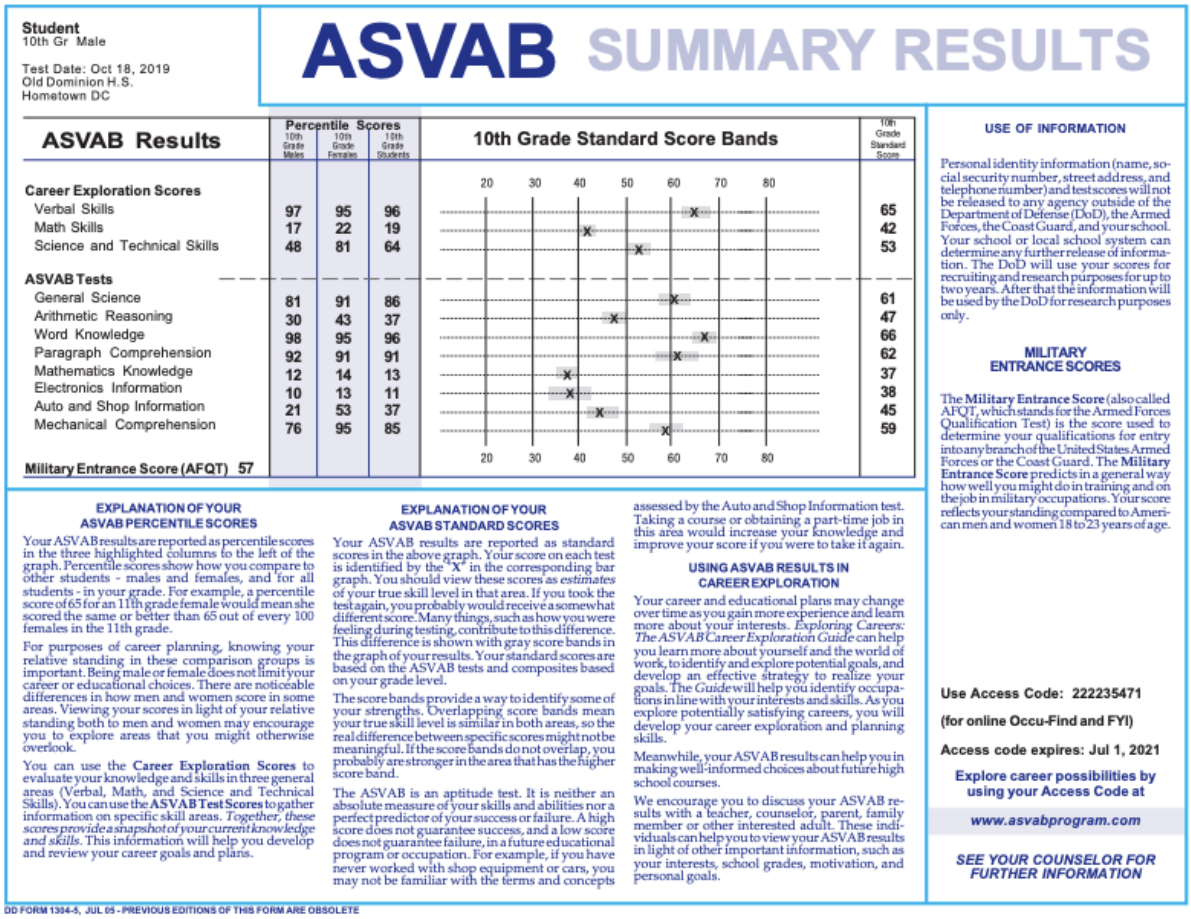
Note. Content of the ASVAB subtests. Reprinted from *ASVAB: Armed Services Vocational Aptitude Battery,* by the Department of Defense, 2021. Reprinted with permission. https://www.officialasvab.com/counselors-educators/subtests/. Reprinted with permission.

Test results are broken into two main categories using composite scores, the Armed Forces Qualification Test (AFQT), and career exploration scores in the areas of math, verbal, and science and technology. These scores help students understand their aptitudes and potential career areas they may want to explore. The ASVAB's score reports include the standard scores for each student. Standard scores have a mean of 50 and a standard deviation of 10 for each individual subtest (Defense Manpower Data Center, 2004). Aptitude composite scores are

reported as percentile scores. See Figure 2 for a sample score report of the ASVAB Career Exploration Program (2021):

Figure 2

ASVAB Sample Score Report



Student
10th Gr Male

Test Date: Oct 18, 2019
Old Dominion H.S.
Hometown DC

ASVAB SUMMARY RESULTS

ASVAB Results	Percentile Scores 10th Grade Males	10th Grade Females	10th Grade Students	10th Grade Standard Score
Career Exploration Scores				
Verbal Skills	97	95	96	65
Math Skills	17	22	19	42
Science and Technical Skills	48	81	64	53
ASVAB Tests				
General Science	81	91	86	61
Arithmetic Reasoning	30	43	37	47
Word Knowledge	98	95	96	66
Paragraph Comprehension	92	91	91	62
Mathematics Knowledge	12	14	13	37
Electronics Information	10	13	11	38
Auto and Shop Information	21	53	37	45
Mechanical Comprehension	76	95	85	59
Military Entrance Score (AFQT) 57				

10th Grade Standard Score Bands: 20 30 40 50 60 70 80

EXPLANATION OF YOUR ASVAB PERCENTILE SCORES

Your ASVAB results are reported as percentile scores in the three highlighted columns to the left of the graph. Percentile scores show how you compare to other students - males and females, and for all students - in your grade. For example, a percentile score of 65 for an 11th grade female would mean she scored the same or better than 65 out of every 100 females in the 11th grade.

For purposes of career planning, knowing your relative standing in these comparison groups is important. Being male or female does not limit your career or educational choices. There are noticeable differences in how men and women score in some areas. Viewing your scores in light of your relative standing both to men and women may encourage you to explore areas that you might otherwise overlook.

You can use the **Career Exploration Scores** to evaluate your knowledge and skills in three general areas (Verbal, Math, and Science and Technical Skills). You can use the **ASVAB Test Scores** to gather information on specific skill areas. *Together, these scores provide a snapshot of your current knowledge and skills.* This information will help you develop and review your career goals and plans.

EXPLANATION OF YOUR ASVAB STANDARD SCORES

Your ASVAB results are reported as standard scores in the above graph. Your score on each test is identified by the "X" in the corresponding bar graph. You should view these scores as *estimates* of your true skill level in that area. If you took the test again, you probably would receive a somewhat different score. Many things, such as how you were feeling during testing, contribute to this difference. This difference is shown with gray score bands in the graph of your results. Your standard scores are based on the ASVAB tests and composites based on your grade level.

The score bands provide a way to identify some of your strengths. Overlapping score bands mean your true skill level is similar in both areas, so the real difference between specific scores might not be meaningful. If the score bands do not overlap, you probably are stronger in the area that has the higher score band.

The ASVAB is an aptitude test. It is neither an absolute measure of your skills and abilities nor a perfect predictor of your success or failure. A high score does not guarantee success, and a low score does not guarantee failure, in a future educational program or occupation. For example, if you have never worked with shop equipment or cars, you may not be familiar with the terms and concepts assessed by the Auto and Shop Information test. Taking a course or obtaining a part-time job in this area would increase your knowledge and improve your score if you were to take it again.

USING ASVAB RESULTS IN CAREER EXPLORATION

Your career and educational plans may change over time as you gain more experience and learn more about your interests. *Exploring Careers: The ASVAB Career Exploration Guide* can help you learn more about yourself and the world of work, to identify and explore potential goals, and develop an effective strategy to realize your goals. The *Guide* will help you identify occupations in line with your interests and skills. As you explore potentially satisfying careers, you will develop your career exploration and planning skills.

Meanwhile, your ASVAB results can help you in making well-informed choices about future high school courses.

We encourage you to discuss your ASVAB results with a teacher, counselor, parent, family member or other interested adult. These individuals can help you to view your ASVAB results in light of other important information, such as your interests, school grades, motivation, and personal goals.

USE OF INFORMATION

Personal identity information (name, social security number, street address, and telephone number) and test scores will not be released to any agency outside of the Department of Defense (DoD), the Armed Forces, the Coast Guard, and your school. Your school or local school system can determine any further release of information. The DoD will use your scores for recruiting and research purposes for up to two years. After that the information will be used by the DoD for research purposes only.

MILITARY ENTRANCE SCORES

The **Military Entrance Score** (also called AFQT, which stands for the Armed Forces Qualification Test) is the score used to determine your qualifications for entry into any branch of the United States Armed Forces or the Coast Guard. The **Military Entrance Score** predicts in a general way how well you might do in training and on the job in military occupations. Your score reflects your standing compared to American men and women 18 to 23 years of age.

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Note. Sample ASVAB Summary Results Sheet. Reprinted from *ASVAB Career Exploration Program,* by The Department of Defense, 2021, https://www.asvabprogram.com/general-resources. Reprinted with permission.

The AFQT score is a composite score calculated by using the standard scores of four subtests and used to determine military eligibility (Personnel Testing Division Defense Manpower Data Center [DMDC], 2012); Welsh, et al., 1990). The four domains are:

- Arithmetic Reasoning (AR)

- Mathematics Knowledge (MK)
- Paragraph Comprehension (PC)
- Word Knowledge (WK)

The Armed Forces Qualification Test (AFQT) is a valid predictor of final school grades, self-paced technical school completion times, first-term attrition, job performance measures, and is a commonly used measure of ability (Welsh, et al., 1990; Marks, 2020). The AFQT primarily measures trainability and predicts job performance in the military (Sands & Waters, 2004). AFQT scores are given in percentile scores between 1-99 based on the NYLS 97 norming data and divided into five ability reference groups. The higher reference groups represent the likelihood of success in a military career (Asvab Scoring, 2021). The AFQT score should represent levels of abilities like those found on other tests of scholastic aptitude such as the SAT.

In addition to the AFQT, students who have taken the ASVAB (CEP) receive composite scores representing verbal, mathematical, and science and technical aptitudes (Asvab Scoring, 2021). The verbal score composite is derived from the WK and PC, the mathematics score from MK and AR, and the science and technical score from GS, EI, and MC (DMDC, 2012). ASVAB scores are primarily used to determine enlistment eligibility, assign military jobs, and help students explore career options (Asvab Scoring, 2021). While individual scores are given for each test, the composite scores ultimately inform the prediction of academic and occupational success.

The ASVAB also claims to be a strong predictor of general cognitive ability (Frey & Detterman, 2004; Koenig et al., 2008; Welsh, et al., 1990). However, Roberts et al. (2000) have questioned whether fluid *(Gf)* or crystallized *(Gc)* intelligence is more prominently measured. *Gf* and *Gc* theory is used to examine a test's validity using these two broad categories of mental

ability. According to Roberts et al., fluid intelligence requires less formal education than crystallized intelligence. Roberts et al.'s findings concluded that the ASVAB was a primary measurement of Gc, meaning the test might be little more than what Roberts et al. calls "acculturated" *g.* Thus, the ASVAB would only reflect the amount of education and type of knowledge accessible to the test taker. However, through research and funding, the Department of Defense has been committed to creating a fair, valid, and reliable measure of general ability, military suitability, and job performance. The test is also a reliable predictor of civilian occupational performance (Sanders & Waters, 2004).

The SAT

More than one million secondary students take the Scholastic Achievement Test (SAT) each year, and it is a globally recognized assessment of a student's scholastic ability and achievement (College Board, 2021–22). Policymakers, high school counselors, college admissions counselors, and scholarship foundations all use student test scores from the SAT in their planning, decision making, and acceptance processes. Test scores allow these entities to make valid inferences to determine post-secondary academic and career paths, admission into college, and student eligibility for monetary scholarships. The SAT content covers core areas essential for college success: reading, writing and language, and math (College Board, 2021–22). The content and knowledge on the SAT are designed to reflect the skills and knowledge that should be taught in the classroom (College Board, 2021–22). Therefore, the test demonstrates a student's scholastic abilities and academic achievement.

The Scholastic Achievement Test (SAT), first known as the Scholastic Aptitude Test, is part of the College Board's suite of educational tests, including the SAT, PSAT/NMSQT, PSAT 10, and PSAT 8/9. The SAT is designed for secondary students in grades 8-12 (College Board,

2021). Since the SAT was first implemented in 1926, it aimed at helping students predict college and career readiness and success in college (College Board, 2017b). According to the College Board Suite of Assessments Technical Manual (2017a), in the past decade, fewer than half of the students who have accessed the SAT have demonstrated the level of academic achievement necessary for success at the post-secondary level. In response to this disturbing decline in academic achievement, the SAT has instituted a suite of tests to help monitor student progress towards this goal at earlier grade levels (College Board, 2017a). The SAT serves as the capstone of academic achievement to determine college and career readiness.

Like the ASVAB, the SAT uses IRT when developing its suite of assessments. The suite of assessments is vertically scaled, allowing for the monitoring of student progress and growth towards college and career readiness throughout a student's K-12 education (College Board, 2021). The SAT ensures that its item content is reliable and is a valid predicter of post-secondary college and career readiness by using a national curriculum survey given to educators (College Board, 2017a). The SAT also uses a nationally representative sample of its student test-takers to provide norming data every three to four years (College Board, 2017a).

The SAT conducts curriculum surveys using a nationally representative sample of middle school, high school, and post-secondary teachers and instructors every three to four years (College Board, 2021). This process is done in conjunction with SAT review committees that serve to review and provide feedback on test materials to ensure "content soundness and fairness" (College Board 2021). The input is then used to refine and adjust the SAT's content and material before it is used. The SAT also uses external review committees to ensure test fairness and item development. Specifically, race, ethnicity, gender, English learners, and

students with disabilities were considered during the 2016 redesign of the SAT suite for this purpose (College Board, 2021).

The 2016 redesign was done specifically to shift the SAT from an aptitude test to a test of student achievement, and to align the test with best practices classroom instruction (College Board, 2017). Each test in the SAT Suite redesign includes a reading test, writing and language test, and a math test, including two portions: calculator and non-calculator. All tests on the SAT are designed to collect evidence and provide appropriate benchmark data regarding student achievement to reach post-secondary college readiness for first-year college students (College Board, 2021). Several studies have also pointed towards SAT scores predicting college success and grade point average after the first year (Sackett & Kuncel, 2018; Westrick et al., 2019). In addition to the reading, language, and math tests, students may choose to take writing and additional subject-matter tests. One of the primary goals of the redesigned SAT is to become a more substantial measure of academic achievement instead of academic aptitude; achievement indicates a specified level of proficiency, while aptitude refers to the capacity to acquire competency of knowledge or a skill. However, the newly redesigned SAT is still new and will need to be continually tested for reliability throughout its implementation.

Still, many believe the SAT measures little more than socio-economic status. In fact, it has been called a test of affluence, or a wealth test, by those opposed to the use of high stakes tests, calling them the "gatekeepers in education" (Sackett & Kuncel, 2018). However, the SAT's ongoing research and feedback from the higher education and K-12 communities continues to demonstrate that the SAT is a fair measure of what post-secondary institutions and faculty deem to be the critical knowledge and skills incoming students should possess (College Board, 2019). The College Board's *Suite of Assessments Technical Manual* (2017a) makes it

clear that SAT scores alone should not be used for making "high-stakes decisions" (College Board, 2017a). It is also critical that the relationship between first-year college and career readiness continues to be examined.

The test also continues to be a reliable measure of college success. The SAT runs its own studies on content validity, the internal structure of assessments, and perhaps, most critically, its predictive validity as a reliable measure of college and career readiness. The College Board (2017a, 2019) found that the redesigned SAT scores continue to predict a linear correlation between high school grade point averages (HSGPA), first-year college GPAs (FYGPA), and first-year college course grades (College Board, 2017, 2019; Westrick P. A., et al., 2019). The College Board and Sackett & Kuncel (2018) concur that the strongest indicator for college and career readiness are SAT scores plus HSGPA. However, the SAT alone does provide a benchmark to indicate the likelihood a student is ready to enter into a post-secondary program of study and achieve passing grades.

Demographic Variables

The ASBAB and the SAT collect demographic data on a voluntary, self-reporting basis for their own internal review process. The primary demographic variables, gender, race, ethnicity, and socio-economic status are almost always calculated when reviewing any literature surrounding academic achievement and ability; specifically, there are statistically significant differences in how gender moderates the tested learning domains of reading and mathematics. For example, Beekman & Ober (2015) found higher scores in math often correlate to male students. Likewise, higher scores in reading are often linked to females (Lubienski et al., 2013). The differences between male and female scores are often explained through gender stereotypes and student's perceptions of themselves (Wolter et al., 2015). However, a study by Callen et al.

(2017), one of the first large-scale representative international examinations reviewing how SES moderate academic achievement, found the achievement gap for both math and reading widened when SES status was also factored in.

The second area studied regarding gender focuses on the timing in which gender gaps are created. Lubienski et al. (2013) found that gender gaps in math and reading abilities typically grew over time, becoming more prevalent in the later grades, but could be seen as early as kindergarten. Robinson and Lubienski (2011) found the female math score gap grew larger during elementary school, but it recovered some throughout middle school. Robinson and Lubienski's findings for male reading scores found the gender achievement gap narrow over time. However, the gender gaps in reading tended to be far more prevalent than the gender gaps in math globally.

Some of the explanations for the gender gap phenomenon include teacher perceptions of students. The literature suggests that teachers rate females higher than males in both subjects, even though the data on cognitive assessments might suggest otherwise. Gender role socialization theory is another explanation for reading and mathematics gender gaps. This theory suggests that parents, teachers, and other adults teach children to conform to gender roles (Robinson & Lubienski, 2011). These explanations offer a sociological or behavioral explanation for differences in academic achievement gaps. However, many academic and gender achievement studies also look at biological differences. Halpern et al. (2010) suggest that slight differences between biological males and females are often developed and magnified depending on cultural contexts. It is widely accepted that academic achievement gaps occur when both gender and SES act as moderators. These gaps stay consistent as the gaps widen among low-achieving and low SES students. This is logical considering that SES and cognitive ability both

impact student academic achievement. The culture a person is raised in may also impact a student's achievement depending on the values the culture places on levels of education, socio-economic status, and social mobility. Culture is also often shaped by factors such as the geographic location a person is raised in, as well as their race and ethnicity.

Coyle and Rinderman (2013) examined the ability and achievement differences of students globally by assessing student test score data on the PISA (Programme for International Student Assessment). This study examined the differences in ability and achievement between students from different geographic locations, cultures, and education systems. The PISA is a widely used international standardized test used as a tool for establishing the level of education and academic competency across cultures, nations, and ethnicity. The PISA provides a reliable measure for investigating the educational differences that may occur between different global education systems. The PISA specifically measures a student's skills, abilities, and academic achievement in reading, mathematics, and science (Schleicher, 2019). Coyle and Rinderman's findings indicated that there was a large statistically significant difference in test scores between Eurocentric and African countries, when all moderators were considered. However, because the PISA's item construction is heavily Eurocentric, some of the differences may be explained by the test's item construction, which may cause a test bias and result in differences across different groups of people.

Ability has been widely studied by Arthur Jensen over the course of his career. Specifically, Jensen (1998) and Rushton and Jensen (2004) established that there are statistically significant differences between black and white students in ability and academic achievement. Jensen looked at the biological and environmental factors between black and white populations in the United States that may be causing the differences, concluding that there were statistically

significance differences between the two groups. However, Jensen also found that the differences between black and white students could also be moderated by socio-economic status. For example, students regardless of race, scored higher on tests of achievement and ability if they came from a higher socioeconomic background.

SES has been categorized by various factors: parent education, parent income, household possessions and resources, and eligibility for free and reduced lunch. The Coleman Report (1966) was the first of its kind to look at the effects of a student's socio-economic status (SES) on academic achievement. Coleman's report was done on the back of the Civil Rights Act of 1964 to study the potential inequities in education and examine how monetary factors impacted student achievement (Kahlenberg, 2001). The report made three main claims. First, family is the most important determinant of achievement. Second, a student's peer SES levels can moderate student achievement and boost an individual's performance when SES increases are present. Finally, Coleman did not find school funding closely related to academic achievement (Coleman, 1988). Coleman's first finding, that family is the most important factor, can also help explain the correlation between a parent's cognitive ability and their child's academic achievement. Parents' cognitive ability and education levels have both been tied to their child's cognitive ability and socio-economic status (Breit et al., 2020; Jensen, 1998).

In several studies, cognitive ability and academic achievement are strongly correlated to socioeconomic status (Marks, 2020). These studies are consistent with Jensen (1998), who found strong correlations between cognitive ability, academic achievement, and socioeconomic status. Specifically, Jensen studied the effects of race, gender, and socio-economic status on academic achievement and cognitive ability. Jensen used large nationally normed standardized tests,

including the ASVAB and SAT, and found test score differences for race and socioeconomic status.

A wealth of additional evidence suggests a substantial transmission of ability between parent and child cognitive ability (Bates et al., 2019; Sackett & Kuncel, 2018; Wai et al., 2018). In fact, it is well accepted that the mother's level of education and cognitive ability both result in their offspring having higher levels of both ability and academic achievement (Jensen, 1998). Bates et al. (2019) found that parent socio-economic status correlated to their student's academic achievement. In turn, higher levels of academic achievement also generally yield higher levels of socioeconomic status (Sackett & Kuncel, 2018). Ansalone (2001) focused on the educational gap created by levels of socio-economic status, arguing that students being tracked in school can explain the SES achievement gap. Economic theorists explain that parents with a higher socioeconomic status can buy educational success (Marks, 2020). The economic theory may also have some ties to Bourdieus's (1977) cultural capital theory, a prominent explanation for the SES-achievement relationship.

Cultural capital theory is rooted in the idea that students from a high socio-economic background have an advantage because they are familiar with the white-elite culture, which is the predominant culture of the education system (Kingston, 2001; Lareau & Weininger, 2003). Therefore, students from high SES backgrounds would naturally be rewarded within the education system because of their familiarity with the curriculum's cultural contexts or the language used on the test (Vance & Hankins, 1978). However, many of these studies are done using small populations that fail to encompass the national population as a whole. The argument of test fairness or bias presented in small population studies would not necessarily warrant claims of test bias because of skewed group test results.

There have been numerous studies done with regard to socio-economic status and ability. Many studies throughout the literature, including Seyfried (1998) and Ripple and Luthar (2000), point to potential environmental factors or a combination of environmental and ability factors, rather than SES lowering cognitive ability or academic achievement. However, when SES is controlled for within the study, lower SES status does not indicate lower levels of academic achievement or cognitive ability (Burchinal et al., 2018). Sidanius and Pratto (1999) found that students from low socio-economic backgrounds develop at a slower rate than students from higher socio-economic backgrounds. According to Reardon et al. (2013), students from low socio-economic backgrounds entering high school have literacy rates five grade levels below their peers. The SES achievement correlations are also present in mathematics, where students from low socio-economic backgrounds typically score one standard deviation below their peers (Baird, 2012). Many cultural or environmental variables are potentially contributing to this phenomenon. These include, but are not limited to, parental attitudes toward the value of education (Hyman, 1993), frequency children are read to growing up (Park, 2008), student engagement (Tomaszewski et al., 2020), and parent involvement with student schoolwork (Berthelsen & Walker, 2010).

The role SES plays, and its influence on student academic achievement, are continuously studied and examined with infinite tweaking of variables and circumstances associated with SES and gender individually and their interactions together. For example, Zwick and Green (2007) found that student correlations between SES and the SAT are smaller than those found when looking at grade point average and class rank. The following section will address the lack of educational opportunities, low family income levels, and challenges that America's rural students face.

Rural Education

Research surrounding the rural education experience is substantially limited, yet nearly 20 percent of United States students attended a rural school (US Department of Education & National Center for Educational Statistics [NCES], 2013). For rural counties, low educational attainment is closely related to higher poverty and child poverty rates, as well as higher unemployment rates (Statti & Torres, 2020). These rural challenges have been documented and often result from a lack of digital resources, fewer opportunities for advanced education, less family and community support, and lower values placed on educational achievements (Statti & Torres, 2020). Rural areas also lag behind urban and suburban areas in overall educational attainment. According to the United States Department of Agriculture (2017), only 19 % of the rural population holds a bachelor's degree, with 20 % of rural women obtaining a bachelor's degree in comparison to men at 15% (Economic Research Service, USDA, 2017). Education levels in rural areas are a stark contrast to urban areas where men and women equally made up the 33% of the population who hold bachelor's degrees in 2015 (Economic Research Service, USDA, 2017).

Rural areas are unique in their understanding and value of education, both at the family and community levels. This unique educational perspective exists partly because the environment provides for a different type of learning than do urban and suburban settings. For example, many rural students spend their time outside of school not studying for admissions exams, but instead working to pay family bills. Many live subsistence lifestyles similar to those of indigenous populations (Kassam et al., 2016). They also note that education "must be embedded in the habitat of the children in indigenous, rural, and other non-urban settings" (Kassam et al., 2016, p.98). The study noted the unique predisposition students growing up in

rural America have in their understanding of science and offered the example of a young girl growing up on a family dairy farm that was able to explain how simple gears worked, not from a textbook, but from watching the mechanical mechanisms used daily on her family's dairy farm. This type of learning, learning by doing, may not always yield the highest academic achievement. However, the practical nature of the knowledge many rural students hold doesn't necessarily mean growing up rural is a barrier to their cognitive development or ability.

Rural areas of the United States are often plagued with poverty, lack of educational opportunity, and lack of school funding. Any one of these might explain why standardized test scores in rural locations tend to be lower. Furthermore, the preparation and coaching recommended by the SAT are often not easily accessible to the nearly 50 million people living in rural areas across the United States (US Department of Education & National Center for Educational Statistics [NCES], 2013). However, several studies show minimal test score gains due to coaching (Sackett & Kuncel, 2018). In addition, the College Board and Khan Academy have partnered to provide free SAT preparation to all students in hopes of bridging the inequities that demystify the belief that the SAT is simply a test of wealth and socioeconomic status. The cultural values embedded in some rural communities, that suggest a lack of focus on education, may contribute to whether students take advantage of and comprehend the need for test preparation.

Rural Oregon is not immune to poverty and lacks opportunities for postsecondary educational achievement; further, it faces two significant challenges: income and distance (Chalkboard Project et al., 2016). Income levels per capita during the 1970s for rural Oregon averaged 96% of the metropolitan average; by 2014 that number had dropped to 83% (Chalkboard Project et al., 2016). For those who do hold a bachelor's degree in rural areas, the

national average salary in 2015 was $41,030 as opposed to $51,564 in urban areas (Economic Research Service, USDA, 2017). The difference in pay for rural residents who hold a professional or graduate degree is even starker with a disparity of $51,996 to $70,146 (Economic Research Service, USDA, 2017). The lack of high-paying jobs makes it harder for rural areas to attract high-level professionals to rural areas, including teachers and educators. It also makes it harder for rural areas to financially justify post-secondary education. The second challenge, distance, causes several issues that impact student academic achievement. Absenteeism can be caused by several factors and affect academic achievement, including the need to travel for high-quality health care (Chalkboard Project et al., 2016). Finally, districts that find themselves in either rural or remote areas of the state can be located hundreds of miles from the nearest university or college campus, causing a larger disconnect between rural communities and universities, whereas suburban and urban students typically live within five to ten miles of a university campus (Chalkboard Project et al., 2016). It is estimated that distance alone keeps more than five hundred students in Oregon each year from enrolling in post-secondary education (Chalkboard Project et al., 2016).

Poverty, lack of educational opportunity, and lack of school funding all contribute to lower academic achievement and scores on standardized tests in rural areas. Kassam et al. (2016) describe these rural pockets of the country as being rich in “cognitive diversity” (p.100). Cognitive diversity, by their definition is, “the multiplicity of perspectives drawn from different ways of knowing, arising from a variety of livelihood activities, life experiences, and cultural backgrounds” (Kassam et al., 2016, p. 100). Thus, cognitive diversity might also be understood as diverse aptitudes of knowing that would benefit from being measured either by multiple tests, alternative tests, or the use of a different testing instrument.

Some colleges and universities are beginning to recognize the untapped potential of rural America's students. Scott McDonald of Texas A&M believes that geographic diversity is just as important as racial and ethnic diversity (Pappano, 2017). SAT scores reported to the College Board have allowed college access and communication students who may have otherwise gone unknown or unrecognized during a different era. Certainly, progress in technology and access to the tests themselves have allowed college access to "the forgotten minority" (Statti & Torres, 2020), and at the least provided colleges with access to those students who have taken the SAT.

Conclusion

The ASVAB (CEP) and SAT both predict general ability and aim to predict potential future outcomes. The SAT focuses on the scholastic aptitudes necessary for students to be college-ready; the ASVAB (CEP) predicts success in both military and civilian occupations. In comparison, both tests have different purposes, but the Department of Defense and College Board engage extensively in research and norming practices to ensure the tests reliably predict their intended occupational and post-secondary education outcomes. Sacket and Kuncel (2018) also note that there are studies in which test fairness and validity for rural regions is called into question. However, the sample sizes of many of these studies are generally small and do not represent the overall national sample of test-takers. This study will also use a small sample size, but its intention will not be to disprove or question the validity or fairness of either the SAT or ASVAB assessments. This study will simply examine and compare one rural town's student test scores on the SAT and ASVAB, examine how gender, race/ethnicity, socio-economics, and HSGPA moderate student scores, and look for how its scores might fall into the national norms already established.

Chapter 3: Methodology

This chapter outlines the research design of this study, including information on the sample population, the data collection process, data analysis, and ethical considerations of the study. The study will focus on Chinook Harbor High School students' high school grade point averages (HSGPA), composite and subtest scores of the Armed Services Vocational Aptitude Battery (ASVAB) and Scholastic Assessment Test (SAT), and the demographic variables that might moderate test scores by using a quantitative, exploratory study of secondary data.

Research Questions

The study explored three research questions:

1. What are the distributions of composite and subtest SAT and ASVAB scores for high school students from a rural Oregon district?
2. To what extent do SAT and ASVAB composite and subtest scores correlate for high school students from a rural Oregon district?
3. To what extent are SAT and ASVAB composite and subtest scores moderated by gender, race, and ethnicity, and socio-economic status for high school students from a rural Oregon district?

Design

This study's design was a quantitative, ex post facto, exploratory study of secondary data. The data collected was from high school students' composite and subtest scores on the Armed Services Vocational Aptitude Battery (ASVAB) and Scholastic Assessment Test (SAT) during the 2017-2018 and 2018-2019 school years. The ASVAB and SAT administration provided these tests during the students' junior year of high school. The ASVAB was administered during the fall semester and the SAT was administered during the spring semester.

The study's design was appropriate because students had already taken the ASVAB and SAT, and the scores are quantitatively scaled. The study is a ex post facto because the data already existed and was analyzed retrospectively. Composite and subtest scores were collected from the school's database, making it appropriately a study of secondary data. The SAT and ASVAB were correlated because of convenience. Students either chose to re-take the PSAT or take the ASVAB during the fall testing week and all students in the district were required to participate in the SAT during the spring.

Sampling

The population for this study comprised 11th grade students attending Chinook Harbor School district during the 2018-19 and 2019-2020 school year. Chinook Harbor is a rural high school in Oregon. The Chinook Harbor high school is the only high school in the school district serving a 15-mile geographic radius of approximately 15,000 people. According to the State Department of Education (2018-2019, 2019-2020), Chinook Harbor's high school student enrollment was 469 for the 2018-2019 school year and 477 for the 2019-2020 school year. During the 2018-19 school year, the State Department of Education reported that 57% of the district's students were white and 43% were reported in another category. During the 2019-2020 school year; 62% of the district's students were reported as white and 39% were reported in another category. The percentage of students who qualified for free and reduced lunch was 46% during 2018-2019. FRL was not reported during the 2019-2020 school year because all students became eligible after school closures occurred due to Covid-19.

The students included in this study attended Chinook Harbor school district's high school during their junior year and took both the ASVAB and SAT during either the 2018-2019 or 2019-2020 school year. The total sample size for this study is 107 students: 51 students from the

2018-2019 school year and 56 from the 2019-2020 school year. This group of students was appropriate for the study because both tests were administered to students during the same academic school year (junior year); additionally, students took the test during the same time, and the Chinook Harbor school district paid for all test fees and expenses.

Variables

The dependent variables for the study were the SAT and ASVAB subtest and composite scores. Each student was given individual scores on all composite and subtest scores for the SAT and ASVAB tests. The subtest scores for the SAT reading and writing subtest score and mathematics subtest score were individually correlated for each of the ASVAB CEP's subtest scores: general science, arithmetic reasoning, word knowledge, paragraph comprehension, mathematics knowledge, electronics information, auto and shop information, and mechanical comprehension. Findings showed how the sample population scores compared to one another. The overall composite score of the SAT and the ASVAB's AFQT score were also correlated because they represent the overall scores for both exams, and those scores are calculated from test scores on similar learning domains.

The test scores were also examined using the following moderators:

- Gender was determined by what was self-reported to the counseling department. Student self-identification of gender is also used officially by both the SAT, and ASVAB.
- Race, and ethnicity was coded dichotomously using the categories of white and non-white.
- Socioeconomic status (SES) was determined by using the free and reduced price lunch program (FRL) enrollment status as either enrolled or not enrolled.
- High school grade point average (HSGPA) represented the student's official high school cumulative GPA received at graduation.

By examining the above moderators, the study was able to compare if gender and SES moderate the test composite and subtest scores within the Chinook Harbor School District.

Administration and Procedures

The high school counseling department houses the scores for the ASVAB and SAT and student demographics information in the district database with the pseudonym easy school data. There are also hard copies of student test scores on file. The information is only available to the counseling department, administrative staff, and individual students to whom the scores belong. The data for this study is housed in two separate places. The SAT scores and ASVAB AFQT scores are housed in the PowerSchool digital database and the ASVAB subtest standard scores were housed in hardcopy format. The counseling department accessed the ASVAB subtest standard scores in hardcopy form, recorded these in a secure spreadsheet, and gave these to the researcher. The counseling department recovered all test scores and demographic data, students' SAT and AFQT scores, and ASVAB subtest scores. The researcher then merged all data using student ID numbers.

This information was FERPA protected; therefore, I first needed to obtain IRB approval. Upon IRB approval, I submitted my proposal and necessary district forms for research to the Chinook Harbor district office and superintendent asking for access to the required student test data, gender, race, and ethnicity, FRL enrollment, and HSGPA. The superintendent then approved the request for data. Once the request for data was complete, the Chinook Harbor High School counseling department compiled the necessary test scores from its database. The specific test scores needed from the district are the composite scores and subject test scores for both the SAT and ASVAB. These include the overall reading and writing and mathematics scores for the SAT, the AFQT score, and the subtest score from the ASVAB CEP. The counseling department

identified which students identified as male or female, white and non-white, and which students were enrolled in the free and reduced lunch during their 11th grade year of high school and provided student cumulative HSGPAs.

Analysis

What are the distributions of composite and subtest SAT and ASVAB scores for high school students from a rural Oregon district?

Research question one was examined with an exploratory data analysis using Tukey's methods of exploratory data analysis (EDA) for the entire sample. Each independent subtest and composite test score distribution was explored using EDA's 5-number summary, which included the smallest and largest values, interquartile ranges, and medians, both in numeric and graphic form. Furthermore, because the random variables follow probabilistic distributions, the central tendency and variability moments, including skewness and kurtosis, were also examined, and applied to the distributions (Tukey, 1977). Tukey's methods of exploratory data were appropriate because they are an effective means for understanding data when the researcher is wishing to explore the data, rather than confirm a specific hypothesis (Tukey, 1977). This allowed for the sample test score data to be examined as a whole group for the district.

To what extent do SAT and ASVAB composite and subtest scores correlate for high school students from a rural Oregon district?

Research question two analyzed the data using Pearson correlational tests for both composite scores and subtests to look for associations between subtest aptitudes. Each of the subtest scores of the SAT and ASVAB were correlated to each subtest score of the SAT. This created a coefficient between each of the aptitude test scores of the ASVAB and each of the SAT's subtests. Each correlation between the two test scores yielded either a positive or negative

correlation between the two tested aptitudes. The standardized correlation criteria for this study was set at .3 to .8 correlation coefficient and was considered a medium to strong correlation. The ASVAB AFQT and overall SAT will also be correlated. The mathematics and verbal subtest scores for both the SAT and ASVAB, and the AFQT and SAT composite scores are most likely to yield the strongest positive correlation because they measure extremely similar aptitudes and domains of learning.

To what extent are SAT and ASVAB composite and subtest scores moderated by gender, race, ethnicity, and socio-economic status for high school students from a rural Oregon district?

Research question three analyzed the data using independent t-tests to look at the respective differences of each test score by demographic variable, gender, race, ethnicity, and SES. The use of t-tests was appropriate for this study because of the small sample size from the district (Urdan, 2017). For gender, male and female test score data for each composite and subtest scores were compared using side-by-side box plots. This allowed for male and female test scores to be compared to each other and to the district sample. Race, ethnicity, and SES status was examined in the same manner. SES was determined by student enrollment in FRL. Research question three also analyzed how HSGPA moderated test scores. To do this, a one-way ANOVA test was run for each composite and subtest of both the SAT and ASVAB to look for statistical significance. A Tukey-Kramer post-hoc test was performed to assess statistical significance. This allowed the study to compare how gender, race, ethnicity, SES, and HSGPA moderated each of the test's composite and subtest scores within the Chinook Harbor School District.

All three research questions were coded to ensure that the secondary data (test scores) was appropriate for the criteria and methods used (Vogt et al., 2014).

Table 1

Data Analysis Procedures

Research Question	Moderating Variable	Dependent Variable	Statistical Tests

RQ1	n/a	• SAT and ASVAB	• Exploratory data analysis using Turkey's method of EDA
			• Test composite and sub-score distributions used EDA's 5-number summary
			  ○ Smallest and largest values
			  ○ Interquartile ranges
			  ○ Medians

RQ2	n/a	• SAT and ASVAB • Pearson Correlation Tests	• Pearson Correlation Tests

RQ3	• Gender: male/female
	• Socio-economic status
	• Race/ethnicity
	• HSGPA
		• SAT and ASVAB	• Use of independent t-tests
			• SES, gender, and race/ethnicity data compared using side-by-side box plots
			• HSGPA
			  ○ One-way ANOVA test
			  ○ Turkey-Kramer post-hoc

Ethics

I have lived in rural America most of my life and continue to do so. Living in a rural area has given me a specific outlook of what I believe the experiences and skills rural students typically acquire in their formal education, and the typical experiences and skills they acquire because of the environment they grow up in. I also have an intimate knowledge of the district, students, and staff that work in the Chinook Harbor School District. Furthermore, I have a personal interest in the results of this study as I seek to better understand the knowledge and skills that rural student possess.

The study results may shape how I communicate with any future students I teach regarding test preparation and college and career goals. This study was also done as a requirement to obtain a doctoral degree at George Fox University. I obtained IRB approval before requesting any information from the district. District policy for accessing the data required a written agreement with the district specifying the study's purpose, scope, duration, and information that was disclosed. The study does not disclose any information regarding parent and student identification. Information obtained from the district was destroyed once it was no longer needed, and the study was complete. The only identifying data that was received were student ID numbers needed to merge student demographic data and test scores. (Chinook Harbor School District 34C [CHSD 34C], 2015). After merging, the student IDs were removed from the dataset.

Chapter 4: Findings

Introduction

This study had three main parts. The first was to examine the overall distributions of student composite and sub-test scores on the SAT and ASVAB for the Chinook Harbor School District using Tukey's Exploratory Data Analysis (EDA). The second purpose was to correlate the composite and subtest scores for the SAT, ASVAB, and HSGPA. This was done to determine the strength of relationship among the test scores and HSGPA. Finally, the study examined how gender, race, and ethnicity, SES, and HSGPA moderated test scores for the district.

Sample Demographics

Demographic information was collected for the sample and coded dichotomously for the following variables: gender (male, female), race, and ethnicity (white, non-white), and socio-economic status, which was determined by enrollment in free and reduced-price lunch (enrolled, not enrolled). Each moderator and its frequency distributions for the sample can be found in Table 2.

Table 2

Sample Demographics

	n	Frequency	Percent
Gender	107		
Male		56	47.7
Female		51	52.3
Ethnicity	107		
White		62	42.1
Non-White		45	57.9
FRL Status	107		
Enrolled		37	34.6
Not Enrolled		70	65.4

This study coded gender by what the students had self-reporting to the Chinook Harbor counseling department. During the 2018/2019 and 2019/2020 school years, the Chinook Harbor School District students' gender was recorded only as male or female. However, non-binary has since been added as an option to the school district's digital records database. Students also self-identify as either male or female when they register to take the SAT and ASVAB. The district sample from the 2018-2019 and 2019-2020 school years contained five more males then females. The ratio of non-white students to white students in the sample was 42 percent non-white and 58 percent white. These percentages were slightly higher than what the State Department of Education had reported for the district during the 2018/2019 and 2019/2020 school years. The students that were reported to be enrolled in the free and reduced-price lunch were proportionately lower than what was reported for the entire high school. This was most likely the result of 11th and 12th grade students who qualify for the program not formally enrolling in it. Students' cumulative high school grade point averages (HSGPA) were used in two ways for this study. First, to determine the association between HSGPA and test scores, a raw score for

HSGPA was used to examine research question two. Second, categorical HSGPA scores (see Table 3) were used to examine how HSGPA moderated test scores in research question three.

Table 3

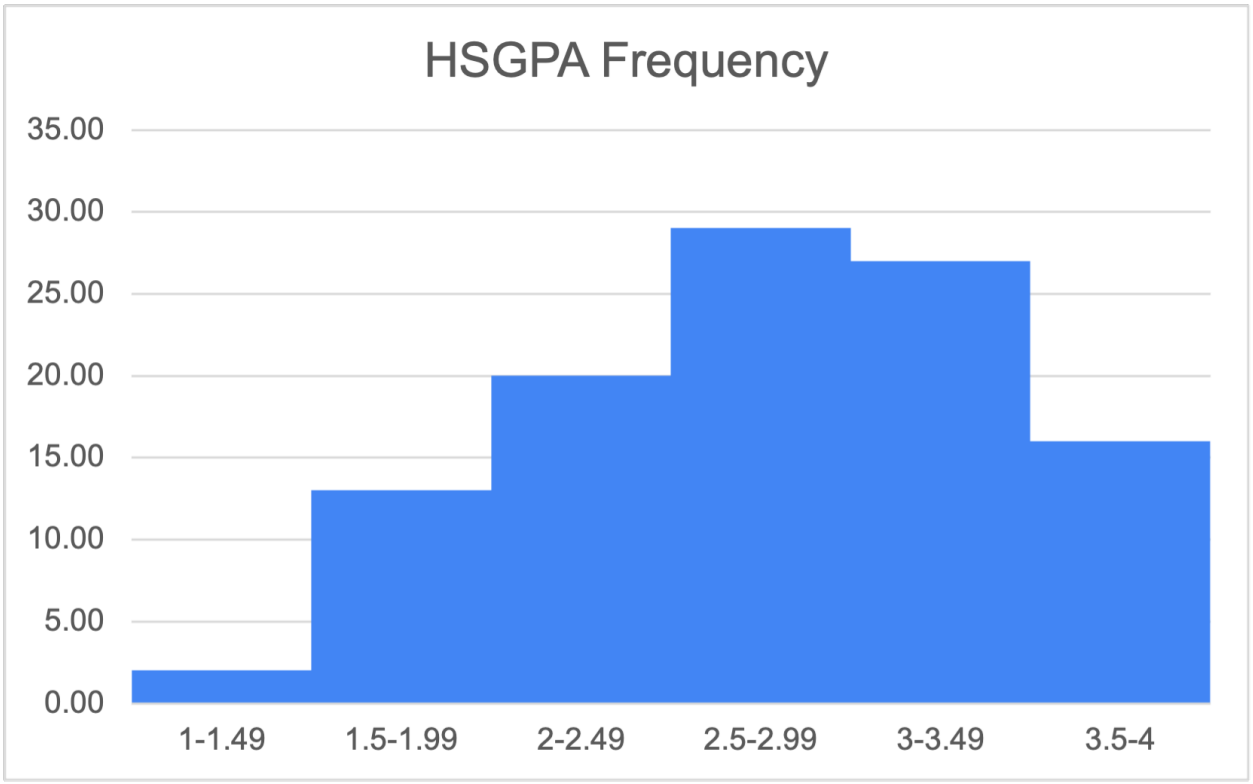
High School Grade Point Average Distribution

HSGPA	Frequency	Percent
1.0-1.49	2	2.0
1.5-1.99	13	12.0
2.0-2.49	20	19.0
2.5-2.99	29	27.0
3.0-3.49	27	25.0
3.5-4.0	16	15.0

A frequency distribution of Chinook Harbor student's HSGPA by category can be found in Figure 3. Grade point averages from the sample were normally distributed. The largest number of students' HSGPAs fell in the 2.5-3.0 range.

Figure 3

HSGPA Distribution Histogram



Research Question One Results

What are the distributions of composite and subtest SAT and ASVAB scores for high school students from a rural Oregon district?

11^{th} grade student test scores (n = 107) were examined using Tukey's 5-point EDA (see Table 4). Since test scores are random variables, the study looked at the moments of central tendency and variability including skewness and kurtosis. The portion of the SAT given to the sample of students consisted of the reading and mathematics sections. The SAT scores examined in this study are the SAT composite score, math score, and reading score. The ASVAB scores examined in this study are the Armed Forces Qualifying Test, composite verbal skills (Verbal Sk.), math skills (Math Sk.), and science and technology (S&T Sk.), and all aptitude subtest scores.

The AFQT is a percentile score calculated from the standard scores of the math and verbal subtest scores using the following equation: AFQT = 2VE +MK + 2VE (Asvab Scoring, 2021; Segall, 2004). The calculated AFQT score is then converted to a percentile score using a conversion table. Scores reported for the ASVAB Verbal Sk., Math Sk., and S&T Sk. are composite scores derived from the sum of the weighted score of the subtests making up each of the composites below (Segall, 2004).

- Verbal Skills= Word Knowledge (WK), Paragraph Comprehension (PC)
- Math Skills= Arithmetic Reasoning (AR), Mathematics Knowledge (MK)
- Science and Technology Skills= General Science (GS), Electronics Information (EI), Mechanical Comprehension (MC)

Central Tendency and Variability

The results in Tables 4 and 5 show student test scores for the Chinook Harbor student sample looking at central tendency. The highest scores from the sample on traditionally tested academic aptitudes occurred for the reading portion of the SAT (*Mdn* = 480, *IQR* = 420-540) and the ASVAB verbal skills (*Mdn* = 52, *IQR* = 46.5-58). The lowest score ranges occurred on the SAT Math (*Mdn* = 440, *IRQ* = 385-520) and mathematics skills of the ASVAB (*Mdn* = 49, *IRQ* = 42-56).

The results from the ASVAB's aptitude subtests found the lowest score ranges on the auto and shop information test (*Mdn* = 45, *IRQ* = 41-52). The highest score ranges on the ASVAB subtests occurred on word knowledge (*Mdn* = 52*, IRQ* = 47-58*),* paragraph comprehension (*Mdn* = 52*, IRQ* = 48-57.5*),* and general science (*Mdn* = 52*, IRQ* = 47-58.5*).* The median and interquartile ranges for each composite and subtest can be found in Table 4.

Table 4

Tukey's EDA for the SAT/ASVAB

	N	Min	Max	Median	Q1	Q3
SAT						
Composite	107	570	1360	930	825	1070
Math	107	300	720	440	385	520
Reading	107	270	700	480	420	540
ASVAB						
AFQT	107	4	95	42	21	62
Verbal Sk.	107	33	68	52	46.5	58
Math Sk.	107	28	66	49	42	56
S&T Sk.	107	27	74	50	44	56.5
GS	107	31	70	52	47	58.5
AR	107	32	72	50	44	56
WK	107	49	73	52	47	58
PC	107	33	67	52	48	57.5
MK	107	27	68	49	40.5	54
EI	107	30	75	47	43	54
ASI	107	33	73	45	41	52
MC	107	27	75	51	45	57

The data was then examined for central tendencies including moments of skewness and kurtosis because the SAT and ASVAB follow probabilistic distributions (see Table 5). The test distributions found the ASVAB electronics information (M = 48.82, SD = 9.26) and auto and shop information (M = 46.77, SD = 8.37) to be positively skewed (> .5). The ASVAB electronics information was found to be a positive .54, indicating that the distribution was right skewed. The skewness of the ASVAB auto and shop information was found to be a positive .74 indicating that the distribution was also right skewed. There were no notable moments of kurtosis (>2.0) on any of SAT or ASVAB test scores.

Table 5

Moments of Central Tendency

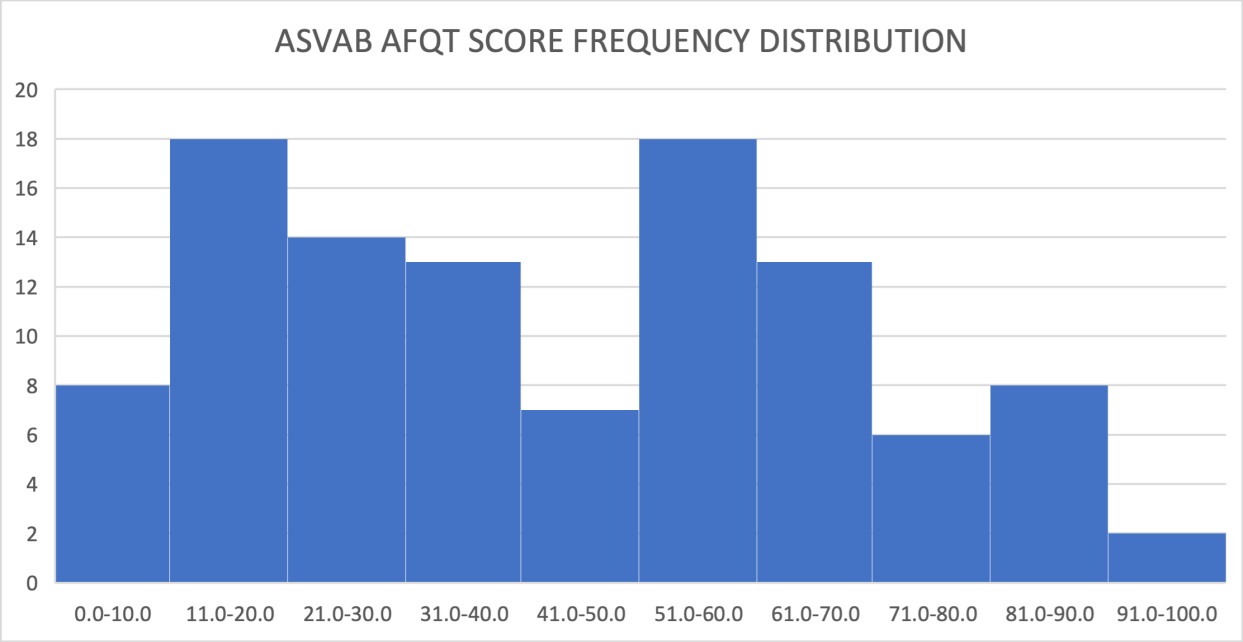
	Mean	SD	Skewness	Kurtosis
SAT				
Composite	937.76	163.0	.19	-.49
Math	453.46	85.33	.27	-.14
Reading	484.30	88.20	.32	-.28
ASVAB				
AFQT	42.80	24.72	.26	-1.07
Verb. Sk.	52.23	7.38	-.19	-.45
Math Sk.	48.88	8.20	.02	-.76
S&T Sk.	50.72	8.52	.21	0.00
GS	51.68	8.63	-.25	-.30
AR	50.23	7.85	.15	-.43
WK	52.37	7.73	.06	.04
PC	52.03	7.37	-.39	-.03
MK	47.90	8.65	-.18	-.84
EI	48.82	9.26	.54	.55
ASI	46.77	8.37	.74	.36
MC	51.41	8.44	.12	.20

The EI test and ASI tests were found to have a positive skew. The EI test had four outlying scores that that positively affected the mean score and skew. The ASI test distribution was more positively skewed than the EI test even though it had only two outliers. This occurred because of having higher lower-end scores. The minimum ASI test score for the distribution was a 33 as opposed to the EI test score minimum of 30. The mean scores for both test score distributions were almost two points higher than their mediums.

The frequency distribution for the AFQT scores (see Figure 4) shows the highest number of students falling into the 11.0-20.0 score range and the 51.0-60.0 score range. The lowest number of students scored in the 91.0-100.00 score range.

Figure 4

Frequency Distribution of ASVAB AFQT Scores



Research Question Two Results

To what extent do SAT and ASVAB composite and subtest scores correlate for high school students from a rural Oregon district?

A Pearson correlation coefficient was computed to assess the linear relationship between SAT, ASVAB, and HSGPA (see Table 6). HSGPA raw scores were used for the second research question. A correlation coefficient of 0.0-0.2 was considered a weak association between the variables; a 0.3-0.7 was considered a medium to strong association between the variables; and a .8-.10 was considered a very strong association between the variables. According to Urdan (2017), these are typically considered acceptable ranges for weak, medium, to strong, and very strong correlations.

The composite test scores all had a very strong association to the test scores that made up the composite with (r >.7), meaning that student tests that measured similar domains procured

similar results. It was also expected that SAT scores and ASVAB test scores with similar aptitudes would show the strongest positive correlation to HSGPA (College Board, 2017).

Medium to strong positive correlations occurred between HSGPA and all the SAT's composite and subtest scores. The SAT math scores association to HSGPA was (r = .652), and the SAT reading scores to HSGPA was (r = 0.574). Medium to strong positive correlations also occurred between the ASVAB's composite and subtest scores that measured similar aptitudes of the SAT subtests. The ASVAB had medium to strong positive correlation between HSGPA and the following subtests: AFQT (r = 0.531), Math Sk. (r = 0.609), AR (r = 0.545), MK (r = 0.593), Verbal Sk. (r = 0.370), WK (r = 0.322), PC (r = 0.354), and S&T Sk. (r = 0.339). However, the strongest test score correlation to HSGPA for this study occurred on the SAT composite (r = 0.652).

The SAT composite and AFQT scores were assumed to have a strong positive correlation to one another because they tested the same or similar aptitudes. There was a very strong positive association between SAT and AFQT scores (r = 0.878) which would indicate that a student who does well on one of the tests would also do well on the other.

Table 6

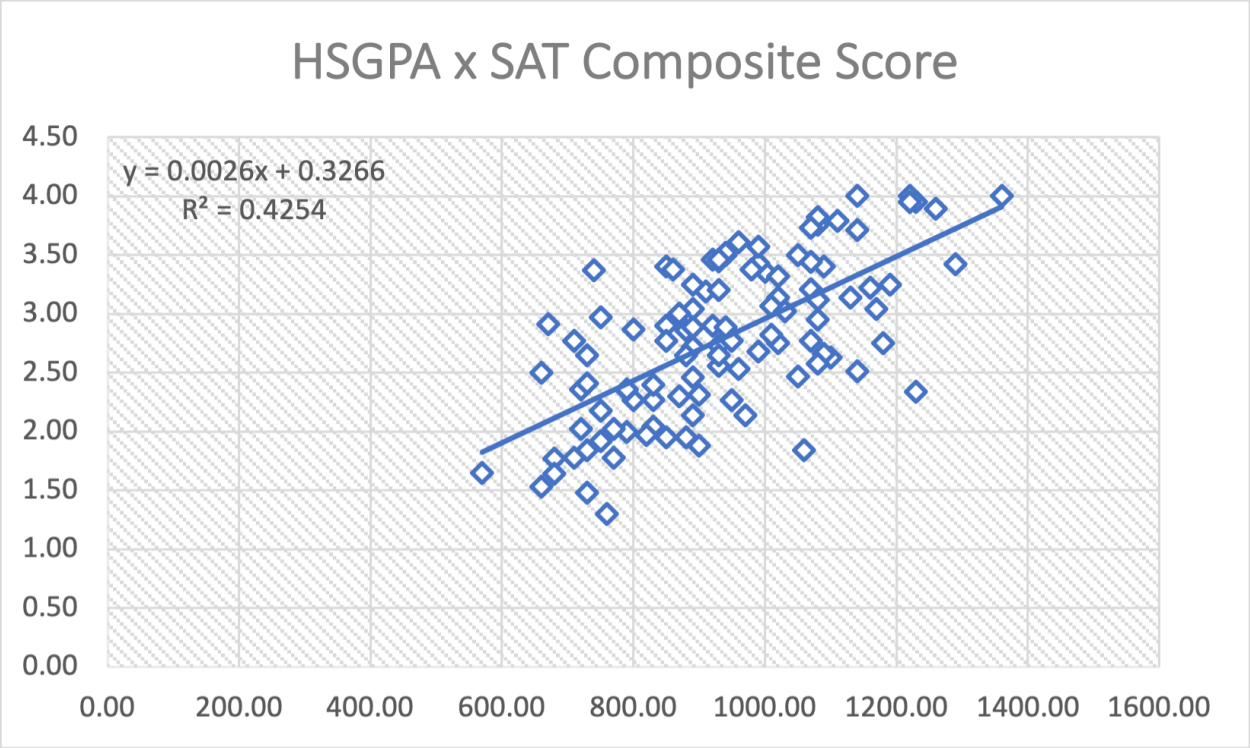
Pearson's r Correlation Coefficients for the SAT, ASVAB, and HSGPA

	HSGPA	*SAT Composite*	*SAT Math*	*SAT Reading*	*ASVAB AFQT*	*Verbal Skills*	*Math Skills*	*S&T Skills*	*GS*	*AR*	*WK*	*PC*	*MK*	*EI*	*ASI*	*MC*
HSGPA	1.000															
SAT Composite	0.652	1.000														
SAT Math	0.652	0.937	1.000													
SAT Reading	0.574	0.941	0.764	1.000												
ASVAB AFQT	0.531	0.878	0.851	0.799	1.000											
Verbal Skills	0.370	0.740	0.673	0.716	0.891	1.000										
Math Skills	0.609	0.854	0.865	0.741	0.916	0.666	1.000									
S&T Skills	0.339	0.649	0.604	0.614	0.693	0.676	0.601	1.000								
GS	0.373	0.620	0.538	0.625	0.674	0.699	0.550	0.858	1.000							
AR	0.545	0.779	0.788	0.676	0.819	0.555	0.929	0.515	0.465	1.000						
WK	0.322	0.714	0.605	0.735	0.827	0.935	0.624	0.652	0.691	0.522	1.000					
PC	0.354	0.605	0.615	0.522	0.774	0.858	0.564	0.546	0.540	0.463	0.626	1.000				
MK	0.593	0.811	0.818	0.707	0.888	0.690	0.930	0.608	0.562	0.732	0.639	0.602	1.000			
EI	0.258	0.542	0.514	0.504	0.566	0.543	0.497	0.868	0.626	0.416	0.543	0.416	0.516	1.000		
ASI	0.151	0.350	0.369	0.289	0.418	0.363	0.397	0.573	0.450	0.348	0.341	0.335	0.400	0.464	1.000	
MC	0.268	0.539	0.521	0.492	0.566	0.522	0.522	0.867	0.628	0.469	0.480	0.453	0.503	0.622	0.548	1.000

Medium to strong positive correlations occurred between students' HSGPA and their SAT composite scores (r = 0.652). The strong association between HSGPA and SAT composite score indicates that the higher a student's HSGPA is the higher a student's test scores are. A scatter plot of the sample's scores and their association with HSGPA can be found in Figure 5.

Figure 5

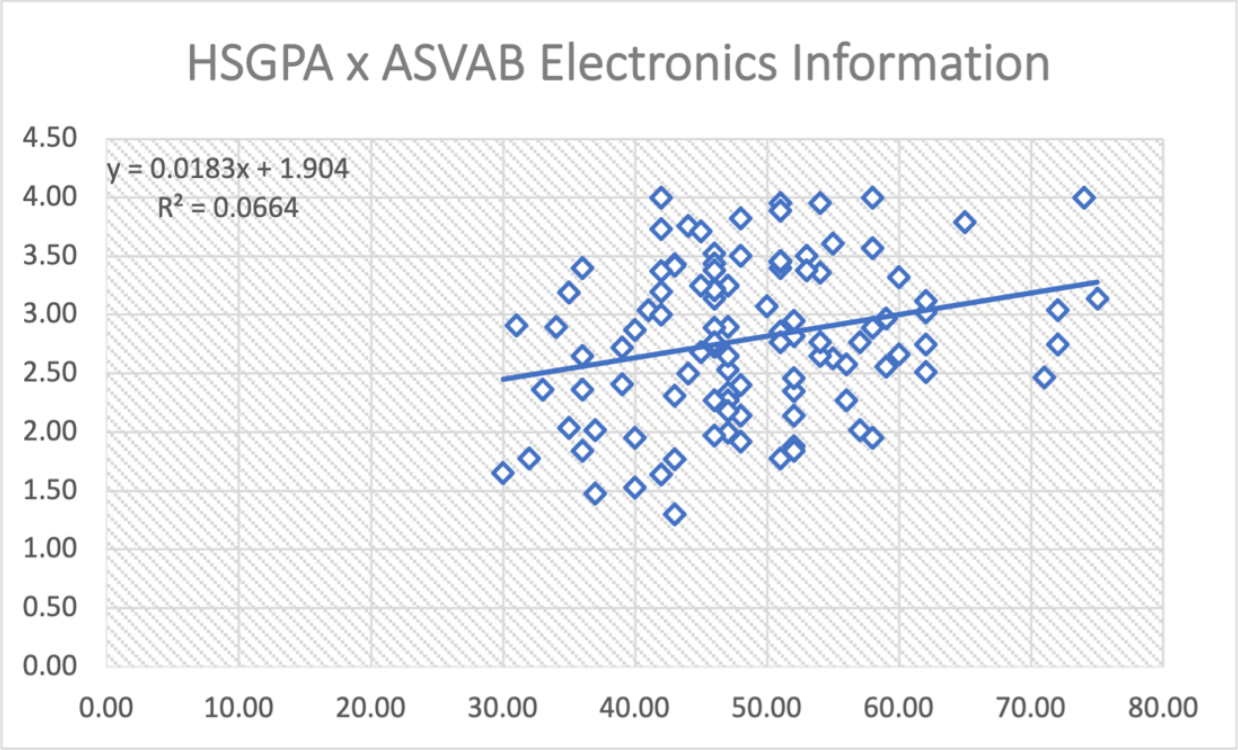
HSGPA x SAT Composite



There were weak positive correlations between HSGPA and the ASVAB's EI subtest scores (r = .258.). This weak association would indicate that HSGPA is not a good indicator of how well a student might do on the EI test. A scatter plot depicts the sample's weak association between EI scores and HSGPA (see Figure 6).

Figure 6

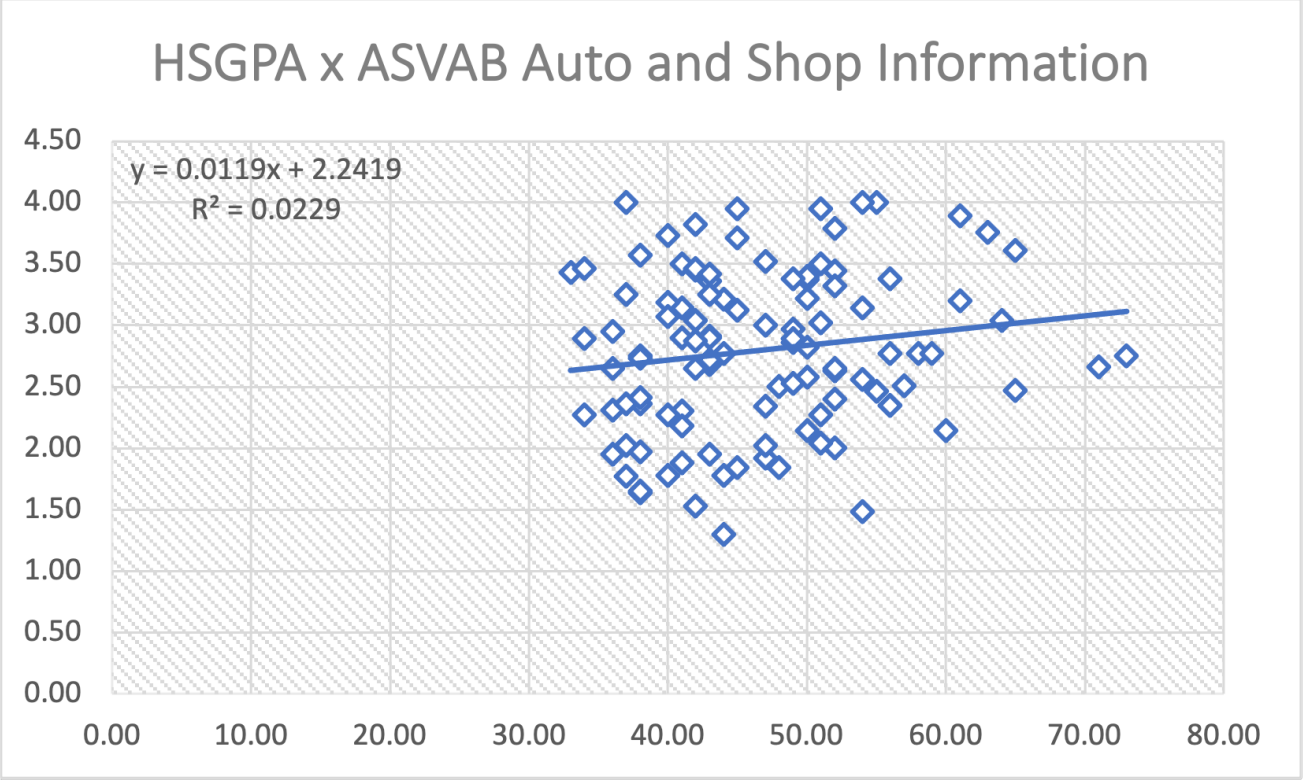
HSGPA x ASVAB Electronics Information Scores



The weakest association between ASVAB subtests and student's raw HSGPA occurred on the ASI subtest ($r = 0.151$). A scatter plot shows the sample's weak association HSGPA and ASI scores (see Figure 7). The two highest scores on the ASI test were from students who both had HSGPAs below a 3.0.

Figure 7

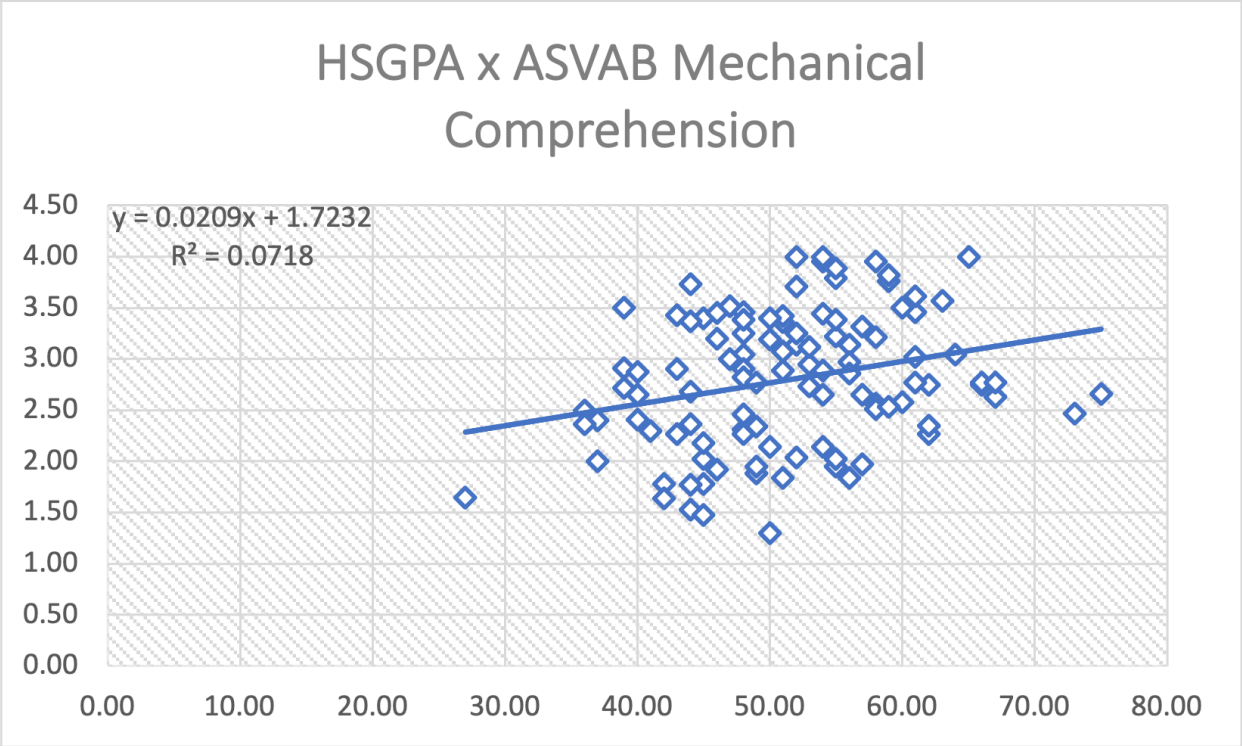
HSGPA x ASVAB Auto and Shop Information Scores



There were weak positive correlations between HSGPA and the ASVAB's MC subtest scores ($r = 0.268$). A scatter plot shows that the sample has a weak association between MC scores and HSGPA (see Figure 8). These subtests with weaker associations to HSGPA are all included in ASVAB's science and technology composite score, with the exception of the ASI score.

Figure 8

HSGPA x ASVAB Mechanical Comprehension



Research Question Three Results

To what extent are SAT and ASVAB composite and subtest scores moderated by gender, race, ethnicity, socio-economic status, and HSGPA for high school students from a rural Oregon district?

Independent samples t-tests assuming equal variance were performed to examine differences between test scores on the SAT and ASVAB for gender (male, female), race, and ethnicity (white, non-white), and socio-economic status. Socio-economic status was determined by student enrollment in the free and reduced lunch program (FRL). There were statistically significant statistical differences found within the t-test results for gender and SES status. When dependent variables for race and ethnicity were examined, no statistically significant differences

were found. HSGPA's influence on test scores were examined again, only this time categorically. To do this a One-Way ANOVA was performed to look for statistically significant differences between each HSGPA category and test scores. A Tukey-Kramer Post-Hoc test was then used to follow up the ANOVA findings.

Gender

An independent samples t-test assuming equal variance was performed to compare test scores on the SAT and ASVAB by gender (see Table 7). A conservative alpha of .01 was used to determine statistical significance. A statistically significant difference was found for gender on the ASVAB's MC test scores between males (M = 54.05, SD = 9.04) and females (M = 48.510, SD = 6.68), p = .0005. A statistically significant difference was also found on the S&T Sk. test scores between males (M = 50.27, SD = 7.66) and females (M =47.35, SD = 8.57), p = .001.

Table 7

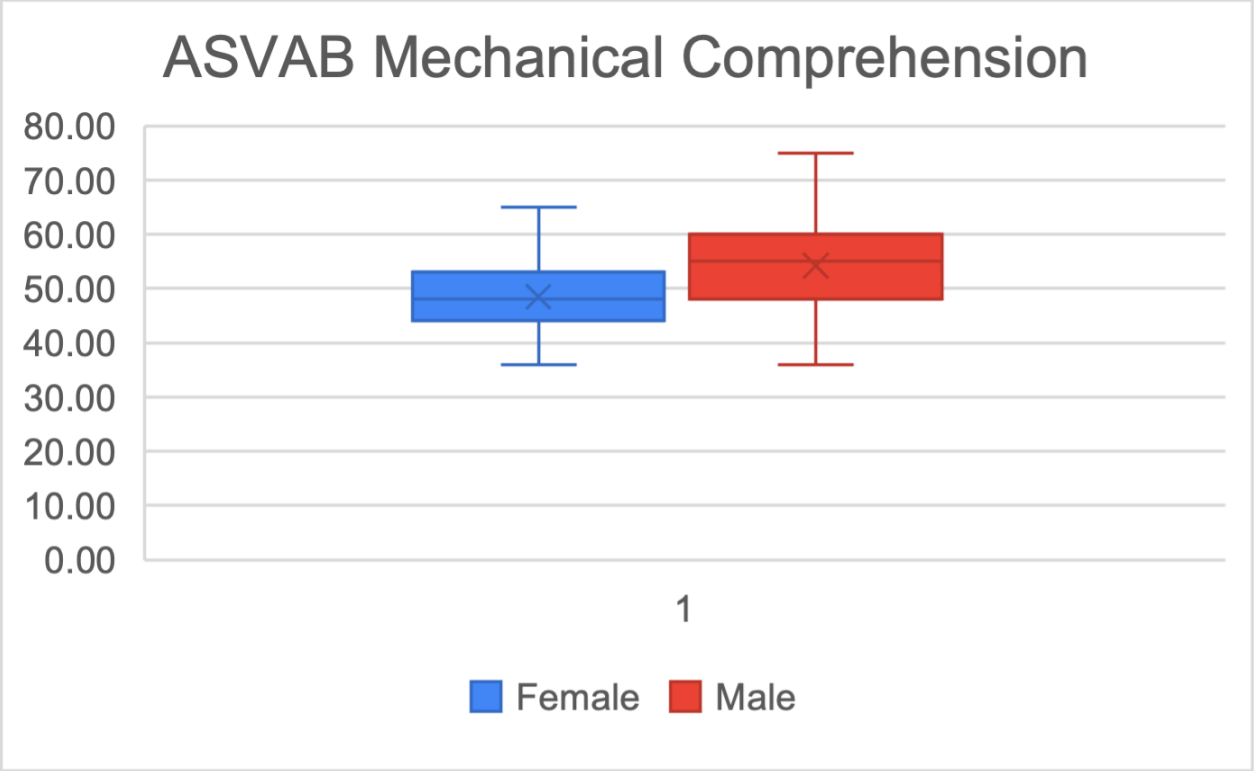
Gender Independent T-tests

	t	df	Sig. 2-Tail	Mean Diff.	Std. Error Diff.	95% Confidence Lower	Upper
SAT							
Composite	-.681	105	.496	21.565	.713	-41.14	84.27
Math	-1.684	105	.095	27.588	1.4	-4.881	60.056
Reading	.351	105	.726	6.022	2.009	-27.969	40.014
ASVAB							
AFQT	-1.673	105	.097	7.942	.126	-9.408	9.408
Verbal Sk.	-.914	105	.362	1.308	.027	-13.494	16.12
Math Sk.	-1.857	105	.066	2.915	.177	-3.112	3.112
S&T Sk.	-3.322	105	.001	5.234	.384	2.110	8.358
GS	-2.362	105	.023	3.776	.153	.530	7.022
AR	-2.284	105	.024	3.406	.098	.450	6.362
WK	-.551	105	.583	.827	.050	-2.151	3.804
PC	-1.195	105	.234	1.702	.090	-1.121	4.525
MK	-1.205	105	.231	2.014	.181	-1.299	5.327
EI	-2.525	105	.013	4.419	.312	.950	7.887
ASI	-4.654	105	9.533	6.897	.321	3.959	9.835
MC	-3.578	105	.0005	5.544	.273	2.471	8.616

The most statistically significant differences between male and female students were found on the ASVAB's MC test. There was a difference between the means of male (M = 54.05, SD = 9.04) and female (M = 48.51, SD = 6.68) standard scores of 5.544 (see Figure 9).

Figure 9

Mechanical Comprehension Scores Compared by Gender



Male students outperformed female students on almost all composite and subtests of the SAT and ASVAB (see Table 8). The only test where females outscored males, was on the SAT reading test with female students on average scoring (M = 487.45, SD = 93.93) and males students on average scoring (M = 481.43, SD = 83.39).

Table 8

Descriptive Statistics for SAT and ASVAB Scores x Gender

Test	Gender	N	Mean	Std. Deviation	Std. Error
SAT					
Composite	Male	56	948.05	164.53	21.99
	Female	51	926.47	162.11	22.70
	Total	107			
Math	Male	56	466.61	91.04	12.17
	Female	51	439.02	76.90	10.77
	Total	107			
Reading	Male	56	481.43	83.39	11.14
	Female	51	487.45	93.93	13.15
	Total	107			
ASVAB					
AFQT	Male	56	46.59	24.62	3.29
	Female	51	38.65	24.39	3.42
	Total	107			
Verbal Sk.	Male	56	52.86	7.64	1.02
	Female	51	51.55	7.10	0.99
	Total	107			
Math Sk.	Male	56	50.27	7.66	1.02
	Female	51	47.35	8.57	1.20
	Total	107			
S&T Sk.	Male	56	53.21	9.50	1.27
	Female	51	47.98	6.32	0.88
	Total	107			
GS	Male	56	53.48	9.14	1.22
	Female	51	49.71	7.63	1.07
	Total	107			
AR	Male	56	51.86	7.53	1.01
	Female	51	48.45	7.89	1.10
	Total	107			
WK	Male	56	52.77	7.76	1.04
	Female	51	51.94	7.76	1.09
	Total	107			
PC	Male	56	52.84	7.82	1.04
	Female	51	51.14	6.81	0.95
	Total	107			
MK	Male	56	48.86	8.18	1.09
	Female	51	46.84	9.10	1.27
	Total	107			
EI	Male	56	50.93	10.22	1.37
	Female	51	46.51	7.52	1.05
	Total	107			
ASI	Male	56	50.05	8.82	1.18
	Female	51	43.16	6.12	0.86
	Total	107			
MC	Male	56	54.05	9.04	1.21
	Female	51	48.51	6.68	0.94
	Total	107			

Race and Ethnicity

An independent samples t-test assuming equal variance was performed to compare test scores on the SAT and ASVAB by race and ethnicity (see Table 9). A conservative alpha of .01 was used to determine statistical significance. No statistically significant differences occurred for any of the SAT or ASVAB's composite or subtest scores between white and non-white students.

Table 9

Race/Ethnicity Independent T-tests

	t	df	Sig. 2-Tail	Mean Diff.	Std. Error Diff.	95% Confidence Lower	Upper
SAT							
Composite	.971	105	.333	31.029	1.162	-32.27	94.327
Math	1.069	105	.287	17.857	.75	-15.255	50.968
Reading	.761	105	.448	13.172	.077	-21.145	47.489
ASVAB							
AFQT	.784	105	.434	3.803	.256	-5.813	13.42
Verbal Sk.	.014	105	.989	.02	.043	-2.860	2.899
Math Sk.	1.453	105	.149	2.322	.155	-.846	5.489
S&T Sk.	.100	105	.920	.168	.32	-3.154	3.490
GS	.332	105	.740	.564	.465	-2.801	3.928
AR	1.415	105	.159	2.167	.174	-.868	5.203
WK	.247	105	.804	.377	.054	-2.639	3.392
PC	-.496	105	.621	.719	.093	-2.154	3.591
MK	1.25	105	.211	2.124	.104	-1.227	5.474
EI	-.168	105	.866	.306	.282	-3.307	3.920
ASI	.524	105	.601	.862	.107	-2.398	4.123
MC	.150	105	.880	.25	.330	-3.043	3.541

White students had a higher mean average than non-white students on all sections of the SAT (see table 10). The composite score for white students on the SAT had a mean average of (M = 950.51, SD = 176.36) and non-white students had a mean average of (M = 919.78, SD = 142.45). There was very little difference between white and non-white student test scores on the ASVAB. The largest difference between mean scores was the AFQT score with white students having a mean average (M = 44.40, SD = 25.61) and non-white students having a mean average of (M = 40.60, SD = 23.54).

Table 10

Descriptive Statistics for the SAT and ASVAB x Race, and Ethnicity

Test	Race/Ethnicity	N	Mean	Std. Deviation	Std.Error
SAT					
Composite	White	62	950.81	176.36	22.40
	Non-white	45	919.78	142.45	21.24
	Total	107			
Math	White	62	469.97	92,62	11.76
	Non-white	45	443.11	73.88	11.01
	Total	107			
Reading	White	62	489.84	93.73	11.90
	Non-white	45	476.67	80.37	11.98
	Total	107			
ASVAB					
AFQT	White	62	44.40	25.61	3.25
	Non-white	45	40.60	23.54	3.51
	Total	107			
Verbal Sk.	White	62	52.24	7.76	0.99
	Non-white	45	52.22	6.90	1.03
	Total	107			
Math Sk.	White	62	49.85	8.23	1.05
	Non-white	45	47.53	8.05	1.20
	Total	107			
S&T Sk.	White	62	50.79	8.15	1.04
	Non-white	45	50.62	9.09	1.35
	Total	107			
GS	White	62	51.92	7.78	0.99
	Non-white	45	51.36	9.75	1.45
	Total	107			
AR	White	62	51.15	7.81	0.99
	Non-white	45	48.98	7.82	1.17
	Total	107			
WK	White	62	52.53	8.11	1.03
	Non-white	45	52.16	7.27	1.08
	Total	107			
PC	White	62	51.73	8.11	1.03
	Non-white	45	52.44	6.28	0.94
	Total	107			
MK	White	62	48.79	8.88	1.13
	Non-white	45	46.67	8.27	1.23
	Total	107			
EI	White	62	48.69	9.07	1.15
	Non-white	45	49.00	9.62	1.43
	Total	107			
ASI	White	62	47.13	8.63	1.10
	Non-white	45	46.27	8.07	1.20
	Total	107			
MC	White	62	51.27	8.03	1.02
	Non-white	45	51.27	9.06	1.35
	Total	107			

Socio-Economic Status

An independent samples t-test assuming equal variance was performed to compare test scores for socio-economic status (see Table 11). Enrollment in the FRL program determined SES status. A conservative alpha of .01 was used to determine statistical significance. All other t-test results can be found in Table 11.

Table 11

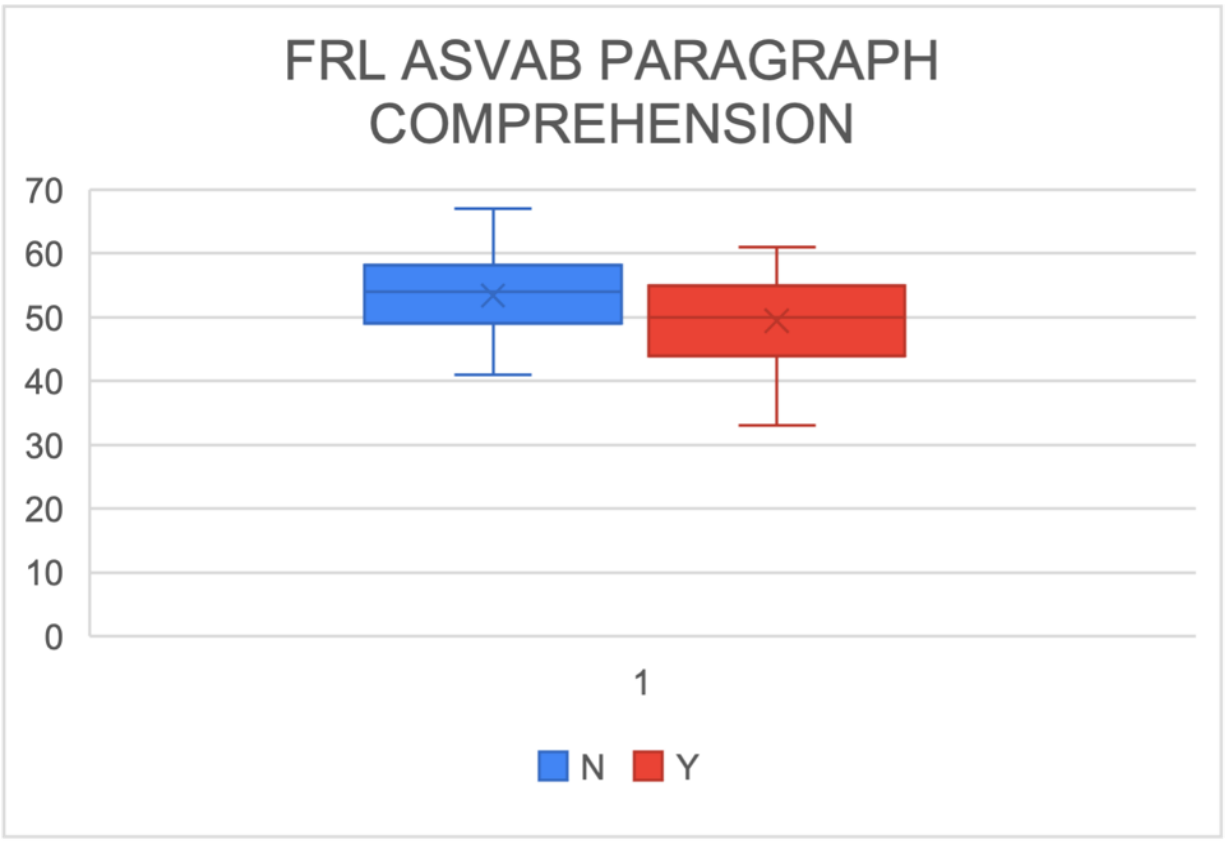
FRL Enrollment Independent T-tests

	t	df	Sig. 2-Tail	Mean Diff.	Std. Error Diff.	95% Confidence Lower	Upper
SAT							
Composite	1.824	105	.070	59.78	3.161	-5.19	124.75
Math	2.226	105	.028	37.923	2.120	4.158	71.688
Reading	1.222	105	.224	21.857	1.724	-13.607	57.321
ASVAB							
AFQT	2.562	105	.012	12.548	.630	2.837	22.259
Verbal Sk.	2.441	105	.016	3.580	.338	3.579	6.487
Math Sk.	2.420	105	.017	3.946	.340	.714	7.178
S&T Sk.	-.056	105	.955	.098	.445	-3.350	3.546
GS	.005	105	.995	.010	.629	-3.484	3.504
AR	2.397	105	.018	3.745	.231	.648	6.842
WK	1.911	105	.058	2.968	.334	-.110	6.045
PC	2.697	105	.008	3.926	.273	1.04	6.813
MK	2.105	105	.037	3.644	.411	.212	7.075
EI	-.099	105	.920	.189	.475	-11.744	12.122
ASI	1.102	105	.272	1.874	.468	-1.495	5.243
MC	-.186	105	.852	.322	.314	-3.095	3.738

A statistically significant difference was found when SES was the moderator, on the ASVAB's paragraph comprehension test (see Figure 10). The statistically significant difference was found between students who were not enrolled in FRL (M = 53.39, SD = 7.27) and students who were enrolled (M = 49.46, SD = 6.95), p = .008.

Figure 10

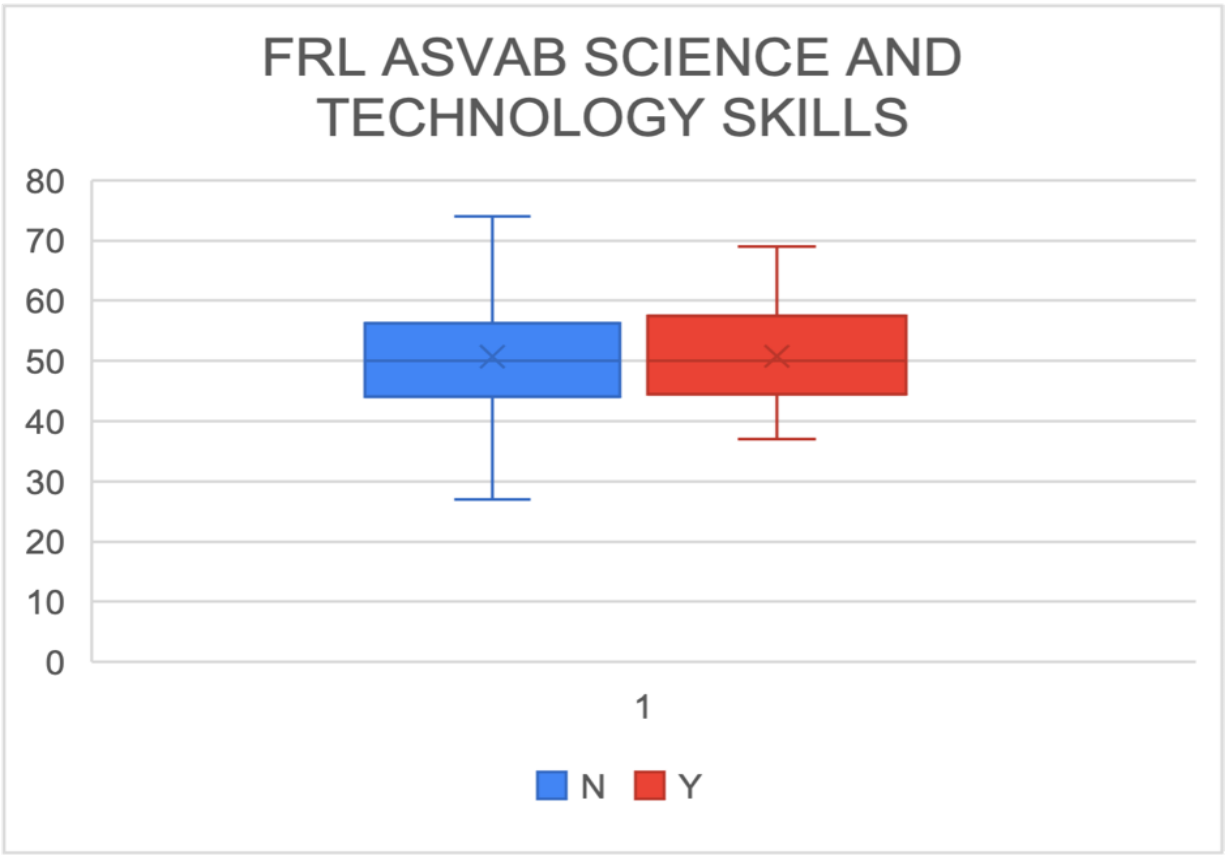
ASVAB Paragraph Comprehension Scores Compared by SES



FRL mean scores were lower in the domains of reading and mathematics. However, this was not true of the S&T Sk. scores. There was a mean difference of only .098 on S&T Sk. for students who were enrolled in FRL and those who were not enrolled in the FRL. The students who were enrolled in the FRL program had a slightly higher mean score on the ASVAB's S&T Sk. composite score than students who were not enrolled (see Figure 11).

Figure 11

ASVAB S&T Skills Differences by SES



There were differences in the mean test score averages for both tests that measured reading and mathematics (see Table 12). One of the largest differences was on the SAT composite score. Students enrolled in the FRL program had a mean average of (M= 898.65, SD = 142.83) and students who were not enrolled in the FRL program had a mean average of (M = 958.43, SD = 170.01).

Table 12

Descriptive Statistics for the SAT and ASVAB x SES

Test	FRL Status	N	Mean	Std. Deviation	Std. Error
SAT					
Composite	Enrolled	37	898.65	142.83	23.48
	Not Enrolled	70	958.43	170.01	20.32
	Total	107			
Math	Enrolled	37	428.65	76.42	12.56
	Not Enrolled	70	466.57	87.38	10.44
	Total	107			
Reading	Enrolled	37	470.00	77.96	12.82
	Not Enrolled	70	491.86	92.80	11.09
	Total	107			
ASVAB					
AFQT	Enrolled	37	34.59	22.07	3.63
	Not Enrolled	70	47.14	25.09	3.00
	Total	107			
Verbal Sk.	Enrolled	37	49.89	7.28	1.20
	Not Enrolled	70	53.47	7.18	0.86
	Total	107			
Math Sk.	Enrolled	37	46.30	7.93	1.30
	Not Enrolled	70	50.24	8.06	0.96
	Total	107			
S&T Sk.	Enrolled	37	50.78	8.82	1.45
	Not Enrolled	70	50.69	8.41	1.01
	Total	107			
GS	Enrolled	37	51.68	9.70	1.59
	Not Enrolled	70	51.69	8.08	0.97
	Total	107			
AR	Enrolled	37	47.78	7.18	1.18
	Not Enrolled	70	51.52	7.94	0.95
	Total	107			
WK	Enrolled	37	50.43	7.60	1.25
	Not Enrolled	70	53.40	7.66	0.92
	Total	107			
PC	Enrolled	37	49.46	6.95	1.14
	Not Enrolled	70	53.39	7.27	0.87
	Total	107			
MK	Enrolled	37	45.51	8.64	1.42
	Not Enrolled	70	49.16	8.45	1.01
	Total	107			
EI	Enrolled	37	48.95	9.56	1.57
	Not Enrolled	70	48.76	9.17	1.10
	Total	107			
ASI	Enrolled	37	45.54	8.76	1.44
	Not Enrolled	70	47.41	8.14	0.97
	Total	107			
MC	Enrolled	37	51.62	8.18	1.35
	Not Enrolled	70	51.30	8.63	1.03
	Total	107			

High School Grade Point Average

A one-way ANOVA was performed to compare the effect of HSGPA on student SAT and ASVAB test scores (see Table 13). It was assumed that HSGPA would yield statistically significant test scores on the SAT, ASVAB AFQT, and ASVAB subtests that tested academic domains. A one-way ANOVA revealed that there were not statistically significant differences between these aptitude test scores and HSGPA. There were statistically significant differences on the science and technology skills score; this was between at least two groups ($F(5,101) = 3.236$, $p = .009$). There were statistically significant differences on the ASVAB general science test. This was between at least two groups ($F(5,101) = 3.467$, $p = .006$). There were statistically significant differences on the scores for ASVAB paragraph comprehension. This was between at least two groups ($F(5,101) = 4.026$, $p = .002$).

Table 13

One-Way ANOVA Test for HSGPA x SAT and ASVAB Scores

		Sum of Squares	df	Mean Square	F	Sig.
SAT						
Composite	Between Groups	1156154.365	5	231230.873	14.076	1.943
	Within Groups	1659107.317	101	16426.805		
	Total	2815261.682	106			
Math	Between Groups	319730.927	5	63946.185	14.286	1.446
	Within Groups	452089.634	101	4476.135		
	Total	771820.561	106			
Reading	Between Groups	263435.798	5	52687.16	9.482	1.948
	Within Groups	561186.632	101	5556.303		
	Total	824622.430	106			
ASVAB						
AFQT	Between Groups	17906.649	5	3581.330	7.717	3.514
	Within Groups	46870.230	101	464.062		
	Total	64776.879	106			
Verbal Sk.	Between Groups	792.371	5	158.474	3.212	.010
	Within Groups	4982.788	101	49.335		
	Total	5775.159	106			
Math Sk.	Between Groups	2596.930	5	519.386	11.574	7.533
	Within Groups	4532.491	101	44.876		
	Total	7129.421	106			
S&T Sk.	Between Groups	1061.486	5	212.297	3.236	.009
	Within Groups	6626.103	101	65.605		
	Total	7687.589	106			
GS	Between Groups	1155.920	5	231.184	3.467	.006
	Within Groups	6735.276	101	66.686		
	Total	7891.196	106			
AR	Between Groups	1837.223	5	367.445	7.893	2.619
	Within Groups	4701.936	101	46.554		
	Total	6539.159	106			
WK	Between Groups	612.333	5	122.467	2.161	.064
	Within Groups	5724.714	101	56.680		
	Total	6337.047	106			
PC	Between Groups	957.097	5	191.419	4.026	.002
	Within Groups	4801.819	101	47.543		
	Total	5758.916	106			
MK	Between Groups	2866.436	5	573.287	11.426	9.418
	Within Groups	5067.433	101	50.173		
	Total	7933.869	106			
EI	Between Groups	806.483	5	161.297	1.964	.090
	Within Groups	8291.143	101	82.091		

		Sum of Squares	df	Mean Square	F	Sig.
	Total	9097.626	106			
ASI	Between Groups	559.101	5	111.820	1.645	.155
	Within Groups	6864.058	101	67.961		
	Total	7423.159	106			
MC	Between Groups	841.643	5	168.329	2.534	.033
	Within Groups	6708.263	101	66.418		
	Total	7549.906	106			

A post-hoc test was then conducted for the science and technology skills score, general science test score, and paragraph comprehension test scores because they were determined to have a statistically significant difference between groups ($p < .01$). Since each group's sample was had an unequal number of scores in each category, a Tukey-Kramer post-hoc test was conducted (see Table 14). The results of the Tukey-Kramer post-hoc test found a statistically significant difference between groups for the ASVAB's paragraph comprehension test between students who had a 2.0-2.49 grade point average and students who had a 3.5-4.0 grade point averages ($p = .001$).

Table 14

Tukey-Kramer Results for HSGPA x ASVAB: S&T Skills, GS, and PC

	Comparison	Mean Diff.	Std. Error	Sig.
S&T Sk.				
1.0-1.49	1.5-1.99	-2.346	4.350	.999
	2.0-2.49	-5.800	4.248	.982
	2.5-2.99	-9.741	4.187	.571
	3.0-3.49	-9.463	4.197	.604
	3.5-4.0	-12.188	4.296	.346
1.5-1.99	1.0-1.49	2.346	4.350	.999
	2.0-2.49	-3.454	2.040	.837
	2.5-2.99	-7.395	1.912	.077
	3.0-3.49	-7.117	1.933	.106
	3.5-4.0	-9.842	2.139	.019
2.0-2.49	1.0-1.49	5.800	4.350	.982
	1.5-1.99	3.454	2.040	.837
	2.5-2.99	-3.941	1.665	.551
	3.0-3.49	-3.663	1.690	.644
	3.5-4.0	-6.388	1.921	.184
2.5-2.99	1.0-1.49	9.741	4.187	.571
	1.5-1.99	7.395	1.912	.077
	2.0-2.49	3.941	1.665	.551
	3.0-3.49	.278	1.532	.999
	3.5-4.0	-2.447	1.784	.927
3.0-3.49	1.0-1.49	9.463	4.197	.604
	1.5-1.99	7.117	1.933	.106
	2.0-2.49	3.663	1.690	.644
	2.5-2.99	-.278	1.532	.999
	3.5-4.0	-2.725	1.807	.894
3.5-4.0	1.0-1.49	12.188	4.296	.346
	1.5-1.99	9.842	2.139	.019
	2.0-2.49	6.388	1.921	.184
	2.5-2.99	2.447	1.784	.927
	3.0-3.49	2.725	1.807	.894
ASVAB GS				
1.0-1.49	1.5.1.99	-3.769	19.236	.999
	2.0-2.49	-7.750	18.339	1.000
	2.5-2.99	-9.655	17.821	.999
	3.0-3.49	-12.444	17.906	.996
	3.5-4.0	-13.500	18.755	.996
1.5-1.99	1.0-1.49	3.769	19.236	.999
	2.0-2.49	-3.981	4.232	.985
	2.5-2.99	-5.886	3.715	.872
	3.0-3.49	-8.675	3.800	.591

	Comparison	Mean Diff.	Std. Error	Sig.
	3.5-4.0	-9.731	4.649	.678
2.0-2.49	1.0-1.49	7.750	2.817	1.000
	1.5-1.99	3.981	4.232	.985
	2.5-2.99	-1.905	2.817	.997
	3.0-3.49	-4.694	2.902	.862
	3.5-4.0	-5.750	3.751	.887
2.5-2.99	1.0-1.49	9.655	17.821	.999
	1.5-1.99	5.886	3.715	.872
	2.0-2.49	1.905	2.817	.997
	3.0-3.49	-2.789	2.902	.962
	3.5-4.0	-3.845	3.234	.959
3.0-3.49	1.0-1.49	12.444	17.906	.996
	1.5-1.99	8.675	3.800	.591
	2.0-2.49	4.694	2.902	.862
	2.5-2.99	2.789	2.385	.962
	3.5-4.0	-1.056	3.319	.999
3.5-4.0	1.0-1.49	13.500	18.755	.996
	1.5-1.99	9.731	4.649	.678
	2.0-2.49	5.750	3.751	.887
	2.5-2.99	3.845	3.234	.959
	3.0-3.49	1.056	3.319	.999
ASVAB PC				
1.0-1.49	1.5-1.99	2.423	3.703	.997
	2.0-2.49	3.750	3.616	.977
	2.5-2.99	-1.397	3.564	1.000
	3.0-3.49	-1.093	3.573	1.000
	3.5-4.0	-5.813	3.657	.870
1.5-1.99	1.0-1.49	-2.423	3.703	.997
	2.0-2.49	1.327	1.737	.994
	2.5-2.99	-3.820	1.627	.561
	3.0-3.49	-3.516	1.646	.658
	3.5-4.0	-8.236	1.821	.022
2.0-2.49	1.0-1.49	-3.750	3.616	.977
	1.5-1.99	-1.327	1.737	.994
	2.5-2.99	-5.147	1.417	.115
	3.0-3.49	-4.843	1.438	.173
	3.5-4.0	-9.563	1.635	.001
2.5-2.99	1.0-1.49	1.397	3.564	1.000
	1.5-1.99	3.820	1.627	.561
	2.0-2.49	5.147	1.417	.115
	3.0-3.49	.304	1.304	1.000
	3.5-4.0	-4.416	1.518	.319
3.0-3.49	1.0-1.49	1.093	3.573	1.00
	1.5-1.99	3.516	1.646	.658
	2.0-2.49	4.843	1.438	.173

	Comparison	Mean Diff.	Std. Error	Sig.
	2.5-2.99	-.304	1.304	1.000
	3.5-4.0	-4.720	1.538	.261
3.5-4.0	1.0-1.49	5.813	3.657	.870
	1.5-1.99	8.236	1.821	.022
	2.0-2.49	9.563	1.635	.001
	2.5-2.99	4.416	1.518	.319
	3.0-3.49	4.720	1.538	.261

Summary

This chapter of the study described the findings of each statistical test in order to examine the Chinook Harbor School District's student test scores on the SAT and ASVAB. First, an exploratory data analysis using Tukey's 5-point EDA was conducted on the SAT and ASVAB test scores for 11th graders during two academic school years. Second, correlations were done to examine the composite and subtest scores correlations, HSGPA correlations to test scores, and correlations between similar and different student aptitude scores. Finally, scores were examined when moderated by gender, race, ethnicity, SES, and HSGPA.

The results and findings in this chapter will be further discussed in Chapter Five. First, the correlations found between the SAT and ASVAB test scores and HSGPA will be discussed. Specifically, the weaker correlations between HSGPA and the ASVAB's test scores for science and technical skills, general science, electronics information, auto and shop information, and mechanical comprehension will be focused on and discussed. Second, I will discuss the statistically significant difference that occurred between male and female test scores for the ASVAB's science and technical skills and mechanical comprehension scores, the lack of statistically significant differences between white and non-white students, and the differences in test scores for SES as a moderator. Finally, Chapter Five will discuss the limitations and proposed next steps of the study.

Chapter 5: Discussion and Conclusions

This study aimed to determine how one rural high school in the Pacific Northwest performed on the SAT and ASVAB tests. The study sought to explore student test score distributions and central tendencies; determine associations between composite scores, subtests scores, and high school grade point average; and determine if gender, race and ethnicity, SES, and HSGPA moderated test scores. This chapter will include a discussion of the findings of the study, practical implications for the study, limitations of the study, and suggestions for future research. This study originated from my desire to better understand how rural students performed comparatively on the SAT and ASVAB, since many students in my experience have self-reported struggling on the SAT, while at the same time doing well on some of the aptitude subtests of the ASVAB.

During the 2018-2019 and 2019-2020 school years, there was a push by the administration and counseling department of Chinook Harbor High School to require all 11th grade students to take the SAT free of charge. The hope of the administration and counselors was that more students would in turn apply to college, since the rural school district typically does not have a high percentage of students going on to a post-secondary education. The community of Chinook Harbor does not place the same value on a college education as the Chinook Harbor School District does, and these conflicting values often leave administrators, counselors, and teachers at a loss for how to help many of its capable students obtain a higher education. I have personally watched many students who have the potential to be successful in post-secondary education opt to stay and work entry-level jobs in the community. Many of the jobs that students are choosing do not lead to careers and are typically low-paying. The High School counseling

department and administration have been frustrated by the district's inability to move more students into post-secondary education, internships, or training programs.

This study's results could provide the administration and counseling department with insight into how its students do on both the SAT and ASVAB. The results could also help the district's leadership recognize where students' occupational and educational potential lies. In turn, the counseling department and, moreover, the district might be able to better assist students in developing post-secondary education and career plans. Finally, the data from this study could aid in developing classes, career pathways, and internships that align with students' post-secondary plans.

Discussion of Findings

There were three research questions in this study. These questions aimed at a better understanding of how the district's 11th grade students performed on the SAT and ASVAB and how the SAT and ASVAB correlated to one another and to HSGPA. Finally, the study sought to determine if gender, race, and ethnicity, SES, and HSGPA moderated test scores.

Research Question One

What were the distributions of composite and subtest SAT and ASVAB scores for high school students from a rural Oregon district?

The first question provided data that would lead to an understanding of the distributions of 11th grade student test scores on the SAT and ASVAB. The lowest median test scores in the study were on the mathematics portions of both the SAT and ASVAB: SAT Math (*Mdn* = 440) and Math Sk. (*Mdn* = 66). These tests scores were consistent with the low number of students demonstrating grade-level proficiency that the Oregon Department of Education reported. The Oregon Department of Education reported that the district fell into the Level 1, low achievement,

category for mathematics, with less than 21 percent of students passing their mathematics state test (Oregon Department of Education, 2019). The study also found that the district's SAT reading (*Mdn = 480)* and ASVAB verbal skills (*Mdn = 33)* scores for the SAT and ASVAB tests were higher than the mathematics scores. These findings were consistent with the department of education reporting that the three-year average for English Language Arts scores fell into the state's Level 3 average category, with around 54 percent of students passing the English Language Arts Test (Oregon Department of Education, 2019). The low mathematics scores are not surprising. The district has been plagued with math teacher turnover, and the K-12 math curriculum has changed twice in eight years. The district has credited the instability of the math department and changing math curriculums as the primary reason for its students' poor performance on standardized math tests.

Mathematics and English Language Arts tests are the only state tests given to Chinook Harbor High School students. However, the district plans to administer the state's general science test in the upcoming 2022-23 school year. This is a logical decision by the district based on the findings of this study, and the conclusions of Kassam et al. (2016), who noted the unique predisposition that students growing up in rural America have for understanding science. The students in the rural district of Chinook Harbor may fit into Kassam et al.'s assessment of rural students, because some of the district's highest overall subtest score averages occurred on the ASVAB's general science (GS) subtest, with a mean score of 51.68. The district's students also scored well on the ASVAB's mechanical comprehension subtest with a mean score of 51.41. The study found the mean score for the GS subtest to be even higher for male students when scores were compared by gender. The discussion in research question three will address this in further detail.

Research Question Two

To what extent did SAT and ASVAB composite and subtest scores correlate for high school students from a rural Oregon district?

The Pearson r correlation test results yielded positive associations between tests that measured similar aptitudes. For example, math and reading scores on the SAT correlated strongly to the ASVAB's tests that measured the same or similar learning domains. The association was very evident in the results correlating the SAT composite scores and ASVAB AFQT scores with a strong association of $r = 0.878$. However, the AFQT to HSGPA association was slightly more moderate than the SAT's composite score to HSGPA with an association of r = 0.531, and the SAT's composite score to HSGPA with an association of $r = 0.652$, indicating that students' grade point averages are predictive of both the SAT and AFQT scores when raw scores for HSGPA are used.

All the ASVAB subtests testing science and technical knowledge and skills showed weaker associations to HSGPA than those measuring the domains of reading, writing, and mathematics. The weak associations between the EI, MC, and ASI test scores to HSGPA is one of the study's most interesting findings. These findings are notable because Chinook Harbor High School, during its 2018-2019 and 2019-2020 school year, did not offer an automotive repair, shop, or welding career pathway for the cohorts of this study. Furthermore, the district had a limited number of welding, robotics, and construction classes available to students. If students had been learning these skills at school, the skills and knowledge needed for student achievement on these tests would have been acquired in a limited number of available classes. Therefore, the students' success on these ASVAB subtests is most likely the result of learning outside of school. The knowledge and skills needed to do well in the science and technical

domain had a moderate positive association (r = 0.339*)*. Therefore, it would be likely that a student who had an average or low HSGPA might still score high on the science and technology domain tests of the ASVAB, or students with a higher HSPGA might not score as high on these tests. The knowledge and skills that students are learning outside of the classroom are what Pappano (2017) refers to as the untapped potential of rural America's students that isn't being recognized or utilized.

Research Question Three

To what extent are SAT and ASVAB composite and subtest scores moderated by gender, race and ethnicity, socio-economic status, and HSGPA for high school students from a rural Oregon district?

The larger body of research on how gender moderates test scores, specifically in reading and mathematics, points toward a difference in test scores by gender and learning domain. Higher reading scores are typically associated with female students (Lubienski et al., 2013), and higher mathematics scores are often associated with male students (Beekman & Ober, 2015). The results from this study were similar. Males outscored females on the SAT and ASVAB's mathematics-associated tests. However, Lubienski et al.'s conclusion that females scored higher on reading tests was not entirely consistent with the Chinook Harbor District. For the two cohorts of this study, females did have a higher mean score on the SAT reading tests but did not have higher scores on any of the ASVAB's reading or verbal skills tests. This study found the most significant test score differences between the two genders on the ASVAB's S&T Skills composite scores and MC scores.

Research on gender and test scores provides several possible explanations for male students' higher scores on S&T Skills and MC. Most notable is Gender Role Socialization

Theory (Bourdieus, 1977; Robinson & Lubienski, 2011). From a young age, male students in the community often talk about working with tools to fix cars and motorized vehicles and about running equipment such as tractors and chainsaws. While some females in the community report similar experiences, it is far less likely. Lack of female interest in the industrial arts was also confirmed when the Oregon Department of Education noted an unequal balance of males to females in industrial arts and Career and Technical Education classes (Chinook Harbor Counseling Department, 2021). As a result, finding ways to enroll more female students into these classes has been the targeted goal of the district and current administration. This study found a statistically significant difference between males and females on the ASVAB's MC test, with male standard scores (M = 54.05, SD = 9.04) averaging almost six points higher than female standard scores (M = 48.51, SD = 6.68.), p = .0005. A statistically significant difference was also found on the S&T Skills composite score. Since the MC test is part of the S&T composite score, it would have contributed to the S&T scores statistically significant finding between males (M = 50.27, SD = 7.66) and females (M =47.35, SD = 8.57), p = .001. The other two tests that make up the S&T score, GS and EI, were not found to have statistically significant differences in the test scores of males and females.

Surprisingly, test score differences were not found on any of the SAT or ASVAB tests when race and ethnicity were considered. This study's finding is not consistent with Jensen's (1998) or Rushton and Jensen's (2004) studies that reported non-white students having lower tests scores than white students. One group that may need to be examined more among minority students is the subset of students participating in an English Language Learners (ELL) program. Theoretically, these students would have been included in the sample of non-white students, but

how well this sub-population of students did on the SAT and ASVAB was not determined in this study.

Students' socio-economic statuses yielded both expected and unexpected results. According to Burchinal et al. (2018), students from low socio-economic backgrounds tend to score lower in reading and mathematics, and poverty plays a prominent role in developing a student's readiness to learn. This study was consistent with these findings, as there were test score differences between students enrolled in the FRL program and those who were not. The test score differences were most prevalent for SES on the paragraph comprehension test. There was a statistically significant difference between students not enrolled in FRL ($M = 53.39$, $SD = 7.27$) and students who were enrolled in FRL ($M = 49.46$, $SD = 6.95$), $p = .008$ on the ASVAB's paragraph comprehension test. These test scores indicated that students who were enrolled in the FRL program did much worse than their peers who were not enrolled in the FRL program. Students who were not enrolled in the FRL had a higher mean score average on almost every composite and subtest. However, this was not true for the S&T Skills composite score.

This study found that students from lower-socio-economic backgrounds scored slightly higher than students who were not enrolled in the FRL program for the S&T Skills composite score. This phenomenon is also consistent with Kassam et al. (2016), who notes that, to be effective, education in indigenous, rural, and otherwise "must be embedded in the habitat of the children" (p.98). General Science scores on the ASVAB for all groups of students were already mentioned above as a strength for the district, and the ASVAB's GS scores are also part of the tests that make up the S&T composite score. This study simply sought to examine test scores for one rural district, and it did not seek to find answers as to why students tested higher on specific aptitude tests. However, given the statistically significant findings of research question one and

three – which reveal students in the district doing well on S&T Skills, especially if the student were male or from a lower socioeconomic background – these discrepancies between tests might be an area that should be studied further.

Limitations and Suggested Future Research

This study presented several opportunities for further research. While the study had practical implications for the Chinook Harbor School District, its sample size was small and only composed of two cohorts of students. Having a small sample size may compromise the study's broader applications for the district. If generalizations are to be made from the study, the statistical analysis should include a larger sample size, and additional studies across more cohorts should confirm its findings. Furthermore, each research question provided several other considerations for future research.

One suggestion that should be considered for future research would be to find ways to increase the study's sample size. Increasing the study's sample size could be done by including additional school districts in the Pacific Northwest, or it could be done by including other school districts nationwide that share similar demographics and characteristics to those of the Chinook Harbor district. Including more districts would allow for a larger sample size and would help to generalize the study. To increase the sample size for a similar study of Chinook Harbor, a study could examine students' ASVAB scores only. The ASVAB has been administered to all Chinook Harbor High School students for over two decades, so these test results could provide a historical understanding of any long-term patterns and trends the district may have within its student population. It would also help eliminate any significant events that may have impacted a single cohort.

The second research question found strong associations between HSGPA and the SAT's composite and ASVAB AFQT scores. One limitation to a better understanding of how HSGPA may have been associated with test scores was that students were given the option to either take the ASVAB or retake the PSAT, which potentially removed some of the highest achieving students from the study. This issue may be part of the reason that the results for the ANOVA and Post-Hoc tests on HSGPA for research question three yielded few statistically significant differences between HSGPA categories and test scores. Since the highest achieving students were removed, associations to HSGPA and test scores may have been weakened when the Pearson's r correlation was computed for SAT and AFQT scores. Furthermore, since the sample size for this study was small, adding a handful of higher achieving students may have caused the results between HSGPA bands to yield more statistical differences, specifically for test scores between students who had a 3.5-4.0 and 1.5-1.99.

There were a few limitations related to the student populations for research question three. First, students self-reported gender to the district as male and female only, without an option to choose non-binary. This reporting was consistent with how the State Department of Education reported gender for the 2018-19 and 2010-20 school years, and how the College Board and Department of Defense collected data on gender. However, the Chinook Harbor Counseling Departments did report that within the 2018-19 and 2019-20 cohorts, there were students who identified as non-binary. Future replicated studies categorizing students as male, female, and non-binary should be considered. Likewise, race, and ethnicity were coded white and non-white, limiting how subcategories within the non-white category did on the tests. This limitation would change the statistical analysis by replacing the use of t-tests for these categories

with additional One-Way ANOVA tests to determine if and where there might be statistically significant differences.

There were also limitations for this study with regard to determining socio-economic status. The first was that, according to the Chinook Harbor Counseling Department, several students not enrolled in the FRL program had younger siblings that were registered. This study only considered a student enrolled if he or she were officially enrolled through the FRL program. There are a few explanations for why this might have happened: students in the upper secondary grades could have been responsible for registering themselves for school and either omitted or forgot to enroll in the program. These students are also more likely to have jobs and not consider that they fall into this category, or they are more likely to live independently and lack guidance regarding assistance programs they are qualified for. Future studies might want to consider using the family's SES status rather than the individual student's SES status to identify students from low socioeconomic families.

As mentioned earlier, the results of research question three regarding students from low SES families found, overall, that students from lower SES backgrounds also had lower scores than their peers from higher socio-economic backgrounds. However, this was not the case for the S&T Skills score or composite tests. This phenomenon would need to be further examined to understand why this is the case, and the phenomenon raises several additional questions that would require follow-up studies. S&T Skills scores and their composites had notable findings for more than one of this study's research questions. It may be beneficial to complete a future study that focuses on understanding the role cultural practices, community values, and students' formal education play in students acquiring this type of knowledge and skills. It may also be beneficial

to examine why the Chinook Harbor School district and other similar rural districts seem to consistently score in level one or two for Oregon's Statewide Accountability Reports.

Recommendations for Practice

According to the College Board (2017a), the SAT's questions are designed to reflect what should be taught with good classroom teaching. The ASVAB, like the SAT, is designed to reflect what a person has learned in the classroom; however, it is also designed to capture the knowledge that a person may have acquired outside of the classroom. With regard to both the SAT and ASVAB AFQT scores, solid classroom instruction over the course of students' academic career is essential for them to do well on both the SAT and ASVAB. The results from this study provide and highlight instructional areas that the district's student population has done well in and the areas in which the student population has struggled. The most significant example from this study concerned the difference between the students' higher reading scores and their lower mathematics scores on the two tests. The differing scores on reading and math may be the result of achievement gaps starting as early as kindergarten. Some of these gaps may be related to gender (Beekman & Ober, 2015; Lubinski et al., 2013), and some may be the result of socioeconomic status (Callen et al., 2017).

This study did in fact find that male students outscored female students on all tests of mathematics. However, female students only outscored males on the reading portion of the SAT and not on the reading portions of the AFQT, which is contrary to what Beekman & Ober (2015) and Lubinski et al. (2013) would suggest. In general, as Callen et al. (2017) found, this study concluded that students from low socioeconomic backgrounds scored lower on the SAT and ASVAB's reading and mathematics tests. While the ASVAB and SAT are both given near the

end of a student's k-12 education, much of the damage that causes students to not do well on these exams may be a result of their earlier years in elementary school.

The district's reading curriculum has been aligned horizontally by grade level and vertically from elementary school to high school. The elementary school has also prioritized regular progress monitoring of its students reading and comprehension skills and has implemented a tiered system of support for students falling behind on fundamental reading skills. The progress monitoring, tiered system of support, and aligned curriculum was implemented when the students in this study were in elementary school. Around this same time the mathematics curriculum was also changed, but the changes did not include progress monitoring or a tiered system of support. Instead, the district's mathematics curriculum shifted to focus on conceptual mathematics and removed any tracking systems that placed students into a high and low math class. Ansalone's (2001) study would support the removal of the school's tracking system, as it found that the achievement gap, between low and high SES status students, could be explained by the tracking of students in school. However, given the differences between reading and mathematics scores for the district and the implementation of new curriculums around the same time, the district may want to fully commit to the continual progress monitoring of mathematics, coupled with a tiered system of support.

The results from this study indicate lower mathematics scores, and the district has also seen its state mathematics scores decrease, as noted above in the reference to the high school's level 1 math rating. The lack of proficiency in basic mathematics creates a compounding effect from kindergarten through twelfth grade and may be partially if not largely responsible for the district's low-test scores. Parents in the district also seem to be frustrated as they feel they are unable to help their children with their mathematics homework. Berthlesen and Walker (2010)

found that parent involvement in a student's education positively affected their academic achievement. Likewise, the Coleman Report (1966) found that family is the most important determinant of student academic achievement. The higher general science and technical skills test scores may be a result of the rural context of the school. It might also be a result of the value the community and families place on practical and occupational skills that are simply embedded in the culture of the community, as opposed to academic skills, particularly mathematics. Therefore, one of the biggest recommendations with regard to this study and finding ways to increasing student mathematics achievement might be to find ways to increase parent and community involvement and build stronger foundational mathematics skills.

Rural districts, however, might also need to look beyond test score data or even HSGPA as an indicators of student achievement. Districts like the Chinook Harbor School District will need to lead the way, to recognize their own students' potential, and find ways to help students capitalize on the strengths and aptitudes they possess. This kind of district initiative could lead to students developing post-secondary plans that align to their interests and aptitudes, and perhaps help them achieve one of the 40-40-20 achievement markers. Currently, neither the district nor high school have provided any sort of clear goals they wish to see their graduates reaching. It could be helpful for the district to provide either a clear marker such as the 40-40-20 goal, or any other explicit goal they wish to see their graduates meet, to provide direction for teachers, staff, and students to focus on when transitioning students out of high school. In the past decade the district has continued its efforts haphazardly without a real system that ensures students are entering college, trade schools, or the military. Knowing that the state, and specifically the state's economy, depends on having citizens who are capable of meeting the occupational needs of the state's society, perhaps there would be a benefit to redirecting the efforts of staff and students

toward moving students into one of the achievement markers. Specifically, the results from the ASVAB aptitude tests could provide critical information about the types of jobs and careers that the forty-six percent of students who are joining the workforce directly out of high school or fall into the other category from the district might consider after high school.

The results of this study indicate that there are three main groups of students the district should consider specifically targeting and helping to move into one of the state goals achievement markers, by considering how to best help them either obtain a certification or attend some sort of post-secondary education. The first group consists of the district's male students. Male students in the district scored higher on almost all tests and subtests of the SAT and ASVAB. However, the National Student Clearinghouse (2022) has reported that that there are 15 percent more female students than male students that attend college their first year immediately after high school. The second group consists of the district's non-white students. This study found that there were not any statistically significant differences in test scores between white and non-white students. However, students who were in the non-white category reported fewer students attending college during their first year than students in the category of white (National Student Clearinghouse, 2022). The third group consists of the district's economically disadvantaged students. While students participating in the FRL did have lower scores in reading and mathematics on the SAT and ASVAB, their higher scores in science and technical domains may make them good candidates for technical certifications and trade schools. The National Student Clearinghouse (2022) reports that only approximately 18 percent of economically disadvantaged students attended some sort of college, as opposed to the 46 percent of students who were not considered economically disadvantaged.

The ASVAB provides a broader picture of students' aptitudes, strengths, and potential. This study shows strong associations between the SAT and ASVAB test scores on similar learning domains. However, these same high-achieving students would, if they took both tests, also have a broader understanding of the careers that their aptitudes would most likely suit and be aligned to. Therefore, the district should consider having all students, regardless of post-secondary plans, take the ASVAB, and the district should continue to provide the SAT free of charge to students voluntarily.

According to Welsh et al. (1990) and Marks (2020), like the SAT, the AFQT is a valid predictor of final school grades. However, because the ASVAB also has the ability to predict job performance and college success (Marks, 2020), the ASVAB may be a more helpful tool for the district to use in helping students with career planning. They may also wish to consider implementing the ASVAB's full career exploration program to help students develop post-secondary plans. What might benefit the district would be to continue providing the SAT free of charge voluntarily, and use students' ASVAB scores to encourage any reluctant students with adequate scores on the ASVAB to also to take the SAT. The PSAT should also be offered to students at a separate time. The ASVAB's strong associations with SAT scores as revealed in this study, specifically the AFQT score and SAT composite score, would still provide the district with insight about students who should be taking the SAT or applying to a university.

The Chinook Harbor School District should consider adopting Oregon's 40-40-20 goal to provide a focus for administrators, counselors, teachers, and students to meet the state's achievement markers. The district should also consider finding ways to better capitalize on its students' strengths to help all of them create post-secondary plans. The ASVAB's strong associations to SAT scores, the AFQT score, and SAT composite score would still provide the

district with insight about the students who may be thinking about applying to a university and would accordingly need to take the SAT for admission purposes. Since this study first began, Oregon's state universities have eliminated the student requirement to take the SAT.

The shift by the state's university system prompted the district to reevaluate the requirement it had that all students take the SAT. The district's administration has now suspended the requirement that all students take the SAT for the 2021-22 school year. However, the SAT is still needed by many students wishing to attend any number of four-year universities, specifically private schools, and many of the district's students would benefit from the opportunity to test for free during school hours. However, having every student take the test may not be a worthwhile practice. The higher test scores for S&T Skills domains suggest that many of the district's students may benefit from entering trade programs, internships, or two-year colleges that lead to occupations in fields that require science and technical skills. Currently the district does not have a specific purpose in administering either of the tests. However, the ability of both tests to predict a student's abilities, aptitudes, and post-secondary outcomes would allow the high school to be informed of areas and certifications that would be beneficial, and would help the district to meet an achievement marker of the 40-40-20 goal.

In the past three years, the district has worked at developing its career pathways and dual-credit programs. Currently, a student attending the Chinook Harbor School District can graduate from high school with several college credits, and they are able to obtain an Allied Health Certification by completing six dual credit courses in the healthcare field. This program of study has been popular among students, and in 2019 over ten percent of the graduating class obtained the certification. The Allied Health Care certification lends itself primarily to students who wish to go into the medical field by obtaining a bachelor's degree or higher, rather than by obtaining a

trade certification. However, according to the Chinook Harbor counseling department, one of the most popular courses in the high school is part of the healthcare career pathway. Each year the First Aid CPR classes are packed with over 70 students a year meeting the standards to become First Aid CPR certified and receive college and high school credit. The counseling department credits the hands-on nature and applicability of the course for its popularity.

Still, there are no programs of study outside of the healthcare pathway that allow a student to obtain a certification in the industrial arts or other science and technical field. The results of this study, specifically the higher scores in science and technical skills for low socioeconomic students and male students, would suggest that some of the district's students would benefit from the district building a more robust CTE pathways program, one that would lead to students obtaining a certification that could be used after high school.

Conclusion

Having been raised in rural America and now working as a rural educator, my experience and understanding of the context and experiences of the rural student can be biased. I do not believe that state lawmakers, educators, and authors of studies always fully understand the rural context, culture, or rural peoples' abilities, nor am I sure they always want to. The absence of resources and opportunities, and life in communities that value what they see as the practical survival skills needed to earn an honest living as opposed to academic achievement, have always been part of my personal, academic, and professional reality. It is this dichotomy between, on the one hand low academic skills and abilities, and on the other high practical and job-related skills and abilities, that prompted my interest in exploring the SAT and ASVAB test scores. Many of the results from this study did not come as a surprise to me, most notably the district's higher scores in mechanical comprehension and general science and low overall scores on mathematics.

The higher MC mean test scores for males, and overall general science test scores having one of the highest median scores of all the tests, confirmed what I believed based on my personal understandings of the knowledge acquired simply by living in rural America. The skills and knowledge needed to do well in the science and technical skills sections of the ASVAB are simply embedded in the way people live their lives in rural America. Living off the land, learning to use tools and machinery, playing outside in an unstructured environment along a riverbank, all lend themselves to a deeper understanding of ecological systems, environments, and basic mechanical principles that are at times needed simply for survival. However, even in my own understanding of these things from living in rural America, I was taken back by the two samples t-test results of students from lower socioeconomic backgrounds slightly edging out students who did not come from lower socioeconomic backgrounds on S&T skills scores.

Throughout this study, it has become evident that not enough research has been done to understand rural America's education system and experiences, even though over 50 million people live there (US Department of Education & National Center for Educational Statistics [NCES], 2013). Rural America is also often plagued with poverty, lack of educational opportunities, and sometimes community cultures that do not place a high value on formalized education (Statti & Torres, 2020). Yet rural America still needs skilled laborers and educated individuals to fill its labor demands. It is the researcher's hope that this study might have some small part in helping to understand education in rural America, and specifically the Chinook Harbor School District.

This study sought to better understand how Chinook Harbor High School students performed on the SAT and ASVAB standardized tests, the associations between test scores and HSGPA, and if test scores were moderated by gender, race, and ethnicity, SES, and HSGPA in

the district. The study concluded that students within the Chinook Harbor district had the lowest overall scores on mathematics-related tests and the highest results on reading and verbal tests. HSGPA and SAT composite and AFQT scores were also strongly associated. This is consistent with the DOD's and College Board's conclusions that HSGPA is a valid predictor of SAT scores (College Board, 2017a), and that the ASVAB's AFQT score is a valid predictor of final school grades (Welsch et al., 1990). In this study a student's science and technical aptitude subtest scores were not predictive of a student's HSGPA and had weaker associations than reading and mathematics domain tests for both the SAT and ASVAB. Male students and students of lower socioeconomic status boasted some of their highest scores in these areas. The weak association between HSGPA and these test scores would also indicate that students with low HSGPAs may have strong scores in science and technology aptitude tests. Students who fit this description may be a subpopulation of students that the district could identify and help to create post-secondary plans that meet the achievement markers set out by Oregon's 40-40-20 goal. Furthermore, the adoption of the 40-40-20 goal or similar achievement markers could provide the district with a direction and purpose as it transitions its students to life after high school.

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Appendix

George Fox University IRB Approval Form

2/2/2023

GEORGE FOX UNIVERSITY HSRC INITIAL REVIEW QUESTIONNAIRE Page 6

Title: The Correlation Between Rural Oregon High School Students' SAT and ASVAB Scores with Gender, SES, and Race/Ethnicity for Moderators.

Principal Researcher(s): Kelly Garvin

Date application completed: 02/12/2022

(The researcher needs to complete the above information on this page)

COMMITTEE FINDING:

/ (1) The proposed research makes adequate provision for safeguarding the health and dignity of the subjects and is therefore approved.

(2) Due to the assessment of risk being questionable or being subject to change, the research must be periodically reviewed by the **HSRC** on a basis throughout the course of the research or until otherwise notified. This requires resubmission of this form, with updated information, for each periodic review.

(3) The proposed research evidences some unnecessary risk to participants and therefore must be revised to remedy the following specific area(s) on non-compliance:

(4) The proposed research contains serious and potentially damaging risks to subjects and is therefore not approved.

Chair or designated member

2/16/22

Date