Annenberg Institute
BROWN UNIVERSITY

EdWorkingPaper No. 26-1613

The Time Costs of Academic Credit Hours

Aaron Albert
US Air Force Academy

Brachel Champion
US Air Force Academy

Do students give up free time with added classes? We estimate the effect of additional credits on leisure using campus departure logs linked to academic records of U.S. Air Force Academy students and two natural experiments. Leveraging pre-assigned schedules, each credit reduces leisure by 7 hours per semester, while unexpected changes to graduation requirements crowded out 17 hours. Foregone leisure accounts for 17–50% of the time required by a 3-credit course. Grades, physical fitness, and extracurricular performance decline, suggesting students pay the remaining time costs by sacrificing performance.

VERSION: October 2026

Suggested citation: Albert, Aaron, and Brachel Champion. (2026). The Time Costs of Academic Credit Hours. (EdWorkingPaper: 26-1613). Retrieved from Annenberg Institute at Brown University: https://doi.org/10.26300/6jfg-6b38

The Time Costs of Academic Credit Hours*

Aaron Albert and Brachel Champion†

September 28, 2026

Abstract

Do students give up free time with added classes? We estimate the effect of additional credits on leisure using campus departure logs linked to academic records of U.S. Air Force Academy students and two natural experiments. Leveraging pre-assigned schedules, each credit reduces leisure by 7 hours per semester, while unexpected changes to graduation requirements crowded out 17 hours. Foregone leisure accounts for 17–50% of the time required by a 3-credit course. Grades, physical fitness, and extracurricular performance decline, suggesting students pay the remaining time costs by sacrificing performance.

Keywords: Higher Education, Leisure Choice, Credit Hours
JEL Classification Numbers: I2, J22, H3

*We thank Kyle Butts, Dan Hamermesh, Richard Mansfield, Michelle McGee, Patrick S. Turner, Nathan Wozny, and participants of 2025 Liberal Arts Colleges Public and Labor Conference, 2026 Society of Labor Economists Meeting, and the University of Arkansas Seminar Series for helpful comments. The authors received no outside financial support but thank the USAFA Registrar for generously providing the data used. The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the United States Air Force Academy, the Air Force, the Department of Defense, or the U.S. Government. This article was reviewed and approved for public release by the USAFA Department of Research, PA number: USAFA-DF-2025-92.

†U.S. Air Force Academy, 2354 Fairchild Dr, Air Force Academy, CO 80840, USA, e-mail: aaron.albert@afacademy.af.edu, brachel.champion@afacademy.af.edu (corresponding author).

1 Introduction

Time spent studying has fallen dramatically in higher education (Babcock and Marks, 2011). Given high opportunity costs of college and low on-time graduation rates,[1] policymakers have sought to fill this perceived free time with more credit hours to keep students on-track and engaged (Attewell et al., 2012). This assumes students will allocate the additional time required by added courses. Instead, they may substitute leisure inelastically to preserve current utility from activities like exercise at the cost of worse grades, offsetting future labor market benefits of academic success (Freier et al., 2015; Hansen et al., 2024; Jones and Jackson, 1990; Khoo and Ost, 2018). In the extreme, broad policies such as tying financial aid to enrollment minimums (Scott-Clayton, 2011) may dissuade some from attending university at all. Despite its importance, leisure time data is rarely collected and existing work has focused almost exclusively on academic outcomes. We address this gap by estimating the causal effect of larger course loads on leisure time directly. We then examine impacts on not only course grades but also physical fitness and success in extracurricular activities to provide insight into how course loads affect student well-being in multiple domains rather than academics alone.

The effect of an additional credit hour on student time allocation is theoretically ambiguous. Additional courses increase total possible grade points earned in a semester, inducing both income and substitution effects. Students may respond by studying less while maintaining the same GPA, especially if the courses added have high average grades and low work requirements. Alternatively, students may study more as increasing workloads increase the marginal return to study. Causally identifying whether additional courses increase study hours as intended is complicated by students accommodating the higher workload in several ways. First, students may endogenously enroll in courses to equate the marginal return to study across terms, biasing estimates of credit hour effects. Second, even if credit hour shocks are exogenous, students may adjust future term enrollments—both in size and average difficulty—to smooth across their college career which dampens effects in any given semester. Third, if students exchange leisure for study time, the adjustment is not uniform across activity types. Rather, they are likely to reduce time to equate the marginal utility of activity types, dispensing first with low-value activities such as scrolling social media before cutting back on high-value weekend trips, for example. Characterizing the substitution between study and leisure by type is therefore necessary for understanding the cost of additional courses. Lastly, estimating the total effect of these competing incentives is confounded by students endogenously choosing when to graduate with no limit on their tenure.

In this paper, we estimate the effect of assigning additional credit hours on leisure time, course grades, physical fitness, and performance in their extracurricular activities. To do this, we link administrative records of campus departure and arrival times of all U.S. Air Force Academy (USAFA) students to their academic records in four consecutive semesters. In addition to measuring high-value leisure time, USAFA provides a unique setting to better identify causal estimates of larger course loads. First, USAFA students cannot design their own schedules; course enrollment is applied as a template by their faculty advisor and many students do not request any changes because of the burdensome paperwork required. Second, the core curriculum

1. Integrated Postsecondary Education Data System (IPEDS), Graduation Rates component final data (2002-2022) and provisional data (2023).

is quite large (93 credit hours) and, when combined with major requirements, leaves few opportunities for reorganization. Finally, USAFA limits tenure to exactly eight semesters (not including summers) with rare exceptions, such as medical emergencies. Thus, there is limited opportunity for endogenous course load selection or intertemporal smoothing.

While difficult, it is still possible for students to endogenously adjust their schedule and allow for more leisure so we additionally exploit a natural experiment in which USAFA unexpectedly reduced the number of credit hours required to graduate by class year relative to an unaffected cohort. Departments facing unanticipated staffing shortages eliminated requirements for some cohorts, but the changes were not widely announced in advance to students or advisors. The result was widespread late schedule changes by advisors, often without any involvement of the affected student. We exploit this exogenous variation in semester course loads by cohort to identify the causal effect of course loads on leisure time alongside a variety of student outcomes that provide broader insight into the impacts of more demanding academic schedules.

Student fixed effects estimates show an additional credit hour reduces high-value leisure time spent off-campus by 6.9 hours, on average, or about 21 hours per 3-hour course. A back-of-the-envelope calculation using required attendance to 40 hours of class meetings implies foregone leisure accounts for 17-50% of the time costs imposed by an additional 3-hour course. While likely unbiased given restrictions on course scheduling, fixed effect estimates are susceptible to bias from semester-varying, student-specific factors; for example, a student overcoming the arduous administrative barriers to schedule fewer courses during a semester they have higher leisure preferences. To combat this, we instrument semester course enrollments with class year to leverage differential graduation requirements. Estimates of the local average treatment effect of higher course loads induced by unexpected schedule changes exceed 17.4 hours of leisure per credit hour. Our results are robust to the number of credits transferred or validated at entrance, the exclusion of students with prior military experience who may be particularly adept at navigating expectations, and the inclusion of fixed effects for military squadrons which have some influence on the ability to leave campus.

We rationalize our findings using a simple labor-leisure model which demonstrates two key points: first, students reduce high-value leisure inelastically,[2] implying the remaining cost of additional credits is paid by reducing time in other activities. Second, changes to high-value leisure hours are a lower bound for unobserved changes to low-value leisure hours on-campus due to travel costs. Thus, the total reduction in both types of leisure caused by extra credit hours is potentially large.

Despite reductions in leisure time, we find that higher course loads reduce student performance. An additional 3 credit hour course reduces term GPA by 0.15-0.24 standard deviations (SD) or about one-third to one-half of a letter grade; a B (3.0) versus a B+ (3.3), for example. Academic probation rates increase slightly as a result, but the effect is not large enough to attribute leisure reductions to accompanying sanctions that restrict students to campus. Physical fitness falls by almost a quarter SD and performance in military duties (akin to professional clubs) by almost a full SD. Taken together, results show students struggle to absorb heavier course loads and impacts are not limited to academic performance.

While certainly distinct as one of five U.S. military service academies, the USAFA student experience

2. $\eta = -0.3$, similar to labor supply elasticities found in other studies of college-aged people in the formal labor market. See Keane (2022) for a review.

is similar to many selective liberal arts colleges. Admitted students have similar standardized test scores, take 15-18 credit hours (approximately 5-6 courses) per semester, attend small class sections of 24 students maximum, and earn an accredited bachelor's degree with a major in the humanities, social sciences, engineering, or life sciences. Students have ample opportunity to socialize outside of class, attend D1 athletic competitions, participate in club sports, exercise, or leave campus to leisure in the nearby metropolitan area. Indeed, our data show students leave campus at all hours of the day, and most often after classes have concluded as undergraduates typically do. Unlike other colleges, significant time is devoted to required military training. But, while some exercises are military-specific like combat training, most are focused on developing broad leadership skills through team activities, planning and executing student body events, and training underclass students. In many ways, time spent in military training at USAFA is similar to extracurricular commitments other students engage in at civilian institutions through Greek-letter organizations or campus affinity groups focused on professional development and community service.

Our work makes several contributions to the literature. First, we are the first study to our knowledge with an objective and systematic measure of leisure time for a large population. Central to any examination of policy effects on student outcomes is accounting for their time outside of class and few address leisure due to data limitations. Those that can examine student time-use rely on small samples of self-reported time diaries administered infrequently (see, for example, Barrow and Rouse (2018); Stinebrickner and Stinebrickner (2008); Chu and Gershenson (2018); Delavande et al. (2022)). While more detailed, time diaries are prone to recall bias (Juster and Stafford, 1991; Te Braak et al., 2023) and measurement error from non-response that is likely correlated with time-use outcomes like work hours (Barrett and Hamermesh, 2019; Hamermesh et al., 2005). Our study improves upon existing efforts to measure student time by using computer logs of all campus departures for the entire student population during four semesters.

Second, we credibly estimate the causal effect of larger course loads on student outcomes. Previous work using student fixed effects or propensity score matching shows higher course loads increase GPA (Huntington-Klein and Gill, 2021), enrollment in future terms (Burridge et al., 2024), and on-time graduation rates (Attewell and Monaghan, 2016) perhaps due to increased academic momentum (Adelman, 1999; Attewell et al., 2012). But, these favorable results could also be explained by positive selection of capable students enrolling in more courses during semesters where they have more time for academics. By contrast, studies leveraging policy reforms that more exogenously increase average term workloads (switching from a quarter to semester system, for example) show more credit hours reduce GPAs (Bostwick et al., 2022) and on-time graduation rates (Aina et al., 2024). Still, the student populations considered have control over their enrollments and none to our knowledge analyze policies that explicitly targeted credit hours, with one exception: Phipps and Amaya (2023) show randomly assigning West Point cadets additional military training courses (hand-to-hand combat, for example) reduces GPA and increases course failure rates. We help to reconcile these differences by presenting fixed effect estimates that are more credible given USAFA students have limited influence in organizing their schedule in tandem with a natural experiment that influenced *academic*—rather than military—credit hour loads directly. As such, our results inform how specifically taking more courses affects students rather than evaluating a policy designed for other purposes that secondarily impacted credit hour loads.

Finally, we contribute by examining impacts of more demanding academic schedules on student life broadly. While grades are of primary importance to university administrators and researchers, the human capital accumulated in college is both cognitive and non-cognitive. With rising grade inflation in post-secondary education (Denning et al., 2022), activities that develop non-cognitive labor market skills like leadership and conscientiousness (Heckman et al., 2006) have increased return to effort. Students likely choose a university and major that is conducive to both academic and non-academic opportunities while allowing for leisure, rather than maximizing academic potential alone. Evaluating educational policy on a single dimension of academic success when college careers are multifaceted likely misses important impacts on other domains that influence where students enroll, how intensely, or at all.

2 Background

Student life at USAFA is, in many ways, similar to what is experienced at other competitive liberal arts colleges. Admitted students have standardized test scores on par with other selective college admissions criteria (see Table 3) and USAFA is regionally accredited by the Higher Learning Commission (HLC). USAFA offers 27 academic majors in common subjects such as History, Mathematics, Biology, and Economics. To meet degree requirements, students spend the bulk of their time dedicated to academic courses similar to those offered by other colleges. USAFA is, however, different in some important ways. After the successful completion of eight semesters of studies,[3] students are awarded a Bachelor of Science in their chosen field, as well as a commission into the United States Air or Space Force. In preparation for their military careers, students must also meet requirements for athletic and military training and obey a strict behavioral code of military discipline.

2.1 Sign Out Logs

Unlike other institutions, USAFA students must maintain accountability for their whereabouts at all times during the academic year. The academic duty day follows a set schedule Monday to Friday beginning around 7 A.M. and concluding after the student's final class meeting of the day, usually early afternoon. Compliance with this schedule—including class attendance—is considered a student's military duty and therefore not optional; any non-emergency absence from academic time must be approved beforehand by a committee of commissioned Air Force officers and is generally granted only for official duties like military events or intercollegiate athletic competitions. After their duty day has ended, students are free to spend their time how they choose but may not leave base without permission; freshmen are only permitted to leave on occasional weekends, sophomores may leave any time Friday through Sunday, while juniors and seniors have standing permission to depart any time after the duty day ends provided they return by late evening. In addition, students are given an off-campus "pass" budget each semester to spend on trips taken outside the aforementioned windows (for example, overnight trips) which grows with class rank and time.

3. Additional semesters are rarely granted and only in extenuating circumstances.

Freshmen are allowed 1 pass per week while seniors are allowed 1-3 per week.[4] The within-rank pass budget increases as students complete phases of military training throughout the academic year. The entire student body progresses through training phases simultaneously regardless of rank so pass budgets for students are almost entirely a function of rank and time-in-rank. In summary, upperclass students are allowed a greater number of passes with greater flexibility in their use and thus we expect them to be more responsive to changes in time costs.

Students account for their time off-campus via a computer log system. When a student signs out, the system records their departure time and asks if the pass to be used is official or recreational.[5] Upon return, they sign back in and the system calculates the elapsed time spent off-campus and deducts the appropriate number of passes from the student's budget. A student departing base without signing out is considered "over the fence" (OTF) which results in considerable discipline ranging from loss of privileges (including permission to leave base) to disenrollment (USAFA, 2023). A student with repeated infractions could even face general court-martial (U.S. Congress, 2023) which could result in loss of monthly stipend, confinement to quarters, or dishonorable discharge from the military. Students punished for OTF are highly visible: they typically would not be allowed to travel for intercollegiate competitions, might be required to march around common areas in a highly-conspicuous uniform, and often must lead other probationary students through the same disciplinary process they experienced.

The chances of being caught OTF are high for two reasons. First, students must appear at mandatory events throughout the day like morning inspection, meals, and evening checks in their residential quarters. This creates moments each day an OTF student would be noticed. Second, the nearest off-campus amenities are at least a 30-minute round trip by car through three badged security checkpoints. A student could, for instance, leave base to quickly purchase food and return without notice. A longer illicit trip, however, likely overlaps with one of the many check-times and would result in an OTF. Because of the severity of punishment and likelihood of detection, students use the sign out system to track most significant trips off-campus.[6]

2.2 Curricular Changes

USAFA is also unique in that all students must complete a large core curriculum of around 93 credit hours. Because class attendance is mandatory, required core and major courses impose a heavy burden on student time. In April 2016, USAFA substantially reduced the number of core credit hours needed to reduce demands on student time. Effective Fall 2018 for graduating class year (CY) 2021 and beyond, new basket options allowed students to use some core classes to satisfy major requirements (USAFA, 2017c).[7] Under

4. No student is allowed more than 72 hours absence nor allowed to travel outside a 150 mile radius around USAFA without special approval.

5. The logs also include a destination field, but is defined by the student and not required. Hence, it is often incomplete or non-specific, "Colorado Springs," for example.

6. Although OTFs are not formally reported and tracked at the institution-wide level, squadron leadership has commented that the logs are mostly accurate for longer trips and most squadrons have no OTF violations in the average semester. The violations that are found are usually due to changes in plans that were not properly reported rather than willful evasion of accountability systems.

7. All curriculum handbooks and change proposals are available upon request from the U.S. Air Force Academy Office of Student Academic Affairs and Academy Registrar.

the previous regime, some majors required 149 credit hours to complete so students needed to enroll in six courses every semester. The overhaul reduced the number of core courses from 32 to 29 which lessened the total credit burden for students in all majors (USAFA, 2016).[8] After these curricular changes, even students selecting majors with the highest course load would only need at most four semesters taking six academic courses.

In April 2017, one of the planned basket options was accelerated to include CYs 2018-2020, effective Fall 2017, resulting in an unanticipated and under-publicized three credit hour reduction in graduation requirements. The basket option combined two 3-hour senior-level sociocultural courses into a single three hour course chosen from seven options (USAFA, 2017c). This change was made suddenly to relieve staffing shortages in the English and Geosciences departments rather than any fundamental curricular priority that could have been anticipated outside these departments (USAFA, 2017a). The adjustment was announced via a 95-page package of institution-wide and (mostly) clerical changes to curricula with little publicity elsewhere, such as email. Because this change was sudden and not communicated well, most students dropped one or both of the old required courses past the pre-registration deadline and many advisors made these changes without involving the affected student.

The April 2017 curricular revisions also resulted in a decrease in Military and Strategic Studies (MSS) requirements totaling 1.5 credits for CY 2019 and 2020. In the original core, MSS requirements included two, 3 credit hour courses: one for sophomores and one for seniors. These would be combined in the new core into a single 4.5 credit hour course for sophomores. Anticipating this change, the MSS department stopped offering the senior-level 3 credit class before CY 2019 and 2020 could take it, but these students would take the old 3 (rather than 4.5) credit hour sophomore course. To remedy this shortage, the MSS department offered a senior-level 1.5 hour stop-gap course to CYs 2019 and 2020 to match what CYs 2021 and beyond would experience, resulting in an unanticipated net decrease of 1.5 credit hours for CYs 2019 and 2020 compared to earlier cohorts (USAFA, 2017b).

In summary, the whole of changes between April 2016 and April 2017 created three distinct cohorts: (1) CY 2017 which experienced the original requirements of 96 credit hours in 32 courses, (2) CY 2018 which only needed 93 hours in 31 courses after implementing the sociocultural option early, and (3) CYs 2019 and 2020 which had 31 courses and only 91.5 credit hours after both the sociocultural and MSS reductions. Because the changes were imposed by graduation year for students who were already enrolled, the iterative process of core revision generated exogenous variation in course loads that deviated significantly from historical semester course enrollments.

3 Conceptual Framework

To illustrate the trade-off between academic requirements and leisure time, we adapt a simple model of leisure choice from Keane (2011). Convex student preferences are given by $U(G_s, L_s, \ell_s, \mathbf{X})$ where G_s is total grade points earned in semester s,[9] L_s is hours of high-value leisure spent off-campus, ℓ_s is hours of

8. The core curriculum change was also part of broader re-alignment of academics with USAFA institutional learning and mission outcomes on the recommendation of an external curriculum review.

9. Defined as credit hours times grade received out of 4.0.

low-value leisure in activities on-base such as scrolling social media or watching TV, and $\mathbf{X}$ is a vector of taste shifters. Since students earn grades instead of money through their labor, utility is a function of grade points rather than consumption. Higher GPA at graduation increases the chances a student is matched to their preferred USAF career assignment (pilot, for example) so replacing consumption with grades is both intuitive and realistic for USAFA students.[10] Additionally, all students receive fixed room, board, and stipend and are legally forbidden from formal employment. Although they enjoy goods consumption, students cannot labor more to increase their consumption as traditional models allow. Thus, their choice variables are limited to L_s, ℓ_s, and G_s.

Students allocate their semester time endowment net of class attendance, military activities, and sleep, T_s, to academic work hours, h_s, low-value leisure, ℓ_s, and high-value leisure, L_s, with constant marginal travel cost, $\tau > 0$. Because students are constrained by the daily schedule which dictates not only class meeting times but also mandatory activities such as morning inspection, meal attendance, and lights out, we assume any flexible time remaining is therefore primarily for studying or leisure. Section 4 shows USAFA students spend time in activities that can be broadly categorized into academics, leisure on- and off-campus, with the remainder going to military duties and personal care. Finally, we model travel costs as marginal rather than fixed to reflect the increasing amenity value over distance from USAFA. There are few establishments near campus with increasing density towards downtown Colorado Springs, Denver, or into the Rocky Mountains. Thus, we assume students less time at the nearby coffee shop, for example, but drive 2-3 hours to ski all weekend, for example.

Students earn grade points according to $G_s = wh_s$ where $w > 0$ is the real return to study hours, h_s, and 0 grade points are earned if a student does not study. Substituting into the time budget and rearranging, the constraint is then $G_s + w(1+\tau)L_s + w\ell_s = wT_s$. The price of low-value leisure on base is therefore $p_\ell = w$ while the price of high-value time away from campus is $p_L = w(1+\tau)$. Students allocate time to high- and low-value leisure such that

$$\frac{MU_L}{w(1+\tau)} = \frac{MU_\ell}{w} \tag{1}$$

and therefore $MU_L > MU_\ell$ in equilibrium. Consider how optimal time allocation changes in response to an increase in the real return to study to $w' > w$: assuming diminishing marginal utility and non-homothetic preferences, our model quite intuitively predicts students reduce time spent in both types of leisure but dispense with more low- than high-value leisure as wages rise. Formally, Equation 1 implies

$$\left|\frac{\partial L^*}{\partial w}\right| < \left|\frac{\partial \ell^*}{\partial w}\right| \tag{2}$$

which allows us to bound effects on unobserved low-value leisure allocation with changes in high-value leisure.

An exogenous increase in credit hours has ambiguous effects on the student's optimal bundle. More credits reduce the total available free time T_s as students must attend more class meetings, labs, common

10. For expositional simplicity, we omit extracurricular performance and physical fitness scores from the model. All three are used to calculate a student's order of merit at graduation but academics receive 50-60% of the weight and represent the majority share of daily time. The key implications of Equation 1 are unchanged if we include these performance measures.

exams, etc. At any interior solution, the marginal rate of substitution between high-value leisure and grade points is $-w(1+\tau)$ which implies less free time only reduces the utility-maximizing number of grade points and not leisure time. However, more credit hours likely change the return to study albeit ambiguously. Additional credit hours increase the number of out-of-class commitments such as homework and studying. As students get busier, the number of grade points earned per study hour may fall. Conversely, increasing credits also increases the total grade points available which may cause the grade points earned per hour studying to rise. The total effect of more credit hours on a student's optimal bundle therefore depends on whether the income or substitution effect dominates. We empirically test the effect of credit hours on leisure in the following sections with student fixed effects and instrumental variables that leverage exogenous academic credit hour adjustments by CY due to curricular changes observed from 2017-2021.

4 Data

4.1 Sample

Our dataset includes academic and demographic records for the entire population of students attending USAFA from Fall 2001 until Spring 2021, covering CYs 2005-2021. These data include information on outcomes such as courses completed and grades earned as well as background factors such as pre-college standardized test scores and demographic attributes. We match academic records to administrative sign out logs which overlap for four semesters: Fall 2016, Spring 2017, Fall 2017 and Spring 2018 which covers CYs 2017-2020. The sign out logs contain 4,233 individual students during these four semesters for a total of 15,168 semester-by-student observations.[11] 13,876 of these student-semesters of sign out data can be linked to academic records resulting in joint data for 4,018 unique students. The majority of student-semesters that cannot be linked can be attributed to students with irregular schedules due to early disenrollment, studying abroad, etc. Our final analytical sample contains 3,758 students with complete records of all variables necessary for analysis.

4.2 Performance Outcomes

In addition to a typical grade point average (GPA), we observe the military performance average (MPA) and physical education average (PEA) of all students each semester,[12] all measured on a common 0-4.0 point scale. MPA is a weighted average of instructors' and squadron commander's[13] subjective ratings of professionalism and leadership abilities based on classroom interactions and duties performed in squadron. Squadron duties can be military-specific in nature such as reciting passages of the USAF code of conduct or uniform inspections but are more often centered around leadership training: organizing squadron activities, planning student life events in coordination with other squadrons, and leading freshmen through basic military training. Students with above average MPAs are often chosen for high-profile responsibilities like

11. Some clearly erroneous records were removed such as sign outs with negative duration or lasting for several weeks.
12. With one exception: final term PEA is not available. See Section 7.
13. Typically an active duty Air Force Major or Lieutenant Colonel whose full time assignment is leading a squadron of approximately 100 students.

at-large leader of a group of squadrons or the entire student body. In many ways, squadron duties are similar to student-led extracurricular activities found at typical universities like Residential Life, Greek Life, or Outdoors Club. Participants are often informally evaluated for their performance by being elected club president or selected to lead pledge rituals, for example, while MPA is a more systematic rating of the time dedicated to the development of non-academic soft skills.

Finally, PEA is a weighted average of a physical fitness test (PFT) score (50%), an aerobic fitness test (AFT) score (15%), and a required physical education (PE) course grade (35%). PFT scores are determined by performing pull-ups, push-ups, and sit-ups; 600-yard run time; and an abdominal measurement, while AFT scores measure 1.5-mile run time. Students who fail the minimum standard in any event are placed on athletic probation until they retest and pass. Ideally, we would examine PFT and AFT scores separately from PE grades but we do not observe the components of PEA. While PE grades partly reflect competency in a particular sport (e.g. tennis), they likely improve with better conditioning. Hence, we assume PEA largely measures physical fitness.

4.3 Leisure Time

Our analytic dataset features 264,406 unique student trips, 90% of which are reported as strictly recreational and 428 passes are for explicitly non-recreational reasons such as medical emergencies or bereavement. We exclude these non-recreational sign outs from all estimates because they are explicitly not leisurely in nature. The remaining 29,350 sign outs were for official travel with prior approval, often related to travel for collegiate sports but also including travel for class field trips, club activities, or other academic or military duties. Whether this official travel should be considered labor or leisure is ambiguous. While we may wish to exclude from our sample intercollegiate athletes traveling with official approval to weekend competitions, we may also wish to include non-athletes traveling to spectate those competitions which also requires the same official approval. Required sport or class activities may not seem particularly recreational, but even these required travel events likely include recreation as students socialize in and around their scheduled travel. Moreover, students may decrease or increase their participation in sports and activities in response to variation in their academic obligations, and excluding official travel would preclude estimating the magnitude of these adjustments. To accurately portray the effects of varying credit hours on different types of student time, we show separate estimates for all non-emergency sign outs (including officially-approved travel) and for purely recreational sign outs (excluding official travel). We further investigate the potential heterogeneity of travel type by showing results for recruited athletes and non-athletes separately.[14]

We supplement these data with a detailed time-use survey administered to a random 25% sample of USAFA students across all class years in January 2014. Students recorded their time spent on predefined categories of activities including sleeping, eating, and studying during a two-week period. Participation was mandatory and time for response was set aside each day. We match these time-use responses to academic records by SSN to measure the returns to study for different course schedules and thus estimate the elasticity of leisure. We describe this process in detail in Section 6.

14. To prevent endogenous selection in and out of athlete status we define athletes as students recruited by an intercollegiate sports team prior to enrolling at USAFA.

The time-use data also helps characterize student life at USAFA. Although USAFA imposes stricter rules governing daily life than a typical university, students appear to spend their time in similar ways as the average undergraduate. Figure 1 compares the average weekday and weekend for USAFA students to students in the American Time-Use Survey (ATUS).[15] USAFA students spend less time sleeping, attending to meals and grooming, and leisuring, but more time in class, studying, and exercising. These differences are not surprising: USAFA students uniformly take classes at a college more competitive than the national average, regularly take 5-6 classes per semester, and must pass periodic physical fitness assessments. Students also spend a fair amount of their day on military duties (the "work" category). But, unlike work at other schools, these duties are not optional and students cannot decrease these hours if the utility maximizing time allocation would suggest spending this time on studying or leisure instead.

Figure 1 also shows USAFA students spend relatively more leisure time away from campus. While the USAFA campus offers some amenities such as a coffee shop and small food court, the options are limited and operate shorter hours than a typical university campus. Although there are a wide variety of amenities off-campus, USAFA lies outside the Colorado Springs municipality in a somewhat isolated area hemmed in by an impassable mountain range on one side and a security perimeter on the other. Leaving base requires non-trivial travel by car and students are not always authorized to do so. Because off-campus recreation is costly and students still so routinely seek it, we define their time away as high-value leisure—higher value than low-value leisure activities on-base such as reading or watching TV. The sign out logs give us an objective and systematic way to measure this high-value leisure time.

Figure 2 displays the relationship between course loads and our primary outcomes. The top left panel underlays the distribution of credit hours for our sample and shows the vast majority of students complete between 15 and 22 credit hours each semester. A local polynomial regression of time spent off-campus and semester credit hour load is negatively sloped (top left), illustrating the trade-off students face. GPA (top right) and physical fitness (bottom right) are also negatively correlated with semester enrollment, while graded performance in military extracurriculars is positively related. Because MPA in part reflects executive functioning, it is unsurprising higher performing students are those who tend to take more classes. Our identification strategy directly addresses this potential for latent ability and idiosyncratic preferences driving the correlations shown.

5 Causal Identification

To combat the endogeneity in labor-leisure decisions due to a host of unobserved student characteristics and preferences, we use two complementary identification strategies: student fixed effects and instrumental variable estimates using cohort-specific curricular changes. This dual approach has two advantages: first, each addresses different sources of selection bias. Fixed effect estimates consider only within-student variation which eliminates influence from student-specific preferences for leisure correlated with course load enrollments. This strategy could be susceptible to bias from time-varying individual preferences for leisure

15. We use the 2012-2019 ATUS sample of full-time students aged 17-23 with no dependents during the academic months of September to April.

that affect credit hour choices. Our instrument addresses this threat by considering only credit hour differences associated with each cohort which averages over any idiosyncratic unobservables that change across semester. This IV strategy is possibly threatened by differences in the composition of cohorts correlated with leisure preferences unlike fixed effects that capture such differences. We show our results are robust to the choice of model which supports our claims of causality.

Second, each model estimates a different but compelling treatment effect. Fixed effect estimates identify the treatment effect of additional credit hours averaged across all semester course schedules and students. This average treatment effect is identified by credit hour variation from term to term as any student might regularly experience. In contrast, our cohort IV identifies the local average treatment effect induced by unexpectedly removing whole courses from student schedules through the USAFA curricular update for students subject to these changes. Sudden schedule changes are not altogether uncommon: for example, colleges often administratively drop students from oversubscribed courses (Mumford et al., 2025; Robles et al., 2021). For these reasons, both the average and local average treatment effects estimated are quite policy relevant.

5.1 Student Fixed Effects

The negative correlation between course load and leisure found above could be driven by student-specific factors. For instance, some students place higher priority on their studies, causing them to both take more classes and spend less time off base. Alternatively, some students may have less opportunity for recreation off-campus and therefore choose to take more classes. Hence, we estimate a student fixed-effects model to address concerns of bias from unobserved, time-invariant student-specific factors:

$$L_{ist} = \beta^{\text{FE}}\text{Credit Hours}_{ist} + \mu_i + \mu_s + \mu_{2018} + \varepsilon_{ist} \tag{3}$$

L_{ist} are sign out outcomes for student i with s semesters of tenure. The estimated effect of credit hours per semester on sign outs, β^{FE}, is additionally conditioned on student fixed effects μ_i to account for any time-invariant, student-specific preferences for sign out leisure time. We also include tenure fixed effects, μ_s, to control for sign out allowances increasing with seniority and a control for calendar year 2018, μ_{2018}, to account for changes to sign out policies that were common to all students and went into effect January 2018.[16] Note we exclude any fixed student-level covariates that are collinear with individual fixed effects. We observe many demographic and academic attributes of students which vary by semester and could in theory be added, such as grades earned and academic major, but these are all likely endogenous and therefore omitted to prevent bias. Finally, standard errors are clustered at the CY by squadron-group[17] level to account for any correlation in leisure time within rank and higher-level squadron leadership which controls some aspects of sign out policy.

16. We do not include calendar year fixed effects to be consistent with the 2SLS model presented in Equation 5 where they are collinear with cohort and semester fixed effects. Student fixed effect results do not differ substantially with the inclusion of calendar year fixed effects (available upon request).

17. Each student is assigned to one of 40 squadrons which are assigned to one of 4 "groups" in hierarchical fashion: students report to their squadron commander who reports to the group commander.

Our estimates of β^{FE} give the causal effect of credit hours on sign outs if there are no time-varying, student-specific shocks correlated with both course load and sign out behavior. Although this assumption may be unrealistic at other institutions, it is likely to hold at USAFA. First, USAFA has a large core curriculum: 93 of the 125 credit hours needed to graduate are required courses which does not leave much space for reorganization. Second, scheduling core classes is subject to strict timing and sequence. For example, two semesters of calculus must be taken in sequence during first year, while a semester each of Econ and Law must be completed during the second year. Third, schedule changes are difficult because many courses are only offered either fall or spring. Fourth, core courses are often over-enrolled preventing any changes in registration. Fifth, academic majors are also quite large, requiring around 45 credit hours on average mirroring both the size and sequencing limitations found in the core curriculum. Within each major, most students are only allowed 3-4 elective courses, which themselves may have prerequisites limiting the semesters a student would be eligible to enroll. Students are usually enrolled in 5-6 courses per semester at a minimum to meet requirements—even in their senior year—leaving little room for additional course enrollments or rearranging required courses. Lastly, in addition to the core and major requirements, students must satisfy semester course registration minimums. Even students with many credit transfers and validations must still take at least 4-5 classes every semester to meet minimum registration. This means students stand little to gain by strategically scheduling courses; for example, front-loading their schedule by overloading classes in early semesters would only result in having to take additional classes later on to meet minimums. In sum, because of the large number of core, major, and semester registration requirements students typically stand to gain very little from any changes to the default prescribed four-year academic schedule.

There are also significant procedural obstacles to students modifying their course enrollment in a given semester. First, during the period of our study student records including scheduling and enrollment were maintained on a proprietary system that granted little control or visibility to the students. Students could see only their schedule of classes for the current term and needed to ask a faculty member for any additional information such as their pre-registration plan for future semesters. Also, unlike most colleges, students at USAFA cannot register for classes or change their academic enrollment independently. Initial courses are set for first-year students during matriculation and changes for undeclared students can only be made in coordination with their faculty advisor along with approval from the lead advisors for undeclared students. For upperclass students, academic courses are set at major declaration by the department lead advisor and future changes can only be made in coordination with their assigned major advisor and then approved by the lead advisor. Although advisors can and do make changes at an advisee's request, it is still a more regimented process than other institutions impose. Pre-registration closes electronically in April and October for the Fall and Spring semesters, respectively—3-5 months ahead of class start. After this deadline, schedule changes require paper documentation hand-delivered to the Registrar with physical signatures by the student, advisor, lead major advisor, and the lead advisor of any courses being added or dropped. Any changes requested after the first week of classes also require signatures from the affected academic department head or Vice Dean (depending on the date). This presents a major obstacle to schedule changes by the student. Because of the curricular inflexibility mentioned above and tedious process to request changes, students largely accept their schedule as dictated by the first-year and major templates. One notable exception is that athletes may

attempt to lighten course loads in-season when they declare their major. Fortunately, we can explicitly test for this strategic scheduling by subsetting our results by athlete status.

5.2 Fixed Effects Results

Table 1 shows fixed effect estimates of credit hours on student sign outs. Each additional credit hour leads to 6.9 fewer hours spent off-campus (4 percent) and 0.24 fewer trips of any length (1.5 percent), both statistically significant at the 1% level. To put this in context, a typical 3 credit hour class leads to 20.7 fewer hours off base per semester and Equation 2 implies the impacts on time in low-value activities on-campus are likely even larger. Columns 3 and 4 show smaller impacts of 2.35 fewer purely recreational hours (statistically insignificant) and 0.163 recreational trips per credit ($p < 0.05$). However, these estimates average over important heterogeneity as we show below.

Consider how an almost 21 hour decrease in time spent off-campus relates to the total time cost per course. The modal course at USAFA consists of 40 one-hour lessons with mandatory attendance, implying the reduction in time off-campus reflects about half of the time cost imposed directly by class time for a 3-hour course. If we assume the recommended class to study time ratio of 1:2 (U.S. Department of Education, 2010), each class costs 120 hours total and, thus, 17% is paid with high-value leisure while the remaining 100 hours must come from decreased time studying for other classes, exercising, investing time in military activities, or low-value leisure time.

Given the graduated permission system and potential for strategic behavior by athletes, we estimate effects by class rank and athlete status in Table 2. Notice first the means of the outcome for each subgroup: upperclass students with more freedom accumulate around 170-210 more hours signed out and take around 6.5 more trips than underclass students who are restricted to campus more often. Athletes in Panel A spend around 90 hours more off-campus in the same number of trips compared to similarly-ranked non-athlete students. Comparing this to average recreational time in Panels C and D, we note the hours difference is entirely driven by official travel—athletes actually take fewer recreational trips so the additional time off-base must come from official travel. This matches our expectations: athletic competitions are logged as official travel and underclass students have much less ability to leave campus for recreation. These patterns of travel further suggest different margins of substitution for athletes and non-athletes which we investigate next.

Columns 1 and 2 of Panel A show the effects of an additional credit hour for upperclass non-athletes and athletes are approximately 10.1 ($p < 0.01$) and 12.9 ($p < 0.05$) fewer hours spent off-campus, respectively. Though both groups spend less time away from school, Panel B shows non-athlete upperclass students take 0.43 fewer trips ($p < 0.01$) while their athlete counterparts reduce the number of trips taken by half as much (-0.25), and the effect is noisily estimated. The large results for non-athletes suggest that athletes' competition travel alone does not explain the effects found in Table 1. We find no impact on underclass non-athlete leisure choice (Panels A and B, column 3) but a large negative effect of 13.2 leisure hours (-0.24 trips) per credit ($p < 0.01, p < 0.10$, respectively) for underclass athletes (column 4) which roughly matches that for upperclass athletes. The effect for athletes is possibly due to strategically reducing credit hours in-season to allow for more intercollegiate sports travel while, as expected, we find no significant effects for

underclass non-athletes who cannot use recreational passes and are not traveling for athletic competition.

Panels C and D of Table 2 show the effect of credits on sign out time is driven by recreational travel for non-athletes and official travel for time-constrained athletes. We estimate non-athlete upperclass students spend 8.5 fewer hours and take 0.39 fewer trips per credit hour, or 24 fewer hours and one fewer trip per 3-hour course (both significant at the 1% level), implying the effect on all leisure time is almost entirely reductions in recreation. On the other hand, recreational travel for upperclass athletes and underclass students of either type is largely unaffected by additional credit hours (columns 2-4 of Panels C and D). These null results serve as placebo tests of the intended mechanism: first, athletes spend so much time on official travel for competition, it is unsurprising they have little margin left for recreation. Second, underclass students have less freedom to leave campus and likely take advantage of every opportunity regardless of academic demands. Instead, the relationship between sign outs and credits is largest for non-athlete upperclass students who are most able to take advantage of their additional free time during low credit semesters.

5.3 Cohort Instrumental Variables

Our fixed effect estimates reflect the causal effect of credit hours on high-value leisure time spent off-campus assuming no student-specific time-varying factors influencing leisure are correlated with credit hours—a reasonable assumption given the enormous barriers to rescheduling courses discussed in Section 5.1, especially for non-athletes. Nonetheless, it may still be possible for students to convince their advisor to adjust their schedule to allow more leisure time, potentially biasing our results if their idiosyncratic efforts vary by semester. For example, some students could move courses to the Fall semester to make their Spring enrollment lighter and allow for more ski weekends. To alleviate concerns that time-varying, student-specific factors threaten our identification, we estimate an instrumental variables model exploiting changes to the core curriculum that occur across graduating year cohorts which are outside the students' and advisors' control.

Figure 3 shows the cohort variation in average credit hours used to identify our IV model. CY 2017 completed similar levels of credit hours each semester as all previous CYs. CY 2018 diverged from previous cohorts in semesters 7 and 8 (their graduating year) by roughly three credit hours which coincides with one fewer sociocultural requirement effective Fall 2017. Compared to CY 2018, CY 2019 completed about half a credit hour less in semesters 5-6 and 2020 completed about half a credit hour less in semesters 3-4—both of which coincide with the MSS reduction for these cohorts. The new core was implemented in Summer 2017 as CY 2021 was entering USAFA. This cohort returned to the typical average semester load of CYs 2004-2017 which suggests indeed that CYs 2018-2020 experienced a cohort-specific shock to their course loads.[18]

To estimate explicitly the effect of these curricular changes on classes taken and then sign out activity we estimate via two-stage least squares:

18. Although the Spring 2020 semester does not appear in our sign out data and is not used to identify the effects of sign outs below, one may also notice the CY 2020 graduates took about 2 credits fewer than would be predicted by the preceding cohorts. This was not due to planned curricular changes but was a response to the Covid-19 pandemic. Seniors were granted early completion at reduced credits for many of their core required courses during the Spring 2020 semester to allow for their early graduation and thus early departure from USAFA.

$$\text{Credit Hours}_{ist} = a + b_1 \text{CY 2018}_i + b_2 \text{CY 2019}_i + b_3 \text{CY 2020}_i + \mathbf{X}_i c + \mu_s + \mu_{2018} + u_{ist} \quad (4)$$

$$L_{ist} = \alpha + \beta^{\text{IV}} \widehat{\text{Credit Hours}}_{ist} + \mathbf{X}_i \gamma + \mu_s + \mu_{2018} + \varepsilon_{ist} \quad (5)$$

In the first stage, we instrument Credit Hours$_{ist}$ with a set of indicators for graduating in 2018, 2019, or 2020, relative to the cohort graduating 2017. We further condition on a vector of student-specific factors, $\mathbf{X}_i$, namely, academic composite (a measure of pre-USAFA academic ability including standardized high school test scores) and the interaction of semesters of tenure, non-White, female, and recruited athlete. Last, we include the same fixed effects for semesters of tenure, μ_s and calendar year 2018, μ_{2018}, as in Equation 3 to account for any semester-specific differences in course loads and the January 2018 sign out policy shift. The second stage uses the predicted number of credit hours as an exogenous determinant of sign out behavior, L_{ist}, conditional on student characteristics, tenure fixed effects, and the 2018 calendar year indicator. We again cluster standard errors at the cohort by squadron-group level to account for any correlations within graduating year and leadership group.

The causal effect of credit hours on sign outs β^{IV} is identified by two-stage least squares if our graduation year cohort instruments satisfy the relevance and exclusion restriction assumptions. Table 4 shows the first stage F-statistic of 275 is quite large so the relevance assumption is likely satisfied. We anticipate cohort to be strongly correlated with credit hour loads because each CY has a default template for both core and major courses. Although students may choose to deviate from the typical course load each semester, this will not bias our estimates so long as cohort is still correlated with credit hours in each semester.

The exogeneity assumption is satisfied if CY is not correlated with outside factors that affect leisure. Table 3 Panel A shows means of pre-USAFA academic characteristics are balanced across CY which supports this assumption. First, students with higher SAT or ACT scores may be able to complete the same courses in less time, leaving more time for leisure. While there are some small differences across cohorts, the absolute value of the mean difference normalized by the standard deviation of the difference is smaller than the 0.25 threshold for significance suggested by Imbens and Wooldridge (2009).[19] Similarly, academic composite scores do not differ significantly across cohort. Next and importantly, differences in credit hour loads by graduation year could be the mechanical result of students entering with more validation credits. However, there were only small and insignificant differences of at most 0.6 hours validated by CY. Panel B shows the demographics of each cohort are also similar. Each cohort admitted roughly the same proportion of recruited athletes, and Black and Hispanic students. While later class years do have slightly more female and Asian students, the normalized differences are not significant. Finally, cohort-specific attrition rates could in theory explain average differences in leisure time. However, attrition was low (10-13%) and similar across graduation years with the largest difference being an insignificant 3 percentage points.[20]

We also argue that graduating class year only affects sign out behavior through semester credit hour

19. The normalized difference in means is independent of sample size which avoids Type I Error that arises from rejecting the null when the difference is economically trivial but sample sizes are large.

20. Cohort differences in preferences for study versus leisure could bias our estimates. However, interest in STEM majors—which require more credit hours and likely demand more attention in academics—reported at matriculation was balanced across CYs 2017-2019 but unfortunately was not recorded for CY 2020 (results available upon request).

loads. The first threat to this assumption is students' strategic selection of USAFA cohort based on knowledge of coming curricular changes and their propensity to sign out. Although it is theoretically possible for some students to strategically time their entry to USAFA, accelerating or delaying college by one year in order to avoid a 3 credit course seems exceedingly unlikely. The fact that these changes were implemented suddenly and without communication outside the USAFA community casts even more doubt.

Our cohort instrument is primarily influenced by birth year as most students begin college immediately after high school. We have no evidence that birth year alone significantly influences affinity for leisure and are not aware of any reason for students born in different years, especially in cohorts so close together, to have significantly different propensities to sign out. Importantly, we show that the differences in sign out behavior are specific to semesters where cohorts differ in average credits, so an alternate explanation driven by cohorts' differential propensity to sign out seems extremely unlikely. Some USAFA students do not come straight from high school and enter USAFA either as previously enlisted military or transfer from another university. Fortunately, we observe prior military experience and address this concern in Section 5.5 below.

Lastly, there could be some unobserved variable correlated with cohort that is also correlated with sign outs in a given semester. However, all results are conditioned on semesters of tenure and a calendar year 2018 dummy to account for a change in sign out policies. This means any tenure-specific or secular variation in pass budgets will not bias our results. It is still theoretically possible that, for instance, cohorts with lower course requirements were systematically granted a larger sign out allowance. This runs contrary to how pass budgets are usually allocated, and we find no evidence of cohort-specific variation in pass allowances based on student military standards documents published during our study period.

5.4 IV Results

Table 4 displays the results from estimating Equation 5 using two-stage least squares. Column 1 shows the first-stage estimates of predicting credit hour loads with CY conditional on student characteristics and fixed effects for tenure and calendar year. CYs 2018-2020 completed between 2.1 and 2.5 fewer credit hours per semester on average than CY 2017 which coincides with the average course loads by cohort shown in Figure 3. The first stage IV estimates do not exactly match differences in stated credit hour requirements for graduation because curricular changes were binding in different semesters for different cohorts due to required sequencing. There is some evidence of monotonicity in graduation year, although we cannot reject the null hypothesis that the effect is the same across cohort at the 10% level. Columns 2-5 show the second stage IV estimates of credit hours effects on sign out behavior. We find that an additional credit hour reduces students' time spent off-campus by 17.4 hours on average, significant at the 1% level. This estimate is much larger than what was found using fixed effects. Intuitively, students' ordinary semester-to-semester variation in credit hours is smaller and more easily anticipated than the large and sudden schedule shift wrought by curricular changes. Column 3 shows that each additional credit hour of enrollment causes students to take 0.52 fewer trips off base, although this effect is noisily estimated. Columns 4 and 5 show similarly negative impacts on strictly recreational sign outs. Unlike our fixed effects results, reductions in sign outs induced by curricular changes are almost entirely driven by recreational leisure: students reduce time off-campus by 12.5 hours and 0.34 trips per semester for every additional credit hour taken. This suggests the additional free

time granted from reducing graduation requirements was spent in more recreation than officially-sanctioned time away.

Table 5 shows second stage estimates for upperclass students by athlete status. We cannot estimate Equation 5 using 2SLS for underclass students separately because we do not observe enough semesters of sign outs for older cohorts during their first four semesters to estimate all of the first stage cohort effects along with semester and year fixed effects. Panel A shows the instrumented effect of an additional credit hour on any time spent off-campus. Non-athletes and athletes reduce sign out duration by 14.4 ($p < 0.05$) and 28.6 hours ($p < 0.01$), respectively. The IV estimates exhibit a similar pattern as fixed effect estimates but the magnitude is larger. Unsurprisingly, upperclass athletes seem especially time-constrained such that they cut almost 90 hours off-campus per semester for every additional three credit hour course. Column 1 of Panel B shows non-athletes reduce sign outs by a statistically insignificant 0.4 trips per credit hour while column 2 shows athletes take 1.32 fewer trips, significant at the 1% level. Unlike previous estimates, Panels C and D show our IV estimates for upperclass students are driven by recreational trips: non-athletes spend 12.87 fewer recreational hours off-campus (column 1, panel C, $p < 0.05$) and take 0.29 fewer recreational trips off base (column 1, panel D). The effect on recreational hours for athletes is insignificant and about half as large for any hours signed out (-14.77) but much larger than was found estimating the same relationship using fixed effects. Finally, column 2 of panel D shows the effect of more credit hours on trips for athletes is almost entirely cutting back on recreational departures; 0.95 fewer recreational trips per credit hour, significant at the 5% level. These instrumental variable estimates provide further evidence that higher course loads causally reduce high-value leisure for college students. As with our fixed-effect results, our most precise estimates for recreational travel are those for upperclass non-athletes—the exact group that is most able to take advantage of their additional free time during semesters with exogenously reduced credit burden.

Because we only observe four consecutive semesters of sign out data, our instrument leverages the same-semester variation between only two cohorts at a time. Ideally, we would observe all eight semesters of the unaffected CY 2017 cohort and use them as comparisons for later CYs. However, the timing of phased curricular changes suggests inherent monotonicity even between affected cohorts: CY 2018 took 1.5 hours more than CYs 2019 and 2020, and CY 2019 had fewer semesters remaining than CY 2020 to take advantage of new course requirements and sequencing. Figure 3 corroborates this assumption: each cohort took fewer credits than the previous at the same point in their career for the semesters considered. We empirically test for monotonicity in Table A1 with the reduced form of our IV strategy using only neighboring cohorts in overlapping semesters (CYs 2018 and 2017 in semesters 7 and 8, 2019 and 2018 in semesters 5 and 6, etc). Credits fall and leisure increases over cohort time with the largest and most statistically significant effects concentrated among CY 2018 in their senior year. Younger cohorts display a similar pattern of monotonicity, albeit smaller in magnitude and occasionally noisier. We conclude, then, the monotonicity assumption is likely satisfied despite incomplete data coverage preventing us from estimating ideal comparisons.

5.5 Robustness

We examine the robustness of our results to potential threats to identification. First, we display estimates by quartile of academic composite in Appendix Table A2. While we include this as a control in 2SLS mod-

els, differences could arise from time-varying shocks that interact with fixed academic ability differently, increased difficulty in required course content, for example. We find some evidence of a U-shaped pattern, but we cannot reject the null hypothesis that effects are equal across the quartiles. Given the top and bottom quartiles have roughly equivalent reductions in leisure, we conclude our estimates are likely not biased by unobserved academic prowess allowing better students to absorb course shocks more easily.

Second, we exclude students with prior military experience in the first two columns of Appendix Table A3. These students may be more adept at organizing their time at USAFA or navigating the requirements to adjust course loads. Importantly, our instrument is heavily dependent on birth year except for those who transfer into USAFA. However unlikely, it is more plausible these students could have strategically timed their entry to benefit from curricular reductions. We show results persist after removing students with prior military service and experience at the USAFA preparatory school.[21]

Third, we remove students with 15 or more credit hours validated in high school or transferred from other universities in columns 3 and 4 of Appendix Table A3. While Table 3 shows similar levels of validation credit by cohort, the number of hours honored mechanically reduces semester course loads and could be evidence of unobserved preferences for academics over leisure, potentially threatening the validity of our fixed effects estimates in particular. But, results are similar when we restrict our sample to those who validated less than 15 credit hours.

Finally, we include fixed effects for the student's military squadron. Squadrons are groups of 100 students led by a full-time USAF officer who dictates in large part how much time will be devoted to military exercises. While off-campus pass budgets are set for the entire student body, squadron leaders have some discretion to award additional merit-based passes. Students are conditionally randomly assigned to their squadron so it is unlikely differences in squadron-specific attributes are biasing our results unless they adjust course loads in response to their squadron assignment.[22] Appendix Table A4 shows broadly similar OLS and IV estimates when we include squadron fixed effects and demographic controls.[23]

6 Elasticity of Leisure Substitution

To further contextualize our findings, we estimate the elasticity of high-value leisure substitution students exhibit in response to higher returns to study. Assuming CRRA preferences that are increasing in leisure,[24] the empirical log-leisure equation is,

$$\ln L_{is} = a + \eta \ln w_{is} + \mathbf{X}_i\theta + \mu_s + \mu_{2018} + \varepsilon_{is} \tag{6}$$

21. Typically reserved for people who do not meet academic admission standards but are admitted contingent on passing a remedial year of instruction.
22. See Albert (2024) for a full description of the randomization process.
23. We cannot separately identify both individual and squadron fixed effects because students are reassigned squadrons only once after their freshman year.
24. Replacing labor hours—which we do not directly observe—with leisure hours merely changes the sign of the elasticity.

where η is the partial elasticity of substitution from a temporary shock to the return to study hours, $d\ln w$. To estimate this equation, we measure L_{is} using total hours signed out[25] by student i during semester s, $\mathbf{X}_i$ is the vector of student-specific covariates used in Equation 5, and μ_s and μ_{2018} are semester fixed effects and the post-2018 dummy, respectively.

Given our model in Section 3, the student-by-semester return to study is $w_{is} = G_{is}/h_{is}$—grade points earned per academic work hour. Unfortunately, we do not observe study hours in our analytical sample. Instead, we use the 2014 detailed time-use survey to construct w during the Spring 2014 semester. We then model the return to study as

$$w_{is} = \kappa_0 + \kappa_1 MAG_{is} + \mathbf{X}_i\delta + \nu_{is}$$

where $\mathbf{X}_i$ is a vector containing demographics, academic composite score, class rank, and major division.[26] MAG_{is} is the moving average grade points earned in the previous three semesters by students with the same course schedule which measures the difficulty of a course load and captures differences in the return to study across students. We then predict out-of-sample using OLS for our analytical sample of students enrolled during the Fall 2016-Spring 2018 semesters. Importantly, this predicted rate of return to study is based on a separate sample who took courses of similar difficulty and thus is entirely unaffected by student effort in our analytical sample. We consider this the exogenously-determined "market return" for all students with a particular set of observable attributes taking the same set of courses in a given semester. While students could strategically design a schedule to increase the value of study, we do not believe this is the case for the same reasons described in Section 5.1. Furthermore, if students did manipulate their schedule it would likely be to smooth effort over time which would bias our estimate of η towards zero.

Panel A of Table 6 shows students exhibit an elasticity of leisure substitution equal to -0.17, significant at the 1% level, conditional on taste-shifters and any semester- or year-specific trends. Intuitively, estimates suggest that every 1% increase in grade points earned per study hour is associated with a 0.17% decrease in leisure time. We find a similar elasticity of -0.149 using instead strictly recreational sign out hours as our measure of leisure, also significant at the 1% level. To further combat the potential for idiosyncratic demand-shocks to wages, we include individual fixed effects in Panel B and find even larger elasticities of -0.377 (any sign outs) and -0.322 (strictly recreational), both significant at the 1% level. This suggests that the substitution effect dominates for the average student: students spend less time leisuring off-campus and presumably more time studying during semesters in which they are most productive, rather than achieving some GPA threshold with less effort and allocating the balance of their time to leisure. Although our "consumption" good of grade points is somewhat unusual and our population younger than the labor market's average, the elasticities themselves are generally in line with previous research (Chetty et al., 2011; Elminejad et al., 2023; Keane and Wasi, 2016; Orr, 2023).

25. We use the predicted total hours signed out from our 2SLS model to avoid reverse causality, though results are similar using observed sign out time.
26. Basic Sciences, Engineering, Humanities, or Social Sciences.

7 Effects on Performance

We have shown students adjust to additional time constraints by reducing their high-value leisure time inelastically, implying they may also reduce their effort assigned to required tasks to preserve some leisure time. To investigate the magnitude of this adjustment, we estimate below how student performance changes in three important domains: academics, military duties, and physical fitness.

We measure academic performance using semester GPA which we standardize within-sample to allow for easier interpretation. USAFA has a relatively low attrition rate (10-13%) with most dropping out in their first year and never re-enrolling. Therefore, it is not relevant to examine impacts on retention or timely graduation (given the 8 semester limit) to understand credit hour impacts on academics. We similarly standardize MPA and PEA to estimate impacts on relative military performance and physical fitness.

Table 7 shows the effect of an additional credit hour on the three measures of performance using both our fixed effects and IV models. Columns 1 (fixed effects) and 2 (IV) show each additional credit hour course reduces a student's semester GPA by 0.054 to 0.084 standard deviations, both significant at the 1% level. This translates to an additional three credit hour course reducing GPA by between one-third and one-half of a letter grade; the distance between a B (3.0) and B+ (3.3), for example. Lower GPA could lead to academic probation and estimates in Appendix Table A5 show more credit hours do slightly increase the probability of probation. Students on academic probation are restricted from leaving campus which could explain why we observe sign outs decreasing in academic credit hours. However, only 1.5-2% of students were on probation and the effect sizes of additional credits range from 0.001-0.005 percentage points per credit hour with most being insignificant. We conclude, then, increased rates of academic probation are not the cause of our results.

Column 3 shows no effect of credit hours on MPA in our fixed effects model but isolating the variation from our cohort-based instrument reveals in column 4 an effect of -0.35 standard deviations per credit hour ($p < 0.01$). The sudden and larger shock to credit hours estimated by the instrument may explain the difference in magnitude and significance between models. Also, it is likely the case students prioritize MPA last for two reasons. First, MPA may have lower returns to effort than GPA which has more transparent standards whereas MPA is determined in large part by instructors' perception of the student. Second, students may view MPA as less important because it receives half the weight GPA does in their overall performance average (30 versus 60 percent, used to rank graduates for career placement) and is not easily transferable. While somewhat subjective, it is no surprise that busier students have less time to dedicate to their extracurricular obligations, leading to lower MPA ratings. Indeed, participation in similar activities like Greek fraternities and sororities crowds out academics (De Donato and Thomas, 2017), particularly in semesters with more social commitments (Even and Smith, 2022).

Lastly, columns 5 and 6 show negative impacts on standardized PEA. Our sample size is smaller because students do not take the fitness test in their graduating semester and thus no semester PEA is available for their final term. Fitness test scores fall by a statistically insignificant 0.008 SD per credit hour when estimated using fixed effects. But, the more substantial IV shock reveals a 0.077 SD per credit hour or 0.23 SD worse physical fitness per 3-hour course, significant at the 1% level. For context, Carrell et al. (2011) in estimating peer effects on the same measure of USAFA student fitness describe a one-half SD increase in

the PFT as running the 1.5 mile in 8 minutes rather than 12, holding the other components constant. Thus, the quarter SD change we find represents a substantial reduction in physical conditioning.

The results in Table 7 imply two important points: first, students do not seem to reallocate the lost off-campus leisure time to military duties or exercise given the lower MPA and physical fitness scores observed. Instead, they may spend those saved hours studying, though we do not observe time in academic preparation. Part of the time is attending additional class meetings; but, one might expect attenuated impacts on GPA if students devoted the remainder to studying. They may indeed study more as course loads rise to avoid even larger decreases in GPA and, potentially, academic probation, but most students evidently prioritize academic success over extracurricular obligations or physical fitness. Taken together, we conclude that increased academic credits harm student performance in multiple domains as well as leisure time.

8 Conclusion

By estimating the causal effects of credit hours on time spent off-campus for college students, this paper presents new evidence on the time costs of higher education in multiple domains of student life. We combine USAFA students' academic history with records from a mandatory sign out log of campus departures to find each additional credit hour taken reduces off-campus time by 6.9 fewer hours on average. During our sign out history USAFA underwent several revisions to its core curriculum which induced exogenous changes to student course loads by graduation year. Exploiting this exogenous variation we estimate a cohort-based IV and find a local average treatment effect of each credit hour on high value leisure to be 17.4 hours off-campus per semester. Attaching to our dataset exogenous returns to study time estimated from untreated cohorts, we find the elasticity of leisure substitution is -0.377 which is similar to estimates of labor supply elasticity for young people found elsewhere in the literature.

Our study is particularly unique in that it examines how student leisure choice interacts with academic and extracurricular performance. A detailed panel of students allows us to observe a broad set of outcomes over time, characterizing credit hour effects not only on leisure and academics but also on physical fitness and non-cognitive skill development through leadership training. Despite significant decreases in leisure time, additional credit hours cause students to suffer worse GPAs, leadership ratings, and physical fitness scores. Unlike previous studies that focus on a narrow set of outcomes, we show students with higher course loads make sacrifices in and out of the classroom.

This paper provides the first credible estimates of the time costs of credit hours in higher education. College students at most schools exert great control over their course load, so choosing the right level of enrollment is important for both their happiness and success. We find that students struggle to balance increased demands on their time without relinquishing performance despite the atypical setting that likely attracts more academically prepared and diligent students. While the median college student elsewhere may enjoy more freedom, many students at other colleges work part- or full-time while enrolled[27] which limits their ability to absorb credit hour shocks. Recognizing students supply academic labor inelastically, universities mandating higher per term course loads or increasing minimum term enrollments for financial

27. U.S. Department of Education, National Center for Education Statistics. Digest of Education Statistics 2023: Table 503.20.

aid may have the unintended consequence of harming students as they struggle to adapt, possibly extending their time-to-graduation as course performance declines. Understanding the time costs of course scheduling can better inform decisions made by both students and university administrators.

References

Adelman, Clifford. 1999. *Answers in the tool box: Academic intensity, attendance patterns, and bachelor's degree attainment*. US Department of Education, Office of Educational Research and Improvement.

Aina, Carmen, Koray Aktaş, and Giorgia Casalone. 2024. "Effects of workload allocation per course on students' academic outcomes: Evidence from STEM degrees." *Labour Economics* 90 102559.

Albert, Aaron. 2024. "Peer effects and honor probation: Evidence from USAFA." *Economics of Education Review* 103 102601.

Attewell, Paul, Scott Heil, and Liza Reisel. 2012. "What is academic momentum? And does it matter?" *Educational Evaluation and Policy Analysis* 34 (1): 27–44.

Attewell, Paul, and David Monaghan. 2016. "How many credits should an undergraduate take?" *Research in Higher Education* 57 (6): 682–713.

Babcock, Philip, and Mindy Marks. 2011. "The falling time cost of college: Evidence from half a century of time use data." *Review of Economics and Statistics* 93 (2): 468–478.

Barrett, Garry F, and Daniel S Hamermesh. 2019. "Labor supply elasticities: Overcoming nonclassical measurement error using more accurate hours data." *Journal of Human Resources* 54 (1): 255–265.

Barrow, Lisa, and Cecilia Elena Rouse. 2018. "Financial incentives and educational investment: The impact of performance-based scholarships on student time use." *Education Finance and Policy* 13 (4): 419–448.

Bostwick, Valerie, Stefanie Fischer, and Matthew Lang. 2022. "Semesters or quarters? The effect of the academic calendar on postsecondary student outcomes." *American Economic Journal: Economic Policy* 14 (1): 40–80.

Burridge, Andrea B, Lyle McKinney, Gerald V Bourdeau, Mimi M Lee, and Yolanda M Barnes. 2024. "The power of one more course: How different first semester credit loads affect community college student persistence." *The Journal of Higher Education* 95 (7): 879–916.

Carrell, Scott E, Mark Hoekstra, and James E West. 2011. "Is poor fitness contagious?: Evidence from randomly assigned friends." *Journal of public Economics* 95 (7-8): 657–663.

Chetty, Raj, Adam Guren, Day Manoli, and Andrea Weber. 2011. "Are micro and macro labor supply elasticities consistent? A review of evidence on the intensive and extensive margins." *American Economic Review* 101 (3): 471–475.

Chu, Yu-Wei Luke, and Seth Gershenson. 2018. "High times: The effect of medical marijuana laws on student time use." *Economics of Education Review* 66 142–153.

De Donato, Andrew, and James Thomas. 2017. "The effects of Greek affiliation on academic performance." *Economics of Education Review* 57 41–51.

Delavande, Adeline, Emilia Del Bono, and Angus Holford. 2022. "Academic and non-academic investments at university: The role of expectations, preferences and constraints." *Journal of Econometrics* 231 (1): 74–97.

Denning, Jeffrey T, Eric R Eide, Kevin J Mumford, Richard W Patterson, and Merrill Warnick. 2022. "Lower Bars, Higher College GPAs: How grade inflation is boosting college graduation rates.." *Education next* 22 (1): .

Elminejad, Ali, Tomas Havranek, Roman Horvath, and Zuzana Irsova. 2023. "Intertemporal substitution in labor supply: A meta-analysis." *Review of Economic Dynamics* 51 1095–1113.

Even, William E, and Austin C Smith. 2022. "Greek life, academics, and earnings." *Journal of Human Resources* 57 (3): 998–1032.

Freier, Ronny, Mathias Schumann, and Thomas Siedler. 2015. "The earnings returns to graduating with honors—Evidence from law graduates." *Labour Economics* 34 39–50.

Hamermesh, Daniel S, Harley Frazis, and Jay Stewart. 2005. "Data Watch: The American Time Use Survey." *Journal of Economic Perspectives* 19 (1): 221–232.

Hansen, Anne Toft, Ulrik Hvidman, and Hans Henrik Sievertsen. 2024. "Grades and employer learning." *Journal of Labor Economics* 42 (3): 659–682.

Heckman, James J, Jora Stixrud, and Sergio Urzua. 2006. "The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior." *Journal of Labor economics* 24 (3): 411–482.

Huntington-Klein, Nick, and Andrew Gill. 2021. "Semester course load and student performance." *Research in Higher Education* 62 (5): 623–650.

Imbens, Guido W, and Jeffrey M Wooldridge. 2009. "Recent Developments in the Econometrics of Program Evaluation." *Journal of Economic Literature* 47 (1): 5–86.

Jones, Ethel B, and John D Jackson. 1990. "College grades and labor market rewards." *The Journal of Human Resources* 25 (2): 253–266.

Juster, F Thomas, and Frank P Stafford. 1991. "The allocation of time: Empirical findings, behavioral models, and problems of measurement." *Journal of Economic Literature* 29 (2): 471–522.

Keane, Michael P. 2011. "Labor supply and taxes: A survey." *Journal of Economic Literature* 49 (4): 961–1075.

Keane, Michael P. 2022. "Recent research on labor supply: Implications for tax and transfer policy." *Labour Economics* 77 102026.

Keane, Michael P, and Nada Wasi. 2016. "Labour supply: the roles of human capital and the extensive margin." *The Economic Journal* 126 (592): 578–617.

Khoo, Pauline, and Ben Ost. 2018. "The effect of graduating with honors on earnings." *Labour Economics* 55 149–162.

Mumford, Kevin J, Richard Patterson, and Anthony LokTing Yim. 2025. "College Course Shutouts." *NBER Working Paper* (w33800): .

Orr, Cody. 2023. "Clocking into Work and Out of Class: College Student Enrollment, Labor Supply, and Borrowing." *mimeo*.

Phipps, Aaron, and Alexander Amaya. 2023. "Are students time constrained? Course load, GPA, and failing." *Journal of Public Economics* 225 104981.

Robles, Silvia, Max Gross, and Robert W Fairlie. 2021. "The effect of course shutouts on community college students: Evidence from waitlist cutoffs." *Journal of Public Economics* 199 104409.

Scott-Clayton, Judith. 2011. "On money and motivation: A quasi-experimental analysis of financial incentives for college achievement." *Journal of Human resources* 46 (3): 614–646.

Stinebrickner, Ralph, and Todd R Stinebrickner. 2008. "The causal effect of studying on academic performance." *The BE Journal of Economic Analysis & Policy* 8 (1): .

Te Braak, Petrus, Theun Pieter van Tienoven, Joeri Minnen, and Ignace Glorieux. 2023. "Data quality and recall bias in time-diary research: The effects of prolonged recall periods in self-administered online time-use surveys." *Sociological Methodology* 53 (1): 115–138.

U.S. Congress. 2023. "10 U.S. Code § 886 - Art. 86. Absence Without Leave." U.S. Government Publishing Office, https://www.govinfo.gov/app/details/USCODE-2023-title10/USCODE-2023-title10-subtitleA-partII-chap47-subchapX-sec886, Accessed: 2024-12-16.

U.S. Department of Education. 2010. "Definition of a Credit Hour." https://www.ecfr.gov/current/title-34/section-600.2, Accessed: 2025-02-03.

USAFA. 2016. "Core Curriculum Revision, Chapter 7 Curriculum Handbook." *USAFA Curriculum Change Proposal* April (16-16): .

USAFA. 2017a. "Accelerated Advanced Sociocultural Option." *USAFA Curriculum Change Proposal* March (49-17): .

USAFA. 2017b. "Add MSS 451, Precommissioning Professional Military Education." *USAFA Curriculum Change Proposal* March (41-17): .

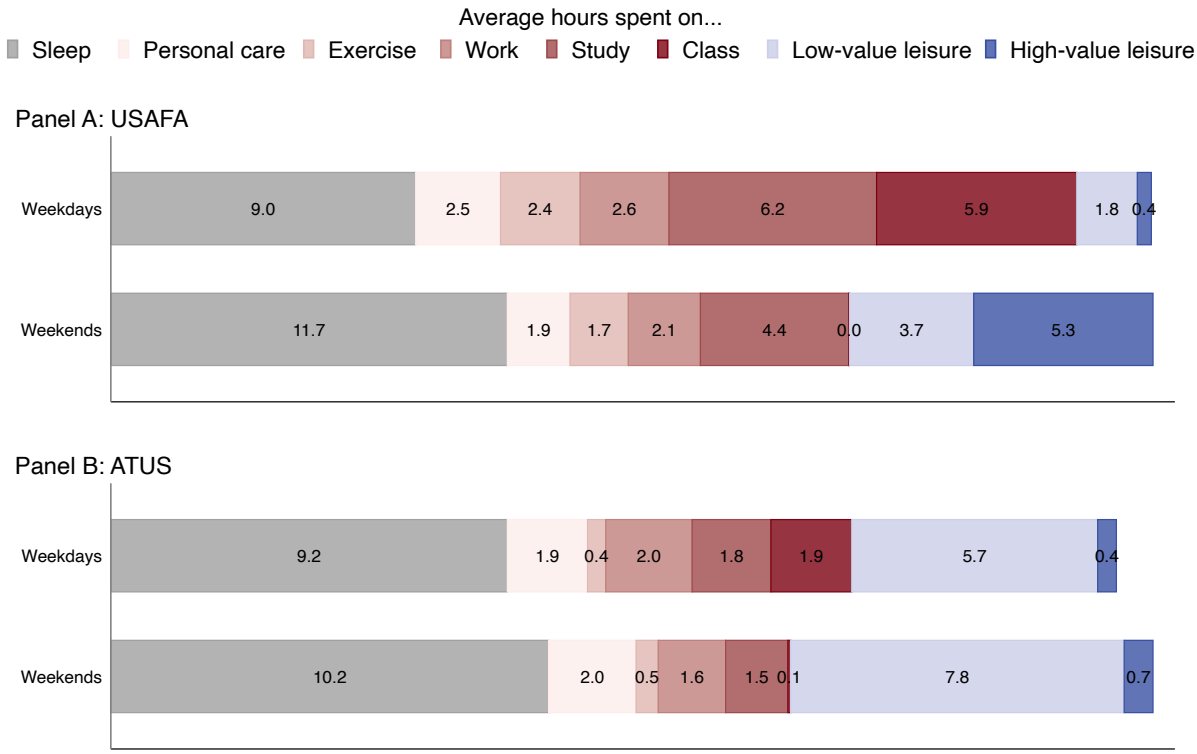
USAFA. 2017c. "U.S. Air Force Academy Curriculum Handbook 2017-2018."

USAFA. 2023. "AFCWI 36-3501: Cadet Standards and Duties." Jan, https://www.usafa.edu/app/

uploads/AFCWI-36-3501-Cadet-Standards-and-Duties-27-JAN-2023.pdf, Accessed: 2024-12-16.

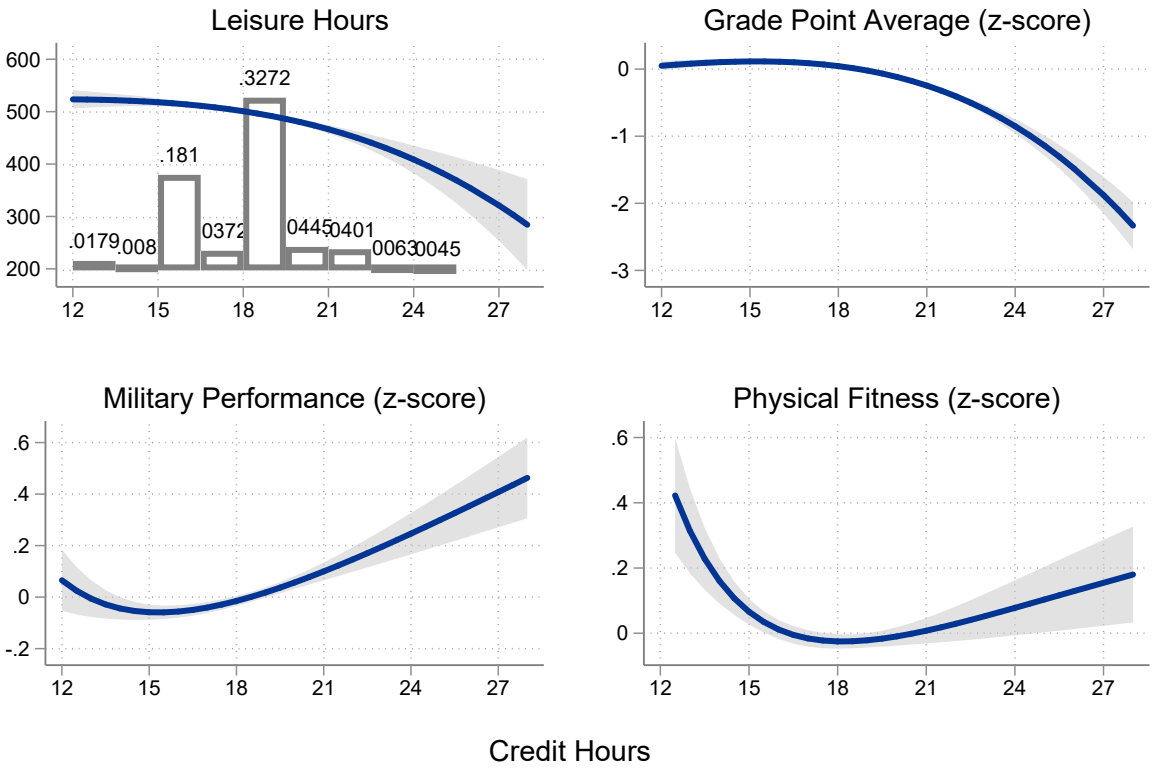
Figures and Tables

FIGURE 1 — DETAILED TIME USE BY USAFA STUDENTS VS OTHER UNDERGRADUATE STUDENTS



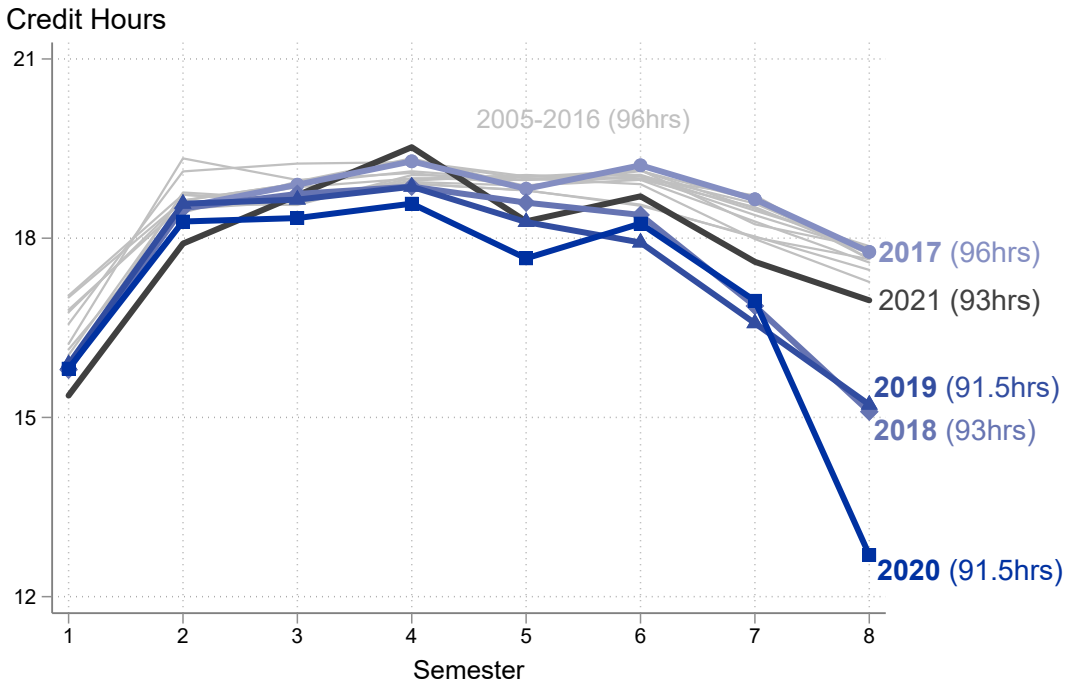
Notes: This figure compares the average time spent on various activities during weekdays versus weekends by USAFA students (Panel A) compared to any post-secondary full-time student aged 17-23 with no dependents during September-April as measured in the 2012-2019 American Time-Use Survey (ATUS). Personal care is defined as time spent on hygiene, grooming, and meals. Work is defined as military duties for USAFA and any work for pay in the ATUS. Low-value leisure is defined as time spent on activities at home such as playing video games or watching movies while high-value leisure includes time in activities outside the home. Totals do not add up to 24 hours given activities irrelevant to this study are omitted.

FIGURE 2 — CREDIT HOURS, LEISURE, AND STUDENT OUTCOMES



Notes: This figure shows the negative relationship between credit hours completed in a given semester and leisure time measured by sign out duration in hours (top left). Academic GPA (top right) and physical fitness (bottom right) are also negatively correlated with credit hours while graded performance in extracurricular military duties is positively related with course loads (bottom left). The density of credit hours is shown in the top left panel with bar labels indicating the proportion of students in each 1.5 credit hour bin. 95% confidence interval in gray.

FIGURE 3 — SEMESTER COURSE LOADS BY GRADUATION YEAR COHORT



Notes: This figure shows the average credit hours completed in each semester by graduating class year (CY) net of validation and transfer credit. Cohort graduation year labels include the number of required core class hours needed to graduate. Course loads were consistent across cohorts except 2018-2020 when the curricular redesign was phased in before returning to the average historical trend in 2021. Many requirements for CY 2020 were waived to ensure graduation despite Covid-19 restrictions, resulting in significantly lower course loads during Spring 2020. This semester is not included in our analysis because it does not overlap with sign out data.

TABLE 1 — STUDENT FIXED EFFECTS: CREDIT HOURS AND SEMESTER SIGN OUT ACTIVITY

	All Sign Outs		Recreational Sign Outs	
	Duration (Hours)	Trips	Duration (Hours)	Trips
	(1)	(2)	(3)	(4)
Credit Hours	-6.910	-0.238	-2.355	-0.163
	(1.757)**	(0.058)**	(1.993)	(0.059)*
Mean of Dep. Var.	497.48	15.72	409.94	14.06
Number of Students	3608	3608	3608	3608
Obs	12654	12654	12654	12654

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows a negative relationship between a student's time spent off-campus per semester and credit hours completed from estimating Equation 3 that includes fixed effects for individual and semesters of tenure, and a 2018 calendar year control. Columns 1 and 2 display impacts on both official and recreational trips while columns 3 and 4 include strictly recreational trips only. Standard errors are clustered at the squadron group by cohort level.

TABLE 2 — STUDENT FIXED EFFECTS: ESTIMATES BY CLASS RANK & ATHLETE STATUS

	Upperclass		Underclass	
	Non-Athlete	Athlete	Non-Athlete	Athlete
	(1)	(2)	(3)	(4)
Panel A: All Sign Outs, Duration (Hours)				
Credit Hours	-10.057	-12.882	-0.773	-13.231
	(1.859)**	(5.117)*	(1.693)	(3.610)**
Mean of Dep. Var.	560.08	649.71	375.52	460.85
Panel B: All Sign Outs, Trips				
Credit Hours	-0.428	-0.248	0.032	-0.238
	(0.061)**	(0.176)	(0.057)	(0.110)+
Mean of Dep. Var.	18.64	18.27	12.20	12.18
Panel C: Recreational Sign Outs, Duration (Hours)				
Credit Hours	-8.552	3.861	1.444	6.376
	(1.759)**	(5.454)	(1.070)	(3.524)
Mean of Dep. Var.	486.64	483.72	316.01	314.59
Panel D: Recreational Sign Outs, Trips				
Credit Hours	-0.399	0.051	0.057	0.095
	(0.062)**	(0.184)	(0.045)	(0.117)
Mean of Dep. Var.	17.30	15.27	10.98	9.32
Number of Students	2041	609	1434	425
Obs	5426	1597	4326	1258

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows the relationship between a student's time spent off-campus per semester by class rank and recruited athlete status. Upperclass students have more flexibility to sign out and larger pass allocations. Athletic competition travel is logged as official rather than recreational time. All estimates include fixed effects for individual and semesters of tenure, and a 2018 calendar year control. Standard errors are clustered at the squadron group by cohort level.

TABLE 3 — BALANCE OF PRE-ADMISSION CHARACTERISTICS BY CLASS YEAR

	CY 2017	CY 2018			CY 2019			CY 2020		
	Mean (1)	Mean (2)	18-17 (3)	18-17/SD (4)	Mean (5)	19-17 (6)	19-17/SD (7)	Mean (8)	20-17 (9)	20-17/SD (10)
Panel A: Prior academics										
SAT Verbal	635.36	631.29	-4.07	-0.04	635.43	0.07	0.00	638.62	3.26	0.03
SAT Math	665.39	660.47	-4.92	-0.05	660.17	-5.22	-0.06	663.43	-1.95	-0.02
ACT Verbal	29.38	29.45	0.07	0.01	29.71	0.33	0.06	29.93	0.55	0.10
ACT Math	29.73	29.82	0.09	0.02	29.48	-0.25	-0.05	29.53	-0.20	-0.04
Academic composite	3350.04	3358.30	8.25	0.02	3355.25	5.20	0.01	3379.07	29.03	0.07
Credit hours validated	6.80	7.43	0.63	0.09	6.92	0.12	0.02	6.95	0.15	0.02
Panel B: Demographics										
Recruited athlete (=1)	0.24	0.23	-0.01	-0.02	0.24	0.01	0.01	0.23	-0.00	-0.01
Female (=1)	0.22	0.22	-0.01	-0.01	0.26	0.04	0.07	0.29	0.06	0.11
Asian (=1)	0.09	0.08	-0.01	-0.01	0.13	0.04	0.09	0.11	0.03	0.06
Black (=1)	0.06	0.05	-0.01	-0.03	0.06	-0.01	-0.02	0.05	-0.01	-0.03
Hispanic (=1)	0.08	0.07	-0.01	-0.02	0.08	-0.00	-0.01	0.09	0.01	0.02
White (=1)	0.76	0.70	-0.06	-0.10	0.65	-0.10	-0.16	0.70	-0.06	-0.09
Other (=1)	0.01	0.10	0.08	0.26	0.09	0.07	0.24	0.05	0.03	0.14
Attrited (=1)	0.13	0.13	-0.00	-0.01	0.12	-0.01	-0.03	0.10	-0.03	-0.07
Obs	1109	1098			1133			1078		

Notes: This table shows pre-admission characteristics are similar across class year (CY). Columns 3, 6, and 9 show the mean difference between that CY and CY 2017. Columns 4, 7, and 10 show the mean difference normalized by the standard deviation of the difference which is not prone to over-rejection of the null hypothesis of no difference when the estimated difference is small but sample sizes are large (Imbens and Wooldridge, 2009). Academic composite is a measure of prior academic performance including high school grades and standardized test scores. Credit hours validated is the number of prior course hours USAFA honored at admission.

TABLE 4 — COHORT INSTRUMENTAL VARIABLES: CREDIT HOURS AND SEMESTER SIGN OUT ACTIVITY

		All Sign Outs		Recreational Sign Outs	
	Credit Hours	Duration (Hours)	Trips	Duration (Hours)	Trips
	(1)	(2)	(3)	(4)	(5)
$\widehat{\text{Credit Hours}}$		-17.409	-0.522	-13.064	-0.356
		(6.065)**	(0.377)	(5.396)*	(0.360)
CY 2018	-2.098				
	(0.075)**				
CY 2019	-2.328				
	(0.149)**				
CY 2020	-2.471				
	(0.191)**				
Means of Dep. Var.					
CY 2017	18.21	654.05	20.53	559.91	18.96
CY 2018	17.23	587.90	18.55	494.02	16.85
CY 2019	18.43	472.21	14.15	386.04	12.54
CY 2020	17.75	366.69	12.38	287.03	10.68
F-stat	275.666				
Obs	12653	12653	12653	12653	12653

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows a negative instrumented effect of additional credit hours on students' time spent off-campus per semester using graduating cohort as the first-stage instrument. All models include controls for semesters of tenure, a 2018 calendar year control, academic composite, and interactions of non-White, female, and athlete. Means of the outcome are shown separately by graduation year. Standard errors are clustered at the squadron group by cohort level.

TABLE 5 — COHORT INSTRUMENTAL VARIABLES: ESTIMATES FOR UPPERCLASS STUDENTS BY ATHLETE STATUS

	Upperclass	
	Non-Athlete	Athlete
	(1)	(2)
Panel A: All Sign Outs, Duration (Hours)		
$\widehat{\text{Credit Hours}}$	-14.398	-28.640
	(7.199)*	(10.934)**
Mean of Dep. Var.	559.74	648.69
Panel B: All Sign Outs, Trips		
$\widehat{\text{Credit Hours}}$	-0.404	-1.321
	(0.496)	(0.431)**
Mean of Dep. Var.	18.63	18.24
Panel C: Recreational Sign Outs, Duration (Hours)		
$\widehat{\text{Credit Hours}}$	-12.869	-14.770
	(5.943)*	(9.274)
Mean of Dep. Var.	486.36	482.98
Panel D: Recreational Sign Outs, Trips		
$\widehat{\text{Credit Hours}}$	-0.292	-0.950
	(0.480)	(0.396)*
Mean of Dep. Var.	17.30	15.24
Obs	5453	1601

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows the instrumented effect of credit hours on students' time spent off-campus per semester using graduating cohort as the first stage instrument, separately for upperclass non-athletes and athletes. All models include controls for semesters of tenure, a 2018 calendar year control, academic composite, and interactions of non-White, female, and athlete. Standard errors are clustered at the squadron group by cohort level.

TABLE 6 — ELASTICITY OF LEISURE SUBSTITUTION

	ln (Sign Out Duration (Hours))	
	All	Recreational
	(1)	(2)
Panel A: Demographic Controls		
$\ln(\widehat{w})$	-0.170	-0.149
	(0.009)**	(0.008)**
Panel B: Student Fixed Effects		
$\ln(\widehat{w})$	-0.377	-0.322
	(0.018)**	(0.016)**
Number of Students	3540	3540
Obs	12422	12422

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows the elasticity of substitution between sign out hours and the estimated return to study. Panel A includes controls for semesters of tenure, a 2018 calendar year control, academic composite, and interactions of non-White, female, and athlete. Panel B replaces individual controls with student fixed effects. Standard errors are clustered at the squadron group by cohort level.

TABLE 7 — CREDIT HOUR EFFECTS ON STANDARDIZED GPA, MILITARY PERFORMANCE, AND PHYSICAL FITNESS

	GPA		Military Performance		Physical Fitness	
	FE	IV	FE	IV	FE	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Credit Hours	-0.084	-0.054	-0.002	-0.350	-0.008	-0.077
	(0.009)**	(0.019)**	(0.005)	(0.013)**	(0.006)	(0.027)**
Number of Students	3608	3619	3591	3610	2757	3488
Obs	12654	12653	12589	12608	9329	10060

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows additional credit hours reduce students' term GPA, performance in military duties, and physical fitness. All outcomes are internally standardized by the sample mean and standard deviation. Odd-numbered columns include student fixed effects while even-numbered columns estimate the effect using a cohort IV conditional on semesters of tenure, a 2018 calendar year control, academic composite, and interactions of non-White, female, and athlete. Standard errors are clustered at the squadron group by cohort level.

Appendix A Appendix Figures and Tables

TABLE A1 — COHORT REDUCED FORM: OVERLAPPING SEMESTER COMPARISONS

		All Sign Outs		Recreational Sign Outs	
	Credit Hours	Duration (Hours)	Trips	Duration (Hours)	Trips
	(1)	(2)	(3)	(4)	(5)
Panel A: CY 2018 vs CY 2017 during Semesters 7-8					
CY 2018	-1.823	39.578	2.046	26.657	1.567
	(0.055)**	(10.629)**	(0.765)*	(10.163)*	(0.781)+
Mean of Dep. Var	17.08	630.66	20.71	530.95	18.92
Number of students	1742	1742	1742	1742	1742
Obs	3458	3458	3458	3458	3458
Panel B: CY 2019 vs CY 2018 during Semesters 5-6					
CY 2019	-0.330	10.698	1.422	-3.696	0.886
	(0.102)*	(9.841)	(0.523)*	(11.502)	(0.491)
Mean of Dep. Var	18.29	531.22	16.46	442.06	14.82
Number of students	1813	1813	1813	1813	1813
Obs	3592	3592	3592	3592	3592
Panel C: CY 2020 vs CY 2019 during Semesters 3-4					
CY 2020	-0.322	10.318	3.827	-1.418	3.190
	(0.043)**	(13.002)	(0.501)**	(11.396)	(0.465)**
Mean of Dep. Var	18.61	413.34	12.80	330.87	11.16
Number of students	1873	1873	1873	1873	1873
Obs	3725	3725	3725	3725	3725

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows the reduced form results of comparing neighboring class years in the same semesters of tenure. All models include controls for semesters of tenure, a 2018 calendar year control, academic composite, and interactions of non-White, female, and athlete. Means of the outcome are shown separately by graduation year. Standard errors are clustered at the squadron group by cohort level.

TABLE A2 — COURSE LOAD EFFECTS ON SEMESTER SIGN OUT ACTIVITY BY ACADEMIC COMPOSITE QUARTILES

	Bottom 25%		Second 25%		Third 25%		Top 25%	
	FE	IV	FE	IV	FE	IV	FE	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: All Sign Outs, Duration (Hours)								
Credit Hours	-8.230	-21.769	-8.989	-14.484	-4.357	-7.890	-6.408	-23.115
	(2.370)**	(9.451)*	(2.128)**	(10.967)	(1.965)*	(12.423)	(2.431)**	(15.689)
Mean of Dep. Var.	516.19	516.61	503.12	503.28	493.90	494.26	476.47	476.47
Panel B: All Sign Outs, Trips								
Credit Hours	-0.204	-0.271	-0.321	-0.411	-0.103	-0.242	-0.286	-1.220
	(0.083)*	(0.403)	(0.087)**	(0.498)	(0.074)	(0.556)	(0.089)**	(0.700)+
Mean of Dep. Var.	14.94	14.95	15.70	15.71	16.17	16.17	16.07	16.07
Panel C: Recreational Sign Outs, Duration (Hours)								
Credit Hours	1.614	-13.444	-3.816	-14.242	-1.893	-6.039	-4.830	-13.761
	(2.275)	(8.259)	(2.095)+	(10.428)	(1.960)	(12.714)	(2.155)*	(15.477)
Mean of Dep. Var.	419.32	419.50	413.53	413.64	412.63	413.01	394.30	394.30
Panel D: Recreational Sign Outs, Trips								
Credit Hours	-0.051	-0.068	-0.226	-0.304	-0.057	-0.139	-0.266	-0.911
	(0.084)	(0.384)	(0.088)*	(0.477)	(0.075)	(0.547)	(0.086)**	(0.692)
Mean of Dep. Var.	13.19	13.20	13.97	13.98	14.62	14.63	14.47	14.47
Number of Students	913	911	908	907	904	903	898	898
Obs	3173	3165	3195	3191	3177	3173	3124	3124

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows the effect of additional credit hours on students' time spent off-campus by quartile of academic composite, a measure which aggregates pre-admission academic ability using standardized test scores, high school GPA, and class rank. Odd-numbered columns include student fixed effects (see Section 5.1) while even-numbered columns estimate the effect using a cohort IV (see Section 5.3) conditional on semesters of tenure, a 2018 calendar year control, academic composite, and interactions of non-White, female, and athlete. Standard errors are clustered at the squadron group by cohort level.

TABLE A3 — ROBUSTNESS: REMOVE ATYPICAL STUDENTS

	No Prior Military		<15 Validation Credits	
	FE	IV	FE	IV
	(1)	(2)	(3)	(4)
Credit Hours	-6.422	-19.614	-6.703	-15.533
	(1.820)**	(5.196)**	(1.857)**	(6.662)*
Mean of Dep. Var.	499.239	499.485	498.967	499.231
Number of Students	2862	2871	3342	3352
Obs	10017	10020	11729	11727

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows our results are robust to the exclusion of students with atypical paths to USAFA. The first two columns remove any students with prior military experience that may have entered with some requirements already completed. The second two columns subsets to students who transferred or validated no more than 15 out of a possible 27.5 hours of required curriculum. Odd-numbered columns include student fixed effects (see Section 5.1) while even-numbered columns estimate the effect using a cohort IV (see Section 5.3) conditional on semesters of tenure, a 2018 calendar year control, academic composite, and interactions of non-White, female, and athlete. Standard errors are clustered at the squadron group by cohort level.

TABLE A4 — ROBUSTNESS: SQUADRON FIXED EFFECTS

	All Sign Outs		Recreational Sign Outs	
	Duration (Hours)	Trips	Duration (Hours)	Trips
	(1)	(2)	(3)	(4)
Panel A: OLS				
Credit Hours	-8.982	-0.282	-5.501	-0.223
	(1.528)**	(0.065)**	(1.545)**	(0.064)**
Panel B: IV				
$\widehat{\text{Credit Hours}}$	-17.580	-0.520	-13.237	-0.354
	(6.294)**	(0.346)	(5.537)*	(0.324)
Obs	12647	12647	12647	12647

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows a negative relationship between a student's time spent off-campus per semester and credit hours completed is robust to the inclusion of fixed effects for squadron commander who has some control over sign out permissions. Panel A presents OLS estimates rather than estimates conditional on student fixed effect which are collinear with squadron assignment. All results are conditional on semesters of tenure, a 2018 calendar year control, academic composite, and interactions of non-White, female, and athlete. Standard errors are clustered at the squadron group by cohort level.

TABLE A5 — COURSE LOAD EFFECTS ON ACADEMIC PROBATION STATUS

	Full Sample		Upper, Non-Athletes		Upper, Athletes	
	FE	IV	FE	IV	FE	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Credit Hours	0.001	0.005	-0.002	0.005	-0.003	0.004
	(0.001)	(0.002)**	(0.001)	(0.002)*	(0.003)	(0.004)
Number of Students	3623	3619	2068	2068	613	613
Proportion on probation	0.022	0.022	0.013	0.013	0.015	0.015
Obs	12669	12653	5453	5453	1601	1601

Notes: ** p<0.01, * p<0.05, + p<0.10. This table shows additional credit hours do not meaningfully impact the probability a student is placed on academic probation and consequently restricted from signing out. Odd-numbered columns include student fixed effects (see Section 5.1) while even-numbered columns estimate the effect using a cohort IV (see Section 5.3) conditional on semesters of tenure, a 2018 calendar year control, academic composite, and interactions of non-White, female, and athlete. Standard errors are clustered at the squadron group by cohort level.