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Research Report

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The Impact of Army JROTC Participation on School and Career Outcomes

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About This Report

This report documents research and analysis conducted as part of a project entitled *Long-Term Outcomes of JROTC* [Junior Reserve Officers' Training Corps] *Participation: Future Accessions and Career Outcomes*, sponsored by the Assistant Secretary of the Army for Manpower and Reserve Affairs. The purpose of the project was to analyze the relationships between JROTC participation and outcomes, including in–high school outcomes; military service; post–high school education success; and science, technology, engineering, and mathematics participation and to determine how outcomes, including accession rates, vary by JROTC program characteristics.

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Summary

Introduction

The Junior Reserve Officers' Training Corps (JROTC) was established through the National Defense Act of 1916 as a citizenship and leadership program. Today, JROTC is among the largest youth development programs in the United States, serving more than a half million students each year in more than 3,400 high schools (Kamarck, 2020). The U.S. Department of Defense (DoD) funds this program, through the military departments, at the cost of $390 million per annum (Kamarck, 2020). The program's mission is to "instill in students in the U.S. secondary educational institutions the values of citizenship, service to the United States (including an introduction to service opportunities in the military, national, and public service), and personal responsibility and a sense of accomplishment" (U.S. Code, Title 10, Section 2031).[1] The U.S. Army JROTC (AJROTC) program serves the largest contingent of JROTC students and school sites each year (Kamarck, 2020). Despite its longevity, the scope of its reach, and the size of its budget, little is known about the associations between JROTC participation and outcomes of importance to the country and the Army.

In 2020, the Assistant Secretary of the Army for Manpower and Reserve Affairs (ASA M&RA) issued a memorandum calling for the modernization of the AJROTC curriculum to improve the "career readiness skills and knowledge tailored to emerging workforce requirements in science, technology, math, computer science, and cybersecurity" (U.S. Army, 2020, p. 1). As part of this modernization, AJROTC curricula and programming contain an increased focus on science, technology, engineering, and mathematics (STEM).

To better understand these associations between AJROTC participation and key outcomes, we developed a logic model, based on DoD, Army, and U.S. Army Cadet Command (USACC) policy and regulations, to represent the theory of change and identify intended outcomes of the AJROTC program. The logic model provided an analytic framework by which to understand expected and actual effects of the AJROTC given its goals. We then used individual-level data from two states' integrated databases to analyze JROTC cadets' outcomes both in high school and beyond. This effort includes analyses of STEM-related instructional capacity in schools, because STEM skills are an important educational objective and a core area for Army workforce needs, aligned with the AJROTC modernization memorandum. We also interviewed JROTC and school stakeholders to better understand important program characteristics, such as student

[1] U.S. education can be divided into primary, secondary, and postsecondary institutions. Secondary education refers to middle and high school, typically grades six to 12.

experience, how program modernization efforts align with the curriculum, and how the value of the program is communicated and perceived.

Although impacts on the Army active and reserve components are not explicit targets for the AJROTC, the service has historically been a beneficiary of investments in the program because participants might transition to roles in the Army on the military side or the civilian side. Using Army personnel data, we analyzed military career outcomes of former JROTC cadets who enlisted in the Army. This analysis also includes special emphasis on STEM-related outcomes.

Findings

Input from AJROTC and School Stakeholders

The ASA M&RA's JROTC modernization strategy released in 2020 calls for making changes to the AJROTC curriculum and management to improve STEM and cybersecurity skills to meet emerging workforce needs. Interviewees reported an awareness and embrace of the modernization strategy and noted that many JROTC STEM and cyber-related activities are in place. They noted that increased support through training, team-teaching, and community partnering could improve implementation.

Interviewees also reported their perception of the importance of communicating the value of JROTC to stakeholder groups that influence the participation choices of potential cadets and determine the placement of JROTC programs, such as students, parents, school counselors, and school district leadership. Interviewees reported that there is room for improvement in this area. In particular, interviewees voiced the importance of conveying JROTC's role in shifting educational outcomes.

Impact of AJROTC on Educational Outcomes

With respect to findings on the effects of AJROTC on educational outcomes—in our case study states of Hawaii and Texas—the results are mixed. Compared with matched peers, Hawaii and Texas students who participate in AJROTC in ninth grade graduate at lower rates, although there are no differences in how likely they are to take STEM courses. With respect to graduation, there is a positive effect for those who participate in AJROTC for all four years of high school; these students are more likely than their peers to graduate. Furthermore, we found that AJROTC students who participate in all four years of the program were less likely than peers to be absent or suspended from school in the twelfth grade. Although those who participate in AJROTC in ninth grade and those who participate for all four years are less likely to enroll in college compared with their respective peers, there is reason to believe this is because of AJROTC students choosing to enlist in the military, particularly those students who participated throughout high school.

It is important to note that many outcomes that are aligned with AJROTC's mission, including community and civics outcomes, lack data such that we were unable to assess the extent to which those outcomes are being achieved. Developing and implementing ways to systematically collect these data for cadets and comparable peers could help measure additional ways that AJROTC dollars are providing a return on investment.

JROTC Participation Is Linked to Army-Related Outcomes

Soldiers who are former JROTC cadets are more diverse in terms of race and gender than those who enlist in the Army through other pathways, as noted by Goldman and colleagues (2017). This demographic composition reflects the demographic composition in AJROTC, which is much more diverse than the military is. For example, approximately 40 percent of AJROTC cadets are female (U.S. Army, 2021) compared with less than 15 percent of Army active component enlisted personnel (DoD, 2019).

When examining outcomes among former JROTC cadets who enlist in the Army (we were not able to examine former cadets serving as officers, serving in other branches, or serving in civilian roles), we find positive outcomes. Former JROTC cadets are less likely to leave service before the end of their first term, compared with enlisted soldiers who were not JROTC cadets; this holds true in both the active and reserve components. There is also evidence that former JROTC cadets serve longer than their non-JROTC peers, again in both the active and reserve components.

Finally, former cadets who start their careers in the active component are more likely to start in a STEM-focused military occupational specialty (MOS) than those who were not identified as JROTC participants. We find no difference in likelihood of a STEM MOS for cadets who participated in JROTC for three or more years, compared with cadets with any JROTC participation.

Recommendations

Using our findings, we identified three key recommendations for ASA M&RA and the USACC.

Support High-Quality Data Collection That Is Aligned with AJROTC Goals

To assess the success of the modernization strategy rollout across cadres, new JROTC Unit Management System metrics might be needed to collect key data. And as metrics are expanded, we recommend reviewing data collection to ensure that all intended outcomes of the JROTC program are measured and that the measurement of those outcomes is formalized in doctrine. If AJROTC is intended to improve in-school outcomes for participants, this needs to be made explicit in policy and regulations.

We also note that data collection can be improved. As shown by the state data analyses, many academic and disciplinary outcomes that are tracked by JROTC instructors are already captured by school systems in state-mandated, consistent ways. Leveraging existing, systematic, and comprehensive data that are already collected by schools, where they exist, can help to reduce the burden of data collection on instructors, increase data consistency and comparability, and free up instructor time to collect data elements that school systems do not collect. We also recommend training instructors and other staff involved in data collection to implement high-quality data collection approaches and database entry for key data points to support data accuracy, completeness, and consistency.

Communicate AJROTC's Value by Documenting the Impact on Participating Students Relative to Peers

AJROTC serves a more–economically disadvantaged population (both in site selection and in student participation in schools), and demographic and socioeconomic differences can lead to naïve comparisons of average outcomes (e.g., test scores and graduation rates) that might inaccurately and negatively portray the impact of AJROTC on student outcomes. Yet AJROTC's participation requirement for satisfactory academic progress (which determines the population allowed to continue in AJROTC) could inaccurately and positively portray the impact on measures of discipline and grade point average. More-rigorous analytic approaches, such as those that use an equivalent comparison group of non-JROTC participants against which to compare the progress and outcomes of AJROTC participants, could help address these potential biases and potentially inaccurate representation of program impacts. Such approaches require substantial resources and analytic capacity, which means this work would likely need to be conducted centrally or be supported by USACC or ASA M&RA. Where more-rigorous analyses are not feasible, ensure that the context and interpretation of the results is clear, framing the results given the baseline differences.

Maintain Existing Policy Flexibility That Leverages Instructors' Local Expertise

DoD and Army doctrine provides flexibility to local JROTC cadre instructors in some aspects of curriculum choices, extracurricular activities, and uniform wearing. The results of our interviews with instructors suggest that this flexibility is being used to tailor activities to meet the needs of local communities and bring in aspects of STEM and cybersecurity. For example, student populations at schools with JROTC cadres vary in the level of comfort with uniform wearing, as well as in the level of interest in such activities as robotics, cybersecurity, and drone racing teams. Local instructors, working within doctrine and the guidance provided by USACC, report offering competitive teams that are appropriate to local interests and adapting aspects of uniform wearing. The belief is reportedly that such adaptation maintains healthy enrollment and supports the modernization strategy. We propose the continuation and support of this flexibility to adapt curriculum choices, extracurricular activities, and aspects of uniform wearing.

There were also reports that USACC could potentially improve the siting of new cadres with better input from Brigade Chiefs and Directors of Army Instruction. Several interviews included references to USACC being unaware of strong STEM and/or cyber schools in districts that could have been potentially better matches to support the modernization strategy than the schools that were selected. Examples included a new magnet school scheduled to open and a school converting to a STEM-focused school. USACC should explore how to better integrate such local expertise into their selection processes.

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Chapter 1. Introduction: Characterizing the Effects of Participation in AJROTC on Student Outcomes

Background

The Junior Reserve Officers' Training Corps (JROTC) was established through the National Defense Act of 1916 as a citizenship and leadership program. Today, JROTC is among the largest youth development programs in the United States, serving more than a half million students each year in more than 3,400 high schools (Kamarck, 2020). Although originally sponsored only by the U.S. Department of the Army, today, each of the U.S. military services operates JROTC units. The U.S. Department of Defense (DoD) funds this program through the military departments at the cost of $390 million per annum (Kamarck, 2020). The program's mission is to "instill in students in the U.S. secondary educational institutions the values of citizenship, service to the United States (including an introduction to service opportunities in the military, national, and public service), and personal responsibility and a sense of accomplishment" (U.S. Code, Title 10, Section 2031).[2] The JROTC program includes classroom instruction, physical fitness training, and cocurricular opportunities for participants (e.g., drill competitions, leadership and academic bowls, and physical fitness competitions) (U.S. Army, 2021).

The U.S. Army JROTC (AJROTC) program serves the largest contingent of JROTC students and school sites each year (Kamarck, 2020). Like the programs operated by the other military services, AJROTC has evolved over time to address emerging needs of the country and its citizens. In fact, in 2020 the Assistant Secretary of the Army for Manpower and Reserve Affairs (ASA M&RA), extending the Army People Strategy, 2019, issued a memorandum identifying a JROTC modernization strategy (U.S. Army, 2020). This memorandum called for the modernization of the AJROTC curriculum to improve the "career readiness skills and knowledge tailored to emerging workforce requirement in science, technology, math, computer science, and cybersecurity" (U.S. Army, 2020, p. 1).

The memo also establishes a framework through which this content modernization strategy will be achieved. First, the program will expand the amount and rigor of instructional content focused on science, technology, engineering, and mathematics (STEM). This STEM expansion likely means a reduction in other content areas (e.g., citizenship and leadership). However, this trade-off is not acknowledged in the memo, and the documentation does not provide an indication of which curricular topics should be reduced or how those reductions might affect the

[2] U.S. education can be divided into primary, secondary, and postsecondary institutions. Secondary education refers to middle and high school, typically grades six to 12.

program's ability to meet its traditional objectives. Second, the modernized curriculum will incorporate a cybersecurity program pilot (henceforth *cyber pilot*) that includes both instructional content changes and additional extracurricular programs (e.g., participation in the national CyberPatriot competition). The memorandum also acknowledged that U.S. Army Cadet Command (USACC), the body (under the U.S. Army Training and Doctrine Command) with direct oversight of AJROTC, will identify the skills necessary for AJROTC instructors to implement the modernized curriculum and provide the requisite training or hire the appropriate talent.[3]

Unpublished work related to this manuscript provides a detailed description of the AJROTC programs and comparisons with other branches' programs. This included the demographics of schools served; level of academic offerings at school sites; program implementation factors, such as criteria to select school sites and student performance on standardized tests; and estimates of program costs to stakeholder organizations. This effort found that the AJROTC program was meeting its traditional strategic objectives, including the objective of serving economically disadvantaged students. The project also found that some AJROTC sites had already incorporated STEM and cyber activities. An examination of the practices that these sites employ could help identify best practices that other sites can use when implementing the modernization strategy.

Purpose and Approach of This Research

In 2020, the ASA M&RA sought to better understand the return on investment made annually in AJROTC. This project was developed to help inform this broad question by specifically analyzing the relationships between JROTC participation and a variety of cadet (i.e., participant) outcomes of importance to the Army. These include in–high school behavior and achievement, postsecondary educational participation, and military service and subsequent career paths of former JROTC cadets. The project also identifies outcomes specific to the areas of STEM and cybersecurity. Finally, the project's findings might inform the implementation of the AJROTC modernization strategy, provide metrics to inform stakeholders of the value of JROTC, and support decisions for future AJROTC sites.

Despite JROTC's longevity, the scope of its reach, and the size of its budget, little is known about the associations between JROTC participation and outcomes of importance to the country and the military. This project leverages rigorous quantitative analyses of education and career data and interviews with key AJROTC stakeholders. There is broad agreement among USACC leadership that sourcing high-quality instructors for JROTC units, particularly in hard-to-staff areas, is the "long pole in the tent" that can make or break a JROTC unit's success. The project

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[3] The memorandum does not provide a timeline by which the full modernization strategy, or components thereof, must be implemented, and assessing the extent to which such components have been implemented is beyond the scope of this project.

interviews provide qualitative evidence on potential strategies and considerations for combatting this challenge. Most of the analyses presented in this report focus exclusively on AJROTC. However, for some analyses, we cannot focus specifically on AJROTC and instead analyze JROTC programs writ large.

Structure of This Report

In Chapter 2, we present and describe the logic model that we developed for AJROTC based on DoD, Army, and USACC policy and regulations to represent the program's theory of change and make explicit the intended cadet outcomes. Chapter 3 presents analyses of the interviews we conducted to understand how the modernization strategy is being implemented, how value might be better communicated to stakeholders, and how the pipeline of JROTC instructors might be strengthened.

We describe the results of our analyses (using Army personnel data) to assess former JROTC cadets' enlisted Army career outcomes, with a special emphasis on STEM-related careers, in Chapter 4. We leveraged data from two states' integrated education and workforce databases to analyze JROTC cadets' outcomes both in high school and beyond, including analyses of STEM-related instructional capacity in schools. We present these results in Chapter 5. Finally, we summarize our work and provide three main recommendations that stem from our analyses in Chapter 6.

The report is followed by several appendixes. Appendix A provides more detail on the strategic literature search methods that informed the logic model (Chapter 2) and provided background for the report. Appendix B contains the full interview protocols by stakeholder group. Appendix C is a companion to Chapter 4's personnel data analyses, providing more detail on the models presented in the main text and several specification and robustness checks. Appendix D is a companion to Chapter 5's student and workforce data analysis in Texas and Hawaii, detailing the process that led to the selection of these states, the construction of the analysis samples, and the quasi-experimental approach used. Appendix E is a one-page summary of the quantitative analyses for use in AJROTC stakeholder discussions.

Chapter 2. AJROTC Logic Model

In this chapter, we present and describe the logic model that we developed for AJROTC based on DoD, Army, and USACC policy and regulations to represent the program's theory of change and make explicit the intended cadet outcomes. We start by describing the purpose and structure of a logic model before turning to the logic model we built for AJROTC.

Logic Models

Developing a logic model is an important first step in assessing the ability of a program to bring about expected outcomes. Logic models visually represent hypotheses and assumptions about how a program, if implemented as designed, produces the intended or desired outcomes (McLaughlin and Jordan, 2010). Program leadership can use the process of developing a logic model to identify gaps in doctrine, such as important aspects of the program that have not been formalized in policy. Program leaders can also use logic models in training to ensure all staff understand required and optional aspects of the program; to communicate with stakeholder groups about the purpose, process, and goals of the program; and to guide decisionmaking about program changes and improvement. Evaluators and researchers use these models to identify what to measure, when specific program outcomes are expected to be realized, the types of data needed, and benchmarks against which to assess measured program performance.

A typical logic model is composed of four key components: resources, activities, outputs, and outcomes. *Resources* are the human, physical, financial, and organizational inputs needed or available to operate the program (e.g., JROTC instructors, classrooms, and curricula). *Activities* are the processes, events, or actions that embody the implementation of the program (e.g., recruitment, instruction, and drill). *Outputs* are the direct result of the activities, including the number of service hours or activities provided or what participants or organizations receive when engaging with the program. *Outcomes* are changes in participants, organizations, or communities that result from implementing the program. Logic models are intended to be read from left to right. That is, the inputs lead to activities, activities lead to outputs, and those outputs are necessary for program participants to realize the intended outcomes.

Outcomes are often divided into three phases, defined by how long after program participation such an outcome is expected to be produced. Short-term outcomes are those that are expected shortly after implementing a program cycle, typically no more than one or two years after the program is completed. A program's intermediate outcomes are expected one to two years after the short-term outcomes. Long-term outcomes are often expected anywhere between three to five years, or more, after program completion. These outcome time frames are estimates; the exact timing of each outcome phase is specific to a program and depends on numerous factors. For example, an AJROTC-specific factor is the age of its participants. First-year high school students typically do not demonstrate post–high school outcomes (e.g., pursuit of STEM careers) for at least three additional years, if not longer.

Logic models are living documents (W. K. Kellogg Foundation, 2017). As a program evolves, its corresponding logic model should be amended to reflect this new phase of program operations. For example, when policy guidance changes to address the adoption of new technology, program regulations shift to incorporate new instructional foci, or program leadership determines forthcoming recruiting efforts should focus on a new target group, these modifications need to be articulated in the logic model such that they can be evaluated and improved on in the future.

Developing an AJROTC Logic Model

We developed an AJROTC logic model to guide our understanding of the program and to identify the outcomes that cadets are expected to achieve as a result of participating in the program. We reviewed key DoD and Army policy and program documents to identify the core components of the AJROTC program. These documents are

- U.S. Code, Title 10, Section 2031, Junior Reserve Officers' Training Corps
- Department of Defense Instruction 1205.13, *Junior Reserve Officers' Training Program*
- U.S. Army Regulation 145-2, *Junior Reserve Officers' Training Corps Program*, 2000
- U.S. Army Cadet Command Regulation 10-5, *Organizations and Functions*, 2016
- U.S. Army Cadet Command Regulation 145-2, *Junior Reserve Officers' Training Corps Program (A Citizenship and Leadership Development Program): Organization, Administration, Operations, Training and Support*, 2012
- U.S. Army Cadet Command Regulation 145-8-3, *JROTC Program for Accreditation*, 2014.

We focused on the operation of an AJROTC unit's program implementation for our logic model.[4] Additional logic models could be developed to reflect USACC's operation of AJROTC or a brigade-level implementation of the program. We present our AJROTC logic model in Figure 2.1.

[4] Per Department of Defense Instruction 1205.13, a *JROTC unit* is "an organized group of JROTC students and faculty at one secondary school" (2021, p. 28). Per U.S. Army Regulation 145-2, 2000, a *unit* is "the organization comprising Junior ROTC cadets and military instructors at one school" (p. 3).

Figure 2.1. AJROTC Unit Logic Model

Inputs

- Qualified instructors
- Policy and standards
- Unit's Master Training Schedule
- Curriculum
- Textbooks
- Equipment
  - Learning technology
  - Air Rifles
  - Color Guard
  - Uniforms
- Facilities
  - Classrooms
  - Storage
  - Office Space
  - Drill Space

Activities

- Recruitment of cadets
- Instruction
  - Academic*
  - Military*
  - Leadership
  - Physical fitness
- Service Learning
- Community Service
- Cadet Safety and Civilian Marksmanship Training
- Confidence and Team Building Activities
- Drill and Ceremonies
- Required and/or optional challenges and competitions
- Assess cadet course progress and performance
- Collect required cadet data
- In-school marketing

Outputs

Cadets:

- Receive academic instruction, including military and leadership content
- Receive non-academic instruction
- Participate in challenges and competitions
- Fulfill course requirements
- Earn awards and certificates
- Qualify for advanced paygrade
  - Military Enlistment
  - Senior ROTC

Short-term outcomes

- Develop life and work skills
  - Communication
  - Critical thinking
  - Self-management
  - Teamwork
  - Leadership
- Appreciate physical fitness
- Knowledgeable about the dangers and effects of substance use
- Knowledgeable about educational and vocational opportunities
- Understand history, purpose, and structure of the military
- Possess global awareness
- Understand principles of good citizenship

Intermediate outcomes

- [Demonstrate life and work skills]
- Maintain physical fitness
- Remain substance free
- Pursue meaningful careers, especially in STEM
- Possess favorable attitudes and impressions of the military and careers in the Armed Forces
- Demonstrate positive citizenship behaviors

Long-term outcome

- Live and work cooperatively with others
- Live a healthy lifestyle
- [Productively contribute to the workforce]
- Serve the US (military, national, and/or public service)
- [Support military and military personnel]
- Become a successful citizen

SOURCES: Authors' synthesis of U.S. Code, Title 10, Section 2031; Department of Defense Instruction 1205.13; U.S. Army Regulation 145-2; U.S. Army Cadet Command Regulation 10-5; U.S. Army Cadet Command Regulation 145-2; and U.S. Army Cadet Command Regulation.
NOTES: The asterisk (*) indicates an instructional area with the potential to include STEM content. Text brackets indicate aspects that were not articulated in policy or regulations but that we deduced from the language used in the policy and regulations. ROTC = Reserve Officers' Training Corp.

As a demonstration of how to read the logic model, we can follow the input of curriculum through to the activity of instruction (academic, military, leadership, or physical fitness) and the output of cadets having received the requisite course instruction. When cadets receive high-quality instruction and are actively engaged in the learning process, we could reasonably expect that they develop new or enhanced knowledge, skills, and abilities (KSAs) (e.g., knowledge about substance use, effective communication, ability to work in a team) in the short term. Those KSAs translate into actions in the intermediate, where they exhibit these KSAs in postsecondary pathways, such as college, career, or even daily life. A cadet who learned the dangers and effects of substance use might be more likely to remain substance free one to two years after completing AJROTC. Over time, cadets continue to employ the KSAs gained through AJROTC and have increased likelihood of maintaining a healthy lifestyle.

In Figure 2.1, there are three aspects indicated in brackets. The brackets indicate aspects that were not articulated in policy or regulations but that we deduced from the language used in the policy and regulations. If, as a short-term outcome, cadets are expected to understand the history, purpose, and structure of the military, and this understanding helps cadets to form favorable attitudes and impressions of the military and careers in the armed forces in the intermediate, then there is likely a longer-term outcome in this chain of succession. For a subset of program participants, that long-term outcome could be realized through U.S. military service, an outcome identified in doctrine. For individuals who do not pursue military service, however, these favorable attitudes and impressions might be expected to translate into support for the military and military personnel. We ensured that each short-term outcome had a corresponding intermediate and long-term outcome and vice versa.

The DoD, Army, and USACC policy and regulations that we reviewed do not explicitly address the expected contributions of AJROTC to in-school outcome improvements for cadets who participate. USACC reports on five quality indicators, which focus on student behavior, academic performance, and attainment in high school, to promote AJROTC's effectiveness (USACC, undated). These indicators include attendance, indiscipline, grade point average (GPA), and both high school dropout and graduation rates. However, these indicators are not clearly connected to the mission, goals, or outcomes stated in the doctrine we reviewed. This suggests that either the program is using data misaligned to its goals to discuss program effectiveness or doctrine needs to be updated to accurately reflect the program's contribution to a cadet's in-school behavior, performance, and attainment.[5]

[5] In Chapter 6 of this report, we provide guidance on accurately measuring the *value-add*, or the contributions, of AJROTC to such student outcomes as academic performance and graduation.

Empirical Evidence Related to the AJROTC Logic Model

After developing the logic model, we explored extant research on youth development programs to understand what evidence was available to support the AJROTC logic model and whether youth development programs that share similar characteristics with JROTC have shown evidence of improving outcomes that were not identified in AJROTC doctrine. More information about our literature search is provided in Appendix A. We present the insights we gained from the extant literature in Table 2.1.

We identified five studies that connect with outcomes in the AJROTC logic model. Two studies were conducted with an explicit focus on JROTC, and the remaining three studies were based on non-JROTC-specific populations. We identified two studies that provide suggestive evidence that JROTC or high school leadership experience is associated with positive outcomes that are not included in the AJROTC logic model, although they do relate to AJROTC's five quality indicators.

The results we present in this section do not cover each of the short-, intermediate-, and long-term outcomes in the AJROTC logic model. The lack of available evidence should not be mistaken for negative or null evidence of effectiveness. Many of these outcomes have not been empirically tested in the JROTC or youth development program context. Some of the intended outcomes of AJROTC might be considered difficult-to-measure constructs or latent characteristics. For example, unlike the ability to measure a person's height, we cannot walk up to an individual and, on using sight alone, determine whether she possesses global awareness. Global awareness comprises varying knowledges, skills, and attitudes (see Gibson, Rimmington, and Landwehr-Brown, 2008), such that measuring the construct means measuring multiple contributing elements. To an extent, the more difficult an outcome is to operationalize or measure, the less likely you might be to find research that evaluates a program's ability to improve that outcome. Thus, research might be more-readily available for measures that are part of regular data collection (e.g., student test scores, absences) than for measures that require new data to be collected (e.g., global awareness).

Table 2.1. Empirical Evidence to Support the AJROTC Logic Model and Other Youth Program Outcomes

Authors	Year	JROTC Specific	Intervention	Population and Data Source	Findings	Logic Model Outcomes
Evidence to support outcomes in the AJROTC logic model						
Chan, Choi, Hailu, Whitford, and DeRouen	2020	No	Structured math- and science-focused out-of-school time (OST) programs	Secondary students in nationally representative panel data	Students who participate in structured math- and science-focused OST programs in eighth grade, relative to nonparticipants, are more likely to (1) express an aspiration to choose and (2) actually choose a STEM major in college.	• Knowledgeable about educational and vocational opportunities • Pursue meaningful careers, especially in STEM
Hendricks, Alemdar, and Ogletree	2012	No	VEX Robotics Competition	Middle and high school students who participated in the program (*n* = 341)	On a self-report survey, students agreed or strongly agreed that participating in the VEX Robotics Competition made them more interested in taking additional math or science classes in high school, 66 percent; more interested in taking math or science classes in college, 78 percent; more interested in taking engineering classes in college, 83 percent; and more interested in having a job in a STEM or computer field, 87 percent.	• Knowledgeable about educational and vocational opportunities • Pursue meaningful careers, especially in STEM
Pema and Mehay	2009	Yes	JROTC	Secondary students in nationally representative panel data who participated in JROTC for at least one class	Individuals who participated in JROTC were more likely to enlist in the military than individuals who did not participate in JROTC.	Serve the United States (military, national, and/or public service)

Authors	Year	JROTC Specific	Intervention	Population and Data Source	Findings	Logic Model Outcomes
Pema and Mehay	2010	Yes	JROTC	Secondary students in nationally representative panel data, who were early JROTC participants who participated in JROTC at some point in the first two years of high schools, late JROTC participants who participate in JROTC at some point in the last two years of high school, or continuous JROTC participants who indicated that they participated in both early and late high school	Early participants and continuous participants are more likely to enlist in the military, as compared with their matched nonparticipant peers at sophomore year.	Serve the United States (military, national, and/or public service)
Pema and Mehay	2012	Yes	JROTC	Non–prior service U.S. Navy personnel	JROTC reduces early turnover from the Navy (i.e., exiting before the end of the first 4-year contract period) and increases long-term attachment (i.e., voluntary reenlistment for a second term).	Serve the United States (military, national, and/or public service)
Jago, Baranowski, and Baranowski	2006	No	Fit for Life	Boy Scouts (13 years old)	Participating in the intervention was associated with a small reduction in sedentary minutes and a slight increase in light activity, as compared with individuals who did not participate in the intervention.	Appreciate physical fitness

Authors	Year	JROTC Specific	Intervention	Population and Data Source	Findings	Logic Model Outcomes
			Evidence to support outcomes not in the AJROTC logic model			
Pema and Mehay	2010	Yes	JROTC	Secondary students in nationally representative panel data, who were (1) early JROTC participants who participated in JROTC at some point in the first two years of high schools, (2) late JROTC participants who participate in JROTC at some point in the last two years of high school, or (3) continuous JROTC participants who indicated that they participated in both early and late high school	Early participants and continuous participants demonstrate higher twelfth grade test scores than their non-JROTC counterparts. All participant groups realized larger test score gains than their non-JROTC counterparts. Early participants and continuous participants (compared with their matched nonparticipant peers from sophomore year) are more likely to earn a high school diploma. There was no effect found for any of the groups on in-school disciplinary issues or on postsecondary enrollment.	N/A
Rouse	2012	No	High school leadership	Secondary students in nationally representative panel data	A student's high school leadership, as compared with no high school leadership, is associated with an increase in years of education completed, an increased probability of college attendance, and an increased probability of college graduation. Conditional on attending college after high school, students with leadership opportunities were more likely to enroll in a four-year college, as compared with a two-year college, first.	N/A

Summary

We developed an AJROTC logic model using DoD, Army, and USACC policy and regulations. This model provides insights into expected program operations and the intended cadet outcomes. We also reviewed the limited body of research that provides evidence to support outcomes in this model. In the remaining chapters of this report, we generate additional evidence that can be used to guide program practices and implementation. The interview data presented in Chapter 3 highlights the perceptions of inputs (i.e., qualified instructors, policy and standards, and curriculum) and activities (e.g., recruiting cadets and collecting required data) identified in the logic model. Chapter 4, which presents analyses on military personnel who participated in JROTC, provides evidence related to outcomes, such as "pursue meaningful careers, especially in STEM" and "serve the United States (military)." Chapter 5 provides some insights about the outcome of "pursue meaningful careers, especially in STEM" as well as rigorous analyses related to the five quality indicators mentioned previously.

Chapter 3. Interview Findings

In this chapter, we discuss our approach to conducting interviews with JROTC stakeholders and our findings derived from an analysis of interview themes.

Approach for Conducting and Coding Interviews

Goals: Topics to Be Informed by Interviews

We developed research questions to address four main areas of interest to the ASA M&RA and USACC: implementation of modernization strategy, communication of JROTC's value, sourcing and retaining qualified instructors, and the siting of new cadres. These topics are listed below with the general areas of questioning that were included in interview protocols.[6]

1. **How to inform the implementation of the modernization strategy**
    a. How have instructors reacted to and implemented an expansion of STEM and cybersecurity content in the curriculum?
    b. What are instructor and cadet experiences with the curriculum and extracurricular activities, particularly the STEM content?
    c. What kind of students are in the program? How many? How do they find the program? How might student composition change if the curriculum changes?
    d. What kinds of partnerships are taking place, or could take place, to improve the implementation of the modernization strategy, including the curriculum and extracurricular activities?
    e. Are there JROTC or AJROTC policies or guidance that can better support the modernization strategy?
2. **How the value of AJROTC is being communicated to stakeholders and how that could be improved**
    a. What metrics are attached to the program—course credit or Career and Technical Education (CTE) credit? How are these communicated?
    b. How does JROTC influence career and educational choices of students?
    c. Do cadets think that expanded STEM content would have been helpful or otherwise influenced their choices and life path?
3. **How to strengthen the pipeline for AJROTC instructors**
    a. What is the current process for hiring and credentialing JROTC instructors?

[6] The exact protocol content was tailored to each stakeholder group—JROTC instructors (senior Army instructors [SAIs] and Army instructors [AIs]), directors of Army instruction (DAIs), brigade chiefs, high school counselors, and JROTC graduates; no group was asked questions on every topic.

b. How might this change in the face of expanded STEM content?

4. **How to potentially improve the selection of new sites for cadres, especially for STEM and cybersecurity emphases**
    a. Is it feasible in all JROTC programs under your purview, or only for certain schools, to increase STEM academic offerings?
    b. Is there anything the Army or USACC could change with regard to policy, regulations, or culture to make it easier for you or your instructors to do your job?

Interview Methods

Interviews were conducted from May through August 2021 through Microsoft Teams video call or conference phone call. (Unless otherwise indicated, quotes in this report are from these interviews.) Protocols were developed for the four groups: instructors (SAIs and AIs), DAIs/brigade chiefs, school administrators and counselors who influence enrollment, and program graduates. Full protocols are available in Appendix B. Interviewees snowballed from the two states examined in the quantitative analysis portion of this project (Texas and Hawaii) and ultimately were primarily located in a six states. The count of interviewees by role is presented in Table 3.1; note that this was a convenience sample and thus likely not representative of the variety of individuals in these roles.

Table 3.1. Roles of Interviewees in Our Sample

Role	Number Interviewed
JROTC Instructor (SAI and AI)	6
Director of Instruction (DAI)	4
Brigade Chief	3
Counselor	4
JROTC Graduate	5

NOTES: DAIs and brigade chiefs were interviewed with the same protocol. Brigade chief regions cannot be listed without violating confidentiality.

The interview notes were first coded based on codes developed from the protocol. These codes were then augmented by a bottom-up thematic analysis. Code themes include the interpretation of modernization goals, including STEM curricular expansion and intraschool partnerships; how the value of cadre participation is communicated to and viewed by stakeholders; how stigma, including around uniforms, is experienced in the school or community;[7] the hiring and career pipeline of JROTC SAIs and AIs; and various issues around

[7] This was an extension of the protocol asking about potential cultural changes, per a request from the ASA M&RA.

site selection and USACC policy, the student experience in JROTC, and the impact of participation on a cadet's life and career.

Identifying Themes

Three researchers used deductive methods to establish the code structure for the semistructured interview analysis, which included 11 root codes and most of the child codes. Primary themes of interest identified prior to coding include the instructor pipeline, STEM curriculum expansion, program marketing and perception, innovations, stigma, student experience in program, and partnerships and collaborations. Interview coding was carried out by a single team member. A handful of child codes were added inductively through the process, but no additional major themes were identified.

Interviews: Thematic Findings

Modernization

The project found an awareness and embrace of the modernization strategy among instructors, DAIs, and brigade chiefs, with many efforts already underway. Awareness and integration of STEM efforts focused on CyberPatriot; some stakeholders discussed VEX Robotics. One brigade chief spoke highly of the drone racing and certification program in his schools, explaining that enthusiasm around drone certification might lead some schools on the Order of Merit List (OML) to consider National Defense Cadet Corps (a program that mirrors JROTC, except that schools bear the full operating costs rather than sharing costs with the DoD). Of note, some instructors did report that in well-resourced or STEM-focused schools, more STEM content in the JROTC curriculum might not attract new students, as many students are already accessing STEM in other courses, and that "blanketing STEM or cyber onto every cadet won't work as well." Another interviewee noted that the schools that might benefit most from a STEM and cyber focus might not have students who are ready to accept other aspects of JROTC: "a lot of the students [in Title I schools] who would be ideal for cyber might not be the most ideal for JROTC program and those aspects: I don't want to cut my hair, I don't want to wear a uniform."

Although stakeholders were generally moderately to very enthusiastic about the STEM curricular expansion, several stakeholders did express concerns about how "instructors can fit it all in," particularly if the required core curriculum is expanded. The 2020 JROTC modernization strategy memorandum does not acknowledge this trade-off nor does it provide guidance regarding other content areas (e.g., citizenship and leadership) that should be reduced (U.S. Army, 2020). It is an open question as to how such reductions might affect the program's ability to meet its traditional objectives. No interviewees indicated that they were provided guidance on how to balance modernization with the traditional components of the AJROTC curriculum.

There appears to be a lack of clarity on the intended implementation of the new requirements and guidance. This lack of clarity might lead to extensive variation in the degree and form of STEM and cyber incorporation in JROTC. As one instructor noted, “Everything we teach is beneficial . . . if I hated anything, I would just drop it. What I chose to teach from the curriculum, I felt like we need.”

Adding to this potential variation, there are many physical STEM resources available to cadre instructors in the classroom, including ample CyberPatriot teaching materials and VEX Robotics kits. However, multiple DAIs and instructors have expressed frustration with the lack of training for STEM activities. In the words of one SAI, “there is no two-week course to teach you how to be a VEX Robotics master.” This experience is supported by prior literature: A review of the literature finds that working out of field can disrupt teachers’ confidence in their instructional abilities and might lead to instructional gaps and challenges if their previous interactions with the subject have been nonexistent or negative (Hobbs, 2012).

It did appear from several conversations that there was a need for continuing education or other educational guidance for SAIs and/or AIs who want to feel more confident in their delivery of STEM extracurricular material. Mentorship from a senior teacher can help out-of-field teachers build confidence (Vale, 2010). However, if formal professional development is desired, a summary of prior research highlights that programs are more successful if they include a strong content focus, are well-aligned with the school district’s practices, are sufficiently long, and generate active participation (National Academies of Sciences, Engineering, and Medicine, 2016). Given interviewees’ mention of the many responsibilities of JROTC instructors, the additional demands of professional development—even if helpful in the long term—might pose a burden. One approach to meeting sufficient duration in a limited professional development time is to use an intensive session, often during the summer, followed by touch points throughout the school year for continued support (May and Lopez, 2020; Shernoff et al., 2017).

It also might be possible to supplement STEM expertise from outside the cadre through team teaching or coteaching or through community partnerships, both of which appear to already occur in multiple JROTC programs. Several instructors and DAIs did intraschool team-teaching partnerships; those mentioned included partnering with a physical education (PE) teacher for core class requirements and pairing with a computer science and a general science teacher for cyber and robotics extracurriculars. One model for STEM coteaching lessons mixes content learning and hands-on projects, with the lecture proceeding the immersive activity (Wang et al., 2020). This approach would permit a school-based content expert (i.e., a math or science teacher) to provide a content lecture and the JROTC instructor to engage students in the application-focused project.

In addition, extraschool partnerships were widely reported by all stakeholders, and most instructors appeared to take strong initiative and have deep roots in the surrounding community. However, these partnerships were primarily focused on the service-learning projects and student community volunteer work, not STEM education. The exception to this came in the form of the

JROTC Cadet Leadership Challenge (JCLC). One interviewed DAI discussed the hybrid STEM camp they run in collaboration with a local university, and another mentioned a STEM-focused JCLC in development. In Mobile County, Alabama, the STEM Leadership Academy is a STEM-intensive alternative to the JCLC funded by the National Science Foundation (Dean et al., 2021). The STEM Leadership Academy features faculty from local colleges, representatives from area industry, and guest motivational speakers to infuse STEM content into the weeklong program. Although this partnering could come with unique challenges, it might be a useful way to bring new expertise in STEM content to AJROTC. We discuss additional opportunities to expand community collaboration in the section focused on the instructor pipeline later in this chapter.

One instructor expressed strong feelings that there should be improvements to the JROTC Unit Management System (JUMS) to better align the system with modernization goals. They explained that instructors are strongly incentivized to complete a minimum number of activities each year and that the options for tagging these activities are fairly fine grained. However, there is no specific option for tagging the CyberPatriot competition, much less the other STEM activities possible with AJROTC. He explained that this exclusion of explicit STEM metrics might create a false sense of unimportance around modernization goals.

Thematic Findings: Communicating Value to Stakeholders

Beyond the need for STEM-specific metrics in JUMS, many interviewees thought that existing JROTC metrics are outdated and not sufficiently effective in appealing to school and community stakeholders (such as potential instructors, school leaders, parents, and students). In our interviews, a brigade chief and multiple SAIs and DAIs explained that, in many regions, a program's success is still defined by drill and other traditional aspects of JROTC rather than by elements emphasized by the modernization strategy. One instructor described getting repeatedly reprimanded by their DAI for not focusing enough on "throwing rifles around," while they felt they were trying to develop a program that focused on VEX Robotics.

Across all groups, there was consensus that communicating the value of JROTC to students, parents, and school counselors could increase enrollment and improve the longevity of programs in schools. Several instructors, DAIs, and school counselors also discussed that stakeholders are drawn to both traditional and updated activities. First, a strong draw for Leadership, Education, and Training (LET) 1 (the first year JROTC course) students is core course credits for graduation, particularly PE, health, and government; students then generally earn elective credits in subsequent years, but the core credit was repeatedly cited as the initial draw. In addition, a variety of schools, instructors, school counselors, and JROTC graduates reported that leadership opportunities were a strong draw for continuation, and occasionally initial enrollment, for many students. Several instructors and JROTC graduates mentioned that students found immense value in personal financial management aspects of the JROTC curriculum but that this content focus was not widely known to students and parents outside the program.

Each JROTC program is required to have a minimum enrollment of 100 students or a minimum of 10 percent of the student body, and some programs struggle to meet the requirement. There was consensus across interviewees that the understanding and buy-in of administrators who oversee course enrollment (e.g., school counselors) is key for ensuring adequate enrollment in JROTC. One DAI remarked, “Normally, when there’s a big drop in the numbers, it’s because counselors don’t understand what the program is actually like.” Although not explicitly solicited, interviewees rarely mentioned active engagement with counselors by instructors or other USACC personnel, but when it was reported, it appeared to be well received.

Finally, JROTC programs are under the purview of school administration, including principals and superintendents, who might move to shutter the program at their discretion. Several DAIs and brigade chiefs we interviewed tied the longevity of the program to communicating the value to the school and district administration. In particular, school leaders unfamiliar with JROTC program elements might struggle to see how program participation can help student performance on measures that school leaders value, including community service, workplace learning experience, and CTE credit. Negative attitudes toward military service (as opposed to college enrollment) might affect the support of JROTC by the school administration. It was reported in interviews that the benefits of JROTC to a school are not always effectively communicated by instructors to school administration. Some DAIs explained that they have been pushing for state-level CTE accreditation of JROTC so that they could demonstrate value on the specific metrics with which principals are concerned.

Uniforms and Potential Stigma

Instructors and JROTC graduates largely agree that uniforms create a sense of camaraderie and pride and contribute to the feeling of being a “family” or a close unit in the larger school. However, there was also simultaneous agreement that uniforms might discourage some students from initially joining. Some cadre leaders reportedly tailored requirements to meet perceived needs of student cohorts; this included wearing the uniform only in class, and not for the full day, as well as wearing a distinctive “khakis and polos with logo” casual uniform and only wearing the formal uniform monthly or for special occasions. Two instructors recommended starting off all LET 1 (and perhaps LET 2) students with a distinctive polo or T-shirt and khaki pants, then allowing committed students to “earn” their full uniform when they have reached LET 2 or LET 3. One instructor expressed frustration with the expense of purchasing and maintaining the uniforms, when they would prefer to use that money “for running a STEM camp for my kids.”

Thematic Findings: Instructor Pipeline

The instructor pipeline was explored in interviews with DAIs and instructors and included questions about initial hiring, desirable instructor qualities, recognition for exceptional instructors, instructor retention, and instructor exit. Reports varied on the difficulty of attracting military retirees, based on desirability of location and cost of living. Although certain urban and coastal areas did not have an issue with the initial hiring of instructors, others did report that rural regions and areas with high cost of living did struggle with vacancies. Every instructor, DAI, and brigade chief was asked how they first heard about JROTC instruction as a career option; no one reported Army or DoD retirement transition assistance as presenting JROTC as a postretirement career option. Instead, they reported a variety of nonsystematic ways in which they were exposed to the opportunity to teach JROTC, including prior personal experience, prior ROTC rotation, and word of mouth. One DAI mentioned putting "two announcements out to 'the network' to find the proper folks" and indicated that they usually filled vacancies with active recruitment.

Retaining "good-fit" SAIs and AIs was generally not seen as a problem by DAIs and brigade staff. Although multiple interviewees reported that many instructors cease teaching after one to two years, the consensus was that these "early exiters" were poor fits for JROTC given cultural differences between military life and the realities of being a high school teacher. Instructors who continued teaching past two years were widely reported to continue for years or even decades. Of note, most DAIs did report struggling to find meaningful ways to recognize outstanding instructors.

The level of SAI and AI compensation was broadly thought to be adequate by DAIs and instructors and was not highlighted by anyone as a cause of hiring or retention issues. JROTC instructors are reportedly often the highest-paid teachers on staff, sometimes nearing or surpassing the pay of the school principal. A few interviewees cautioned that the high pay sometimes created tension with other teachers in the school. A DAI and a brigade chief did mention that the pay, although they felt it was adequate, might not be enough to draw retirees with STEM skill sets away from industry positions and to JROTC instruction.

Alternatively, JROTC could leverage the STEM talent already present in community organizations, such as OST programs, local colleges and universities, and professional association chapters. This approach can build internal school and program capacity to sustain a new effort even if the partnership lapses (Shah et al., 2019). As a youth development program, JROTC might be particularly well suited to an intergenerational mentorship model that leverages both adult experts and undergraduate students (Rogers et al., 2020).

Some interviewees voiced support for allowing an *itinerant instructor* approach. Interviewees explained that an SAI and/or AI might travel to another nearby school with a population of interested students but that is perhaps not large enough to routinely meet the minimum enrollment requirements of USACC Regulation 145-2. One SAI appeared to feel strongly about finding solutions to enrollment requirements, remarking that "itinerant teachers already exist in the broader school system, and I would like to have an itinerant JROTC program where I have the flexibility to go out and support other schools that I know want JROTC."

Thematic Findings: Site Selection

Multiple DAIs and a brigade chief had critiques of the OML and selection processes, noting that they might overlook strong candidates and local knowledge. One interviewee provided an example: the opening of a new cadre in their district. The interviewee knew of a new high school scheduled to open in the near future in a nearby district that was a cyber magnet school, which might have been a better choice in alignment with the modernization strategy. Other examples were similar: A site was chosen when there appeared to be potentially better options (e.g., a school with a STEM emphasis).

In addition, there was consistent support expressed by various SAIs, DAIs, and school counselors for expanding JROTC to middle school ages. They felt that prior instruction in JROTC skills of citizenship, self-discipline, and others would benefit students just entering high school. Interviewees also shared their perception that the absence of strict graduation requirements as in high school (replaced by grade promotion requirements) could potentially provide more room in student schedules for JROTC participation.

Chapter 4. Analyses of Former JROTC Cadets Who Enlisted in the U.S. Army

Although JROTC participation does not require any promise of military service, many former JROTC cadets enlist in the Army. This chapter discusses the results of an analysis of their military careers.

Introduction and Research Questions

There are many postcompletion pathways for JROTC cadets. Some might pursue postsecondary education; some might join the civilian workforce; and some might pursue military service, either immediately or after further education or work experience. Chapter 6 includes an analysis of the frequency of different postcompletion pathways. In this chapter, we focus exclusively on those who join the Army, and our analysis is constrained to those who enlist—excluding commissioned officers.

We explore the relationship between participating in JROTC and career outcomes in the Army. Specifically, we focus on the likelihood of first-term attrition, the length of Army service, and the STEM focus of a soldier's first occupation specialty to see whether former JROTC cadets have better or worse Army career outcomes. We also describe the baseline characteristics of enlistees who participated in JROTC, those who earned an advanced paygrade at enlistment through other means, and other enlistees. Note that, in this analysis, we cannot distinguish those who participated in AJROTC from those who participated in another service's JROTC, such as Navy JROTC: All earn the same advanced paygrade. When we refer to JROTC in this chapter, we intend that to mean all JROTC programs, not just AJROTC.

To our knowledge, previous work is limited. Pema and Mehay, 2009, previously identified a higher rate of enlistment among JROTC participants compared with peers. In work focused on the Navy, Pema and Mehay, 2012, find that JROTC participants have lower early-career attrition and higher rates of reenlistment and promotion. They also find that, at least for the Navy, alignment between services makes a difference. Men who participated in Navy JROTC have significantly lower attrition compared with men who participated in other services' JROTC programs. They find no such alignment difference for women—women have a reduced rate of attrition regardless of which JROTC program they participated in.

Personnel Data and Analytic Approach

Sample and Data Source

For our personnel analyses, we use data on enlisted soldiers from the Army Analyst files (U.S. Army Reserve Analyst and Regular Army Analyst) linked to the Total Army Personnel Database (TAPDB). These data allow us to observe a soldier's full military profile, including enlistment and accession into the Army, demographic and background characteristics, military occupational specialties (MOSs), deployments, and reasons for separation. We received records on all enlisted active and reserve component soldiers between 1999 and 2021, yielding a total of 2,045,900 unique soldiers. We restrict to a subsample of this population, the approximately 1.4 million soldiers whose enlistment date and length of first contract enable us to potentially see them through to the end of their first contracted term. For example, a soldier signing a four-year contract accessing in 2016 would be included, but a soldier accessing in 2018 with the same contract would not. We exclude Army National Guard personnel from our analyses because their contracts are typically six or more years, and the Guard data accessible to the RAND Corporation date back to only 2015. Additional variable completeness restrictions narrow our sample to about one million soldiers who began their careers in the active component and 210,000 soldiers who began their careers in the reserve.

Identifying JROTC Cadets

AJROTC programs do not collect data on cadets (e.g., Social Security numbers) that enable linking program enrollment data with the Army's enlistment and accessions data. Rather, we use the accession paygrade and reason for advanced paygrade codes in the TAPDB to identify former cadets.[8] Individuals who successfully complete a JROTC course earn an advanced paygrade at the time of enlistment. Rather than entering as an E-1, those who participated in a JROTC program for one or two years may enlist as an E-2, and those who participated for three or more years may enlist as an E-3. Thus, using the TAPDB data, we identify a subset of former cadets who go on to enlist.

There are several challenges imposed by this approach. First, we are not able to differentiate participation in an AJROTC program from participation in another service branch's JROTC program—JROTC participation merits an advanced paygrade in all services regardless of which service "owns" the JROTC program, per policy (Department of Defense Instruction 1205.13). Second, any cadet who goes on to receive a four-year degree, whether through a service academy, an ROTC program, or another college or university and then is commissioned as an officer is not included in these data. Third, former AJROTC cadets who join other service branches are similarly missed by this approach.

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[8] The variable provided by TAPDB is *reason for advanced rank*, but we use *paygrade* throughout this document for consistency.

And finally, there are other reasons for receiving an advanced paygrade.[9] For example, individuals who participate in the Army Civilian Acquired Skills Program, who complete one year of senior ROTC, or who complete a two-year vocational training program earn the E-3 paygrade at accession. Thus, if a JROTC participant completed two years of JROTC (earning the E-2 paygrade at accession) and participated in any of these programs, she would enter the Army as an E-3. Her JROTC participation would not be captured in our data because another program earned her a higher paygrade. Similarly, other reasons for an individual earning a paygrade of E-2 could also obscure JROTC participation, depending on how the rationale was coded. A Girl Scout who received her Gold Award would also merit classification as an E-2, and this reason might supersede JROTC participation in how her reason for advanced paygrade was coded. Given these challenges, we view our approach as a sufficient but imperfect underestimate of the number and character of JROTC cadets who accession into the Army.

Identifying STEM Occupations

We are not aware of a systematic STEM coding of enlisted MOSs in the Army.[10] We leveraged the U.S. Census classification of STEM for civilian occupations, incorporating the MOSs whose civilian equivalent was classified as either "STEM" or "STEM related" to create our STEM MOS indicator (U.S. Census Bureau, 2019a). The details of this classification are available in Appendix C, but broadly, this includes all medical, chemical, cyber, surveying, and laboratory MOSs. We exclude certain temporary or placeholder MOSs from this indicator (classifying them as neither STEM nor non-STEM and dropping such soldiers from the STEM analysis).

Analytic Approach

We employ two analytical methods. First, to descriptively compare former cadets with noncadets, we use two-sample, two-tailed *t*-tests, a statistical technique to determine whether the average value among two different populations is equal. We use this method to explore the demographic characteristics and the accession characteristics of enlisted soldiers.

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[9] Reasons include JROTC participation (one to two years; three or more years), Senior ROTC participation (one year or more), prior education at a U.S. service academy, college attendance (more than 24 credit hours, more than 48 credit hours, two or more years, bachelor's degree), Army referral program, Billy Mitchell Award (Air Force Civil Air Patrol), prior military service, Boy Scout Eagle Award, Girl Scout Gold Award, Army Pre-Basic Training Task List, Army Civilian Acquired Skills Program, Quartermaster Award or Certificate Advancement (Naval Sea Cadet Program), and Special Forces Enlistment Program. Starting in 2020, there are new categories, such as referral of other qualified applicants, Venturing Scout Silver Award, and the Future Soldier preexecution checklist with certain physical fitness requirements.

[10] Army officers can be classified as STEM based on the college major taxonomies of Classification of Instructional Programs (CIP) codes. Both the Department of Homeland Security and National Science Foundation offer definitions of which CIP codes are STEM.

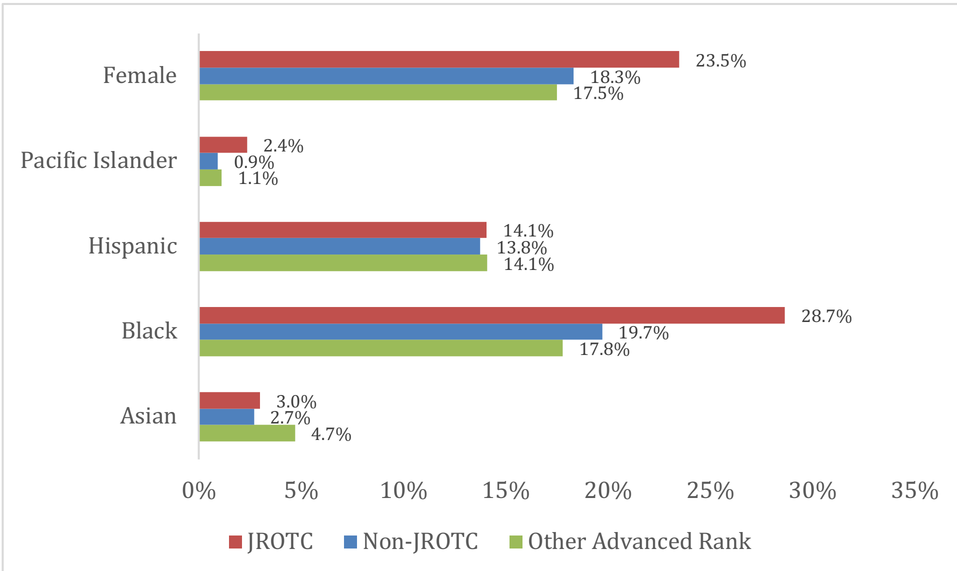
Second, to explore the correlation between JROTC participation and Army career outcomes, we use multivariate regression analysis. This analysis cannot be interpreted as causal—we are unable to account for the baseline differences between former cadets and noncadets before their service, because we only observe them only starting at the point of accession. However, our preferred models control for some variables that contribute to or reflect these baseline differences—demographics, years of education, Armed Forces Qualification Test (AFQT) score, and other reasons for advanced paygrade—and several variables that contribute to baseline variation in career outcomes, such as timing of accession; length of contract; deployments in the first term; and; in some models, first MOS. Regression models first estimate the overall relationship between JROTC participation and the outcome of interest (without accounting for MOS or first-term deployments) and then account for the number of years of participation. We do this additively by including an indicator for overall participation (JROTC [ever]) and a stacking indicator for participation for three or more years. A former cadet who participated for three years would have a value of one for *both* these indicators; thus, we can sum them to get the total relationship. Finally, we add in controls for MOS and first-term deployments (except for models in which the outcome is pursuing a STEM MOS). This is our preferred model and what is discussed in text.

We are not able to control for whether an individual's high school offered JROTC. Some of the individuals in our non-JROTC group might have specifically chosen to not participate in JROTC when their school offered the program. These individuals are inherently different than former JROTC cadets, but such differences cannot be observed in our data. We also are unable to control for some recruiting environment variables, such as the local unemployment rate and the military connectedness of the local community.

Characteristics of Former JROTC Cadets

We first look at the descriptive characteristics of former cadets in contrast to other enlisted. We compare two groups: other enlisted who enter with an advanced paygrade (some of whom might be former JROTC cadets) and those who enlist as E-1s. Former cadets are more diverse in terms of race and gender than those who come to the Army through other pathways. This demographic composition is reflective of the demographic composition in AJROTC, which is much more diverse than the military, as previously noted by Goldman and colleagues, 2017; approximately 40 percent of cadets are female (U.S. Army, 2021), compared with less than 15 percent of Army active component enlisted personnel (DoD, 2019). As shown in Figure 4.1, former cadets who enlist are 6 percentage points more likely to be female (24 percent compared with 18 percent), twice as likely to be Pacific Islanders (2 percent versus 1 percent), and 9 to 11 percentage points more likely to be Black (29 percent compared with 18 percent among other advanced paygrade and 20 percent among enlisting E-1s). A two-tailed *t*-test for each of these differences indicates a highly statistically significant ($p < 0.01$) difference. There was no significant difference in the ethnic composition of enlistees by JROTC participation (approximately 14 percent of each of the three groups is Hispanic). JROTC cadets who enlist are significantly less likely to be of Asian descent.

Figure 4.1. Race, Ethnicity, and Gender of Army Enlisted, by JROTC Participation



SOURCE: Analysis of U.S. Army Reserve Analyst and Regular Army Analyst data.

Figure 4.2 displays accession characteristics among the same three groups. We calculate the share with an enlistment waiver, average score percentile on the AFQT, average Skilled Technical line score calculated from the Armed Services Vocational Aptitude Battery, the share falling into recruitment Tier I (a high school diploma–holder or a nongraduate with at least 15 hours of college credit) and Tier II (General Education Development certificate holder),[11] and average age. Former JROTC cadets are significantly less likely to have required a waiver at enlistment (7 percent compared with 10 to 11 percent among other enlisted). Former JROTC cadets also are the most likely to be Tier I recruits among the three groups ($p < 0.01$). Former JROTC cadets have significantly lower average AFQT score percentiles (averaging 55th, compared with 56th among E-1s and 63rd among those with other reasons for advanced paygrade) and significantly lower line scores on the Skilled Technical. These differences are driven by differences in the upper tail of each group's AFQT and Skilled Technical distributions (i.e., the share with very high AFQT score percentiles and Skilled Technical line scores is higher for those with other reasons for advanced paygrade) rather than by any notable differences in the

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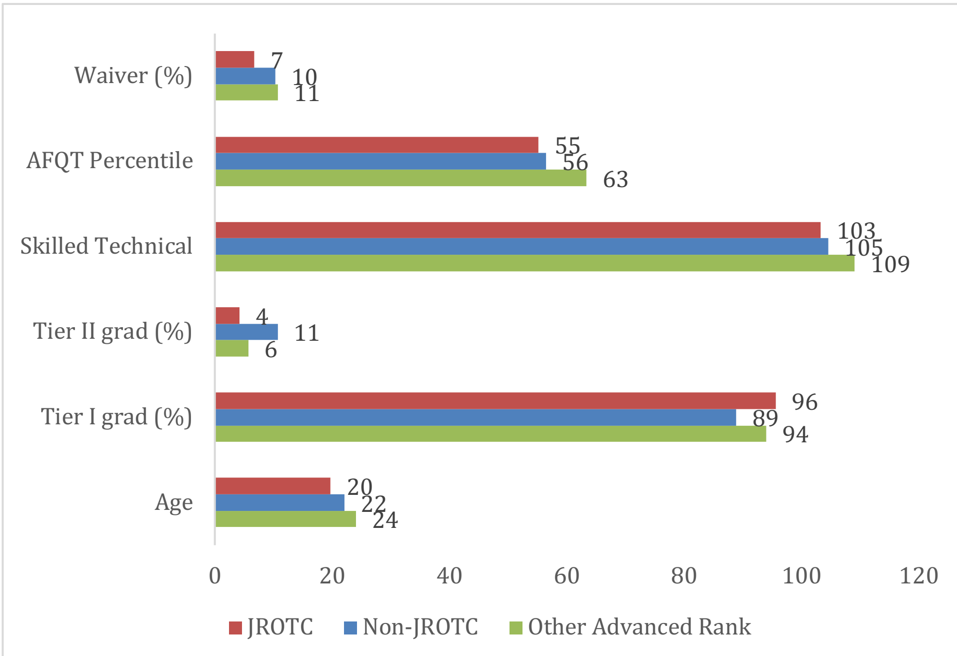
[11] Tier III graduates hold no education credentials. Because of their rarity in our sample, we do not present statistics on this group.

lower tail. If college attenders have higher AFQT scores on average, these differences could be driven by the college attenders in the "other reasons for advanced paygrade" group.

A table with full descriptive statistics for key variables is available in Appendix C, Table C.1.

Figure 4.2. Accessions Characteristics Among Army Enlisted, by JROTC Participation



SOURCE: Analysis of U.S. Army Reserve Analyst and Regular Army Analyst data.

First-Term Completion and Attrition

Among enlisted soldiers who start in the active component in our sample, more than 23 percent do not complete their first contracted term. Among reserve enlisted soldiers, this rate is 42 percent. We find, as shown in Table 4.1, that former cadets are less likely to leave service before the end of their first term. This finding is consistent with prior research, which shows that former JROTC participants were less likely to leave the Navy before the end of their first (four-year) contract term (Pema and Mehay, 2012). Cadets who start in the active component are, on average, 3 percentage points (about 13 percent) less likely to attrit. This is concentrated among cadets who participated in JROTC for three or more years, who are 5 percentage points (about 22 percent) less likely to attrit. Accounting for initial MOS (column 3) does not meaningfully change the magnitude or the significance of this estimate. Additional analyses suggest this reduced attrition comes primarily from a reduction in the risk of involuntary discharge.

In the reserve component, we see a smaller overall relationship (column 4), and no significant differences by number of years of JROTC (columns 5 and 6). Cadets in the reserve have a 1.1 percentage-point (a little less than 3 percent) reduction in the likelihood of first-term attrition compared with other enlisted. However, the smaller sample and smaller coefficient mean that, when we account for initial MOS, the coefficient is less-precisely estimated and does not meet some standards of statistical significance.

Table 4.1. Attrition During First Contracted Term, by JROTC Participation, Linear Probability Model

Characteristics	(1) Active	(2) Active	(3) Active	(4) Reserve	(5) Reserve	(6) Reserve
JROTC (ever)	−0.030***			−0.011**		
	(0.002)			(0.003)		
JROTC (1–2 years)		0.000	−0.002		−0.010*	−0.010*
		(0.003)	(0.003)		(0.005)	(0.005)
JROTC (3+ years)		−0.050***	−0.052***		−0.011**	−0.010*
		(0.003)	(0.003)		(0.004)	(0.004)
Female	0.172***	0.173***	0.176***	0.047***	0.047***	0.048***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Asian	−0.066***	−0.067***	−0.065***	0.005	0.005	0.005
	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)
Black	−0.041***	−0.042***	−0.035***	−0.010***	−0.010***	−0.012***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Hispanic	−0.080***	−0.080***	−0.078***	−0.044***	−0.044***	−0.046***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Other reason for advanced paygrade	−0.065***	−0.065***	−0.075***	−0.014***	−0.014***	−0.015***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Controls						
First MOS	No	No	Yes	No	No	Yes
Accession characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Age	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,014,118	1,014,118	1,013,335	209,548	209,548	209,329
R-squared	0.043	0.043	0.081	0.218	0.218	0.221

SOURCE: Analysis of U.S. Army Reserve Analyst, Regular Army Analyst, and Total Army Personnel Database data.
NOTES: Accession characteristics include month and year of accessions, recruitment tier, AFQT score, citizenship, and contracted term length. Robust standard errors are in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

The finding of a reduced risk of first-term attrition raises the question of pathway. If the reduction occurs primarily through a reduction of *voluntary* attrition, this suggests that there is substantial selection underlying these models, because former JROTC cadets would have a revealed differential propensity toward (for example) disability, targeting under force reduction, or parenthood. Thus, we repeat our model of first-term attrition, but substitute first-term involuntary discharge as our dependent variable in Table 4.2.[12] Note that involuntary discharge is

[12] Reasons for involuntary discharge include disability, misconduct, court martial, force reduction, and insufficient performance.

not coded for any separations in the reserve component during our analysis window; thus, we focus on the active component.

Table 4.2. Involuntary Discharge During First Contracted Term, by JROTC Participation, Linear Probability Model

Characteristics	(1) Active	(2) Active	(3) Active
JROTC (ever)	−0.029***		
	(0.002)		
JROTC (1–2 years)		−0.002	−0.001
		(0.003)	(0.003)
JROTC (3+ years)		−0.046***	−0.046***
		(0.003)	(0.003)
Other reason for advanced paygrade	−0.078***	−0.078***	−0.077***
	(0.001)	(0.001)	(0.001)
Controls			
First MOS	No	No	Yes
Accession characteristics	Yes	Yes	Yes
Age	Yes	Yes	Yes
Observations	967,042	967,042	966,294
R-squared	0.042	0.042	0.044

SOURCE: Analysis of U.S. Army Reserve Analyst, Regular Army Analyst, and Total Army Personnel Database data.
NOTES: Accession characteristics include month and year of accessions, recruitment tier, AFQT score, citizenship, and contracted term length. Sample excludes discharged individuals whose type of discharge was not coded. Robust standard errors are in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

We find a substantial reduction in involuntary discharge among those who completed three or more years of a JROTC program, although the magnitude of the relationship is somewhat smaller than that of the “other reason for advanced paygrade” variable. Participating in JROTC for at least three years is associated with a more than 4 percentage-point reduction in involuntary discharge during the first term, off a base of 16.4 percent (a 28 percent reduction).

Occupational Specialties

Table 4.3 displays the results of a linear probability model for having an initial MOS that is STEM focused (for reference, about 8 percent of enlisted soldiers in our sample meet this definition). Note that this model’s sample is comparatively large because we do not need to exclude more-recent accessions (no issue of truncation). Overall, former cadets who start their careers in the active component (columns 1 and 2) are 0.8 percentage points (10 percent) more likely to start in a STEM-focused MOS than those who were not identified as JROTC participants. This magnitude is comparable with what is observed among those with other reasons for an advanced paygrade at enlistment (i.e., 0.9 percentage points). We find no difference in likelihood of a STEM MOS for cadets who participated in JROTC for three or more years, compared with cadets with one to two years of JROTC participation. Among those who start in the reserve component (columns 3 and 4), we find a slightly smaller coefficient of 0.2 to 0.5 percentage points, but these less-precise estimates are not statistically significant and are smaller than the (significant) coefficient on other reason for advanced paygrade.

Choosing a STEM MOS as an enlisted soldier is just one way that a former cadet might leverage the STEM knowledge gained through JROTC participation. In this analysis, we are unable to assess the STEM contributions of those who earn a commission and serve as officers in the Army and of those who pursue STEM careers in civilian life. Moreover, the cadets who are most motivated by STEM might be the most likely to obtain bachelor's degrees, the vast majority of whom would mechanically be excluded from this analysis (although some enlisted soldiers hold bachelor's degrees, most do not).

Table 4.3. Initial Occupational Specialty Is STEM, by JROTC Participation, Linear Probability Model

Characteristics	(1) Active	(2) Active	(3) Reserve	(4) Reserve
JROTC (ever)	0.008***		0.004	
	(0.001)		(0.003)	
JROTC (1–2 years)		0.008***		0.005
		(0.002)		(0.004)
JROTC (3+ years)		0.009***		0.002
		(0.002)		(0.004)
Female	0.094***	0.094***	0.059***	0.059***
	(0.001)	(0.001)	(0.001)	(0.001)
Asian	0.053***	0.053***	0.050***	0.050***
	(0.002)	(0.002)	(0.003)	(0.003)
Black	0.023***	0.023***	0.009***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)
Hispanic	0.025***	0.025***	0.014***	0.014***
	(0.001)	(0.001)	(0.002)	(0.002)
Other reasons for advanced paygrade	0.009***	0.009***	0.011***	0.011***
	(0.001)	(0.001)	(0.002)	(0.002)
Controls				
Accession characteristics	Yes	Yes	Yes	Yes
Age	Yes	Yes	Yes	Yes
Observations	1,270,605	1,270,605	324,471	324,471
R-squared	0.064	0.064	0.064	0.064

SOURCE: Analysis of U.S. Army Reserve Analyst, Regular Army Analyst, and Total Army Personnel Database data.
NOTES: Accession characteristics include month and year of accessions, recruitment tier, AFQT score, citizenship, and contracted term length. Robust standard errors are in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Career Duration

The final Army service outcome we examine is the length of military service. Prior research suggests that former JROTC participants serving in the Navy demonstrate higher rates of second-term reenlistment than Navy personnel who did not participate in JROTC (Pema and Mehay, 2012). We extend the research in this area by examining total length of service, not just second-term reenlistment. Because this analysis extends beyond the first contracted term for many soldiers, we characterize the component in which the soldier started their service, noting that this might not be where they completed their service. As with the analysis of first-term attrition, we control for demographics; accession characteristics; and, in some models, initial MOS. The average career length of soldiers in our sample is 5.5 years among those who started their service in the active component and 6.7 years among those who first served in the reserve component.

As shown in Tables 4.4 and 4.5, we find strong evidence that former cadets serve longer. In column 1, we see that, in the active component, former cadets are 7.3 percentage points more likely than non-JROTC cadets to serve at least 6 years and 4.2 percentage points more likely to serve at least 15 years. The majority of this effect is driven by cadets who participated in JROTC for three or more years, but we find a statistically significant effect for both groups for the majority of analyses.

Recall that we showed in Table 4.1 that former cadets are more likely to complete their first terms than noncadets, which could be driving this result. In column 4 of Tables 4.4 and 4.5, we add in an indicator for first-term attrition, and we see that the service lengthening extends beyond just completing the first term: Although the coefficient for those with three or more years of participation attenuates somewhat, it remains statistically significant, suggesting longer service comes over and above completing the first term. However, the career-lengthening influence of JROTC appears to attenuate over the career, with a 7 percentage-point impact on careers being at least six years versus a 4 percentage-point impact on careers being at least 15 years.

We find a similar pattern among reservists: Former cadets are 4.6 percentage points more likely to serve at least six years, and 4.4 percentage points more likely to serve at least 15 years. We can see in column 8 that this extends beyond first-term completion in the reserve as well for those who participated in JROTC for at least three years.

Note that the coefficient on “other reasons for advanced paygrade” is comparable in magnitude with the coefficient for participating JROTC for at least three years and is notably larger than the coefficient for participating in JROTC overall (any amount of time).

Table 4.4. Length of Service Is Six or More Years, by JROTC Participation, Linear Probability Model

Characteristics	(1) Active	(2) Active	(3) Active	(4) Active	(5) Reserve	(6) Reserve	(7) Reserve	(8) Reserve
JROTC (ever)	0.073***				0.046***			
	(0.002)				(0.005)			
JROTC (1–2 years)		0.033***	0.031***	0.032***		0.027***	0.026***	0.011
		(0.004)	(0.004)	(0.003)		(0.006)	(0.006)	(0.005)
JROTC (3+ years)		0.100***	0.096***	0.069***		0.062***	0.060***	0.049***
		(0.003)	(0.003)	(0.002)		(0.006)	(0.006)	(0.005)
Female	−0.127***	−0.127***	−0.145***	−0.036***	−0.091***	−0.091***	−0.094***	−0.051***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Asian	0.048***	0.049***	0.045***	0.006*	0.013*	0.013*	0.011*	0.020***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)
Black	0.067***	0.067***	0.058***	0.034***	0.022***	0.022***	0.022***	0.013***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)
Hispanic	0.083***	0.083***	0.080***	0.033***	0.074***	0.074***	0.074***	0.056***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.003)	(0.003)	(0.003)	(0.002)
Other reasons for advanced paygrade	0.113***	0.113***	0.116***	0.070***	0.095***	0.095***	0.101***	0.054***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)	(0.002)
Controls								
First MOS	No	No	Yes	Yes	No	No	Yes	Yes
Accession characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First-term attrition	No	No	No	Yes	No	No	No	Yes
Observations	898,662	898,662	897,879	897,879	236,228	236,228	235,473	235,473
R-squared	0.065	0.065	0.078	0.356	0.155	0.155	0.167	0.362

SOURCE: Analysis of U.S. Army Reserve Analyst, Regular Army Analyst, and Total Army Personnel Database data.
NOTES: Accession characteristics include month and year of accessions, recruitment tier, AFQT score, citizenship, and contracted term length. Model includes accession years 2000 to 2014. Robust standard errors are in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table 4.5. Length of Service Is 15 or More Years, by JROTC Participation, Linear Probability Model

Characteristics	(1) Active	(2) Active	(3) Active	(4) Active	(5) Reserve	(6) Reserve	(7) Reserve	(8) Reserve
JROTC (ever)	0.042***				0.044***			
	(0.004)				(0.008)			
JROTC (1–2 years)		0.029***	0.029***	0.026***		0.025*	0.024*	0.015
		(0.005)	(0.005)	(0.005)		(0.010)	(0.010)	(0.010)
JROTC (3+ years)		0.055***	0.055***	0.044***		0.064***	0.063***	0.048***
		(0.005)	(0.005)	(0.005)		(0.011)	(0.011)	(0.010)
Female	−0.073***	−0.073***	−0.080***	−0.034***	−0.060***	−0.060***	−0.060***	−0.034***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Asian	0.032***	0.032***	0.033***	0.018***	0.004	0.004	0.005	0.014
	(0.004)	(0.004)	(0.004)	(0.004)	(0.008)	(0.008)	(0.007)	(0.007)
Black	0.052***	0.052***	0.049***	0.040***	0.044***	0.044***	0.042***	0.033***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)
Hispanic	0.049***	0.049***	0.050***	0.032***	0.048***	0.048***	0.048***	0.040***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)	(0.005)	(0.004)
Other reasons for advanced paygrade	0.071***	0.071***	0.072***	0.057***	0.043***	0.043***	0.046***	0.026***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.005)	(0.004)
Controls								
First MOS	No	No	Yes	Yes	No	No	Yes	Yes
Accession characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First-term attrition	No	No	No	Yes	No	No	No	Yes
Observations	293,293	293,293	292,554	292,554	76,080	76,080	76,045	76,045
R-squared	0.039	0.039	0.045	0.107	0.179	0.179	0.187	0.248

SOURCE: Analysis of U.S. Army Reserve Analyst, Regular Army Analyst, and Total Army Personnel Database data.
NOTES: Accession characteristics include month and year of accessions, recruitment tier, AFQT score, citizenship, and contracted term length. Model includes accession years 2000 to 2005. Robust standard errors are in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Limitations

As noted previously, we cannot identify all former JROTC cadets who enlist, and the missing cadets are not random. If additional education and skills (which either merit other reasons for advanced paygrade or correspond with a commission) are considered positive traits, we are missing a subset of the "best" former cadets. Moreover, this analysis is not causal—potential enlistees were not randomly assigned to participate in JROTC, and which former cadets choose to enlist is similarly nonrandom. Our analyses are vulnerable to the potential threat that particular populations, equally interested in the military, differentially decide to participate in JROTC based on other characteristics (e.g., their ability to show up to school regularly, maintain disciplinary standards, or remain in good academic standing) that might also affect their success in the military. However, our findings of reduced first-term attrition are consistent with former cadets having a keener understanding of military life and capacity to adapt to expectations.

Chapter 5. Outcomes of AJROTC Cadets in High School and Beyond

AJROTC seeks to foster in young people knowledge of a variety of educational and vocational opportunities and to result in their pursuit of meaningful careers and contributions to their communities. A key component of this project was to examine the outcomes of AJROTC cadets, relative to similar noncadets, in terms of educational, career, and life outcomes. In this chapter, we present analyses of data from two case study states—Texas and Hawaii—that allow us to estimate the impact of AJROTC participation on high school outcomes and rates of enrollment in postsecondary education. In Texas, we also explore associations between program participation and workforce outcomes and intentions to enlist in the military.

The two case study states differ greatly from each other. Texas is among the most populous states in the nation, accounts for more AJROTC students and schools than any other state, and has a student population that skews more Hispanic, more economically disadvantaged, and slightly more urban than the national average. By contrast, Hawaii is among the least populous states, contains large Asian and Native Hawaiian or Other Pacific Islander populations, and has a student population that is somewhat less economically disadvantaged and a bit more likely to attend schools in rural areas or small towns than the national average. These differing settings allow us to compare and contrast impacts on the two different populations of students.

Our analyses leverage novel data sets developed by these states that track students throughout high school and beyond and employ a research design known as a *quasi-experiment* that allows us to estimate the impact of the program by comparing AJROTC students with students with similar characteristics at schools with similar characteristics as AJROTC students' schools but that do not offer JROTC. Our quasi-experimental methods yield estimates that approximate causal impacts much more closely than naïve comparisons or regression analyses that are unable to account for characteristics of AJROTC students prior to participating in the program. Nevertheless, they are not strictly causal because of the potential for unobserved differences in student characteristics to bias our results. We follow the best practices established by the What Works Clearinghouse—a U.S. Department of Education program that assesses whether education program evaluations meet rigorous standards for research design—to address any observed differences in characteristics. In addition to our impact analysis, we draw on the same data from Texas and Hawaii to analyze existing cyber and computer science teaching capacity at AJROTC schools.

Overview of Analytic Approach and Data

Conceptually, the ideal way to assess AJROTC program impacts on student outcomes would be by *random assignment*—that is, assigning students at random to participate or not. Such an experimental research design provides confidence that any differences in outcomes between participants and nonparticipants are because of the program, as opposed to resulting from preexisting differences between participants and nonparticipants. However, random assignment to participate in AJROTC is not a viable implementation approach. First, AJROTC seeks particular community and school characteristics when determining where to place its programs. These site selection factors purposively place programs in schools that serve larger proportions of students from historically marginalized backgrounds. Second, students self-select into participating in AJROTC when their school offers the program.

The next-best analytic approach to estimating the effects of AJROTC on students is to identify an appropriate comparison group—students who are as similar as possible to AJROTC students prior to their participation in the program—and to compare outcomes for this group with AJROTC students after they have participated in the program. Conducting such analyses requires a large volume of individual- and school-level data to identify AJROTC students, construct an appropriate comparison group, and track outcomes for both groups over time. It also relies on sophisticated statistical analysis techniques that approximate a random experiment by controlling, to the greatest extent possible, for preexisting differences between AJROTC students and schools and nonparticipants. Here we briefly explain our analytic approach, describing our data sources and methods. Additional details are included in Appendix D.

Data Sources

We used data from the Statewide Longitudinal Data Systems (SLDS) for Texas and Hawaii. SLDS are relatively novel data resources, the result of an emphasis on compiling and linking data across previously siloed administrative data systems to support evaluation of the long-term impacts of educational programs and other interventions. Most states have an SLDS in some form; however, the quality, contents, and accessibility of these data systems vary widely. Essential for our analysis was a means through which to identify AJROTC students in the SLDS data, enough AJROTC schools in the state to support the analysis, and enough years of high-quality data to track AJROTC participants throughout high school and into postsecondary education. We sought SLDS data from four states across three USACC brigades; ultimately, we were able to reach data-sharing agreements with two of these states in time to conduct the analyses: Texas and Hawaii.[13] More details on the constraints we faced in selecting case study states are available in Appendix D.

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[13] We also pursued data from two states in USACC's 7th brigade but were unable to gain access to the data in time to conduct analyses for this project.

Texas and Hawaii offer differing settings in which to analyze the impacts of AJROTC participation. Texas is among the largest states in the nation, is home to several major Army installations, has a larger veteran population than any state except California (U.S. Census Bureau, 2019b), has the most active AJROTC programs, and has the most AJROTC students in the country. Students in Texas are more likely to be Hispanic and less likely to be white than the national average, more likely to be eligible for free or reduced-price lunch (FRPL) (a common measure of economic disadvantage in education research), and about 2 percentage points more likely to attend schools in urbanized areas than the national average (see Table 5.1).[14]

Hawaii is much smaller in area and population yet also has a large military presence and has among the highest propensities to enlist in the Army among young people (Center for Naval Analyses, 2018). Students there are less likely to be eligible for FRPL than the national average, are slightly more likely to be enrolled at rural or small town schools, and are much more likely to identify with a race or ethnicity other than Black, white, or Hispanic, owing to the large Native Hawaiian, Pacific Islander, and Asian populations in Hawaii.

Table 5.1. Descriptive Comparison of All Students in Texas and Hawaii

Characteristics	National	Texas	Hawaii
USACC Brigade	First Through Eighth	Fifth	Eighth
White	47%	27%	12%
Black	15%	13%	2%
Hispanic	27%	53%	15%
Other Race	11%	7%	71%
FRPL Eligible	52%	61%	46%
City or Suburban	70%	72%	68%
Rural or Small Town	30%	28%	32%
Relative Propensity to Enlist in Army Active Component, Ages 18–24	1.00	1.29	1.56

SOURCES: U.S. Department of Education, undated-a (2018–2019 data accessed); U.S. Department of Education, undated-b (2018–2019 data accessed); Center for Naval Analyses, 2018.
NOTES: Student data include all students (not limited to JROTC participants) in public elementary and secondary schools as of fall 2018. “FRPL eligible” indicates the share of students eligible for FRPL under the National School Lunch Program. Relative propensity to enlist data are for fiscal year 2018 and reflect the ratio of the state’s share of all U.S. non–prior service enlisted accessions to the Army active component to the state’s share of the U.S. civilian population, ages 18 to 24.

[14] The National Center for Education Statistics locale categorization system for schools includes four main categories: city, suburban, town, and rural. City and suburban schools are those located in *urbanized areas*, defined by the U.S. Census Bureau a having a “densely settled core” and at least 50,000 people (National Center for Education Statistics, undated; U.S. Census Bureau, undated).

Our Texas data include students entering high school in the 2003–2004 school year through those entering in 2015–2016, allowing us to look at four-year on-time graduation rates for 13 cohorts of students (the 2018–2019 school year was the last available to us). Hawaii data include five fewer cohorts of students but one more year of data, with our eight cohorts including high school entrants in 2009–2010 through 2016–2017.

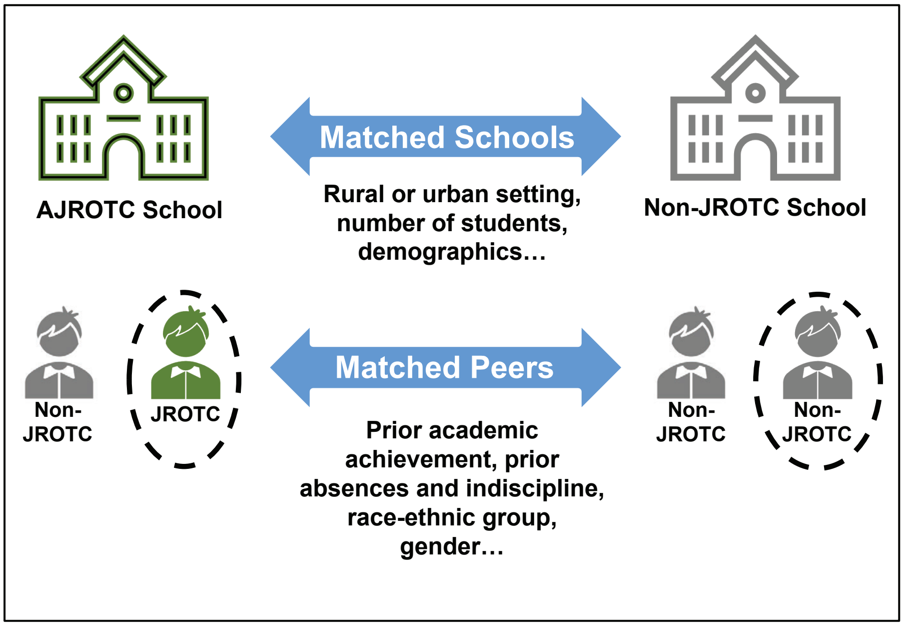
Both Texas and Hawaii SLDS data include course-level information on individual students that allow us to identify AJROTC participants. They also include a wide variety of information on students' demographic and socioeconomic characteristics, academic records, and high school outcomes. Both data sets include a measure of postsecondary enrollment, although Texas data generally are limited to enrollments in public schools in Texas. In addition, the Texas SLDS includes wage information and data on students' intentions to enlist in the military as reported by their schools for a subset of cohorts.

We supplemented the individual-level SLDS data with three additional data sources. First, we used publicly available National Center for Educational Statistics data on school-level characteristics, accessed through a data portal made available by the Urban Institute. Second, we received data from USACC to identify schools with AJROTC programs and from DoD Civil Military Programs to identify schools with JROTC programs of other service branches. Third, we used the Defense Installations Spatial Data Infrastructure Program's Military Installations, Ranges, and Training Areas publicly available file, linked to AJROTC program locations, to measure school proximity to military installations (DoD, 2017). Complete details on our data sources are provided in Appendix D.

Methods

We analyze the impact of AJROTC on student outcomes via a quasi-experiment that seeks to answer the basic question: What if students who had access to AJROTC and chose to participate instead attended an otherwise similar high school that did not offer JROTC? Answering this question requires two steps: (1) identifying schools that are like AJROTC schools but that do not have JROTC programs and (2) identifying students at those schools who are like AJROTC students. Figure 5.1 provides a visual representation of this two-level matching approach. Our treatment group, AJROTC participants at AJROTC schools, is compared with a control group of students at non-JROTC schools that is weighted such that students who are most like AJROTC students have the largest influence on the analysis.

Figure 5.1. Quasi-Experimental Matching Approach



We primarily used public data to match each AJROTC school in Texas and Hawaii with up to three non-JROTC comparison schools based on their total student enrollment, urbanicity, and additional demographic and socioeconomic factors. In Texas, we also incorporated a measure of proximity to military installations in the school-level matching. For both states, we drew on both DoD data and SLDS data to refine the set of potential comparison schools to those without JROTC programs of any service branch.[15] The school-level matching process resulted in sets of *matched blocks* of schools—one or more AJROTC schools grouped with up to three similar comparison schools.

We then use a quasi-experimental approach known as propensity score weighting to weight students at the comparison schools in each block such that students most similar to the AJROTC students at the AJROTC school(s) in that block receive the largest weights and factor into the analysis to a greater degree. These weights are determined based on student characteristics prior to entering high school, drawn from the SLDS data, including academic achievement, absences and indiscipline (i.e., in-school or out-of-school suspensions), and an array of demographic and socioeconomic measures. Students attending AJROTC schools but not participating in the program are excluded from the analysis.

Having constructed a comparison group that is very similar to AJROTC participants in many important dimensions at the point of entry to high school, we then estimate the impact of

[15] We further restricted the set of AJROTC and potential comparison schools to schools that were open during the bulk of the time span of the analysis, that were not alternative or charter schools, and that included ninth through twelfth grades. See Appendix D for details.

AJROTC participation on high school, postsecondary, and workforce outcomes. Our impact estimation approach accounts for both school-level differences (via the matched blocks) and student-level differences (via the propensity weights) between participants and nonparticipants; it incorporates additional statistical controls to account for differences over time and between schools. This quasi-experimental method enables us to estimate impacts of AJROTC participation that approximate causal impacts.

We run the analyses—both propensity weighting and outcome impact estimation—for three sets of AJROTC-treated and comparison groups:

- students participating in AJROTC in *at least* ninth grade and therefore receiving at least some exposure to the program in high school
- students participating in AJROTC in *at least* ninth and tenth grades
- students participating in AJROTC all four years in high school.

In all cases, we require both AJROTC and comparison students to follow standard grade progression in high school (e.g., students retained in grade nine are excluded from the analysis of ninth and tenth grade participants). This is to mitigate the extent to which criteria that govern whether students are permitted to participate in AJROTC (e.g., students might not be able to participate if they are not on track to graduate) influence our impact estimates. We note that, although students must have participated in AJROTC in the specified high school grades to be in the analyses (at least ninth, at least ninth and tenth, or all four years), they did not necessarily successfully complete that number of years of AJROTC; they might have enrolled in just one semester, failed the course, or received an incomplete.

Descriptive Comparison: AJROTC and Non-JROTC Schools and Students

The motivation for the quasi-experimental research design described above in part is our recognition that AJROTC and non-JROTC schools, and students at AJROTC schools who do or do not choose to participate in the program, differ on many important characteristics that might be associated with the outcomes we study. Simple outcome comparisons, therefore, might reflect these preexisting differences rather than identify the value-add of participating in AJROTC. We see this clearly in Texas and Hawaii. In both states, typical AJROTC schools are much larger than schools that do not offer JROTC programs and are more likely to be in urbanized areas (cities and their surrounding suburbs) than in rural areas or small towns. In Table 5.2, AJROTC schools are those in our analysis, whereas non-JROTC schools are referred to as *potential comparison schools* because only a subset of them that *are similar* to one or more AJROTC schools end up in our analysis.

Table 5.2. Size and Urbanicity of AJROTC and Non-AJROTC Potential Comparison Schools

Characteristics	AJROTC Schools	Non-JROTC Potential Comparison Schools
Texas		
Number of Schools	184	820
Median Total Enrollment	1,851	580
Share in Cities or Suburbs	89%	12%
Hawaii		
Number of Schools	16	20
Median Total Enrollment	1,362	663
Share in Cities or Suburbs	63%	25%

SOURCE: University of Texas at Dallas Education Research Center, 2021; Hawai‘i P-20 Partnerships for Education, 2021.
NOTE: Enrollment and urbanicity data reflect 2017–2018 school year data.

Students at schools with AJROTC programs have higher rates of economic disadvantage than students at non-JROTC schools, are more likely to be Black or Hispanic in Texas or Native Hawaiian in Hawaii, have higher rates of absences in eighth grade, and score lower on average on eighth grade math exams.[16] The disparities are especially pronounced for students at AJROTC schools who take AJROTC, underscoring the differences not just between the schools but between students who opt to participate in AJROTC versus those who do not. The averages presented in Table 5.3 reflect students enrolled in ninth grade at AJROTC and "potential comparison" schools that did not offer JROTC over the years in our analysis, including 2003–2004 through 2015–2016 cohorts in Texas and 2009–2010 through 2016–2017 cohorts in Hawaii.

Table 5.3. Descriptive Comparison of Students at AJROTC and Non-AJROTC Potential Comparison Schools, Ninth Grade Cohorts in Years in Analysis

Characteristics	Non-JROTC Potential Comparison Schools, All Students	AJROTC Schools, Students Never Taking AJROTC	AJROTC Schools, Students Ever Taking AJROTC
Texas			
Number of Students	996,654	779,153	128,427
Economically Disadvantaged	43%	68%	78%
Black or Hispanic	38%	79%	84%
Average Eighth Grade Absence Rate	3.8%	4.3%	4.6%

16 We present descriptive differences for additional characteristics in Appendix D.

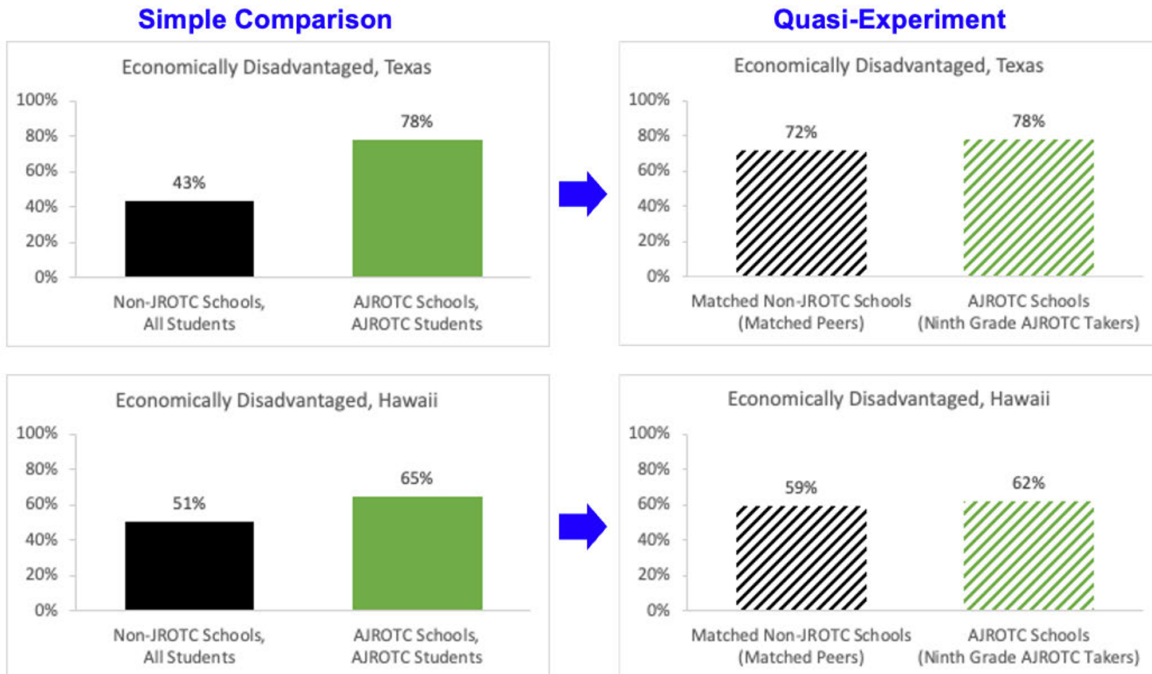
Characteristics	Non-JROTC Potential Comparison Schools, All Students	AJROTC Schools, Students Never Taking AJROTC	AJROTC Schools, Students Ever Taking AJROTC
Average Percentile on Eighth Grade Math Exam	54	47	43
Hawaii			
Number of Students	25,738	34,328	6,462
Economically Disadvantaged	51%	56%	65%
Native Hawaiian or Other Pacific Islander	34%	34%	38%
Average Eighth Grade Absence Rate	5.2%	5.5%	5.6%
Average Percentile on Eighth Grade Math Exam	52	50	40

SOURCE: Summary statistics are based on data pooled across cohorts and include the 2003–2004 through 2015–2016 ninth grade cohorts in Texas the 2009–2010 through 2016–2017 ninth grade cohorts in Hawaii. University of Texas at Dallas Education Research Center, 2021; Hawai‘i P-20 Partnerships for Education, 2021.
NOTES: Data reflect the characteristics of students in ninth grade cohorts at schools without JROTC programs and schools with AJROTC programs depending on whether students took AJROTC at any point in high school.

A simple comparison of outcomes finds stark differences between AJROTC students and students at schools without JROTC programs: On-time graduation rates are about 12 percentage points lower for Texas AJROTC students than for their non-JROTC school counterparts (80 versus 92 percent), and about 5 percentage points lower in Hawaii (82 versus 87 percent). However, this simple comparison might reflect preexisting differences between AJROTC students and schools and their counterparts and *does not answer* the question of whether participating in AJROTC affected the participating students' trajectories in high school relative to what would have happened had those same students attended schools that did not offer JROTC.

Our quasi-experimental analysis approach allows us to make estimates that approximate causal impacts because it yields AJROTC student and comparison groups that are *much more similar* on entry to high school than in the simple comparison. Although unobservable characteristics might differ between the AJROTC student and comparison groups, we expect that balancing on these observable characteristics increases the likelihood that unobservable characteristics are also similar. Figure 5.2 illustrates the improvement in balance between groups for one characteristic and one analysis group. In this case, the focal characteristic is the percentage of students who are economically disadvantaged, and the analysis group is students taking AJROTC in ninth grade (and possibly beyond).

Figure 5.2. Percentage Economically Disadvantaged, Simple Comparison Versus Ninth Grade AJROTC Takers, Quasi-Experimental Analysis



SOURCE: University of Texas at Dallas Education Research Center, 2021; Hawai'i P-20 Partnerships for Education, 2021.
NOTES: Economically disadvantaged students are those eligible for FRPL through the National School Lunch Program. Matched schools reflect a subset of schools in each state that did not offer JROTC and that are similar to one or more schools offering AJROTC; see Appendix D for details on our school-level matching approach.

Baseline characteristics vary across our treatment samples depending on the state and on years of participation in the AJROTC program. In general, students who persist in AJROTC are higher achieving, have lower absence rates, and are less likely to be economically disadvantaged or in racial or ethnic minority groups than those who do not. Table 5.4 provides a selection of descriptive statistics for the three treatment samples in each state. We underscore that the differences between the three treatment samples result in matched comparison groups that also differ—each one constructed to match each treatment sample. We include descriptive statistics for additional characteristics and both treatment and comparison groups in Appendix D.

In both states, the *number* of students who take AJROTC in at least ninth grade is much larger than the number who take AJROTC in at least ninth and tenth grades or who take it all four years in high school. We note that the much larger number of students we observe in our "at least ninth grade" samples in Texas and Hawaii is consistent with broader trends in AJROTC participation. According to program data tracked by USACC, nearly half of all AJROTC students nationally were in ninth grade versus about one-quarter who were in tenth grade and only about one-eighth who were in eleventh and twelfth grades.

Table 5.4. Descriptive Comparison of Students in AJROTC Treatment Samples, by State and Analysis Sample, Ninth Grade Cohorts in Years in Analysis

Characteristics	Ninth Grade AJROTC Takers	Ninth and Tenth Grade AJROTC Takers	All Four Years AJROTC Takers
Texas			
Number of Students	105,023	45,220	18,920
Economically Disadvantaged	78%	74%	79%
Black or Hispanic	87%	80%	84%
Average Eighth Grade Absence Rate	4.6%	3.6%	3.2%
Average Percentile on Eighth Grade Math Exam	42	47	50
Hawaii			
Number of Students	4,340	2,145	1,041
Economically Disadvantaged	62%	56%	50%
Native Hawaiian or Other Pacific Islander	37%	33%	31%
Average Eighth Grade Absence Rate	5.3%	4.1%	5.6%
Average Percentile on Eighth Grade Math Exam	43	50	54

SOURCE: Summary statistics are based on data pooled across cohorts and include the 2003–2004 through 2015–2016 ninth grade cohorts in Texas and the 2009–2010 through 2016–2017 ninth grade cohorts in Hawaii. University of Texas at Dallas Education Research Center, 2021; Hawaiʻi P-20 Partnerships for Education, 2021.
NOTES: Data reflect the characteristics of students in ninth grade cohorts at schools with AJROTC programs depending on whether students took AJROTC in at least ninth grade, at least ninth and tenth grades, and ninth through twelfth grades. Students in the latter two samples must have followed normal grade progression.

Our regression models that estimate the impact of AJROTC participation include statistical controls that account for the much smaller, remaining differences on this and a wide variety of other student-level characteristics as well as a set of school-level factors and differences over time. In the sections that follow, we discuss our main findings with respect to on-time graduation; additional high school outcomes, such as absences, suspensions, and STEM course taking; and postsecondary enrollment. Our findings for workforce outcomes in Texas are included in Appendix D.

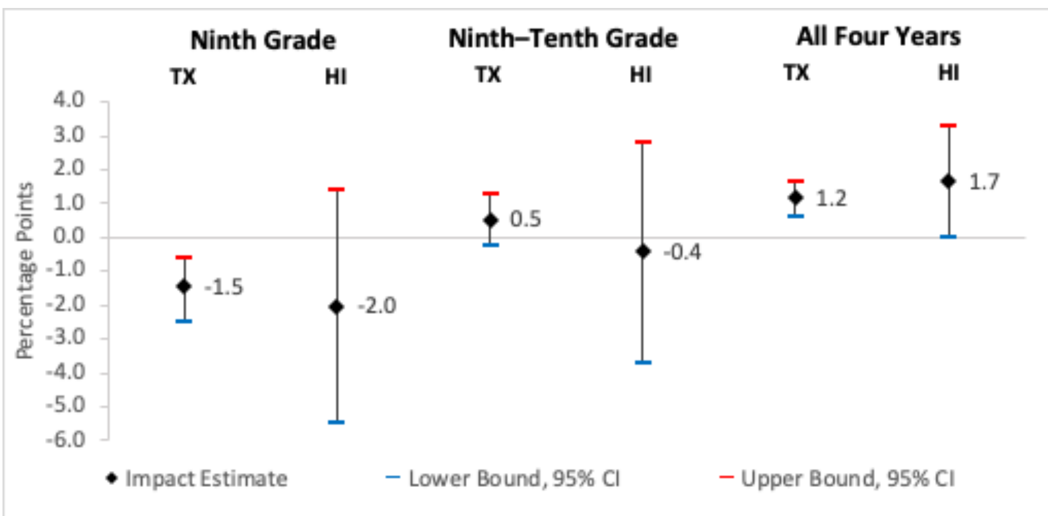
Findings: On-Time Graduation

Prior research on JROTC suggests varied effects of the program on high school graduation. A study conducted by Pema and Mehay, 2009, shows both negative effects of JROTC (less likely to graduate) and null effects (no difference in high school graduation) when comparing JROTC participants with a matched comparison group of non-JROTC participants. Another study conducted by Pema and Mehay, 2010, suggests that early participants and continuous participants in JROTC programs are more likely to graduate high school than their matched non-

JROTC peers.[17] Each of these studies relies on a panel of nationally representative students who were in high school in the early 1980s and early 1990s. Thus, what extant research tells us about JROTC's contributions to high school graduation might not adequately reflect today's program and students.

We find mixed impacts of AJROTC participation on the rate at which students graduate from high school on time (i.e., within four years), as shown in Figure 5.3. For both states, our analysis of students who participate in AJROTC in at least ninth grade, thus gaining some exposure to the program, finds a negative average impact on graduation rates, meaning that AJROTC students graduate on time at lower rates than the matched comparison group of otherwise similar students. This negative impact (of 1.5 percentage points) is statistically significant in Texas, whereas, in Hawaii, it is not statistically significant despite being numerically larger in absolute value. This can be seen in the figure: The 95 percent confidence interval line for Hawaii crosses the zero line, whereas it does not cross the zero line in Texas. On average across the two states, the comparison group graduation rate is about 84 percent.

Figure 5.3. Impact of AJROTC Participation on On-Time High School Graduation



SOURCE: University of Texas at Dallas Education Research Center, 2021; Hawai'i P-20 Partnerships for Education, 2021.
NOTES: 95% CI is the 95% confidence interval. On-time high school graduation refers to graduating within four years of entering ninth grade. Ninth grade analysis refers to the comparison between students at AJROTC schools taking AJROTC in at least ninth grade and matched peers at matched schools; Ninth–tenth grade analysis refers to the comparison between students at AJROTC schools taking AJROTC in at least ninth and tenth grades and matched peers at matched schools, with both treatment and control group students reaching tenth grade in the second year of high school; All four years analysis refers to the comparison between students at AJROTC schools taking AJROTC in ninth through twelfth grades and matched peers at matched schools, with both treatment and control group students reaching twelfth grade in the fourth year of high school.

[17] Pema and Mehay, 2010, defined *early participants* as those individuals who participated in JROTC at least one of the first two years of high school and not in either of the last two years of high school. *Continuous participants* are those who participated in at least one year of both the first two years and the last two years of high school.

Notably, the disparity in graduation rates between ninth grade AJROTC takers and the matched comparison group (about 1.5 to 2.0 percentage points) is much smaller than the disparity in graduation rates in the simple comparison between students ever taking AJROTC and students at schools without JROTC (more than 5 percentage points in Hawaii and 10 percentage points in Texas). Moreover, when we turn to the analysis of participating for at least two years, the negative impact is no longer present, suggesting that students who take AJROTC in ninth grade only and do not persist are driving the negative finding from the analysis of ninth grade participants. Although we are unable to discern intent in enrolling, persisting, or not persisting in JROTC, we note that students can fulfill the Texas state graduation requirement to complete one credit in PE in high school by taking JROTC. Although students can continue to earn elective credits for taking JROTC beyond the one year, it does not meet a specific requirement (Texas Education Agency, 2010).

Last, for students who participate in AJROTC all four years in high school, we find positive impacts on graduation. Although the overwhelming majority of students who make it to twelfth grade by their fourth year of high school (as we require of both our AJROTC and matched comparison students) do indeed graduate that year (about 96 percent to 97 percent across the two states), our analysis finds that AJROTC students are even more likely than the comparison group to do so, by a statistically significant 1.2 percentage points in Texas. Again, the result in Hawaii is numerically larger but has a confidence interval that touches zero; this might be because of the much smaller number of students in our analysis in Hawaii.

Findings: Additional High School Outcomes

We analyzed four additional high school outcomes for both states and for all three samples reflecting varying minimum levels of AJROTC participation: (1) absence rate, (2) in-school suspension, (3) out-of-school suspension, and (4) STEM credit earning. The first three are assessed in students' fourth year of high school (typically twelfth grade), with (1) reflecting the percentage of enrolled days absent and (2) and (3) indicating whether a student received suspensions of each type. The final analyzed outcome (4) is a measure that we constructed based on course-taking information in the SLDS data that tabulates the number of STEM credits (beyond those required of all students for graduation) earned over a student's high school career.[18] Notably, only one prior study of JROTC that we identified examined any of these outcomes: Pema and Mehay, 2010, found no significant effect of JROTC participation on in-school disciplinary issues. In literature on other youth development programs, research on Big Brothers Big Sisters of America and the YMCA Youth Institute provide suggestive evidence that

[18] The set of courses included in the STEM credit-earning outcome varies by state depending both on offerings and the set of courses included in the SLDS data we received. See Appendix D for details.

youth programs of this type might have either no or positive associations with attendance (Mac Iver and Mac Iver, 2015; O'Donnell and Kirkner, 2014).

Table 5.5 includes the impact estimates for each of these outcomes as well as the graduation measure. All outcomes except STEM credits reflect percentage point impacts. The number of students listed is the number of AJROTC-treated students in each analysis sample, although the number with outcome data varies by outcome; for example, only students who make it to the fourth year are included in the absence and the in-school and out-of-school suspension measures. Appendix D includes counts of treatment and control students in each state that contribute to each impact estimate presented here. The appendix also includes our regression-adjusted estimates of the values for these measures for the treatment and weighted control groups, in addition to the impact estimates shown here, which indicate the difference between those averages.

Table 5.5. High School Outcomes Impact Estimates

Analysis Sample	State	No. of AJROTC Students	On-Time Graduation Rate	Absence Rate	In-School Suspension	Out-of-School Suspension	STEM Credits
Ninth Grade	Texas	105,023	−1.46**	−0.28	1.13	−0.14	−0.158
	Hawaii	4,340	−2.02	−0.82	−0.94	0.20	−0.0189
Ninth and Tenth Grade	Texas	45,220	0.54	−0.61***	−0.32	−0.92**	−0.139
	Hawaii	2,145	−0.42	−1.69*	−0.89*	0.27	0.0341
All Four Years	Texas	18,920	1.16***	−1.21***	−2.17**	−1.58***	−0.150
	Hawaii	1,041	1.67	−2.24***	−0.23	−0.64	0.173

SOURCE: University of Texas at Dallas Education Research Center, 2021; Hawai'i P-20 Partnerships for Education, 2021.

NOTES: On-time graduation refers to graduating within four years of entering ninth grade. Absence and suspension outcomes are assessed in students' fourth year of high school. STEM credits are cumulative across all high school grades. All regressions include student-level propensity weights, student-level covariates, school-level covariates, fixed effects for school blocks, cohort fixed effects, and standard errors clustered on students' ninth grade schools.
*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

We do not find statistically significant impacts on these outcomes for students in our largest analysis sample, consisting of all students enrolled in AJROTC in ninth grade, who might or might not persist in the program after that. Conversely, we typically see beneficial impacts with respect to these outcomes on students enrolled for all four years in AJROTC. Specifically, we see absence rates in twelfth grade about 1 to 2 percentage points lower than they are for the comparison group (statistically significant in both Texas and Hawaii) and lower likelihoods of in- and out-of-school suspensions in Texas. (The impact on these measures is not statistically significant in Hawaii.) This is consistent with the dosage effect we saw with high school graduation, and it parallels several of our findings in Chapter 4, for example, that former JROTC cadets who had participated in the program for several years were less likely to attrit in their first term than those with some exposure to JROTC but who might not have persisted in the program.

When it comes to earning STEM credits above and beyond those required for high school graduation, we find very small impacts in both states, none of which are statistically significant.

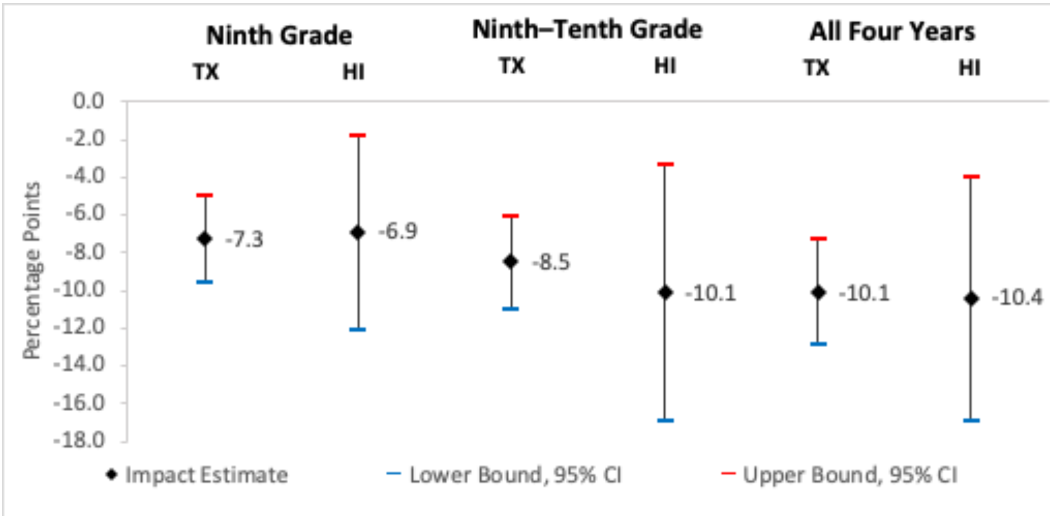
This is notable in and of itself, given that we do not consider AJROTC to be a STEM course for the purposes of this analysis; this means that taking AJROTC does not crowd out students' ability to take STEM courses at a similar rate as otherwise similar students who are not in AJROTC.

For all high school outcomes in Texas, where we have more cohorts and far more students in our analyses, we analyzed whether there were differences between impacts on students who started high school in the mid- to late-2000s and students entering high school from 2009–2010 forward. We did not find statistically significant differences in impacts on older and more-recent cohorts of students, with the sole exception that the impact on out-of-school suspensions for recent cohorts of students taking AJROTC all four years is smaller, albeit still indicative of a lower rate of suspensions for AJROTC than comparison students.

Findings: Postsecondary Enrollment

Across both states and all three analysis samples, we consistently find that AJROTC students are less likely to enroll in postsecondary institutions upon exiting high school. Prior research has also shown that participation in JROTC is related to either a lower likelihood of postsecondary enrollment, lower rates of postsecondary enrollment, or that participation is unrelated to postsecondary enrollment (Pema and Mehay, 2009; Pema and Mehay, 2010). As Figure 5.4 shows, all results are statistically significant, with none of the confidence intervals crossing zero. In contrast to the high school outcomes, here we find larger percentage-point impacts on students who participate in AJROTC programs for all four years in high school. There are no statistically significant differences in these impacts between older and more-recent cohorts in Texas. Note that our last year of both high school and postsecondary data in Texas was 2018–2019; hence, we can analyze postsecondary outcomes for 12 cohorts rather than the 13 for high school outcomes.

Figure 5.4. Impact of AJROTC Participation on Postsecondary Enrollment



SOURCE: University of Texas at Dallas Education Research Center, 2021; Hawaiʻi P-20 Partnerships for Education, 2021.
NOTES: 95% CI is the 95% confidence interval. Postsecondary enrollment measures vary by state based on available data. In Texas, the measure is of enrollment in public postsecondary institutions in Texas within the first full academic year following high school; in Hawaii, the measure is of enrollment in any postsecondary institution in the fall after high school. Ninth grade analysis refers to the comparison between students at AJROTC schools taking AJROTC in at least ninth grade and matched peers at matched schools. Ninth-tenth grade analysis refers to the comparison between students at AJROTC schools taking AJROTC in at least ninth and tenth grades and matched peers at matched schools, where both treatment and control group students reach tenth grade in the second year of high school. All four years analysis refers to the comparison between students at AJROTC schools taking AJROTC in ninth through twelfth grades and matched peers at matched schools, where both treatment and control group students reach twelfth grade in the fourth year of high school.

Several factors lead us to believe that these results reflect a disproportionate tendency for AJROTC students, particularly those engaged with the program for four years, to pursue an alternative path after high school, specifically, to enlist in the military.

First, for a subset of cohorts in Texas, we can explore this directly, and we find suggestive evidence that AJROTC students are more likely than comparison students at non-JROTC schools to choose military enlistment. Specifically, for the three cohorts of students for which data are available (reflecting students finishing high school in 2016–2017 through 2018–2019), we find that students who took AJROTC for four years were nearly 20 percentage points more likely to enlist in the military out of high school than comparison students, according to the information reported by their schools to the state education agency in Texas. For just two cohorts, we can analyze whether students *either* enrolled in postsecondary education *or* were identified as enlisting; here, we find a positive, statistically significant impact of 8.3 percentage points for four-year AJROTC students, meaning that the AJROTC students were more likely to have one of these successful transitions after high school than otherwise similar students without access to JROTC.

Second, it is striking that the negative postsecondary enrollment impacts on the “all four years” group is larger in magnitude than the impact estimates for the other analysis samples. We find that these students are more likely to graduate high school and less likely to be absent or suspended in twelfth grade than comparison students who also make it to twelfth grade by the fourth year of high school. This suggests that the AJROTC students are just as, if not more, capable of leaving high school and entering postsecondary education as that comparison group; very possibly, they are *choosing* to do something else.

Third, we conducted exploratory analyses in both Texas and Hawaii to consider whether students who enrolled in postsecondary education persisted to a second year of college. We find that four-year AJROTC takers are no more or less likely than their non-AJROTC counterparts to persist if they enroll. This underscores that the differences are driven by differences at the point of path selection, not by differences in abilities to continue on that path should they opt for postsecondary education.[19]

Fourth, analyses of Texas data, which support separately analyzing impacts on enrollments in two-year public postsecondary institutions (e.g., community colleges and technical schools) and four-year public colleges and universities find larger negative impacts on two-year enrollments than four-year enrollments. This suggests that AJROTC students might be substituting military enlistment for community college enrollments, although AJROTC students are only somewhat less likely than comparison group students to enroll in four-year schools.

Last, using Texas data, we can analyze whether AJROTC cadets are more or less likely than the comparison group to have wage earnings in the state of Texas. We assess this outcome eight years after high school to allow students sufficient time to enroll in and complete postsecondary education. We find that AJROTC students are less likely to have wage earnings in Texas eight years post–high school, with a larger gap for students taking AJROTC all four years. Although several factors might contribute to these findings (e.g., they might not have wages or might have left Texas), the larger gap for the "all four years" group provides additional suggestive evidence that these students might be opting to pursue a different path. We provide additional results for wage earnings in Appendix D.

Our finding that AJROTC cadets are less likely to enroll in postsecondary education but that four-year AJROTC participants in particular might be more likely to enlist is consistent with the findings of Pema and Mehay, 2010, who found that early high school JROTC participation, coupled with persistence in the program, yielded lower postsecondary enrollment and higher rates of military accession. Table 5.6 provides impact estimates (in percentage points) for our main postsecondary enrollment outcome for all three groups in both states. It also includes the exploratory analyses of two- versus four-year school enrollments, military enlistments, and the "enroll or enlist" outcome for Texas only. Full results for all analyses described above, including

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[19] Hawaii postsecondary data include both in- and out-of-state enrollments in public and private schools. Our main analysis in Texas is restricted to public schools in Texas. Data available for a subset of cohorts in Texas on out-of-state postsecondary enrollments (public and private) suggest that AJROTC students are also a little less likely than comparison students to enroll in those schools. See Appendix D for details.

treatment and control student counts and regression-adjusted average enrollment rates are in Appendix D.

Table 5.6. Post–High School Outcomes Impact Estimates

Analysis Sample	State	Enroll in Postsecondary	Enroll in 2-Year Postsecondary	Enroll in 4-Year Postsecondary	Enlist in Military	Enroll in Postsecondary or Enlist
Ninth Grade	Texas	−7.25***	−5.12***	−3.46***	7.69***	1.94
	Hawaii	−6.90*				
Ninth and Tenth Grade	Texas	−8.47***	−6.56***	−3.27**	13.0***	5.09**
	Hawaii	−10.1**				
All Four Years	Texas	−10.1***	−8.75***	−2.38*	19.8***	8.34***
	Hawaii	−10.4**				
No. of Cohorts in Analysis	*Texas*	*12*	*12*	*12*	*3*	*2*
	Hawaii	*8*				

SOURCE: University of Texas at Dallas Education Research Center, 2021; Hawaiʻi P-20 Partnerships for Education, 2021.

NOTES: All regressions include student-level propensity weights, student-level covariates, school-level covariates, fixed effects for school blocks, cohort fixed effects, and standard errors clustered on students' ninth grade schools.
*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Limitations of Impact Analysis

Our impact analysis draws on a large volume of student-level SLDS data that spans high school, postsecondary education, and the workforce and that uses rigorous statistical methods to estimate impacts of AJROTC participation that account for observable baseline differences and approximate causal impacts. Although this is a distinct improvement over simple comparisons that do not account for student- and school-level differences that exist prior to ever engaging with the program, our data and methods have limitations.

From a methods standpoint, although our quasi-experiment controls for student-level differences between participants and nonparticipants, we can control only for characteristics that are observed, measured, and included in the SLDS data. These include an array of demographic, socioeconomic, prior achievement, and prior in-discipline measures. Thus, there might be unobservable differences in student motivation to persist in high school or pursue certain pathways after high school between AJROTC and comparison students that we cannot include. Our exclusion from the comparison group of students at AJROTC schools who do not participate in the program is designed to mitigate this, because unobservable factors are especially concerning when it comes to the decision to participate in AJROTC for similar students at the same school.

In addition, although we take steps to account for differences across schools by comparing AJROTC students with students at non-JROTC schools that are similar to their own schools on several key characteristics and although we further adjust for school-level factors in our impact estimation models, schools that do not offer JROTC programs might differ from AJROTC schools in important, unobservable ways that contribute to differences in student outcomes.

Allowing comparison schools to be included in multiple matched blocks could compound the influence of these unobservable differences for schools in multiple blocks.

However, if unobservable factors that influence outcomes of interest are very tightly correlated with characteristics that we can observe and include in our models, our impact estimates would essentially reflect the causal impact of participation in the program. For analyses of students who enroll in AJROTC in ninth grade (and might or might not persist), this is more plausible than for those who participate all four years, for whom the possibility of unobserved differences between students motivated to participate in AJROTC throughout high school and the comparison group likely is of greater concern.

With respect to data, there are two main limitations. First, the breadth of our data across states is a basic limitation of our analysis. Although we see broadly consistent results across Texas and Hawaii, these states might not be representative of the full set of AJROTC programs across the country. Future analyses should seek to replicate our methods in a wider array of states, drawing on SLDS data where available. Second, the SLDS data from Texas and Hawaii do not offer a full picture of possible outcomes for all students. Notably, we only have access to an indicator of student intentions to enlist in the military for a few cohorts in Texas. Our workforce data for Texas is limited to wages earned in Texas and excludes federal employers. We do not have data on military enlistments or workforce outcomes for Hawaii. Postsecondary data also have limitations, including the inability to observe enrollments beyond public schools in Texas for all cohorts in that state or to differentiate between two- and four-year enrollments in Hawaii.

Last, an analysis of long-term impacts necessarily suffers from an inability to observe those outcomes for current and very recent AJROTC students. Hence, our findings might not capture recent changes to the program that might result in differences in outcomes for AJROTC students. Our data also do not allow us to consider long-term impacts on wages or postsecondary enrollments for Texas students expressing intentions to enlist in the military because intention-to-enlist data are available only for the most-recent cohorts. Future work could update and expand our analyses to monitor the cohorts that we have analyzed over a longer period and include additional, more-recent cohorts.

Capacity for STEM Instruction in AJROTC Schools

The SLDS data from Texas and Hawaii support an analysis of existing capacity in schools to teach STEM courses, in addition to the impact analyses that constitute the bulk of the discussion in this chapter. Specifically, we drew on course-taking data for students in these states to understand whether schools have existing capacity to teach *cyber and computer science courses*, using whether students are taking these courses as a proxy measure of teaching capacity.

The course-taking data available to us varied by state; for each, we bucketed schools into three categories based on student course taking: (1) schools offering Advanced Placement (AP) or International Baccalaureate (IB) computer science (and therefore likely to have strong teaching capacity), (2) schools with some computer science or cyber course offerings, and (3) schools with little to no offerings in these subject areas.[20] We draw on data from the 2017–2018 school year in Texas, and our last cohort of students in Hawaii (2015–2016 ninth graders). We note that this analysis cannot account for recently launched offerings in either state.

We explored differences in characteristics for schools in each of these three buckets, both for the AJROTC schools in our impact analyses and for the full set of potential comparison schools without JROTC programs. Table 5.7 and Table 5.8 display our findings for the following: (1) the share of schools in urbanized areas (cities or their surrounding suburbs), (2) median total school enrollment, (3) median share by race or ethnicity (Black and Hispanic in Texas, Native Hawaiian or Pacific Islander in Hawaii), and (4) median share eligible for FRPL. Across both states and both AJROTC and non-JROTC schools, we find that schools with more computer science or cyber offerings tend to be larger and have lower proportions of economically disadvantaged students. In Texas, schools with more offerings tend to be in cities or suburban areas; we see this in Hawaii as well for non-JROTC schools, but we see the opposite for AJROTC schools, where those with the fewest offerings (albeit just five schools) are in cities or suburbs whereas three of five schools with AP or IB computer science are in rural areas or small towns. With respect to race and ethnicity, we see higher shares of Hispanic students among AJROTC schools with limited offerings in Texas and higher shares of Native Hawaiian or Pacific Islander students for these schools in Hawaii. The pattern is similar for non-JROTC schools in Hawaii but not in Texas.

Overall, this analysis suggests that the AJROTC Cyber Pilot Program might be more able to leverage existing teaching capacity in larger, less–economically disadvantaged schools, whereas it is more likely to bring in novel capacity at smaller, more–economically disadvantaged schools. On balance, the Cyber Pilot Program would be more likely to result in new capacity by targeting rural or small-town schools, whereas schools in urbanized areas tend to have capacity already.

Table 5.7. Characteristics of AJROTC and Non-JROTC Schools by Computer Science and Cyber Course Offerings, Texas

Schools	No. of Schools	% Cities or Suburbs	Median Total Enrollment	Median Share Black	Median Share Hispanic	Median Share FRPL Eligible
AJROTC Schools						
All	184	89.1%	1,851	8.4%	74.6%	76.7%

[20] Our thresholds for assigning schools to these categories differed by state. In Texas, we use a threshold of 25 or more course takers to indicate whether schools offered AP or IB computer science or computer science or cyber courses generally. In Hawaii, we used a threshold of ten. These roughly reflect the magnitude of the difference in average STEM course taking by students in these states based on the course data available to us, which included all courses in Texas and a selection of courses in Hawaii that might not capture all STEM offerings of schools.

Schools	No. of Schools	% Cities or Suburbs	Median Total Enrollment	Median Share Black	Median Share Hispanic	Median Share FRPL Eligible
Offers AP Computer Science	33	97.0%	2,449	8.9%	60.7%	62.9%
Offers Computer Science or Cyber	166	91.0%	1,946	8.9%	73.0%	75.0%
Few to No Offerings	18	72.2%	1,093	3.1%	87.5%	81.8%
Non-JROTC Schools						
All	820	12.1%	580	2.3%	27.7%	52.0%
Offers AP Computer Science	43	72.1%	875	8.1%	22.9%	23.4%
Offers Computer Science or Cyber Courses	359	22.0%	747	3.5%	27.8%	47.9%
Few to No Offerings	461	4.3%	208	1.7%	27.4%	55.6%

SOURCE: University of Texas at Dallas Education Research Center, 2021.
NOTE: School characteristics reflect 2017–2018 school year data.

Table 5.8. Characteristics of AJROTC and Non-JROTC Schools by Computer Science and Cyber Course Offerings, Hawaii

Schools	No. of Schools	% Cities or Suburbs	Median Total Enrollment	Median Share Native Hawaiian or Pacific Islander	Median Share FRPL Eligible
AJROTC Schools					
All	16	62.5%	1,362	41.0%	51.3%
Offers AP Computer Science	5	40.0%	1,311	32.5%	51.0%
Offers Computer Science or Cyber Courses	11	54.5%	1,363	32.5%	49.5%
Few to No Offerings	5	80.0%	1,136	54.0%	57.1%
Non-JROTC Schools					
All	20	25.0%	663	41.2%	51.1%
Offers AP Computer Science	7	42.9%	1,126	27.6%	38.1%
Offers Computer Science or Cyber Courses	9	44.4%	1,126	27.6%	38.1%
Few to No Offerings	11	9.1%	455	55.2%	66.7%

SOURCE: Hawai‘i P-20 Partnerships for Education, 2021.
NOTE: School characteristics reflect 2017–2018 school year data.

Chapter 6. Findings and Recommendations

Summary of Findings

In this section, we summarize the findings we derived from the logic model, quantitative analyses, and interviews. We designed a logic model for AJROTC through a review of key DoD, Army, and USACC policy and regulations. This logic model identified key aspects of program implementation (i.e., inputs, activities, and outputs) and identified how the doctrine describes the outcomes expected for JROTC participants. We highlighted that, although doctrine does not reference any expected contributions of AJROTC to in-school outcome improvements for cadets, USACC uses academic achievement, attendance, behavior, graduation, and dropout measures to market program effectiveness (USACC, undated). This represents a misalignment between AJROTC doctrine and the data collected to evaluate the program. We also noted the alignment between prior literature and the hypothesized effects of JROTC on cadet outcomes. We found a lack of research evaluating the impact of AJROTC on civic engagement, community service, and related outcomes. This dearth of research might be the result of general measurement challenges and specific data collection gaps—a theme also highlighted in some interviews.

The interview findings suggested that there is a growing knowledge and embrace of the goals of the modernization strategy and that implementation of changes associated with increased activities related to STEM and cybersecurity. These activities include competitive teams for VEX Robotics, CyberPatriot, and drone racing. There was also a perceived demand for increased support to effectively teach these topics through specific training and support of team-teaching with experts from in schools or from outside organizations. We discussed successful models and considerations for leveraging school and community expertise as documented in prior literature. The interviewees also identified ways in which USACC could gather better data on STEM and cybersecurity activities via changes to JUMS without adding large burdens for the instructors. There was general support for trusting local instructor expertise to appropriately tailor JROTC doctrine and guidance in areas of STEM and cybersecurity inclusion and for uniform wearing. Many interviewees believed that the pool of candidate instructors for AJROTC could be improved, especially with respect to those with STEM and/or cyber expertise, if the option of teaching AJROTC was explicitly included in the counseling of soldiers during their transition out of the Army. Finally, there was a belief that the siting of new cadres could be improved with greater input from local-level AJROTC staff who could have knowledge of new or converting schools that were focused on STEM and cybersecurity.

In our first set of quantitative analyses, we found that enlisted soldiers who previously participated in JROTC are more diverse, receive fewer waivers, and are more likely to be Tier I recruits than enlisted soldiers who did not previously participate in JROTC. However, former

JROTC cadets also have lower Armed Services Vocational Aptitude Battery scores, including a lower Skilled Technical line score and AFQT score percentile. Former JROTC cadets are more likely to pursue STEM MOSs, are more likely to complete their first terms, and have longer careers in the Army than noncadets.

In Texas and Hawaii, AJROTC participation in at least ninth grade is associated with lower rates of high school graduation and postsecondary enrollment compared with matched peers. However, those who participate in ninth and tenth grade have neutral to positive impacts on graduation, and those who participate in all four years of high school have significantly higher rates of graduation than peers who also start twelfth grade. The negative effect on college enrollment persists; exploratory analysis suggests that this is primarily the result of a decreased rate of community college attendance and a (greatly) increased rate of military enlistment. Cadets who participate all four years are less likely to be absent and less likely to be suspended in twelfth grade compared with matched peers.

Recommendations

Support High-Quality Data Collection Aligned with AJROTC Goals

There are two pieces to this recommendation—both the alignment and the data quality are key. AJROTC should review its policy and regulations along with the logic model presented in Chapter 3 of this report. The goal of this review is to ensure that the program is accurately reflected in doctrine and that any gaps or changes to the program are adequately addressed. The modernization strategy, for example, is a critical part of AJROTC's future. Thus, ensuring that the goals of this strategy are captured in documentation and included in the logic model is important. As our review of DoD, Army, and USACC policy and regulations identified, there is no indication that AJROTC is intended to improve in-school outcomes (e.g., indiscipline, attendance, academic achievement, or graduation) for its cadets. Yet these measures are used as quality indicators of program effectiveness. If these are intended outcomes of AJROTC, they need to be integrated into official doctrine. These documents are used for staff training, to communicate the purpose and value of the program to key stakeholders, and to guide program evaluation and improvement practices. It is critical that they accurately capture the program. As it stands, the program appears to be measuring program effectiveness with data that do not align with intended outcomes.

Next, USACC needs to ensure that required program metrics align with what is needed to track progress and performance for those intended outcomes. If increasing STEM activities is of critical emphasis, then enabling systematic data collection on such activities should be enacted. This could mean expanding the data fields in JUMS such that STEM-focused competitions or community service are explicitly tracked.

We also note that data collection can be improved. As shown by the state data analyses, many academic and disciplinary outcomes that are tracked by JROTC instructors are already captured by school systems in state-mandated, consistent ways. Leveraging existing, systematic, and comprehensive data, where they exist, can help to reduce the burden of data collection on instructors, increase data consistency and comparability, and free up instructor time to collect data elements that school systems do not collect. We also recommend training instructors and other staff involved in data collection in high-quality data collection approaches and in database entry for key data points. Some of our interviews suggested there might be inconsistencies in the way that instructors deal with missing information. Having common standards on data accuracy, completeness, and consistency will improve the quality of the data collected to support decisionmaking.

Communicate AJROTC's Value by Documenting Impact on Participating Students Relative to Peers

As shown in the state data in Chapter 5, there are substantial differences in baseline characteristics among AJROTC and non-JROTC schools and, even within AJROTC schools, between cadets and other students. In both cases, JROTC serves a more–economically disadvantaged population. These demographic and socioeconomic differences can make a naïve comparison of averages (see Figure 5.2) inaccurately negatively portray the impact of AJROTC on student outcomes. At the same time, the participation requirement of good academic standing could inaccurately positively portray impacts (i.e., one would expect higher GPAs regardless of program effects). Leveraging analysis strategies that create appropriate comparison groups, as we did in the Chapter 5 analysis, can address this. Such approaches require substantial resources and analytic capacity, which means this work would likely need to be conducted centrally or be supported by USACC or ASA M&RA. Where more-rigorous analyses are not feasible, ensure that the context and interpretation of the results presented is clear, framing the results given the baseline differences. For example, when presenting information comparing outcomes for AJROTC students and nonparticipants, provide descriptive information on the characteristics of both groups (e.g., rates of economic disadvantage and race and ethnicity distribution) and average outcomes for students with those characteristics. Appendix E gives a one-page summary to help USACC and other AJROTC personnel talk with schools, parents, and students about the results found in this study.

Maintain Existing Policy Flexibility That Leverages Instructors' Local Expertise

Interviewees emphasized their understanding of their local communities and wanted more opportunities to share that expertise to enhance the AJROTC program. A theme in the interviews with brigade chiefs and DAIs was the perception that they have valuable local information that could support cadre siting decisions. For example, a DAI mentioned a new STEM-focused school that was opening in his area but that was not on the list of candidates for the Cyber Pilot

Program. Our interviews suggested that mechanisms to engage brigade chiefs and DAIs in siting decisions could be strengthened to leverage their local knowledge.

DoD and Army doctrine provides flexibility to local JROTC cadre instructors in some aspects of curriculum choices, extracurricular activities, and uniform wearing. The results of our interviews with instructors suggest this flexibility is being used to tailor activities to meet the needs of local communities and to bring in aspects of STEM and cybersecurity. For example, student populations at schools with JROTC cadres vary in the level of comfort with uniform wearing and in the level of interest in such activities as robotics, cybersecurity, and drone racing. Local instructors, working within doctrine and the guidance provided by USACC, report offering competitive teams that reflect local interests and adapting aspects of uniform wearing. The belief is reportedly that such adaptation can help to maintain healthy enrollment and support the modernization strategy. We propose the continuation and support of this flexibility to adapt curriculum choices, extracurricular activities, and aspects of uniform wearing.

We balance our recommendation for flexibility with the need for key guidance. We recommend that curriculum experts at USACC address the concerns voiced by several stakeholders regarding how STEM content can be best integrated into the curriculum, balancing modernization with the program's traditional objectives. There is potential value in carrying out a review of the curriculum to identify options for how instructors can "fit it all in" and communicating those options to instructors. And finally, USACC could consider ensuring that instructors are provided the training and content expertise needed to deliver the full scope of STEM content in a manner relevant to the community and cadets they serve.

Closing Thoughts

Like many youth development programs, AJROTC is multifaceted. Therefore, assessing the impact of the program is challenging, especially because the program continues to evolve in response to Army and community needs. This report details many positive findings that support the value of AJROTC to students, to the community, and to the Army. However, our findings included some neutral and some negative outcomes. These findings provide foci for both potential improvements and follow-on research to understand the causes underlining these findings. By continuing to track these outcomes, and doing so with more-consistent and more-complete data, the Army can monitor and manage changes to JROTC that could influence these outcomes and, in particular, the potential effects of the modernization strategy. We believe that the leadership at ASA M&RA and USACC should work to broadly socialize these findings within the Army and the U.S. population more broadly, we have provided Appendix E to support that effort.

The forces of automation and globalization have created a demand for an increasingly technically skilled U.S. workforce. The World Economic Forum's 2016 review of the future of jobs cites the importance of changes in educational and learning environments to help people stay employable in the labor force of the future (World Economic Forum, 2016). The Army has taken steps, including the JROTC modernization strategy, to make changes to address this challenge. The skills emphasized by the JROTC modernization will benefit the U.S. economy more generally and will directly benefit the Army by potentially preparing future soldiers, future Army civilians, and future Army contractors.

Appendix A. Strategic Literature Search Methods

AJROTC is one of many in-school or OST programs that focus on high school student development. Extant research on positive youth development programs, those serving students both during and outside the school day, might provide guidance on the types of outcomes AJROTC might feasibly influence and the type or direction of changes such programs generate in outcomes of interest. Therefore, we conducted a search for extant research focused on what is known about JROTC, other military-related youth programs, branded youth development programs (e.g., Head, Heart, Hands, and Health [4H]), and general OST programs and activities (e.g., academic or school clubs) and their impacts on youth outcomes in high school and beyond. In the section below, we discuss our strategic literature search methods.

Search and Inclusion Criteria

We searched for available literature in the Education Research Information Center (ERIC), Education Abstracts, PsychINFO, Scopus, and Web of Science; for the gray literature, we used advanced Google search. We identified a set of search strings to guide our work, which we present in the next section, using our ERIC search as an example. Papers had to be published after 2005 and had to be either peer-reviewed journal articles or gray literature evaluating a youth development program. The analyzed outcomes needed to fall into at least one of the following categories: (1) academics, (2) whole child well-being (e.g., social and emotional skills and competencies, school safety, and mental health), (3) behavior (e.g., school discipline), (4) civics or community service (e.g., voting and volunteering), or (5) physical health and fitness. Promotional materials, dissertations, and conference abstracts were explicitly excluded.

Example Search Terms

ERIC; all doc types; 2005 to 6 January 2021; English
“middle school” OR “high school” OR “secondary school” OR “junior high” OR “14 year old*” OR “15 year old*” OR “16 year old*” OR “17 year old*” OR fourteen OR fifteen OR sixteen OR seventeen OR teenager OR “young adult”

AND

“Junior Reserve Officers Training Corps*” OR JROTC OR 4H OR “4H (Head, Heart, Hands, and Health)” OR “Being Educated Leaders for Life” OR BELL OR “Big Brothers” OR “Big Sisters” OR “Boy Scouts” OR “Girl Scouts” OR “Do Something” OR “Future Business Leaders of America” OR FBLA OR “Future Farmers of America” OR FFA OR “Girls Inc” OR “Girls

Who Code" OR "Junior Statesmen of America" OR "Key Club" OR "National Beta Club" OR "Quantum Opportunities Project" OR "Teen Outreach Program" OR "United Nations Children Fund (UNICEF) High School" OR YMCA OR "Young Men's Christian Association" OR "the Y" OR "Academic Decathlon" OR "First Robotics Competition" OR "Geeks Rule" OR "High School Innovation Challenge" OR "Math League" OR "Mathematical Association of America" OR "National Association of Rocketry" OR "Odyssey of the Mind" OR "Students Against Destructive Decisions" OR SADD OR "Vex Robotics" OR Choir OR "Civics Club" OR "Debate Team" OR "Mock Trial" OR "Model Congress" OR "Model UN" OR Orchestra OR "School Band" OR "School Sport* Team*" OR "Interscholastic Athletics" OR "Student Government" OR Theater OR "S.A.Y. Yes! Centers" OR "Youth Arm of the Union Hebrew Congregations" OR NFTY OR "California Cadet Corps" OR "Civil Air Patrol" OR "Middle School Cadet Corps" OR "Navy League Cadet Corps" OR "United States Army Cadet Corps" OR "Young Marines" OR "cocurricular activit*" OR "extracurricular activit*"

AND

attendance OR "career readiness" OR "civic engagement" OR citizenship OR "college appl*" OR "trade school appl*" OR "community college appl*" OR "junior college appl*" OR "college readiness" OR "trade school readiness" OR "community college readiness" OR "junior college readiness" OR "college enrollment" OR "trade school enrollment" OR "community college enrollment" OR "junior college enrollment" OR "community service" OR "high school GPA" OR "drop-out" OR graduation OR "experiential learning tools" OR "immersive learning" OR indiscipline OR leaders* OR math OR mentors OR "physical activity" OR "problem solving" OR resourcefulness OR responsibility OR science OR "self-confidence" OR service OR "service learning" OR STEM OR technology OR trustworthy OR "well-being" OR "course enrollment" OR "course completion" OR discipline OR English OR "language arts" OR "physical fitness" OR "social and emotional competency" OR "social and emotional learning" OR "soft skills" OR suspension OR "non-cognitive skills"

AND

impacts OR increases OR cause OR effect OR produce OR decrease OR show OR display OR associated OR correlated OR affects OR influence OR relationship

Appendix B. Interview Protocols

In this appendix, we provide the interview questions for each group of interviewees. All interviews began with consent procedures and language about interviewee confidentiality.

Protocol: AJROTC Instructors

Basic Background Questions

1. How did your career as a JROTC instructor begin?
    a. Probe: who oversaw the hiring process? DAI, or other?
    b. Probe: how did you hear about the SAI/AI job opening?
    c. Probe: what is your education level?
2. Can you provide a brief history of the AJROTC program in your district?
    a. Probe: If this is a new program, what role did you play in bringing it to the district?

Program—Students

1. Tell us a little more about the students in your program.
2. How do students find their way into your JROTC Program?
    a. Probe: Do you do any kind of outreach or marketing in the school or district?
    b. Probe: Do you struggle to meet the minimum student enrollments laid out in Cadet Command regulations?
3. How do you believe JROTC helps your students in their lives and careers moving forward?
    a. Probe: What are the next steps for your majority of students?
        i. Probe: Army? ROTC?
        ii. Probe: What is your program's relationship with Army recruiters?
4. What course credit(s) is offered for JROTC participation? (Physical Education vs. Computer Science vs. other)
5. Do you lose students due to competition for their time from other extracurricular or student development organizations?
    a. Probe: (reword?) Which youth development organizations in your school tend to draw students away from JROTC?
6. What is the main reason students don't join JROTC?
    a. Probe: We've heard that uniforms can push some students away from JROTC—is that true?

b. Probe: why do they leave?

Program—Curriculum

1. What are the most valuable parts of the AJROTC curricular and extracurricular offerings?
    a. List of activities: JROTC Leadership Challenge and Academic Bowl (JLAB), STEM camps, JROTC raider challenges, Air Rifle Competitions, Drill Competitions
2. What is your view on the amount of STEM/cyber content in the current curriculum?
    a. Probe: Who teaches the current 2 hours of STEM core curriculum?
    b. Probe: What has your experience been with the CyberPatriot program?
        a. Probe: If no current CP component, probe for perception of program
    c. Probe: What other STEM activities do your cadets participate in?
        a. Probe: Robotics? Rocketry?
3. If you add STEM curriculum, which part of the curriculum would you have to, or want to, drop?
4. If you added more STEM curriculum, would you get more students? Different students? Would some students leave JROTC?

Program—Instructor Pipeline and Retention

1. What training were you given on content and instructional strategies? How useful were they?
    a. Probe: And what might you change?
    b. Probe: for professional development opportunities. NOTE: See chapter 8 in 145-2: broken out into (1) certification courses, (2) re-certification courses, (3) professional development courses, and (4) professional development opportunities
2. What are the personal and professional characteristics of a quality JROTC instructor?
    a. Probe: Have you witnessed the departure of quality instructors?
    b. Probe: What might be done to prevent exits of quality instructors?
3. Has your program ever had issues with staffing?
    a. Probe: what were the causes of the staffing issue, and
    b. Probe: what might be changed to ensure adequate staffing in the future?
4. Current regulations specify that an SAI and an AI are required for every program. Do you think that two instructors per class is practically necessary?
    a. Probe: What is the value of the second Army instructor?

School—Perceptions, Teacher Partnerships

1. How do the other teachers in the school/district view JROTC and your role within the school?

2. The Air Force outreach installations host and facilitate programs for grades 5–12. Do your programs, or your students, have any connections or relationships with earlier grades in the school or larger district?
3. If there were to be more emphasis on cyber, robotics, or other STEM in the core curriculum, what teachers or other in-school student development organizations (clubs, etc.) might you partner with in your school?

Community—Partnerships, Perceptions

1. Extracurricular programs like the Boy Scouts and 4H have close relationships with universities, businesses, and other community partners for mentors and student learning opportunities. Is that something that you have tried in your own school?
    a. Probe (if not): Is that something that would work with AJROTC?
    b. Probe: What has been the focus of these partnerships? STEM content? Others?
    d. Probe: Looking forward to the future, which community partner or organizations would you most be interested in working with? What would be the focus of those partnerships?

National and Cadet Command—Regulations, Restrictions, Support

1. Have you sought outside funding sources, particularly for STEM-related activities? If so, where? Have there been any successes?
2. Is there anything the Army could do (policy, relationships, outreach installations) to make it easier to accomplish what you're trying to do?

Closing Comments and Questions

1. If you were king/queen for a day of AJROTC, what would you do to help bring more STEM or Cyber content into the AJROTC Program?

Protocol: Instructor Pipeline (DAIs, Brigade Chiefs)

Basic Background Questions

1. How did your career with JROTC begin?
    a. Probe: How did you hear about the job opening?
    b. Probe: What is your education level?
    c. Probe [DAI]: Did you have any experience with JROTC/ROTC before joining the program as an instructor?
2. [DAI] Can you provide a brief history of the AJROTC program in your district?
    a. Probe: Did you help start any new programs in the district?
    b. Probe: Have you helped close any programs?

3. [CHIEF] On a daily basis, how closely do you communicate with DAIs, SAIs, AIs, and school officials at the local and state level?
4. What core academic credit is currently offered for JROTC in your [district/brigade]?
    a. Probe: Do you have any plans to work to change or expand what credit JROTC is eligible for?
    b. Probe: Do certain programs particularly struggle or succeed based on what academic credit is offered?

Instructors and Retention

1. We've heard that instructors really are the keystone of a successful program. In your [district/brigade], what are the personal and professional characteristics of a quality JROTC instructor?
    a. Probe: Why do most instructors leave the JROTC program, and what could be done to retain quality educators?
2. What draws instructors to the JROTC program? What are incentives for instructors to teach?
    a. Probe: What is the current process in your [district/brigade] for recruiting and recommending?
    b. Probe: Do you do any outreach to the Army Retirement Services Program in your region, or directly to soldiers transitioning to retirement?
3. What is the current process for interviewing and approving JROTC instructors in your [district/brigade]?
    a. Probe: How does the Instructor Management Division (IMD) assist you with identifying and hiring qualified personnel?
    b. Probe: Are there any administrative friction points you would like to see reduced? Any ideas how?
    c. Probe: Is there any loss of high potential instructors before hiring is completed?
4. Which, if any, of the JROTC programs under your purview struggle with hiring or retaining instructors?
    a. Probe: How many schools do you know of with empty instructor positions?
    b. Probe: As per 145-2, some schools may be designated by the JROTC Director as "hard to fill." In your [district/brigade], do any schools have this official designation? If so, what kind of "exceptions" have been made to instructor requirements?
    c. Probe: How well do schools with instructor vacancies function? Are there some schools that function well with only 1 instructor?
5. What is the current process in your [district/brigade] to ensure that new instructors attend the initial USACC trainings and the refresher training on schedule?

    a. Probe: Are there any points of friction or mis-match that might be improved in the certification, recertification, or professional education processes?
6. [DAI] Can you tell us a little more about the bi-annual instructor evaluations you're required to conduct using the "JROTC Coaching Rubric"?
    a. Probe: Can you provide some examples of positive and negative feedback you've provided during these evaluations?
    b. Probe: How useful do you and others find the process? How might it be improved?
7. [CHIEF] For schools without a DAI, 145-2 specifies that you "or a designated staff member" perform the counseling for SAIs. Who handles this in your brigades?
    a. Probe: Can you tell us a little more about the bi-annual instructor evaluations you're required to conduct using the "JROTC Coaching Rubric"?
    b. Probe: Can you provide some examples of positive and negative feedback you've provided during these evaluations?
    c. Probe: How useful do you find the process? How might it be improved?
8. [DAI] In the program, the DAI is the "instructional leader" for the SAIs and AIs. 145-2 specifies that you "stay abreast of current educational trends and initiatives" and suggests signing up for "at least two professional publications or free on-line newsletters." What are your preferred ways to keep up with developments and best practices in education?
    a. Probe: Are you a member of any "state education association, career and technical education, or similar state organizations"?
9. How are outstanding instructors "recognized for their talents and accomplishments"?
10. We've heard that many instructors leave JROTC after a handful of years. In your experience, what are some of the main events that causes the loss of instructors/reasons for instructors leaving?
    a. Probe: What might incentivize good instructors to remain in the program?

Curriculum and ECAs (STEM, Other)

1. Currently, STEM content in JROTC may include CyberPatriot teams or robotics. Who currently teaches the STEM content in your [district/brigade] in the JROTC program? Is it the instructors, or do they partner with other people in the school or community?
2. How might the hiring of new instructors change with increased STEM or otherwise changed curriculum within JROTC?
3. Do you know of success stories (or cautionary tales) of JROTC instructors partnering with other teachers or community volunteers to deliver class material, in particular, STEM content?
    a. Probe: Who else might be pulled in to teach or volunteer if the STEM content were expanded?

4. If we wanted to increase the STEM academic offerings, do you think it's feasible in all JROTC programs under your purview, or do you think only certain schools?
    a. Probe: what are the characteristics of a school that might want more STEM?

The School—Costs, Resources, Administration

1. JROTC is an incredibly valuable program, but not inexpensive. How might you advise a program in a school facing funding cuts that wants to demonstrate value to principals or school administration?
    a. Probe: Has the presence of the JROTC program improved any district or state-wide academic, disciplinary, or community engagement outcome measures?
    b. Probe: [DAI] What are the measures of program success that are important to the schools in your district, such as college readiness via SAT prep or CTE credit?
2. How regularly do you communicate with school principals or other district administration on "the effectiveness of JROTC," as required by 145-2? Can you tell us a little more about what you share and how it is generally received?
3. Why have you seen schools close in the last few years?

Community Engagement/Outreach, Public Relations

1. [CHIEF] Do you do any outreach at the state or regional level?
    a. Probe: experiential learning/internships?
    b. Probe: outside instruction?
    c. Probe: mentorship?
2. [DAI] Does your [district/brigade] partner with community organizations for service learning?
    a. Probe: experiential learning/internships?
    b. Probe: outside instruction?
    c. Probe: mentorship?
    d. Probe: What relationships would you want to develop next, particularly if the STEM content was expanded?
3. [DAI] In 145-2, it mentions that DAIs should "Interpret data from the Army and other agencies to assist in developing favorable public relations." Can you share with us what kind of data you look at, how you develop these relations?
    a. Probe: What does the JROTC program do to develop its image within the community?

Vertical Alignment

1. How well is senior ROTC integrated with junior ROTC in the programs in your [district/brigade]?
    a. Probe: What are some outstanding examples of integration?

b. Probe: How could the connection between JROTC and ROTC be made stronger?

2. We've heard many instructors and students say that each program is as unique as the school it's embedded in. Lots of instructors are innovative! If one of your instructors has a really cool idea and just needs a little help to get it done, what kind of financial or community resources might you connect them with?
3. Is there anything else the DOD, Army, or Cadet Command could change with regard to policy, regulations, or culture to make it easier for you or your instructors to do your job?

Closing Comments and Questions

1. If you were king/queen for a day of AJROTC, what would you do to help make JROTC the best program possible for the students in your district?

Protocol: School Administrators Who Oversee Course Enrollment (e.g., School Counselors)

Basic Background Questions

1. Let's start with your background. How long have you been at your current school?
    a. Probe: Has your position changed or evolved over time?
2. How do you see the role of the JROTC program in your school/district?
3. Can you provide a brief history of the AJROTC program in your school and/or district?
    a. Probe: What was your initial perception of AJROTC?
    b. Probe: Has that changed over time? Why has it changed?
    c. Probe: Have you had other personal or professional experience with the US military?

Program Promotion and Students

1. How do students at your school usually end up in AJROTC?
    a. How many self-select or choose on their own, and why?
2. Which students do you refer to JROTC?
    a. Probe: Why do you bring up the program to this group of students?
    b. Probe: How much do students know about the program prior to you bringing it up? What are their views about it?
    c. Probe: Do you tell them about ROTC, ROTC scholarships, enlistment bonuses, and military options?
    d. Probe: We've heard anecdotes that JROTC has been used as a "disciplinary measure" for some students, in your experience have you seen JROTC as a program for a group that needs discipline?

3. What school performance metrics is JROTC attached to at your school? Course credit, college prep through SAT/ACT prep, CTE credit, etc.?
4. Are JROTC students commonly involved in other youth development programs?
    a. Probe: What are the competitions for students' time for other youth development programs, and what are the most popular programs at the school?
    b. Probe: What are major draws that pull those students away from JROTC and into other programs?
5. In your school are there specific racial/ethnic/SES/gender groups that JROTC serves better than others?
    a. Probe: Are there cultural issues with the program that serve some groups better than others? Or make some groups more inclined to join the program?
6. Is the program promoted within the school or other outside sources?
    a. Probe: If so, who does the promotion? The JROTC instructors? Others?
    b. Probe: what form does this promotion take? Print media? Parades? Other demonstrations? Outreach programs?
7. We've heard from people involved with JROTC that there may be some stigma around JROTC, particularly around the uniform requirements. Have students been reluctant to join JROTC for these or other "social cost" reasons?
8. Are there financial costs associated with joining JROTC that prohibit certain students from joining?

Questions About STEM/Cyber Curriculum

1. In your opinion, does the JROTC program have a visible (or robust) STEM component?
    a. Probe: Is this a program you would direct STEM Oriented students to?
    b. Probe: Are you familiar with CyberPatriot? What do you know or think about it?
2. Are there enrichment science or technology opportunities at your school?
    a. Probe: Does this make them more or less appealing than JROTC for students?
3. How will students, parents, and other stakeholders likely react to an expansion of STEM content?

Perceptions of the AJROTC Program and Military

1. How professionally integrated is the JROTC instructor into the larger school?
    a. Probe: what is the perception of JROTC among teachers and administration in the larger school or district?
2. How supportive do you consider your school's community to be of military personnel? How prevalent and respected are military personnel in the community?
    a. Probe: What is your relationship to recruiters for JROTC program?
3. Can you provide a rough estimate of the percentage of students in the entire school who have expressed interest to you in a military career (not just those in JROTC)?

Closing Comments and Questions

1. If you were king/queen for a day of AJROTC, what would you do to help make JROTC the best program possible for the students in your school?

Protocol: AJROTC Cadre Graduates

Basic Background Questions

1. Let's start with your background. Where did you go to high school? When did you join JROTC?
    a. Probe: Did you have (family) experience with the military prior to joining JROTC?
2. What did you do after high school graduation?
    a. Probe: Did you enlist in the Army? Another branch? ROTC? Career?
    b. Probe: What is your highest education level? College?

Perception, Initial Entry, and General Experience

1. How did you first hear about JROTC?
    a. Probe: What aspects made you want to join?
    b. Probe: Did anyone at the school or in your life encourage you to join? Did anyone discourage you?
2. What did you want to get out of JROTC? What were your goals for joining?
    a. Probe: did those change over time?
3. What were the most impactful parts of JROTC for you?
4. Were there challenging aspects that may have made you (or other students) reluctant to join JROTC in your school?

Curriculum and ECAs (STEM, Other)

1. What were your experiences with the JROTC curriculum, and extracurricular activities?
    a. Probe: What were your favorite parts?
    b. Prove: What parts would you have preferred to skip?
2. Did you learn important and relevant skills from the instructors?
    a. Probe: Did the instructors struggle to guide any particular students?
    b. Probe: Do you have any continued mentorship contact with the JROTC instructors?
3. What was your experience with STEM or cyber content in the program? Do you think more STEM would have helped your career? Would it have been of interest to you?
    a. Probe: Are you familiar with CyberPatriot?
        i. Probe: (if yes): What was your experience?

ii. Probe: (if yes) Did you or your cadre compete in CyberPatriot?

b. Probe: Did your cadre participate in any robotics, rocketry, or other STEM activities?

Community Partners

1. Did your program work with community partners for service learning or other activities? What was your experience?
    a. Probe: If not, do you wish you had had that opportunity? Would you have found it valuable to be more connected with organizations in your local community?

Outcomes—Army and ROTC

1. Did you or any of your friends plan to pursue ROTC in college?
    a. What were reasons for joining ROTC?
    b. Were there any reasons that joining was challenging?
2. How many of your fellow students in high school planned to join or actually joined the military after graduation? How did JROTC inform those goals?
3. (ONLY IF MILITARY) Would you consider teaching as a JROTC instructor after you retire? Why or why not?

Outcomes—Student

1. Did JROTC influence the type of job you wanted to do?
    a. Probe: What were the other primary influences on your career path, and where would JROTC rank on that influence scale?
2. How did JROTC prepare you for your current job?
    a. Probe: Professionally?
    b. Probe: Personally?
    c. Probe: Academically?
3. What are some of the things JROTC might do differently to better prepare cadets for the demands of the 21st century career and military landscape?
4. What are the next steps for your career?

Closing Comments and Questions

1. What would you tell someone who is considering joining JROTC?

Appendix C. Analyses of Personnel Data

In this appendix, we provide more detail on the specific estimation models underlying the results presented in Chapter 4 and share the results of additional analyses to demonstrate robustness to various specifications and analysis windows.

Descriptive Statistics

In Table C.1 below, we present the sample size, mean, standard deviation, minimum, and maximum for the key variables used in our analysis. As visible in column 1, there are a few variables not available for all soldiers. Some are dependent on entry year (years of service), and some are missing for a small sample (age, noncitizen, recruitment tier, and AFQT score). We chose a narrow, essential set of controls to maximize the size of our analysis sample, and thus, we dropped soldiers from our analysis if they were missing values for these key controls.

Table C.1. Descriptive Statistics

Variables	(1) *N*	(2) mean	(3) sd	(4) min.	(5) max.
First-term attrition	1.407e+06	0.404	0.491	0	1
Years of service	1.394e+06	6.374	5.224	0	49.42
JROTC (ever)	1.407e+06	0.0421	0.201	0	1
Asian	1.407e+06	0.0347	0.183	0	1
Black	1.407e+06	0.194	0.395	0	1
Hispanic	1.407e+06	0.138	0.345	0	1
Female	1.407e+06	0.182	0.386	0	1
Accession year	1.407e+06	2008	4.799	1999	2020
Other reason for advanced rank	1.407e+06	0.373	0.484	0	1
Age	1.406e+06	22.02	4.660	17	60
Noncitizen	1.265e+06	0.0410	0.198	0	1
STEM initial MOS	1.381e+06	0.0808	0.273	0	1
JROTC, 1–2 years	1.407e+06	0.0180	0.133	0	1
JROTC, 3–4 years	1.407e+06	0.0242	0.154	0	1
Tier I recruit	1.406e+06	0.891	0.311	0	1
Tier II recruit	1.406e+06	0.104	0.306	0	1
Tier III recruit	1.406e+06	0.00415	0.0643	0	1
AFQT_cat_num1	1.406e+06	0.0568	0.232	0	1
AFQT_cat_num2	1.406e+06	0.327	0.469	0	1
AFQT_cat_num3	1.406e+06	0.597	0.491	0	1
AFQT_cat_num4	1.406e+06	0.0195	0.138	0	1
AFQT_cat_num5	1.406e+06	0.000388	0.0197	0	1
6+ years of service	1.307e+06	0.471	0.499	0	1
15+ years of service	511,321	0.1827	0.386	0	1

SOURCE: RAND analysis of U.S. Army Reserve Analyst and Regular Army Analyst data.
NOTE: sd = standard deviation.

Detailed Methods

For the descriptive comparisons between former JROTC cadets and our two other enlisted populations—those with no advanced paygrade and those enlisting with an advanced paygrade for other reasons—we performed a series of two-sample, two-tailed t-tests (testing once to compare with advanced paygrade and once to compare with other enlisted).

We also employ multivariate regression. For ease of interpretation, we use ordinary least squares regression. With a binary outcome, such as first-term attrition or pursuit of a STEM MOS, this takes the form of a linear probability model, and coefficients can be interpreted as percentage point differences in the outcome. For example, we estimate:

$$y_i = \beta_0 + \beta_1 JROTC_i + \beta_2 accessions_{char_i} + \beta_3 other_{adv_{paygrade_i}} + t_i + \epsilon_i. \quad (1)$$

Where $JROTC_i$ is an indicator for JROTC participation (as induced through advanced paygrade) and $accessions\_char_i$ is a vector that includes sex, race, ethnicity, citizenship, years of education, age, contracted term length, and AFQT score percentile. The variable $other\_adv\_paygrade_i$ indicates whether a soldier had a non-JROTC reason for having an advanced paygrade, and t_i is a vector of (accession timing) month and year fixed effects.

We first pool all former JROTC cadets, estimating a single coefficient regardless of years of participation. We then split by years of participation, expanding the term to also include an indicator for three or more years of participation. We extend this model by incorporating initial MOS and first-term deployment. MOS and deployment are both outcomes, and they are realized after JROTC completion. To that end, they are endogenous, and we previously showed that initial MOS differs by JROTC participation. However, career outcomes are strongly correlated with MOS and with first-term deployments (Marrone, 2020); thus, we account for these so that we can determine any additional relationship with JROTC beyond these contributions.

There are many known distributional issues with employing linear probability models, so we additionally estimate probit models and calculate average marginal effects, which can be interpreted like linear probability model coefficients. These robustness checks can be found at the end of this appendix.

STEM Coding of Occupations

Most taxonomies of STEM occupations rely on specific credentials, leveraging CIP codes for bachelor's degrees and beyond. Because most enlisted soldiers do not hold postsecondary credentials, we need to use a different approach. The Census Bureau has classified occupations into STEM, STEM-related, and non-STEM-related occupations at the six-digit Standard Occupational Classification code level. Military occupations are included in an aggregate manner, but they span only four categories, all of which are classified as non-STEM related. We adapt the coding of civilian occupations using knowledge of their general tasks and the general tasks in Army MOSs. However, this is likely an imperfect categorization and might reflect only a subset of STEM-focused MOSs.

In the civilian categorization, there are a few broad categories that are included in STEM and STEM-related occupations: engineering and drafting, health services, computer and mathematical occupations, and pure science roles (spanning life, physical, and social sciences and both scientists and technicians). With this list of civilian occupations, we scanned Army MOSs for title and task similarity. Note that no civilian telecommunications, pilot, installation, maintenance, or repair (even computer repair) occupations are considered STEM or STEM related. Our assessment of Army-enlisted MOSs by branch or branch equivalent is given in Table C.2. Not all branches are listed; some have no or very few enlisted MOSs, so if there are few MOSs and none of them are STEM, we exclude them from the table.

Table C.2. STEM Focus of Enlisted Military Occupational Specialty by Branch Equivalent

MOS Grouping	STEM MOSs
Infantry	None
Corps of Engineers	12T Technical Engineer and 21S Surveyor (no longer used)
Field Artillery	None
Air Defense Artillery	None
Aviation	None
Cyber	17C Cyber Operations Specialist
Special Forces	None
Armor	None
Signal Corps	25B Information Technology Specialist and 25D Cyber Network Defender
Military Police	None
Medical Career Management Field	All MOSs (n = 68)
Chemical Corps	74D Chemical, Biological, Radiological, and Nuclear Specialist
Logistics Corps	None
Quartermaster Corps	92L Petroleum Laboratory Specialist

SOURCE: RAND adaptation of U.S. Census Bureau, 2019a.

Additional Analyses

Consistency over Time

Table C.3 presents two panels. Panel A duplicates the results presented in the main text using all accession cohorts. Panel B is limited to those accessing from 2006 to 2021. We see that the patterns found in the full sample persist in the recent data for the active component—former JROTC participants are less likely to leave before the end of their first term, and this is concentrated among those with more years of participation (in fact, those with fewer years of participation appear slightly *more* likely to attrit, although this seems to be influenced by initial

MOS). In more-recent cohorts, the small relationship found among members of the reserve component has attenuated further, and none of the models for the reserve component in Panel B show a significant coefficient on either JROTC term.

Table C.3. Attrition During First Contracted Term, by JROTC Participation, Linear Probability Model

Characteristics	(1) Active	(2) Active	(3) Active	(4) Reserve	(5) Reserve	(6) Reserve
Panel A: Accessions 1999–2021						
JROTC (ever)	−0.030***			−0.011**		
	(0.002)			(0.003)		
JROTC (1–2 years)		0.000	−0.002		−0.010*	−0.010*
		(0.003)	(0.003)		(0.005)	(0.005)
JROTC (3+ years)		−0.050***	−0.052***		−0.011**	−0.010*
		(0.003)	(0.003)		(0.004)	(0.004)
Other reason for advanced paygrade	−0.065***	−0.065***	−0.075***	−0.014***	−0.014***	−0.015***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Panel B: Accessions 2006–2021						
JROTC (ever)	−0.022***			−0.001		
	(0.003)			(0.003)		
JROTC (1–2 years)		0.013**	0.008*		−0.004	0.000
		(0.004)	(0.004)		(0.005)	(0.004)
JROTC (3+ years)		−0.043***	−0.033***		0.002	0.003
		(0.003)	(0.003)		(0.004)	(0.004)
Other reason for advanced paygrade	−0.065***	−0.066***	−0.053***	−0.035***	−0.035***	−0.032***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Controls						
First MOS	No	No	Yes	No	No	Yes
Accession characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Age	Yes	Yes	Yes	Yes	Yes	Yes

SOURCE: RAND analysis of U.S. Army Reserve Analyst, Regular Army Analyst, and Total Army Personnel Database data.
NOTES: Accession characteristics include month and year of accessions, recruitment tier, AFQT score, citizenship, and contracted term length. Robust standard errors are in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table C.4 displays the equivalent comparison for those having started in a STEM-focused MOS. The results are quite consistent over time, with a slightly larger magnitude relationship found between JROTC participation and STEM-focused MOS in the more-recent cohorts. As with the full sample, there is a positive but insignificant relationship found in the reserve component.

Table C.4. Initial Occupational Specialty Is STEM, by JROTC Participation, Linear Probability Model

Characteristics	(1) Active	(2) Active	(3) Reserve	(4) Reserve
Panel A: Accessions 1999–2021				
JROTC (ever)	0.008***		0.004	
	(0.001)		(0.003)	
JROTC (1–2 years)		0.008***		0.005
		(0.002)		(0.004)
JROTC (3+ years)		0.009***		0.002
		(0.002)		(0.004)
Other reasons for advanced paygrade	0.009***	0.009***	0.011***	0.011***
	(0.001)	(0.001)	(0.002)	(0.002)
Panel B: Accessions 2006–2021				
JROTC (ever)	0.009***		0.004	
	(0.002)		(0.004)	
JROTC (1–2 years)		0.010***		0.006
		(0.002)		(0.005)
JROTC (3+ years)		0.009***		0.002
		(0.002)		(0.005)
Other reasons for advanced paygrade	0.004***	0.004***	0.007***	0.007***
	(0.001)	(0.001)	(0.002)	(0.002)
Controls				
Accession characteristics	Yes	Yes	Yes	Yes
Age	Yes	Yes	Yes	Yes

SOURCE: RAND analysis of U.S. Army Reserve Analyst, Regular Army Analyst, and Total Army Personnel Database data.
NOTES: Accession characteristics include month and year of accessions, recruitment tier, AFQT score, citizenship, and contracted term length. Robust standard errors are in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table C.5 shows the same over-time comparison for having an Army career of at least six years. Panel A shows the results from the main text that use the full sample of accession cohorts, and Panel B contains only those who accessioned after 2005. We see somewhat smaller, but still highly statistically significant, coefficients for all models. The active component coefficients on three or more years of JROTC participation are relatively consistent between samples, whereas the coefficient on one or two years of participation shrinks by about one-third.

Table C.5. Length of Service Is More Than Six Years, by JROTC Participation, Linear Probability Model

Characteristics	(1) Active	(2) Active	(3) Active	(4) Active	(5) Reserve	(6) Reserve	(7) Reserve	(8) Reserve
Panel A: Accessions 1999–2021								
JROTC (ever)	0.073***				0.046***			
	(0.002)				(0.005)			
JROTC (1–2 years)		0.033***	0.031***	0.032***		0.027***	0.026***	0.011
		(0.004)	(0.004)	(0.003)		(0.006)	(0.006)	(0.005)
JROTC (3+ years)		0.100***	0.096***	0.069***		0.062***	0.060***	0.049***
		(0.003)	(0.003)	(0.002)		(0.006)	(0.006)	(0.005)
Other reasons for advanced paygrade	0.113***	0.113***	0.116***	0.070***	0.095***	0.095***	0.101***	0.054***

	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)	(0.002)
Panel B: Accessions 2006–2021								
JROTC (ever)	0.068***				0.035***			
	(0.003)				(0.005)			
JROTC (1–2 years)		0.020***	0.018***	0.023***		0.016*	0.016*	0.004
		(0.004)	(0.004)	(0.003)		(0.007)	(0.007)	(0.007)
JROTC (3+ years)		0.097***	0.094***	0.064***		0.051***	0.049***	0.046***
		(0.003)	(0.003)	(0.003)		(0.007)	(0.007)	(0.006)
Other reasons for advanced paygrade	0.110***	0.110***	0.112***	0.065***	0.101***	0.101***	0.107***	0.062***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)
Controls								
First MOS	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Accession characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First-term attrition	No	No	No	Yes	No	No	No	Yes

SOURCE: RAND analysis of U.S. Army Reserve Analyst, Regular Army Analyst, and Total Army Personnel Database data.

NOTES: Accession characteristics include month and year of accessions, recruitment tier, AFQT score, citizenship, and contracted term length. Robust standard errors are in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Alternative Specifications

Finally, we conduct several specification checks as described in the detailed methods section above. In Table C.6, we compare the original model with the coefficients obtained using a probit model and marginal effects. The results are incredibly robust to model specification, with no more than 0.003 difference between any of the coefficients on JROTC. We see similar consistency in the coefficients on other reason for advanced paygrade.

Table C.6. Attrition During First Contracted Term, by JROTC Participation

Characteristics	(1) Active	(2) Active	(3) Active	(4) Reserve	(5) Reserve	(6) Reserve
Panel A: Accessions 1999–2021						
JROTC (ever)	−0.030***			−0.011**		
	(0.002)			(0.003)		
JROTC (1–2 years)		0.000	−0.002		−0.010*	−0.010*
		(0.003)	(0.003)		(0.005)	(0.005)
JROTC (3+ years)		−0.050***	−0.052***		−0.011**	−0.010*
		(0.003)	(0.003)		(0.004)	(0.004)
Other reason for advanced paygrade	−0.065***	−0.065***	−0.075***	−0.014***	−0.014***	−0.015***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Panel B: Accessions 2006–2021						
JROTC (ever)	−0.029***			−0.011**		
	(0.002)			(0.004)		
JROTC (1–2 years)		0.000	−0.002		−0.010	−0.010
		(0.003)	(0.003)		(0.005)	(0.005)
JROTC (3+ years)		−0.050***	−0.050***		−0.012*	−0.010*
		(0.003)	(0.003)		(0.005)	(0.005)
Other reason for advanced paygrade	−0.065***	−0.065***	−0.075***	−0.015***	−0.015***	−0.016***

Characteristics	(1) Active	(2) Active	(3) Active	(4) Reserve	(5) Reserve	(6) Reserve
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Controls						
First MOS	No	No	Yes	No	No	Yes
Accession characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Age	Yes	Yes	Yes	Yes	Yes	Yes

SOURCE: RAND analysis of U.S. Army Reserve Analyst, Regular Army Analyst, and Total Army Personnel Database data.
NOTES: Accession characteristics include month and year of accessions, recruitment tier, AFQT score, citizenship, and contracted term length. Robust standard errors are in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table C.7 displays the equivalent comparison for those having started in a STEM-focused MOS. There are no substantial differences in sign, magnitude, or significance between the models. Former JROTC participants who enlist in the active component are significantly more likely to start their careers in a STEM-focused MOS, regardless of specification.

Table C.7. Initial Occupational Specialty Is STEM, by JROTC Participation

Characteristics	(1) Active	(2) Active	(3) Reserve	(4) Reserve
Panel A: Linear Probability Model				
JROTC (ever)	0.008*** (0.001)		0.004 (0.003)	
JROTC (1–2 years)		0.008*** (0.002)		0.005 (0.004)
JROTC (3+ years)		0.009*** (0.002)		0.002 (0.004)
Other reasons for advanced paygrade	0.009*** (0.001)	0.009*** (0.001)	0.011*** (0.002)	0.011*** (0.002)
Panel B: Probit Marginal Effects				
JROTC (ever)	0.010*** (0.001)		0.004 (0.003)	
JROTC (1–2 years)		0.009*** (0.002)		0.006 (0.004)
JROTC (3+ years)		0.010*** (0.002)		0.002 (0.004)
Other reasons for advanced paygrade	0.008*** (0.001)	0.008*** (0.001)	0.008*** (0.001)	0.008*** (0.001)
Controls				
Accession characteristics	Yes	Yes	Yes	Yes
Age	Yes	Yes	Yes	Yes

SOURCE: RAND analysis of U.S. Army Reserve Analyst, Regular Army Analyst, and Total Army Personnel Database data.
NOTES: Accession characteristics include month and year of accessions, recruitment tier, AFQT score, citizenship, and contracted term length. Robust standard errors are in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table C.8 contrasts a linear probability model (Panel A) with a probit marginal effects model (Panel B) for the length of Army careers. The coefficients differ by less than 0.002 between

Panels A and B, showing that once again, these relationships are remarkably robust to specification choice.

Table C.8. Length of Service Is More Than Six Years, by JROTC Participation

Characteristics	(1) Active	(2) Active	(3) Active	(4) Active	(5) Reserve	(6) Reserve	(7) Reserve	(8) Reserve
Panel A: Linear Probability Model								
JROTC (ever)	0.073***				0.046***			
	(0.002)				(0.005)			
JROTC (1–2 years)		0.033***	0.031***	0.032***		0.027***	0.026***	0.011
		(0.004)	(0.004)	(0.003)		(0.006)	(0.006)	(0.005)
JROTC (3+ years)		0.100***	0.096***	0.069***		0.062***	0.060***	0.049***
		(0.003)	(0.003)	(0.002)		(0.006)	(0.006)	(0.005)
Other reasons for advanced paygrade	0.113***	0.113***	0.116***	0.070***	0.095***	0.095***	0.101***	0.054***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)	(0.002)
Panel B: Probit Marginal Effects								
JROTC (ever)	0.072***				0.043***			
	(0.002)				(0.004)			
JROTC (1–2 years)		0.033***	0.030***	0.031***		0.024***	0.023***	0.008
		(0.004)	(0.004)	(0.003)		(0.006)	(0.006)	(0.005)
JROTC (3+ years)		0.099***	0.095***	0.068***		0.060***	0.056***	0.044***
		(0.003)	(0.003)	(0.002)		(0.006)	(0.006)	(0.005)
Other reasons for advanced paygrade	0.112***	0.112***	0.114***	0.071***	0.094***	0.094***	0.098***	0.049***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)	(0.002)
Controls								
First MOS	No	No	Yes	Yes	No	No	Yes	Yes
Accession characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Characteristics	(1) Active	(2) Active	(3) Active	(4) Active	(5) Reserve	(6) Reserve	(7) Reserve	(8) Reserve
First-term attrition	No	No	No	Yes	No	No	No	Yes

SOURCE: RAND analysis of U.S. Army Reserve Analyst, Regular Army Analyst, and Total Army Personnel Database data.
NOTES: Accession characteristics include month and year of accessions, recruitment tier, AFQT score, citizenship, and contracted term length. Robust standard errors are in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Appendix D. State-Level Data Analysis

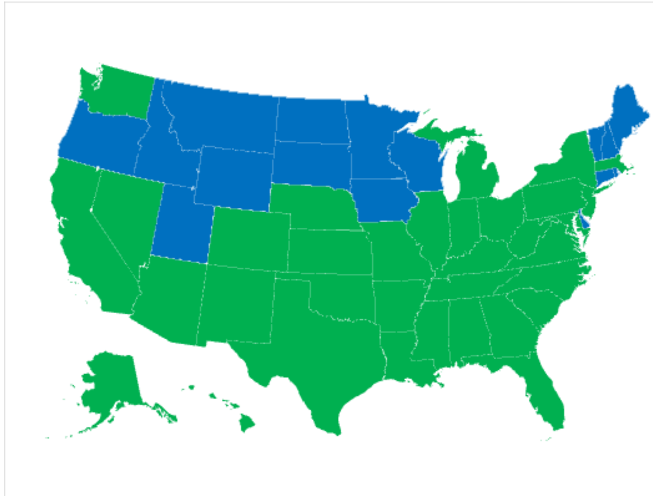
This appendix provides details on the data and statistical methods we used to estimate the impact of AJROTC participation on student outcomes in Texas and Hawaii. We describe the constraints we faced in selecting case study states for our analyses, the data sources we drew on, the construction of our analytic samples, and our quasi-experimental analysis approach. We present detailed data tables that expand on those provided in the main report and show results for additional exploratory analyses.

Case Study State Selection

We arrived at our pair of case study states though an iterative process that considered the number of AJROTC schools in the state, whether longitudinal data tracking students over time were available, whether those data included the information we needed for our analysis, and whether the data could be made available to us as researchers on the timeline for this project. We sought diversity in the set of states in our analysis along several key dimensions: size, urbanicity, race and ethnicity of student populations, economic conditions, propensity of young people to enlist in the military, and USACC brigade. However, our choice set of case study states was quite constrained.

First, the locations of AJROTC programs constrained our choice of states. To support a meaningful analysis, we required there to be more than five AJROTC programs in operation in the state. Figure D.1 shows how this criterion rules out much of the upper Midwest, northwest, and New England. States colored green are those with six or more AJROTC programs.

Figure D.1. States with More Than Five AJROTC Programs

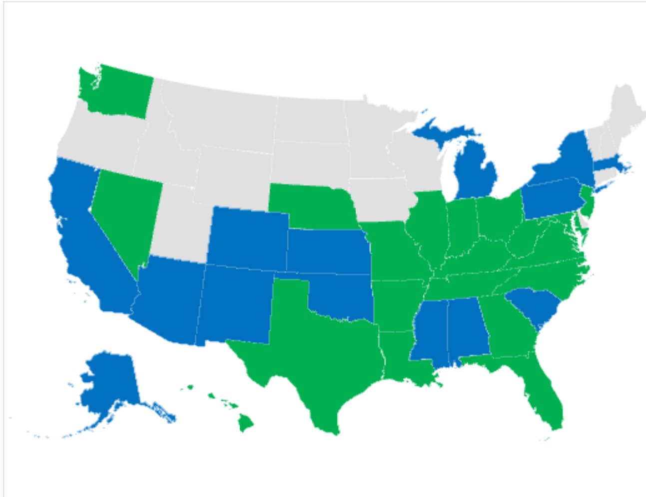


SOURCE: RAND analysis of AJROTC site data and review of SLDS availability.
NOTES: Green indicates that the state has more than five AJROTC programs; blue denotes five or fewer.

Next, a lack of sufficient state longitudinal data further restricted our choice set. Although SLDS hold the promise of enabling research to evaluate the impacts of educational interventions in high school (or earlier) on long-term outcomes for students in postsecondary education and the workforce, not all states have SLDS, and those that do are often newly developed and do not support analyses of long-term outcomes for students who were in high school in the past. The specific program we were seeking to analyze—participation in AJROTC in high school—also required that the SLDS contain course-taking data that reliably tracked whether students were enrolled in JROTC. Some SLDS do not include course-taking data, whereas others include it only for certain required courses as opposed to all courses students took. In addition, we required some measure of postsecondary enrollment for our analyses; some states with SLDS data covering K–12 education do not extend to postsecondary education.

In Figure D.2, blue denotes states with at least six AJROTC programs but without the SLDS data we needed. States with five or fewer programs are in gray; those remaining in green are states with both sufficient data and AJROTC programs to support the envisioned analysis.

Figure D.2. States with More Than Five AJROTC Programs and Sufficient SLDS Data

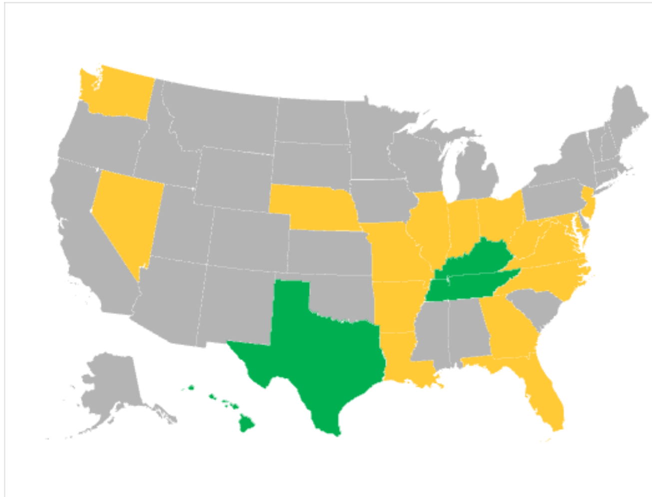


SOURCE: RAND analysis of USACC JROTC program data and review of SLDS availability.
NOTES: Green indicates that the state has sufficient SLDS data. Blue indicates insufficient SLDS data. Gray indicates that the state has five or fewer AJROTC programs.

Last, we needed to be able to obtain the SLDS data on the timeline needed for our one-year project. This last constraint was a substantial one. Importantly, although SLDS data exist for many states with AJROTC programs, individual student-level data are not publicly available, and the process of applying for and accessing the data can take considerable time and resources. This is true not only for the research organization making the request but also for state agencies who respond to these requests. As an SLDS guide describes, "Researchers should realize . . . that responding to research questions about, and requests for, SLDS data can take substantial time and resources on the part of state staff, who often must respond first to state priorities" (Levesque, Fitzgerald, and Pfeiffer, 2015). States can require extensive applications for data and separate approval from each individual state agency that contributes its data to the SLDS (e.g., K–12 education agencies, postsecondary systems, and the unemployment insurance system). In addition, states might review applications only at periodic or irregular intervals throughout the year. Even after approval, data agreements must be drawn up and executed, with states understandably taking careful steps to protect the privacy of student-level data.

Figure D.3 displays in green the set of states for which we applied for data access—where we anticipated that it could be possible to obtain data for our analysis in time. States shaded in yellow might be possible for future analyses, but through a combination of a review of state websites, initial consultations with state agencies, and internal expertise from colleagues with experience applying for data access from the states, we ruled them out in this case because we did not believe we would be able to work through the logistical obstacles to receive data access in time. States in gray are those with either too few programs or a lack of SLDS data for the analysis.

Figure D.3. States with More Than Five AJROTC Programs and Accessible SLDS Data



SOURCE: RAND analysis of USACC JROTC program data and review of SLDS availability.
NOTES: Green indicates that the state has sufficient SLDS data that was accessible in the project's timeline, whereas yellow indicates a slower timeline or other logistical obstacles. Gray indicates that the state has five or fewer AJROTC programs and/or insufficient SLDS data.

We applied for data from four states: Kentucky, Hawaii, Tennessee, and Texas. These states span three USACC brigades and offer diverse settings in which to analyze the impacts of AJROTC in terms of their urbanicity, demographics, and propensity to enlist among young people. We ultimately were able to receive approvals, execute data use agreements, and obtain data in time for our analyses for two of these states: Hawaii and Texas.

Data Sources

We drew on three categories of data for our analyses: (1) student-level SLDS data, (2) school-level data from public sources, and (3) data from the DoD and USACC. We describe each in turn.

SLDS Data

The SLDS data from Texas and Hawaii are the primary data sources for our analyses. The Texas data to which we had access included data for all students at all schools overseen by the Texas Education Agency from the 1999–2000 to 2018–2019 school years (University of Texas at Dallas Education Research Center, 2021). In addition to data from the K–12 system, the Texas SLDS linked to postsecondary records at Texas public two- and four-year postsecondary institutions and wage data from the Texas Workforce Commission for all cohorts, and to National Student Clearinghouse data on out-of-state postsecondary enrollments for a subset of cohorts (University of Texas at Dallas Education Research Center, 2021). The Hawaii data included cohorts of students enrolled in ninth grade at schools overseen by the Hawaii State Department of Education from the 2009–2010 to 2016–2017 school years along with baseline year (i.e., eighth grade), high school, and postsecondary data from the National Student Clearinghouse, reflecting enrollments nationwide for these cohorts (Hawai‘i P-20 Partnerships for Education, 2021).

Both Texas and Hawaii SLDS data include course information on individual students that allowed us to identify AJROTC participants. In Hawaii, we can distinguish students taking AJROTC because the courses are named *Army JROTC* from Army JROTC 1 (specifically, with course names of Army JROTC 1, Army JROTC 1A, and Army JROTC 1B) through Army JROTC 8 (specifically, Army JROTC 8, Army JROTC 8A, and Army JROTC 8B), along with two courses named Army JROTC Leadership Challenge (offered at levels 1 and 2). In Texas, course codes pertain to JROTC (of any service branch) and include four courses under the Military Science subject area (Reserve Officer Training Corps [ROTC] I through IV) and a PE course named PE Substitution JROTC. We identify AJROTC students in Texas by virtue of the school they attend.

Both SLDS included a wide variety of information on students' demographic and socioeconomic characteristics (e.g., gender, race and ethnicity, economic disadvantage status), their prior academic achievement (e.g., standardized test scores from middle school), and prior attendance and disciplinary records. This rich array of student-level data enabled our quasi-experimental analytical approach. SLDS data from both states also included key outcomes in high school and beyond, which we analyzed for treated and comparison students. We describe how we constructed these outcome measures for each state in the Creating the Analytic Samples section that follows.

School-Level Data

We supplemented the individual-level SLDS data with public data on school-level characteristics to identify schools that had similar characteristics as AJROTC schools but that did not offer JROTC. These included data from the U.S. Department of Education's CCD on school size, demographics, location (e.g., urban or rural), and rates of FRPL eligibility. We also drew on data from the U.S. Department of Education's Civil Rights Data Collection (CRDC) data sets, specifically the rate of student enrollment in AP coursework. We obtained CCD and CRDC data for the 2011–2012 and 2017–2018 school years from the Urban Institute's Education Data Portal (Urban Institute, 2021).

U.S. Army Cadet Command and DoD Data

We drew on three sources of military data for the analysis. First, USACC data on AJROTC program placement enabled us to identify active AJROTC program schools. Second, we obtained from DoD Civil Military Programs a list of JROTC programs (of any service branch) operating in 2019 to facilitate screening out other JROTC program schools from the pool of potential comparison schools, because we were not seeking to compare AJROTC with other JROTC programs. Third, we accessed the Defense Installations Spatial Data Infrastructure Program's

Military Installations, Ranges, and Training Areas data and used these data to construct measures of school proximity to military installations (DoD, 2017). We constructed measures of distance as the crow flies from high schools to the nearest installation (of any service) and the number of installations within an hour's drive of high schools.

Creating the Analytic Samples

We used a set of decision rules to scope our analytic samples to enable a rigorous comparison between AJROTC students and students at non-JROTC schools while making some exclusions based on data availability and time constraints that could limit the generalizability of the findings. We describe these scoping decisions for students and schools, define our primary outcome measures for students in each state, and then present basic comparisons of baseline characteristics and outcomes for students at AJROTC and non-JROTC schools.

Scoping the Sample of Students

We constructed sets of cohorts of first-time ninth graders entering high school from 2003–2004 through 2015–2016 in Texas and from 2009–2010 through 2016–2017 in Hawaii. Students who moved into the state public school system after ninth grade are excluded from the analyses, on the grounds that we cannot know whether those students participated in JROTC in their initial high schools. We further require students in our analyses to have been enrolled in eighth grade in the public school system in the school year prior to entering ninth grade, because our analysis approach requires pre–high school data on students to make appropriate comparisons.

For students missing demographic information linked to their eighth grade year, we substituted their information from their ninth-grade year; however, we do not impute test scores and exclude students without them. Collectively, these exclusions mean that our analyses might not fully represent the experiences and outcomes of students who moved in from out of state at the start of high school (or attended private schools in eighth grade) or students who did not take eighth grade math and reading exams. Future analyses could use regression-based imputation methods to preserve students with missing baseline data in the analyses; however, time constraints of this project precluded us from implementing these advanced methods.[21]

Scoping the Sample of Schools

We used data provided by USACC to identify schools with AJROTC programs in both states. In Hawaii, we were able to validate this list using SLDS data because the course-taking data we received identified the service branch of the JROTC program in which students were enrolled. In Texas, we were able to validate that schools on the USACC list had students taking

[21] For examples of imputation methods that the What Works Clearinghouse recommends for handling missing baseline data, see What Works Clearinghouse, 2020, p. 37.

JROTC but relied exclusively on the USACC information to identify AJROTC schools. For both states, we drew on DoD data and SLDS data to refine the set of potential comparison schools to those without JROTC programs of any service branch. In Hawaii, this was straightforward, given the relatively small number of schools in the state.

In Texas, we excluded schools identified on the DoD Civil Military Programs list as having JROTC programs from the comparison pool but note that (1) the Texas SLDS data showed large numbers of students taking JROTC at schools that were not on the DoD list (suggesting a nonidentified program) and (2) based on the undercounting of AJROTC schools, the DoD list likely undercounted programs of other service branches as well. Based on the course-taking data (over the 2003–2004 to 2018–2019 time frame), we identified possibly undercounted JROTC schools as any schools with either (1) five or more years with JROTC takers and at least ten students in at least one year or (2) eight or more years of JROTC takers with at least five in at least one year. We removed these possibly undercounted schools from the analysis. In addition to screening out JROTC programs of other service branches, this method possibly could have screened out schools with no-longer-operational AJROTC programs.

We also restricted the set of AJROTC and potential comparison schools in the analysis to those open during the bulk of the time span of the analysis (specifically, in both the 2011–2012 and 2017–2018 school years) that were not alternative or charter schools and that included ninth through twelfth grades. For AJROTC schools, we required them to have at least two cohorts that could be tracked through to high school graduation, meaning that very recently launched programs are not included. These exclusions collectively were made to facilitate our analysis approach and to screen out schools from the comparison pool that are not appropriate comparators (e.g., because few AJROTC schools are alternative schools or charters, we did not want to compare with them). However, this means that a small number of active AJROTC programs in Texas are not in the analysis. These include seven schools with AJROTC programs established more recently than 2014–2015, one school not yet open in 2011–2012, one charter school, five schools not spanning grades nine through twelve, and three more schools with irregular enrollment patterns that impeded linking students taking JROTC to AJROTC schools.

Ultimately, our sample included 184 AJROTC schools and 820 non-JROTC potential comparison schools in Texas, and 16 AJROTC schools and 20 potential comparison schools in Hawaii. Across all cohorts of ninth graders that meet the criteria described above in the Scoping the Sample of Students section, there were 1.9 million AJROTC and potential comparison students in Texas and 66,500 students in Hawaii who could contribute to our analysis. Again, we refer to these as *potential comparison* schools and students because our analysis approach first matches AJROTC schools to up to three comparison schools, and schools that do not match to any AJROTC schools are not included in the impact analysis.

Defining Outcome Measures

We defined a set of outcome measures for students in each state. For both states, we were able to analyze high school outcomes and a measure of postsecondary enrollment post–high school. In Texas, we were also able to explore workforce outcomes and student intentions to enlist in the military for a subset of cohorts.

High School Outcomes

With respect to high school outcomes, SLDS data from both states included information on high school graduation, attendance, and indiscipline. We define our high school graduation outcome as graduating *on time*—if students graduated in or prior to the fourth year of high school (e.g., by 2018–2019 for ninth graders in 2015–2016). Students who earn a certificate of completion by the fourth year are counted as graduating in addition to those earning a traditional diploma. Our attendance outcome is the student's absence rate in the fourth year of high school, defined as the percentage of enrolled days that the student is absent. Our in-school and out-of-school suspension outcomes are binary indicators for whether the student received one or more suspensions of the specified type in the fourth year of high school. For attendance and suspensions, students need not progress to twelfth grade for the outcome to be assessed.

SLDS data from both states included course-taking data that supported the construction of a composite measure of STEM credits earned in high school beyond those required for graduation. (We excluded Algebra 1, Geometry, and Biology 1 from our measure in both states on these grounds.) We note that we requested and received a more limited set of STEM course-taking data from Hawaii, focused on advanced STEM courses and computer science and cyber, whereas we had access to a full set of course-taking data for all students in Texas and included a wider array of nonrequired STEM courses in our measure. The measures, therefore, are not comparable across states, with Hawaii focused on advanced STEM and computing or cyber.

For all outcomes, students with documented transfers out of the state public educational systems (e.g., who moved out of state) are excluded from the outcome analysis because we are unable to track their outcomes. This holds for both high school and postsecondary outcomes.

Postsecondary Outcomes

For both states, we assess a measure of enrollment in postsecondary education the year after students left high school. The Hawaii data we received capture enrollments at most postsecondary institutions nationwide, drawing on data from the National Student Clearinghouse. Our main outcome is assessed the fall after high school graduation; we also received an indicator for whether students persisted in postsecondary education to the second fall after high school. In Texas, the SLDS data included enrollments in Texas public and independent postsecondary institutions only for all cohorts.[22] The outcome is assessed during the student's first full year post–high school, including fall and spring terms, and we construct a measure of persistence to a second year of postsecondary education. Texas data allowed for differentiating between enrollments at two- and four-year postsecondary institutions, whereas the Hawaii data did not.

Postsecondary outcomes are assessed without conditioning on high school graduation. Students who do not appear in the postsecondary data are coded as not enrolling.

Additional Texas Outcomes

In addition to signaling postsecondary enrollments, for the last three cohorts in Texas, the SLDS data include information reported by students' high schools on whether they enlisted in the military by the end of the calendar year in which they graduate.[23] We caution that the military enlistment data are not independently verified by DoD, and concerns have arisen about potentially bad-faith overreporting of enlistments by some schools. Therefore, we refer to this outcome as a student's *intention* to enlist and expect that it might overstate actual enlistments.

Last, the Texas SLDS data link to Texas Workforce Commission records on wages earned in the state, which we use to analyze whether students had wages and the amount of these wages. We assess wage outcomes eight years after students leave high school and, specifically, 11 years after the spring of their ninth grade year. This is to allow sufficient time for students to enroll and complete postsecondary education so that the comparison is less affected by differences that might arise from being enrolled in postsecondary programs. We annualize wages earned in the second quarter of the year (April to June) and adjust for inflation to 2020 dollars using the Consumer Price Index. We note that, in addition to out-of-state wages, the data do not include information on wages earned in federal employment, whether military or civilian.

Descriptive Comparison

In Chapter 5, we provided some information on how AJROTC students differ on average from students at their schools who do not take AJROTC and especially from students at schools without JROTC programs. We provide these descriptive comparisons of student characteristics to underscore that AJROTC students differ from non-JROTC students before ever entering the program and that a simple comparison of outcomes might reflect these preexisting differences rather than identify the value-add of participating in AJROTC. Tables D.1 and D.2 show these differences for Texas and Hawaii, respectively, for the full set of student-level baseline characteristics that we used in our analyses, both when weighting the comparison group and as controls in our impact models. As in Table 5.3 in the main report, these data reflect students enrolled in ninth grade at AJROTC and potential comparison schools over the years in our

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[22] For a list of postsecondary institutions that fall under the umbrella of the Texas Higher Education Coordinating Board and that are included in the main analysis, see Texas Higher Education Coordinating Board, 2018.

[23] Guidance provided to schools for reporting this indicator is available at Texas Education Agency, undated.

analysis, including 2003–2004 through 2015–2016 cohorts in Texas and 2009–2010 through 2016–2017 cohorts in Hawaii. We clearly see that, across a wide variety of characteristics, AJROTC students differ from their non-JROTC counterparts.

For Hawaii, we include both federal race and ethnicity categories and Hawaii State Department of Education (HIDOE) categories that reflect the unique demographics of the state. In Hawaii, Native Hawaiians and Pacific Islanders consistently have lower achievement scores and on-time graduation rates than their peers in other race or ethnicity groups, according to state data (HIDOE, 2021). In Texas, race and ethnicity data reflect student self-identification under a prior federal categorization scheme with five categories that did not allow for identifying both a race (e.g., white or Black) and an ethnicity (e.g., Hispanic or Latino). Because we had access to student data from earlier years, the Texas SLDS data supported identifying race or ethnicity for more-recent students under this prior categorization scheme, but assigning students who were coded under the prior scheme to the existing categories would have required additional assumptions.[24]

Table D.1. Descriptive Comparison of Students at AJROTC and Non-AJROTC Potential Comparison Schools, Ninth Grade Cohorts, 2003–2004 to 2015–2016, Texas

Characteristics	Non-JROTC Potential Comparison Schools, All Students	AJROTC Schools, Students Never Taking AJROTC	AJROTC Schools, Students Ever Taking AJROTC
Number of Students	996,654	779,153	128,427
Female	49.4%	50.2%	45.0%
Black/African American	10.1%	15.9%	17.2%
Hispanic/Latino	28.3%	63.2%	66.7%
Asian or Pacific Islander	2.3%	2.2%	1.4%
American Indian or Alaskan Native	0.4%	0.2%	0.3%
White	58.8%	18.5%	14.4%
Average Age, Eighth Grade	13.2	13.2	13.3
Gifted	10.1%	11.3%	7.1%
Limited English Proficiency	3.3%	11.2%	14.4%
Special Education Program	7.5%	7.0%	11.2%
Economically Disadvantaged	43.5%	67.8%	78.0%
Average Absence Rate, Eighth Grade	3.8%	4.3%	4.6%
In-School Suspension, Eighth Grade	19.9%	23.3%	26.5%
Out-of-School Suspension, Eighth Grade	5.9%	12.8%	16.5%

[24] For a discussion of the change in federal race and ethnicity categories and suggested methods for bridging across the change, see National Forum on Education Statistics, 2008.

Characteristics	Non-JROTC Potential Comparison Schools, All Students	AJROTC Schools, Students Never Taking AJROTC	AJROTC Schools, Students Ever Taking AJROTC
Severe Disciplinary Action, Eighth Grade	2.9%	4.0%	4.4%
Eighth Grade Math Exam Standardized (*z*) Score	0.08	−0.08	−0.18
Eighth Grade Reading Exam Standardized (*z*) Score	0.09	−0.10	−0.19

SOURCE: University of Texas at Dallas Education Research Center, 2021.
NOTES: Data reflect the characteristics of students in ninth grade cohorts at schools without JROTC programs and schools with AJROTC programs depending on whether students took AJROTC at any point in high school. Summary statistics are based on data pooled across cohorts and include the 2003–2004 through 2015–2016 ninth grade cohorts in Texas. Severe disciplinary actions include expulsions and placement in a Disciplinary Alternative Education Program (DAEP) or Juvenile Justice Alternative Education Program (JJAEP). Math and reading exam scores shown in this table are *z*-scored by subject and year such that the mean is zero and the standard deviation across all takers (whether in our analyses or not) is equal to one.

Table D.2. Descriptive Comparison of Students at AJROTC and Non-AJROTC Potential Comparison Schools, Ninth Grade Cohorts, 2009–2010 to 2016–2017, Hawaii

Characteristics (Source)	Non-JROTC Potential Comparison Schools, All Students	AJROTC Schools, Students Never Taking AJROTC	AJROTC Schools, Students Ever Taking AJROTC
Number of Students	25,738	34,328	6,462
Female	48.6%	51.1%	34.1%
Age, Eighth Grade	14.2	14.2	14.2
American Indian or Alaska Native (Federal)	0.5%	0.4%	0.5%
Asian (Federal)	38.6%	40.4%	35.9%
Black (Federal)	0.8%	1.7%	1.6%
Hispanic (Federal)	6.4%	5.8%	6.0%
Multiracial (Federal)	8.6%	8.8%	9.5%
Native Hawaiian or Other Pacific Islander (Federal)	33.6%	33.6%	38.1%
White (Federal)	11.4%	9.2%	8.3%
Asian (HIDOE)	17.3%	16.6%	10.4%
Filipino (HIDOE)	24.9%	27.2%	28.2%
Native Hawaiian (HIDOE)	31.4%	26.5%	25.6%
Other Race/Ethnicity (HIDOE)	7.5%	8.3%	9.2%
Pacific Islander (HIDOE)	4.8%	10.0%	16.2%
White (HIDOE)	14.2%	11.4%	10.4%
Economically Disadvantaged	50.8%	55.6%	65.0%
ELL and/or Student with Disability	18.4%	19.2%	30.7%
Absence Rate, Eighth Grade	5.2%	5.5%	5.6%

Characteristics (Source)	Non-JROTC Potential Comparison Schools, All Students	AJROTC Schools, Students Never Taking AJROTC	AJROTC Schools, Students Ever Taking AJROTC
In-School Suspension, Eighth Grade	3.8%	2.0%	2.9%
Out-of-School Suspension, Eighth Grade	11.1%	9.5%	12.1%
Eighth Grade Math Exam Standardized (*z*) Score	0.05	0.00	−0.25
Eighth Grade Reading Exam Standardized (*z*) Score	−0.01	−0.03	−0.29

SOURCE: Hawaiʻi P-20 Partnerships for Education, 2021.
NOTES: Data reflect the characteristics of students in ninth grade cohorts at schools without JROTC programs and schools with AJROTC programs depending on whether students took AJROTC at any point in high school. Summary statistics are based on data pooled across cohorts and include the 2009–2010 through 2016–2017 ninth grade cohorts in Hawaii. Federal refers to federal race and ethnicity categories, and HIDOE refers to categories reported by the Hawaii State Department of Education. Math and reading exam scores shown in this table are *z*-scored by subject and year such that the mean is zero and the standard deviation across all takers in the cohorts for which we received data (whether in our analyses or not) is equal to one.

A simple comparison of students ever taking AJROTC and students at non-JROTC schools similarly finds stark differences in outcomes in high school and beyond. Tables D.3 and D.4 present these comparisons for our main outcomes in Texas and Hawaii. We include columns indicating the number of students in each group (AJROTC takers, nontakers at AJROTC schools, and students at non-JROTC schools) with outcome data. These numbers vary across outcome measures based on the number of cohorts for which we can assess the outcome. For instance, year 4 absence and indiscipline outcome data are available only if students made it to the fourth year of high school (not dropping out earlier in their high school careers), and, in Texas, only students with a valid unique identifier could be linked from high school to postsecondary and workforce outcomes (about 1 percent did not have an identifier, with little difference in this rate between AJROTC takers and students in the other groups).

Critically, these differences, which typically show AJROTC students performing worse than their peers, should not be interpreted as the result of participating in AJROTC in high school. Rather, differences in outcomes reflect various factors, including preexisting differences between AJROTC students and students at schools without JROTC programs. We present these tables to show how a simple comparison can misleadingly negatively portray the AJROTC program. In the sections that follow, we detail the statistical methods that we used to develop an appropriate comparison group and our results when accounting for the numerous differences between students not taking JROTC and AJROTC students before ever entering the program.

Table D.3. Descriptive Comparison of Outcomes for Students at AJROTC and Non-AJROTC Potential Comparison Schools, Ninth Grade Cohorts, 2003–2004 to 2015–2016, Texas

	Number of Students with Outcome Data			Average Outcomes		
Characteristics	**Non-JROTC School Students**	**AJROTC Schools, Students Never Taking AJROTC**	**AJROTC Schools, Students Ever Taking AJROTC**	**Non-JROTC School Students**	**AJROTC Schools, Students Never Taking AJROTC**	**AJROTC Schools, Students Ever Taking AJROTC**
On-Time Graduation	904,454	704,875	113,988	92.4%	84.8%	79.7%
Average Absence Rate, Year 4	877,227	674,183	109,035	6.6%	8.6%	9.7%
In-School Suspension, Year 4	863,237	660,453	106,138	13.3%	13.2%	14.8%
Out-of-School Suspension, Year 4	863,237	660,453	106,138	3.7%	6.1%	7.6%
STEM Credits Earned in High School	904,604	704,928	114,009	5.1	4.9	4.5
Enroll in 2-Year Postsecondary Year After High School	825,907	635,944	102,368	36.5%	34.1%	24.9%
Enroll in 4-Year Postsecondary Year After High School	825,907	635,944	102,368	25.0%	22.7%	12.1%
Enroll in Either 2- or 4-Year Postsecondary Year After High School	825,907	635,944	102,368	54.9%	51.0%	34.6%
Enlist in Military	207,467	157,855	27,128	3.6%	3.3%	10.4%
Enroll in 2- or 4-Year Postsecondary or Enlist in Military	134,826	95,780	16,837	52.2%	49.1%	40.1%
Any Wages in Texas 8 Years After High School	312,459	251,612	37,114	80.0%	77.7%	73.2%
Average Wages 8 Years After High School (Texas wages only)	249,972	195,622	27,185	$40,308	$34,966	$30,319

SOURCE: University of Texas at Dallas Education Research Center, 2021.
NOTES: Data reflect outcomes for students in ninth grade cohorts at schools without JROTC programs and schools with AJROTC programs depending on whether students took AJROTC at any point in high school. Summary statistics are based on data pooled across cohorts and include the 2003–2004 through 2015–2016 ninth grade cohorts in Texas. Postsecondary enrollments include Texas public postsecondary institutions only. Wages reflect annualized wages earned in the second quarter 11 years after the spring of a student's ninth grade year, adjusted for inflation to 2020 dollars using the Consumer Price Index.

Table D.4. Descriptive Comparison of Outcomes for Students at AJROTC and Non-AJROTC Potential Comparison Schools, Ninth Grade Cohorts, 2009–2010 to 2016–2017, Hawaii

	Number of Students with Outcome Data			Average Outcomes		
Characteristics	**Non-JROTC School Students**	**AJROTC Schools, Students Never Taking AJROTC**	**AJROTC Schools, Students Ever Taking AJROTC**	**Non-JROTC School Students**	**AJROTC Schools, Students Never Taking AJROTC**	**AJROTC Schools, Students Ever Taking AJROTC**
On-Time Graduation	24,017	34,328	6,462	86.7%	85.5%	81.5%
Average Absence Rate, Year 4	22,744	34,328	6,462	8.5%	8.4%	10.2%
In-School Suspension, Year 4	22,746	34,328	6,462	1.1%	0.3%	0.3%
Out-of-School Suspension, Year 4	22,746	34,328	6,462	4.1%	3.5%	5.0%
STEM Credits Earned in High School	24,017	34,328	6,462	2.2	2.3	1.7
Enroll in Either 2- or 4-Year Postsecondary Year After High School	24,017	34,328	6,462	49.3%	48.5%	29.1%

SOURCE: Hawaiʻi P-20 Partnerships for Education, 2021.
NOTES: Data reflect outcomes for students in ninth grade cohorts at schools without JROTC programs and schools with AJROTC programs depending on whether students took AJROTC at any point in high school. Summary statistics are based on data pooled across cohorts and include the 2009–2010 through 2016–2017 ninth grade cohorts in Hawaii. Postsecondary enrollments are assessed the fall after leaving high school and include enrollment in public or private postsecondary institutions nationwide.

Analytic Approach

There are three main steps to our analytic approach: (1) matching AJROTC schools to one or more comparison schools, (2) weighting students at matched comparison schools so that AJROTC students and students in the comparison pool are statistically similar to each other prior to entering high school, and (3) estimating the impacts of AJROTC participation while accounting for preexisting differences between students and schools. We discuss each in this section.

Matching Schools

We used primarily public data to match each AJROTC school in Texas and Hawaii with up to three non-JROTC comparison schools based on their total student enrollment, urbanicity, proportion of underrepresented minority students (Black and Hispanic students in Texas and Native Hawaiian or Other Pacific Islander students in Hawaii), FRPL eligibility rates, and AP course-taking rates. In Texas, we also incorporated a measure of proximity to military installations in the school-level matching.[25] We performed static matching using characteristics

[25] We found that, given the unique island geography of Hawaii and the small number of potential comparison schools, using a measure of proximity to military installations in the calculation of school-level propensity scores

of schools as of the 2011–2012 school year, a point roughly in the middle of the time on which our analysis focuses.

We implemented this strategy using the *psmatch2* package in the Stata program (Leuven and Sianesi, undated). Given information in the data set on the treatment status of schools (i.e., whether the school offers AJROTC) and the set of key characteristics of these schools listed above, the program uses multivariate probit regression to calculate a propensity score that reflects each school's probability of being an AJROTC school based on the observable factors included in the model. This score ranges from 0 to 1. Although we *know* that certain schools are AJROTC schools, these AJROTC schools receive propensity scores as well, which in effect provides a quantitative measure of how likely that school is to be an AJROTC school given these characteristics and absent the knowledge that it does in fact have an AJROTC program.

The *psmatch2* program identifies non-JROTC schools with similar propensity scores as AJROTC-treated schools. Users input the number of potential matches for each treated school, whether comparison schools can be included as matches for multiple treatment schools, and the maximum allowable difference in propensity scores for a school to be considered similar enough to be a match (known as the *caliper*). Literature offers little guidance on the selection of an appropriate caliper, though tighter calipers yield more-closely matched schools than wider ones (Lunt, 2013). For our purposes, given the limited choice set of potential comparison schools in Hawaii and the relatively small number of AJROTC programs there, we used the data to determine a caliper width that would allow for the inclusion of all AJROTC schools in the analysis—a caliper of 0.25. In Texas, we set this value at 0.20. Both are wider than would be appropriate for a school-level analysis; however, our analyses are done at the student level, and we employ additional measures to achieve balance on student-level characteristics (described below). We also account for an array of additional school-level factors in our outcome estimation models.

In both states, AJROTC schools could match to up to three non-JROTC schools in the specified calipers. If more than three schools fell within the specified caliper, we used the three schools with the closest propensity scores to each treated school. We allow for matching with replacement (i.e., comparison schools can be matched to multiple treated schools), again in recognition of the limited choice set of potential comparison schools in Hawaii in particular. Thus, although each AJROTC school is in only one matched block of schools, comparison schools can be in multiple matched blocks, for example, if they fall roughly midway between two treatment schools in terms of their propensity score. We make statistical adjustments to account for this duplication by reducing the student-level weights of students at comparison schools in multiple blocks by dividing their weight by their number of blocks.

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resulted in nearly half our AJROTC school sample failing to match within a 0.25 caliper to any comparison schools. Hence, we dropped this variable from the school-matching models; however, we do include it in the outcome estimation models to account for the influence of this factor on student outcomes.

In Texas, we end up with 55 blocks comprising 184 AJROTC schools (each in only one block) and 72 comparison schools (that might be in multiple blocks). In Hawaii, we have 10 blocks comprising the 16 AJROTC schools and 14 comparison schools. The remainder of the potential comparison schools in Texas and Hawaii did not match to any AJROTC schools and are not in the analyses.

Propensity Score Weighting Students

We then use propensity score weighting to weight students at the comparison schools in each matched block, such that students who are most similar to the AJROTC students at the AJROTC school(s) in that block receive the largest weights and factor into the analysis to a greater degree. These weights are determined based on student characteristics prior to entering high school and are drawn from the SLDS data. For both states, these characteristics include gender, race and ethnicity, economic disadvantage status, absences in eighth grade, suspensions in eighth grade, achievement on eighth grade math and reading exams, and cohort indicators for the year that students entered ninth grade. In the Texas analysis, we also incorporate information on whether students are in gifted programs, have limited English proficiency, or are in special education programs. In the Hawaii analysis, we include a combined indicator that identifies English language learners (ELLs) or students in special education.

We calculate the propensity weights by first estimating propensity scores at the student level, using a method known as *generalized boosted modeling* (GBM), which is a machine learning approach that does not impose a fixed relationship between the student characteristics in the model and treatment (i.e., it is nonparametric) (McCaffrey et al., 2013). Rather, GBM tests various functional forms and relationships between the included characteristics and the treatment to arrive at propensity scores that reflect the probability of being an AJROTC-treated student conditional on the set of included baseline characteristics. We implemented the GBM approach using the *twang* package in Stata (Cefalu, Liu, and Martin, 2015).[26] We did so separately for each matched block in each state, allowing for the possibility that characteristics of AJROTC students might differ across the matched blocks.

The *twang* program converts the propensity scores into weights, which are used in the impact estimation models. AJROTC students receive weights of one (because we know they are treated students), and students at comparison schools are weighted by the ratio of their propensity score to one minus that score. For example, if a control student has a propensity score of 0.50 (equally likely to participate as not participate), that student receives a weight of one. Control students who are more likely than not to participate in AJROTC (if given the option) receive weights greater than one (and count more in the analysis), and students who are less likely to participate receive weights less than one (and count to a lesser degree in the analysis). Students attending

[26] Models were allowed to run 20,000 times with two-way interactions of the covariates. Models were chosen to minimize the mean effect size statistic for treatment and control groups.

AJROTC schools but not participating in the program are excluded from the analysis. This is to avoid biasing the comparison considering unobservable factors that very likely contribute to the decision to participate in AJROTC for students who have the option to do so.

We run the GBM process separately for our three treatment groups of interest, all of which we require to have attended a school offering AJROTC in ninth grade: (1) students who took AJROTC at least in ninth grade, (2) students who took AJROTC in at least ninth and tenth grades, and (3) students who took AJROTC in all four years of high school. In all cases, we require students to follow normal grade progression in high school to be in either the treatment or comparison groups. To construct appropriate comparison groups and facilitate the GBM for each matched block of schools, we exclude comparison students from the analysis who are in ninth grade cohorts that do not have any treated students. For example, if an AJROTC program began at a school in the middle of the set of cohorts in our analyses and that was the only treated school in the block, students at comparison schools in that block in years prior to the establishment of the AJROTC program are excluded from the analysis.

A critical marker of the success of the propensity score weighting method is whether treated students are equivalent to control students (applying the propensity weights) on baseline characteristics. If so, this means that we have constructed an appropriate comparison group that can then be used to estimate impacts of AJROTC participation on students that approximate causal impact estimates. For each of the characteristics presented in the simple descriptive comparisons earlier in this appendix, we show the results (1) when restricting the set of treatment and control students to those in our three analytic samples but without applying the propensity weights and (2) when applying propensity weights for the comparison students. Tables D.5 through D.10 show how the application of the weighting procedure narrows average differences between treatment and control groups across all samples in both states.

The final two columns in these tables display the standardized effect size difference between the treatment and comparison groups, first for the unweighted comparison and then for the weighted comparison. These are calculated as the difference between the treatment and control means divided by the unweighted pooled standard deviation (i.e., across both treatment and control observations). The What Works Clearinghouse applies a standard of an effect size of no more than 0.05 in absolute value to be considered equivalent and not require additional statistical adjustments, and no more than 0.25 in absolute value to be considered adequate for establishing baseline equivalence if the covariates are also included in the outcome estimation models (What Works Clearinghouse, 2014). Although in a few instances, the standardized differences exceed 0.05 with the weights, in no cases do they exceed 0.25.[27] In any case, we include the full set of

[27] The tables present simple treatment means and both unweighted and weighted comparison means. In addition, we tested whether there were statistically significant differences between treatment and comparison students using a regression framework that controlled for the matched block the students were in. To do so, we regressed each covariate (individually) on a treatment indicator and the set of block indicators. Coefficients on the treatment

baseline characteristics in all outcome estimation models as covariates. This practice is referred to as *doubly robust modeling* and adjusts for the small, remaining baseline differences on these observable student-level characteristics (Bang and Robins, 2005).

Table D.5. Baseline Equivalence Tables, Ninth Grade AJROTC Takers Analysis, Texas

Characteristics	AJROTC-Treated Student Mean	Comparison Student Mean		Treatment and Comparison Group Standardized Difference	
		Unweighted	Weighted	Unweighted	Weighted
Number of Students	105,023	233,387			
Female	44.8%	50.1%	43.9%	−0.11	0.02
Black/African American	16.7%	15.0%	15.7%	0.05	0.03
Hispanic/Latino	66.9%	35.6%	60.6%	0.63	0.13
Asian or Pacific Islander	1.3%	5.2%	1.6%	−0.20	−0.01
American Indian or Alaskan Native	0.3%	0.3%	0.3%	−0.01	−0.01
White	14.8%	43.8%	21.8%	−0.61	−0.15
Average Age, Eighth Grade	13.3	13.2	13.2	0.24	0.04
Gifted	7.2%	11.1%	6.9%	−0.13	0.01
Limited English Proficiency	14.0%	5.2%	10.7%	0.33	0.12
Special Education Program	10.7%	7.1%	10.0%	0.13	0.03
Economically Disadvantaged	77.8%	42.0%	71.5%	0.72	0.13
Average Absence Rate, Eighth Grade	4.6%	3.7%	4.5%	0.22	0.04
In-School Suspension, Eighth Grade	26.7%	19.3%	28.7%	0.18	−0.05
Out-of-School Suspension, Eighth Grade	16.7%	8.3%	14.9%	0.27	0.06
Severe Disciplinary Action, Eighth Grade	4.4%	2.9%	4.7%	0.09	−0.02
Average Eighth Grade Math Exam Standardized (*z*) Score	−0.19	0.14	−0.15	−0.32	−0.04
Average Eighth Grade Reading Exam Standardized (*z*) Score	−0.19	0.12	−0.15	−0.31	−0.04

SOURCE: University of Texas at Dallas Education Research Center, 2021.
NOTES: Data reflect the characteristics of students in ninth grade cohorts at schools without JROTC programs and schools with AJROTC programs depending on whether students took AJROTC at any point in high school. Summary statistics are based on data pooled across cohorts and include the 2003–2004 through 2015–2016 ninth grade cohorts in Texas. Severe disciplinary actions include expulsions and placement in a DAEP or JJAEP. Math and reading exam scores shown in this table are *z*-scored by subject and year such that the mean is zero and the standard deviation across all takers (whether in our analyses or not) is equal to one.

indicator were statistically significant at the 0.05 level in just four instances in Texas—the student with disability indicator across all samples and the female indicator in the AJROTC all four years sample. However, the regression-adjusted standardized effect size differences remained below 0.25 standard deviation in all cases.

Table D.6. Baseline Equivalence Tables, Ninth and Tenth Grade AJROTC Takers Analysis, Texas

Characteristics	AJROTC-Treated Student Mean	Comparison Student Mean		Treatment and Comparison Group Standardized Difference	
		Unweighted	Weighted	Unweighted	Weighted
Number of Students	45,220	212,306			
Female	45.3%	50.8%	44.1%	−0.11	0.02
Black/African American	14.3%	14.6%	13.4%	−0.01	0.03
Hispanic/Latino	65.7%	34.6%	58.4%	0.63	0.15
Asian or Pacific Islander	1.7%	5.5%	1.9%	−0.18	−0.01
American Indian or Alaskan Native	0.2%	0.3%	0.3%	−0.02	−0.01
White	18.1%	45.0%	26.0%	−0.55	−0.16
Average Age, Eighth Grade	13.2	13.1	13.2	0.19	0.03
Gifted	9.2%	11.9%	8.7%	−0.09	0.01
Limited English Proficiency	11.9%	4.6%	8.8%	0.31	0.13
Special Education Program	10.9%	6.7%	9.8%	0.16	0.04
Economically Disadvantaged	74.4%	39.9%	67.6%	0.69	0.14
Average Absence Rate, Eighth Grade	3.6%	3.3%	3.6%	0.10	0.02
In-School Suspension, Eighth Grade	18.9%	16.5%	21.0%	0.06	−0.06
Out-of-School Suspension, Eighth Grade	10.3%	6.4%	9.1%	0.15	0.05
Severe Disciplinary Action, Eighth Grade	2.3%	2.0%	2.6%	0.02	−0.02
Average Eighth Grade Math Exam Standardized (*z*) Score	−0.07	0.19	−0.03	−0.26	−0.04
Average Eighth Grade Reading Exam Standardized (*z*) Score	−0.08	0.16	−0.05	−0.25	−0.04

SOURCE: University of Texas at Dallas Education Research Center, 2021.
NOTES: Data reflect the characteristics of students in ninth grade cohorts at schools without JROTC programs and schools with AJROTC programs depending on whether students took AJROTC at any point in high school. Summary statistics are based on data pooled across cohorts and include the 2003–2004 through 2015–2016 ninth grade cohorts in Texas. Severe disciplinary actions include expulsions and placement in a DAEP or JJAEP. Math and reading exam scores shown in this table are *z*-scored by subject and year such that the mean is zero and the standard deviation across all takers (whether in our analyses or not) is equal to one.

Table D.7. Baseline Equivalence Tables, All Four Years AJROTC Takers Analysis, Texas

Characteristics	AJROTC-Treated Student Mean	Comparison Student Mean		Treatment and Comparison Group Standardized Difference	
		Unweighted	Weighted	Unweighted	Weighted
Number of Students	18,920	186,714			
Female	44.1%	50.9%	43.6%	−0.14	0.01
Black/African American	13.6%	14.4%	12.6%	−0.02	0.03

Characteristics	AJROTC-Treated Student Mean	Comparison Student Mean		Treatment and Comparison Group Standardized Difference	
		Unweighted	Weighted	Unweighted	Weighted
Hispanic/Latino	65.1%	34.5%	57.6%	0.63	0.16
Asian or Pacific Islander	2.0%	5.8%	2.3%	−0.17	−0.01
American Indian or Alaskan Native	0.3%	0.3%	0.3%	−0.01	0.00
White	19.0%	45.0%	27.2%	−0.52	−0.17
Average Age, Eighth Grade	13.2	13.1	13.2	0.17	0.04
Gifted	9.9%	12.3%	9.7%	−0.07	0.01
Limited English Proficiency	10.8%	4.4%	7.8%	0.30	0.14
Special Education Program	11.5%	6.4%	9.4%	0.21	0.08
Economically Disadvantaged	71.9%	38.9%	64.7%	0.67	0.15
Average Absence Rate, Eighth Grade	3.2%	3.1%	3.1%	0.04	0.02
In-School Suspension, Eighth Grade	14.9%	14.8%	16.5%	0.00	−0.04
Out-of-School Suspension, Eighth Grade	7.7%	5.2%	6.7%	0.11	0.05
Severe Disciplinary Action, Eighth Grade	1.4%	1.5%	1.6%	−0.01	−0.01
Average Eighth Grade Math Exam Standardized (*z*) Score	0.00	0.21	0.02	−0.21	−0.02
Average Eighth Grade Reading Exam Standardized (*z*) Score	−0.03	0.18	−0.01	−0.22	−0.02

SOURCE: University of Texas at Dallas Education Research Center, 2021.
NOTES: Data reflect the characteristics of students in ninth grade cohorts at schools without JROTC programs and schools with AJROTC programs depending on whether students took AJROTC at any point in high school. Summary statistics are based on data pooled across cohorts and include the 2003–2004 through 2015–2016 ninth grade cohorts in Texas. Severe disciplinary actions include expulsions and placement in a DAEP or JJAEP. Math and reading exam scores shown in this table are *z*-scored by subject and year such that the mean is zero and the standard deviation across all takers (whether in our analyses or not) is equal to one.

Table D.8. Baseline Equivalence Tables, Ninth Grade AJROTC Takers Analysis, Hawaii

Characteristics (Source)	AJROTC-Treated Student Mean	Comparison Student Mean		Treatment and Comparison Group Standardized Difference	
		Unweighted	Weighted	Unweighted	Weighted
Number of Students	4,340	21,592			
Female	31.2%	48.6%	35.1%	−0.35	−0.08
Age, Eighth Grade	14.2	14.1	14.2	0.21	0.06
American Indian or Alaska Native (Federal)	0.5%	0.4%	0.5%	0.01	0.00
Asian (Federal)	35.2%	42.1%	36.2%	−0.14	−0.02
Black (Federal)	1.8%	0.8%	1.2%	0.10	0.06
Hispanic (Federal)	6.1%	6.5%	6.3%	−0.02	−0.01

Characteristics (Source)	AJROTC-Treated Student Mean	Comparison Student Mean		Treatment and Comparison Group Standardized Difference	
		Unweighted	Weighted	Unweighted	Weighted
Multiracial (Federal)	9.6%	9.1%	9.4%	0.02	0.01
Native Hawaiian or Other Pacific Islander (Federal)	37.4%	31.0%	36.7%	0.14	0.01
White (Federal)	9.6%	10.1%	9.8%	−0.02	−0.01
Asian (HIDOE)	11.5%	19.4%	10.4%	−0.21	0.03
Filipino (HIDOE)	26.4%	26.5%	28.6%	0.00	−0.05
Native Hawaiian (HIDOE)	25.4%	28.4%	27.6%	−0.07	−0.05
Other Race/Ethnicity (HIDOE)	9.5%	7.6%	8.6%	0.07	0.04
Pacific Islander (HIDOE)	15.4%	5.1%	12.8%	0.41	0.10
White (HIDOE)	11.8%	12.9%	12.0%	−0.03	−0.01
Economically Disadvantaged	61.9%	48.5%	59.3%	0.27	0.05
ELL and/or Student with Disability	25.7%	18.6%	24.2%	0.18	0.04
Absence Rate, Eighth Grade	5.3%	4.9%	4.9%	0.06	0.07
In-School Suspension, Eighth Grade	3.2%	4.0%	2.3%	−0.04	0.05
Out-of-School Suspension, Eighth Grade	11.7%	10.6%	11.1%	0.04	0.02
Average Eighth Grade Math Exam Standardized (z) Score	−0.17	0.07	−0.13	−0.24	−0.05
Average Eighth Grade Reading Exam Standardized (z) Score	−0.19	0.02	−0.13	−0.21	−0.06

SOURCE: Hawaiʻi P-20 Partnerships for Education, 2021.
NOTES: Data reflect the characteristics of students in ninth grade cohorts at schools without JROTC programs and schools with AJROTC programs depending on whether students took AJROTC at any point in high school. Summary statistics are based on data pooled across cohorts and include the 2009–2010 through 2016–2017 ninth grade cohorts in Hawaii. Federal refers to federal race and ethnicity categories, and HIDOE refers to categories reported by the Hawaii State Department of Education. Math and reading exam scores shown in this table are z-scored by subject and year such that the mean is zero and the standard deviation across all takers in the cohorts for which we received data (whether in our analyses or not) is equal to one.

Table D.9. Baseline Equivalence Tables, Ninth and Tenth Grade AJROTC Takers Analysis, Hawaii

Characteristics (Source)	AJROTC-Treated Student Mean	Comparison Student Mean		Treatment and Comparison Group Standardized Difference	
		Unweighted	Weighted	Unweighted	Weighted
Number of Students	2,145	18,695			
Female	33.1%	50.2%	38.4%	−0.34	−0.11
Age, Eighth Grade	14.2	14.1	14.2	0.18	0.07
American Indian or Alaska Native (Federal)	0.4%	0.3%	0.5%	0.02	−0.01
Asian (Federal)	40.7%	45.2%	42.9%	−0.09	−0.04

Characteristics (Source)	AJROTC-Treated Student Mean	Comparison Student Mean		Treatment and Comparison Group Standardized Difference	
		Unweighted	Weighted	Unweighted	Weighted
Black (Federal)	1.8%	0.7%	1.3%	0.12	0.06
Hispanic (Federal)	5.4%	6.0%	5.4%	−0.02	0.00
Multiracial (Federal)	9.3%	8.6%	8.7%	0.03	0.02
Native Hawaiian or Other Pacific Islander (Federal)	32.9%	29.5%	32.1%	0.07	0.02
White (Federal)	9.4%	9.7%	9.2%	−0.01	0.01
Asian (HIDOE)	13.1%	20.9%	11.1%	−0.19	0.05
Filipino (HIDOE)	30.7%	28.2%	34.8%	0.06	−0.09
Native Hawaiian (HIDOE)	24.9%	27.4%	26.4%	−0.05	−0.03
Other Race/Ethnicity (HIDOE)	8.9%	6.7%	8.0%	0.09	0.03
Pacific Islander (HIDOE)	10.6%	4.4%	8.3%	0.29	0.11
White (HIDOE)	11.8%	12.4%	11.5%	−0.02	0.01
Economically Disadvantaged	56.3%	46.0%	53.6%	0.20	0.05
ELL and/or Student with Disability	23.5%	17.1%	20.9%	0.17	0.07
Absence Rate, Eighth Grade	4.1%	4.3%	3.9%	−0.05	0.03
In-School Suspension, Eighth Grade	2.2%	3.3%	1.7%	−0.06	0.03
Out-of-School Suspension, Eighth Grade	8.6%	8.0%	8.4%	0.02	0.01
Average Eighth Grade Math Exam Standardized (*z*) Score	−0.01	0.16	0.01	−0.18	−0.02
Average Eighth Grade Reading Exam Standardized (*z*) Score	−0.03	0.10	0.03	−0.13	−0.06

SOURCE: Hawaiʻi P-20 Partnerships for Education, 2021.
NOTES: Data reflect the characteristics of students in ninth grade cohorts at schools without JROTC programs and schools with AJROTC programs depending on whether students took AJROTC at any point in high school. Summary statistics are based on data pooled across cohorts and include the 2009–2010 through 2016–2017 ninth grade cohorts in Hawaii. Federal refers to federal race and ethnicity categories, and HIDOE refers to categories reported by the Hawaii State Department of Education. Math and reading exam scores shown in this table are *z*-scored by subject and year such that the mean is zero and the standard deviation across all takers in the cohorts for which we received data (whether in our analyses or not) is equal to one.

Table D.10. Baseline Equivalence Tables, All Four Years AJROTC Takers Analysis, Hawaii

Characteristics (Source)	AJROTC-Treated Student Mean	Comparison Student Mean		Treatment and Comparison Group Standardized Difference	
		Unweighted	Weighted	Unweighted	Weighted
Number of Students	1,041	17,231			
Female	35.9%	50.2%	42.8%	−0.29	−0.14
Age, Eighth Grade	14.2	14.1	14.2	0.17	0.05

Characteristics (Source)	AJROTC-Treated Student Mean	Comparison Student Mean		Treatment and Comparison Group Standardized Difference	
		Unweighted	Weighted	Unweighted	Weighted
American Indian or Alaska Native (Federal)	0.5%	0.3%	0.8%	0.03	−0.05
Asian (Federal)	46.4%	46.9%	50.9%	−0.01	−0.09
Black (Federal)	1.0%	0.6%	0.6%	0.04	0.05
Hispanic (Federal)	5.1%	5.6%	4.6%	−0.02	0.02
Multiracial (Federal)	8.4%	8.3%	7.3%	0.00	0.04
Native Hawaiian or Other Pacific Islander (Federal)	30.8%	29.3%	28.3%	0.03	0.06
White (Federal)	7.9%	9.0%	7.6%	−0.04	0.01
Asian (HIDOE)	16.3%	21.7%	12.7%	−0.13	0.09
Filipino (HIDOE)	33.3%	29.2%	41.0%	0.09	−0.17
Native Hawaiian (HIDOE)	24.8%	27.4%	25.1%	−0.06	−0.01
Other Race/Ethnicity (HIDOE)	7.3%	6.1%	6.3%	0.05	0.04
Pacific Islander (HIDOE)	8.1%	4.0%	5.5%	0.20	0.13
White (HIDOE)	10.2%	11.6%	9.4%	−0.04	0.02
Economically Disadvantaged	50.2%	45.1%	46.5%	0.10	0.07
ELL and/or Student with Disability	22.3%	16.4%	19.0%	0.16	0.09
Absence Rate, Eighth Grade	3.6%	4.1%	3.4%	−0.11	0.03
In-School Suspension, Eighth Grade	1.7%	3.1%	1.5%	−0.08	0.01
Out-of-School Suspension, Eighth Grade	5.9%	7.3%	5.9%	−0.05	0.00
Average Eighth Grade Math Exam Standardized (*z*) Score	0.10	0.19	0.12	−0.09	−0.02
Average Eighth Grade Reading Exam Standardized (*z*) Score	0.06	0.11	0.10	−0.05	−0.05

SOURCE: Hawai‘i P-20 Partnerships for Education, 2021.
NOTES: Data reflect the characteristics of students in ninth grade cohorts at schools without JROTC programs and schools with AJROTC programs depending on whether students took AJROTC at any point in high school. Summary statistics are based on data pooled across cohorts and include the 2009–2010 through 2016–2017 ninth grade cohorts in Hawaii. Federal refers to federal race and ethnicity categories, and HIDOE refers to categories reported by the Hawaii State Department of Education. Math and reading exam scores shown in this table are *z*-scored by subject and year such that the mean is zero and the standard deviation across all takers in the cohorts for which we received data (whether in our analyses or not) is equal to one.

Impact Estimation

Having constructed comparison groups that are very similar to AJROTC participants on many important dimensions at the point of entry to high school, we then estimate the impact of AJROTC participation on high school; postsecondary; and, in Texas, workforce outcomes. Our impact estimation approach accounts for both school-level differences (via the matched blocks) and student-level differences (via the propensity weights) between participants and nonparticipants and incorporates additional statistical controls to account for differences over time and between schools. This quasi-experimental method enables us to estimate impacts of AJROTC participation that approximate causal estimates.

School-level covariates include averages of all student-level characteristics in the propensity score weighting models, an indicator for urbanicity (equal to one for city and suburban schools and zero for rural and town schools), and two measures of school proximity to military installations: the distance to the nearest installation as the crow flies and a count of the number of installations within an hour's drive. In Texas, measures are based on characteristics of all students in the school as of a student's ninth grade; in Hawaii, measures are based on ninth graders only. In both states, math and reading standardized scores reflect averages of eighth-grade test scores for students in the school in a given student's ninth grade year (all students in Texas, ninth graders only in Hawaii). We also include measures of school enrollment in the models: all students in Texas and ninth graders in Hawaii. Students contribute to school-level averages regardless of whether they otherwise are included in our analytic samples (e.g., school-level covariates for AJROTC schools include students not taking AJROTC).

For each outcome, analysis sample, and state, our impact estimation model is as follows:

$$Y_{ijk} = \beta_0 + Trt_{ijk}\beta_1 + X_{ijk}\beta_2 + S_j\beta_3 + M_k\beta_4 + \varepsilon_{ijk}.$$

In this model, Y_{ijk} is the outcome for student *i* in school *j* in matched block *k*; Trt_{ijk} is an indicator for whether students are AJROTC-treated students; X_{ijk} is a vector of student-level covariates (including cohort indicators) also included in the propensity score weighting process; S_j is a vector of school-level covariates that reflects the characteristics of students' schools in the ninth grade year; M_k is a set of block indicators that account for differences across matched blocks of schools; and ε_{ijk} is a student-level stochastic error term. All regressions are estimated using ordinary least squares models (also known as *linear probability models* in the case of binary outcomes) and are weighted by the propensity score weights. We account for the clustering of students in schools using cluster-robust standard errors. The coefficient β_1 on the Trt_{ijk} indicator reflects the impact of participating in AJROTC.

Results

Chapter 5 presented our main impact analysis results for the following outcomes for all three analytic samples in both states: on-time high school graduation, absences and in- and out-of-school suspensions in the fourth year of high school, STEM course taking in high school, and a measure of enrollment post–high school in postsecondary education. It also included exploratory analyses, supported by the Texas data only, of postsecondary enrollments split into enrollments in two- and four-year institutions and, for a subset of recent cohorts, a school-reported measure of student intentions to enlist in the military.

In the sections that follow, we provide detailed results tables that expand on the information reported in Chapter 5 and additional results that explore questions surrounding enrollment and persistence in postsecondary education, whether our findings for Texas students are meaningfully different between older and more-recent cohorts, and wage outcomes for students in Texas for whom we can assess these outcomes.

Main Results

Tables D.11 through D.16 present detailed results for the main outcomes reported in Chapter 5. Each table corresponds to a specific analytic sample in one of the two states (e.g., the ninth grade AJROTC takers sample in Hawaii). In addition to the impact estimates in main report chapter, the tables include the standard error of this estimate, treatment and (weighted) control group averages for each measure, and the size of the treatment and control groups in each outcome analysis. Except for STEM credits and wage earnings, all treatment and control averages are percentages, whereas all impact estimates and corresponding standard errors are reported in percentage points.

Table D.11. Main Results Tables, Ninth Grade AJROTC Takers Analysis, Texas

Characteristics	Impact Estimate	Impact Standard Error	Treatment Mean	Control Mean (Weighted)	No. of Treatment Students	No. of Control Students
On-Time Graduation Rate	−1.46**	0.53	82.4%	83.9%	92,390	214,898
Absence Rate	−0.28	0.16	9.0%	9.2%	87,805	208,755
In-School Suspension	1.13	0.63	16.5%	15.3%	85,416	205,777
Out-of-School Suspension	−0.14	0.36	7.9%	8.1%	85,416	205,777
STEM Credits	−0.16	0.09	4.60	4.76	92,408	214,935
Enroll in Postsecondary	−7.25***	1.16	36.1%	43.4%	83,082	195,283
Enroll in 2-Year Postsecondary	−5.12***	0.95	26.5%	31.6%	83,082	195,283
Enroll in 4-Year Postsecondary	−3.46***	0.79	12.3%	15.8%	83,082	195,283
Enlist in Military	7.69***	1.20	11.8%	4.1%	21,731	48,181
Enroll in Postsecondary or Enlist	1.94	1.72	45.5%	43.5%	13,517	30,777

SOURCE: University of Texas at Dallas Education Research Center, 2021.
NOTES: All regressions include student-level propensity weights, student-level covariates, school-level covariates, fixed effects for school blocks, cohort fixed effects, and standard errors clustered on students' ninth grade schools. All 13 cohorts are included in graduation, absences, suspensions, and STEM credits outcomes. Cohorts 1–12 are included in postsecondary enrollment outcomes. Enlistment outcome includes cohorts 11–13 only, and enroll or enlist outcome includes cohorts 11–12 only. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table D.12. Main Results Tables, Ninth and Tenth Grade AJROTC Takers Analysis, Texas

Characteristics	Impact Estimate	Impact Standard Error	Treatment Mean	Control Mean (Weighted)	No. of Treatment Students	No. of Control Students
On-Time Graduation Rate	0.54	0.39	91.1%	90.6%	42,472	202,129
Absence Rate	−0.61***	0.16	7.4%	8.0%	41,887	198,426

Characteristics	Impact Estimate	Impact Standard Error	Treatment Mean	Control Mean (Weighted)	No. of Treatment Students	No. of Control Students
In-School Suspension	−0.32	0.63	13.4%	13.7%	41,284	196,307
Out-of-School Suspension	−0.92**	0.33	5.7%	6.6%	41,284	196,307
STEM Credits	−0.14	0.09	4.99	5.12	42,486	202,163
Enroll in Postsecondary	−8.47***	1.25	39.9%	48.4%	38,506	184,229
Enroll in 2-Year Postsecondary	−6.56***	1.04	27.8%	34.4%	38,506	184,229
Enroll in 4-Year Postsecondary	−3.27**	0.99	15.5%	18.8%	38,506	184,229
Enlist in Military	13.00***	1.59	17.4%	4.3%	10,113	45,439
Enroll in Postsecondary or Enlist	5.09**	1.80	51.8%	46.7%	6,543	29,535

SOURCE: University of Texas at Dallas Education Research Center, 2021.
NOTES: All regressions include student-level propensity weights, student-level covariates, school-level covariates, fixed effects for school blocks, cohort fixed effects, and standard errors clustered on students' ninth grade schools. All 13 cohorts are included in graduation, absences, suspensions, and STEM credits outcomes. Cohorts 1–12 are included in postsecondary enrollment outcomes. Enlistment outcome includes cohorts 11–13 only, and enroll or enlist outcome includes cohorts 11–12 only. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table D.13. Main Results Tables, All Four Years AJROTC Takers Analysis, Texas

Characteristics	Impact Estimate	Impact Standard Error	Treatment Mean	Control Mean (Weighted)	No. of Treatment Students	No. of Control Students
On-Time Graduation Rate	1.16***	0.27	97.4%	96.2%	18,747	185,257
Absence Rate	−1.21***	0.15	5.6%	6.8%	18,920	186,459
In-School Suspension	−2.17**	0.74	10.3%	12.5%	18,920	186,714
Out-of-School Suspension	−1.58***	0.35	3.9%	5.5%	18,920	186,714
STEM Credits	−0.15	0.09	5.26	5.41	18,753	185,290
Enroll in Postsecondary	−10.10***	1.42	42.0%	52.0%	17,040	169,768
Enroll in 2-Year Postsecondary	−8.75***	1.17	27.7%	36.4%	17,040	169,768
Enroll in 4-Year Postsecondary	−2.38*	1.17	18.6%	21.0%	17,040	169,768
Enlist in Military	19.80***	2.31	24.4%	4.5%	4,623	40,924
Enroll in Postsecondary or Enlist	8.34***	2.38	58.2%	49.9%	3,059	27,253

SOURCE: University of Texas at Dallas Education Research Center, 2021.
NOTES: All regressions include student-level propensity weights, student-level covariates, school-level covariates, fixed effects for school blocks, cohort fixed effects, and standard errors clustered on students' ninth grade schools. All 13 cohorts are included in graduation, absences, suspensions, and STEM credits outcomes. Cohorts 1–12 are included in postsecondary enrollment outcomes. Enlistment outcome includes cohorts 11–13 only, and enroll or enlist outcome includes cohorts 11–12 only. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table D.14. Main Results Tables, Ninth Grade AJROTC Takers Analysis, Hawaii

Characteristics	Impact Estimate	Impact Standard Error	Treatment Mean	Control Mean (Weighted)	No. of Treatment Students	No. of Control Students
On-Time Graduation Rate	−2.02	1.68	82.4%	84.4%	3,920	20,188

Characteristics	Impact Estimate	Impact Standard Error	Treatment Mean	Control Mean (Weighted)	No. of Treatment Students	No. of Control Students
Absence Rate	−0.82	0.64	8.3%	9.1%	3,636	19,157
In-School Suspension	−0.94	0.49	0.1%	1.0%	3,636	19,159
Out-of-School Suspension	0.20	0.88	4.4%	4.2%	3,636	19,159
STEM Credits	−0.02	0.08	1.87	1.89	3,920	20,188
Enroll in Postsecondary	−6.90*	2.52	35.7%	42.6%	3,920	20,188

SOURCE: Hawaiʻi P-20 Partnerships for Education, 2021.
NOTES: All regressions include student-level propensity weights, student-level covariates, school-level covariates, fixed effects for school blocks, cohort fixed effects, and standard errors clustered on students' ninth grade schools. All eight cohorts are included in all outcomes. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table D.15. Main Results Tables, Ninth and Tenth Grade AJROTC Takers Analysis, Hawaii

Characteristics	Impact Estimate	Impact Standard Error	Treatment Mean	Control Mean (Weighted)	No. of Treatment Students	No. of Control Students
On-Time Graduation Rate	−0.42	1.59	91.2%	91.6%	2,019	17,964
Absence Rate	−1.69*	0.66	6.0%	7.7%	1,971	17,541
In-School Suspension	−0.88*	0.35	−0.1%	0.8%	1,971	17,543
Out-of-School Suspension	0.27	0.90	4.0%	3.8%	1,971	17,543
STEM Credits	0.03	0.09	2.23	2.20	2,019	17,964
Enroll in Postsecondary	−10.10**	3.34	39.5%	49.6%	2,019	17,964

SOURCE: Hawaiʻi P-20 Partnerships for Education, 2021.
NOTES: All regressions include student-level propensity weights, student-level covariates, school-level covariates, fixed effects for school blocks, cohort fixed effects, and standard errors clustered on students' ninth grade schools. All eight cohorts are included in all outcomes. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table D.16. Main Results Tables, All Four Years AJROTC Takers Analysis, Hawaii

Characteristics	Impact Estimate	Impact Standard Error	Treatment Mean	Control Mean (Weighted)	No. of Treatment Students	No. of Control Students
On-Time Graduation Rate	1.67	0.82	98.5%	96.8%	1,041	17,142
Absence Rate	−2.24***	0.46	4.2%	6.4%	1,041	17,231
In-School Suspension	−0.23	0.45	0.4%	0.7%	1,041	17,231
Out-of-School Suspension	−0.64	1.05	2.9%	3.5%	1,041	17,231
STEM Credits	0.17	0.11	2.55	2.38	1,041	17,142
Enroll in Postsecondary	−10.40**	3.17	44.9%	55.4%	1,041	17,142

SOURCE: Hawaiʻi P-20 Partnerships for Education, 2021.
NOTES: All regressions include student-level propensity weights, student-level covariates, school-level covariates, fixed effects for school blocks, cohort fixed effects, and standard errors clustered on students' ninth grade schools. All eight cohorts are included in all outcomes. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Additional Results

We used the SLDS data to explore four additional questions:

- If they enroll, do AJROTC students persist in postsecondary education at greater or lower rates than comparison students?
- For the limited number of cohorts for which data are available, is there any evidence to suggest that Texas AJROTC students are opting to enroll at out-of-state postsecondary institutions at different rates than comparison students?
- Are there any statistically significant differences in impact estimates for earlier and more-recent Texas cohorts?
- Are AJROTC students in Texas more or less likely to earn wages in Texas eight years post–high school?

First, in both states, we used a measure of whether students persisted in postsecondary education to see if there were differences in terms of persistence accounting for the initial decision about whether to enroll. For all analysis samples in both states, we did so by including an additional covariate in the regression models that controlled for enrollment in assessing a compound outcome of *enroll and persist*, which takes a value of one for students who enrolled in postsecondary education the year after high school *and* remained enrolled in postsecondary education in the second year after high school and zero for students who either did not enroll in the first place or who enrolled but did not persist. We find small but statistically significant negative impacts on persistence for Texas students taking AJROTC in at least ninth and at least ninth and tenth grades, although these are much smaller than the impact estimates for the same outcome without controlling for the initial decision to enroll. In the all four years AJROTC analysis sample in Texas and all three analysis samples in Hawaii, we do not find a statistically significant difference between treatment and control students when controlling for enrollment.

For the all four years AJROTC treatment groups only, we conducted an additional analysis that restricted the sample to students who enrolled in postsecondary education the first year after high school, calculating propensity weights separately for this group in an identical fashion as we did for each of our three main analysis groups.[28] We then estimated the impact of AJROTC participation on persistence in postsecondary education for this group that by construction enrolled. Here, for both Texas and Hawaii, we find quantitatively small and statistically insignificant differences between AJROTC and comparison students. Collectively, these results, presented in Table D.17, suggest that AJROTC students are roughly equally likely as comparison students to persist in postsecondary education should they choose that path post–high school.

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[28] Baseline equivalence tables for this analysis sample are not displayed but are available on request. Again, we do not find baseline student-level differences in excess of 0.25 standard deviation. We control for the same set of baseline covariates in the outcome models in addition to incorporating them in the propensity score weighting, making our impact estimates doubly robust.

Table D.17. Persistence in Postsecondary Education Outcomes

Analysis Sample	State	Enroll and Persist in Postsecondary (Compound Outcome)	Enroll and Persist (Controlling for Enrollment)	Persist in Postsecondary (Restrict Sample to Enrolled)
Ninth Grade	Texas	−6.49***	−1.43***	
	Hawaii	−6.01***	−1.33	
Ninth and Tenth Grade	Texas	−7.66***	−1.56***	
	Hawaii	−8.27***	−2.09	
All Four Years	Texas	−8.04***	−0.76	−0.78
	Hawaii	−8.28***	1.48	2.65
No. of Cohorts in Analysis	Texas	11	11	11
	Hawaii	7	7	7

SOURCE: University of Texas at Dallas Education Research Center, 2021; Hawai'i P-20 Partnerships for Education, 2021.
NOTES: All regressions include student-level propensity weights, student-level covariates, school-level covariates, fixed effects for school blocks, cohort fixed effects, and standard errors clustered on students' ninth grade schools.
*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Second, we used Texas SLDS data available for a portion of the cohorts in our analysis to explore whether AJROTC students are more likely than comparison students to enroll in out-of-state postsecondary institutions. Our main analysis is limited to public postsecondary institutions in Texas, using data from the Texas Higher Education Coordinating Board (University of Texas at Dallas Education Research Center, 2021). However, for ninth graders entering high school in 2004–2005 through 2011–2012, the SLDS data included information from the National Student Clearinghouse on enrollments post–high school in public and private *out-of-state* postsecondary institutions (University of Texas at Dallas Education Research Center, 2021). We found that AJROTC students in these cohorts were a little less likely than comparison students to be at these out-of-state institutions, on top of being less likely to be enrolled at in-state public postsecondary institutions. For the at least ninth grade and at least ninth and tenth grade AJROTC samples, our impact estimates were between 1.1 and 1.2 percentage points less likely to enroll out of state, and both were statistically significant. Our impact estimate for the all four years AJROTC sample was of a less than 1 percentage-point difference (less likely), and this was not statistically significant.

Third, we leveraged the extended time series of data in Texas to consider whether impacts differed for older versus more-recent cohorts of students. To do so, we ran our regression models using an interaction term for treatment in recent cohorts, defining *recent cohorts* as the seven cohorts entering ninth grade from 2009–2010 through 2015–2016. The statistical significance of this interaction term indicates whether there is a statistically significant difference for recent cohorts. With the solitary exception of out-of-school suspension for the all four years AJROTC group (in which we see less of a reduction for recent cohorts), we did not find any statistically significant differences between the first six and more-recent seven cohorts in Texas. Table D.18 displays these results for our main outcomes, including the estimate for the interaction term, and the impact estimates separately for more-recent and older cohorts in all three analysis samples. Except for STEM credits, all values reflect percentage-point differences.

Table D.18. Main Results for Recent Versus Older Cohorts, Texas

Characteristics	Interaction Effect (Recent vs. Older)	Recent Cohorts Impact Estimate	Older Cohorts Impact Estimate
Ninth Grade Analysis Sample			
On-Time Graduation Rate	−0.09	−1.50*	−1.41*
Absence Rate	−0.47	−0.48*	0.00
In-School Suspension	−1.50	0.50	2.00*
Out-of-School Suspension	1.09	0.32	−0.77
STEM Credits	0.01	−0.16	−0.16
Enroll in Postsecondary	−0.41	−7.44***	−7.03***
Ninth to Tenth Grade Analysis Sample			
On-Time Graduation Rate	−1.38	−0.04	1.34*
Absence Rate	−0.21	−0.70**	−0.49*
In-School Suspension	−0.23	−0.42	−0.18
Out-of-School Suspension	1.42	−0.33	−1.75*
STEM Credits	−0.05	−0.16	−0.11
Enroll in Postsecondary	−1.34	−9.08***	−7.74***
All Four Years Analysis Sample			
On-Time Graduation Rate	−0.81	0.83**	1.64***
Absence Rate	−0.44	−1.38***	−0.95***
In-School Suspension	−0.63	−2.43***	−1.80
Out-of-School Suspension	1.69*	−0.90**	−2.59***
STEM Credits	−0.05	−0.17	−0.12
Enroll in Postsecondary	−1.60	−10.80***	−9.17***

SOURCE: University of Texas at Dallas Education Research Center, 2021.
NOTES: All regressions include an interaction term that is equal to one for recent, treated students; student−level propensity weights; student-level covariates; school-level covariates; fixed effects for school blocks; cohort fixed effects; and standard errors clustered on students' ninth grade schools. Recent cohorts are defined as cohorts 7–13. All 13 cohorts are included in graduation, absences, suspensions, and STEM credits outcomes. Only cohorts 1–12 are included in postsecondary enrollment outcome. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Last, in Texas, the SLDS data also include information on wage earnings in Texas that can be linked back to students' high school and postsecondary records. We use these data to analyze (1) whether AJROTC participants are more or less likely to have wage earnings eight years after leaving high school[29] and (2) whether these wages are on average higher or lower than those of comparison students. The first question can be answered using our impact analysis methods,

[29] We assess wage impacts eight years post–high school or, more specifically, 11 years after beginning high school, to allow students sufficient time to enroll in and complete postsecondary education. We analyze wages earned in the second quarter (April to June) of the year, for example, in quarter 2 2020 for students who were ninth graders in 2008–2009, and annualize them.

which use quasi-experimental methods to estimate the impacts of AJROTC on whether individuals have wage earnings. The second question can be answered only for those who have wage earnings—a subset of the initial sample—and therefore our findings are less likely to reflect the causal impact of AJROTC. In both cases, we analyze workforce impacts for the first six cohorts of students in Texas only, given the number of years post–high school needed to measure these outcomes while allowing time for students who do enroll in postsecondary institutions to complete their education.

We find that AJROTC students are less likely to have wage earnings in Texas eight years post–high school. The difference is 3.3 percentage points for students taking AJROTC at least in ninth grade, widening to 5.1 percentage points for students taking AJROTC all four years. Several factors might contribute to these findings. First, earnings might not exist: AJROTC students might be more likely to be unemployed. Alternatively, they be more likely to be (1) living and earning wages outside the state of Texas (which we cannot observe in the Texas SLDS data); (2) working in a civilian capacity for the federal government, which does not report wage earnings for employees to the Texas state workforce commission (Texas Workforce Commission, undated); or (3) serving in the military. The larger gap in whether AJROTC students have wage earnings for the all four years group provides additional evidence that these students might be opting to pursue a different path: military service.

With respect to wage earnings, we find a negative association between AJROTC participation and wages, on the order of $2,800 to $3,500 annually depending on the analysis sample. We caution that the composition of the groups earning wages in Texas might contribute to this finding and that it should not be considered as the direct result of AJROTC. Rather, if the AJROTC students with the greatest potential for higher wage earnings are disproportionately likely to be the ones who leave Texas, work in federal civilian employment, or pursue a military career, while the same is not the case for comparison students, this could yield a finding of lower average wages for AJROTC students who do stay and work in Texas.

Table D.19 displays these results for our three analysis samples in Texas.

Table D.19. Wage Outcomes, Texas

Characteristics	Impact Estimate	Impact Standard Error	Treatment Mean	Control Mean (Weighted)	No. of Treatment Students	No. of Control Students
Ninth Grade						
Any Wages in Texas 8 Years Post–High School	−3.29***	0.80	57.5%	60.8%	39,611	90,163
Average Wages 8 Years Post–High School	−$2,808***	$484	$32,791	$35,600	22,703	55,782
Ninth and Tenth Grades						
Any Wages in Texas 8 Years Post–High School	−4.35***	0.86	58.3%	62.7%	18,381	84,438

Characteristics	Impact Estimate	Impact Standard Error	Treatment Mean	Control Mean (Weighted)	No. of Treatment Students	No. of Control Students
Average Wages 8 Years Post–High School	−$3,516***	$583	$33,856	$37,371	10,724	52,767
All Four Years						
Any Wages in Texas 8 Years Post–High School	−5.14***	1.14	58.6%	63.7%	7,661	78,042
Average Wages 8 Years Post–High School	−$3,284***	$683	$34,650	$37,934	4,471	49,164

SOURCE: University of Texas at Dallas Education Research Center, 2021.
NOTES: All regressions include student-level propensity weights, student-level covariates, school-level covariates, fixed effects for school blocks, cohort fixed effects, and standard errors clustered on students' ninth grade schools. Wage outcomes are for cohorts 1–6 only. Wages reflect wage earnings in Texas in the second quarter of the year (April to June) 11 years after the spring of the ninth grade year, annualized by multiplying by four and inflation-adjusting to 2020 dollars using the Consumer Price Index. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Appendix E. Stakeholder Discussion Points

The RAND Arroyo Center, the Army's federally funded research and development center, housed at the nonprofit, nonpartisan RAND Corporation, analyzed the effects of AJROTC participation on in-school and longer-term cadet outcomes. This analysis used a quasi-experimental approach to account for many ways in which students who choose to participate in AJROTC might be different from other students. Thus, the results approximate the causal impact of AJROTC participation. The analysis was conducted using data from Texas and Hawaii only. These states together account for 13 percent of all AJROTC students and schools and span the diverse student body and school settings in which AJROTC is implemented.

The key findings are

- AJROTC serves more–economically disadvantaged schools and, in those schools, serves students who are more economically disadvantaged than their peers
- During twelfth grade, cadets who have participated in all four years of the program, as compared with noncadets who also start twelfth grade on time:
  - are more likely to graduate
  - have higher rates of attendance
  - have lower rates of suspension.
- Cadets who participate in AJROTC and their non-JROTC peers enroll in a similar number of high school STEM courses. In other words, AJROTC does not appear to "crowd out" STEM course taking for cadets.
- AJROTC students are less likely to enroll in college upon exiting high school (regardless of the number of years of participation).
  - Among those who do enroll, they appear to be equally likely to persist in college to a second year.
  - Among those who do not enroll, they are substantially more likely to plan to join the military.

RAND Arroyo Center also conducted a descriptive analysis of military careers among former JROTC cadets who enlisted between 1990 and 2021.

- Former JROTC (any service) cadets who enlist in the Army active or reserve, as compared with soldiers who were not identified as former JROTC cadets:
  - are more likely to complete their first terms
  - are more likely to pursue STEM occupational specialties
  - have longer Army careers.

Abbreviations

4H	Heart, Head, Hands, and Health
AFQT	Armed Forces Qualification Test
AI	Army instructor
AJROTC	Army Junior Reserve Officers' Training Corps
AP	Advanced Placement
ASA M&RA	Assistant Secretary of the Army for Manpower and Reserve Affairs
CCD	Common Core of Data
CIP	Classification of Instructional Programs
CTE	Career and Technical Education
DAEP	Disciplinary Alternative Education Program
DAI	director of Army instruction
DoD	U.S. Department of Defense
ELL	English language learner
ERIC	Education Research Information Center
FRPL	free or reduced-price lunch
GBM	generalized boosted modeling
GPA	grade point average
HIDOE	Hawaii State Department of Education
IB	International Baccalaureate
JJAEP	Juvenile Justice Alternative Education Program
JROTC	Junior Reserve Officers' Training Corps
JUMS	JROTC Unit Management System
LET	Leadership, Education, and Training
MOS	military occupational specialty
OML	Order of Merit List
OST	out-of-school time
PE	physical education
SAI	senior Army instructor
SLDS	Statewide Longitudinal Data Systems
STEM	science, technology, engineering, and mathematics
TAPDB	Total Army Personnel Database
USACC	U.S. Army Cadet Command

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Despite the U.S. Army Junior Reserve Officers' Training Corps' (AJROTC's) longevity, the scope of its reach, and the size of its budget, little is known about the associations between AJROTC participation and outcomes of importance to the country and military. To understand these effects, the authors reviewed U.S. Department of Defense, Army, and U.S. Army Cadet Command policies and regulations and created a logic model to identify desired outcomes. They conducted interviews with Junior Reserve Officers' Training Corps (JROTC) and school stakeholders to determine important program characteristics, such as student experience, how the value of the program is communicated and perceived, and how program modernization efforts (including science, technology, engineering, and mathematics [STEM]-focused efforts) align with the curriculum. Using individual-level data on programs in Texas and Hawaii, the authors analyzed participant outcomes both in high school and beyond, with a focus on STEM-related outcomes.

The authors found that AJROTC serves more–economically disadvantaged schools and students, which makes simple benchmarks less informative. Once accounting for these differences, the authors found that cadets who participate in all four years of AJROTC are more likely to graduate, have higher rates of attendance, and have lower rates of suspension compared with matched peers. However, after graduating from high school, they are less likely to immediately enroll in college and more likely to plan to join the military. Former JROTC (any service) cadets who enlist in the Army are more likely to complete their first terms and more likely to pursue STEM occupational specialties.

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