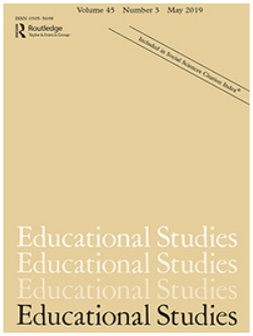

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Homeschool background, time use and academic performance at a private religious college

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ABSTRACT

We study the effects of homeschool background and time use on academic performance among students at Patrick Henry College, a private religious institution with a 63-credit core classical liberal arts curriculum. Using ordinary least squares regression analysis, we examine four research questions: (1) Does time use influence academic performance? (2) Do homeschooled students perform differently than traditionally schooled students? (3) Does parental education moderate the impact of homeschooling on academic performance? (4) Does homeschooling moderate the impact of ACT scores on academic performance?

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Academic performance; homeschool background; parental education; personality; student time use

1. Introduction

Homeschooling, or parent-led home-based education, has a long and distinguished history in the United States, with many prominent historical figures (e.g. George Washington, Thomas Jefferson, Benjamin Franklin, Andrew Carnegie and Franklin Roosevelt) receiving at least part of their education at home (Coulson 1999). With the rise of compulsory school attendance laws in the mid-nineteenth and early twentieth centuries, the practice of homeschooling diminished significantly (Lips and Feinberg 2008), with the number of homeschooled students dropping to around 13,000 by the early 1970s (Lines 1991). By this time, homeschooling had become "an unacceptable practice for satisfying compulsory education requirements in most states" (Lines 2000, 77).

Homeschooling, however, began to regain popularity beginning in the 1970s among so-called pedagogues, who believed that the growing bureaucratisation and professionalisation of public schools were undermining instruction of their children. The so-called ideologues, seeking to impart religious values on their children, joined the homeschool movement by the 1980s (Van Galen 1991). Despite these emerging trends, the right to homeschool was largely not protected by law, as only three states permitted homeschooling in 1980 (Coulson 1999). Over the next two decades, state legislatures gradually changed their laws. By the start of the twenty-first century, homeschooling was legal in all 50 states (Lines 2000), facilitating rapid growth in the number of homeschooled students (Lips and

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Feinberg 2008). The Department of Education estimated that the number of homeschooled students increased from 850,000 (1.7% of the 5–17-year-old population) in 1999 to 1.8 million (3.4%) in 2012 (Redford, Battle, and Bielick 2017). Ray (2016) estimated that the number of homeschooled students reached 2.3 million by 2016.[1]

Although homeschooling is now legal across the country and is widely accepted by the public as a viable education option (Lines 2000), the degree to which it is regulated differs considerably across states (Lips and Feinberg 2008; Ray and Eagleson 2008) and there remains considerable debate over the degree to which homeschooling should be regulated (see, for example, Ray and Eagleson (2008) and references therein). A lack of reliable evidence about the academic outcomes of homeschooled students is one of the main concerns of proponents for stricter governmental regulation of homeschooling (e.g. Reich 2005).[2] Indeed, there is mixed evidence on the collegiate academic performance of homeschooled students relative to traditionally schooled students (Cogan 2010; Jones and Gloeckner 2004; Snyder 2013).

The current study contributes to the literature on the academic performance of homeschooled students by examining the factors affecting the academic performance of students at Patrick Henry College (PHC). PHC provides a well-controlled environment for such a study for several reasons. As discussed further in the methods section, the relative homogeneity in terms of religious beliefs and educational background of the student population, as well as relative homogeneity of the coursework and residency status, provide an excellent environment for a case study of factors that contribute to differences in academic performance among a population of primarily homeschooled students. We conducted an anonymous and voluntary survey of PHC students to gather data about their grade point average (GPA) and time use during the Fall 2014 semester. Additionally, we collected information about the students' homeschool background, parental education level, personality type, major and class rank. Using ordinary least squares (OLS) regression analysis, we test the following four research questions:

(1) Does time use influence academic performance?
(2) Do homeschooled students perform differently than traditionally schooled students?
(3) Does parental education moderate the impact of homeschooling on academic performance?
(4) Does homeschooling moderate the impact of ACT scores on academic performance?

The remainder of the paper is organised as follows. Section 2 discusses the methods. A review of related literature is provided in Section 3. The results are presented in Section 4. Section 5 offers concluding remarks.

2. Methods

2.1. Methodological approach

The current study examines the determinants of academic performance at PHC, a private selective religious liberal arts college that predominantly serves homeschooled students. We employ a quantitative research approach using OLS regression analysis to address the research questions posed in the introduction.

2.2. Hypotheses

This study attempts to address four research questions related to the influence of homeschooling and time use on academic performance among students at PHC. Specifically, the following null hypotheses were tested using a quantitative research approach:

H_1: Students who spend more time on non-academic activities (e.g. extra-curricular activities, paid work, dating, sleep) do not perform differently academically than students who spend less time on non-academic activities;

H_2: There is no difference in academic performance between homeschooled students and non-homeschooled students;

H_3: There is no difference in academic performance between homeschooled students with college-educated parents and homeschooled students whose parents do not have a college education; and

H_4: The impact of pre-college academic preparation on academic performance is not conditional on whether a student was homeschooled.

2.3. Study design

This paper contributes to the literature by examining the factors affecting academic performance among students at PHC, a selective private Christian residential liberal arts college in northern Virginia. PHC provides a well-controlled environment for such a study for several reasons.

First, PHC was founded in 2000 with the objective of providing a high-quality classical liberal arts education for Christian homeschooled students. The majority (79%) of PHC students have at least some homeschool background (Patrick Henry College 2015). Second, PHC has a classical liberal arts curriculum, and of the 123 credits needed to graduate, all students are required to take the same 63-credit core curriculum; further, the recommended course sequence is very similar across majors. This enhances the comparability of grades significantly, particularly once we control for class and major.

Third, the vast majority of students (90% of all students, 99% of freshman) reside on campus (Patrick Henry College 2015), so the potential effect of residency status on academic performance is not a serious factor. Lastly, PHC is a religious institution that voluntarily chooses not to accept government funding, and all students are required to sign a statement of faith prior to enrolling. These institutional characteristics likely exert a strong student selection effect, minimising the potential impact of unobserved cultural differences attributable to religious and social upbringing.

2.4. Sample selection

As discussed in the study design section, PHC is a relatively well-controlled environment to examine the impact of homeschool background and other factors such as time use and personality type on academic performance. The data used for this study were collected through a voluntary and anonymous survey of the PHC student population during the Spring 2015 semester.

The survey, which is provided in the Appendix, consisted of 14 questions. Voluntary responses were solicited through an email sent through the campus email system to all

students, as well as two posts to the college-wide Facebook page.[3] Students were asked to report their *GPA* for Fall 2014 and to answer questions related to their time use that semester. In addition, the survey contained questions related to homeschooling background, standardised test scores, major, class and their parents' educational attainment. The survey was designed to extract individual-level characteristics that have been previously found to influence collegiate academic performance (see literature review section for additional information).

The electronic survey was set up to ensure student responses were anonymous and limited students to completing only one survey. Of the 326 students enrolled at PHC at the time of survey, 109 responded to the survey, so our sample accounts for one-third of the student population. The vast majority of the 109 students in our sample (94%) completed at least some of their pre-college education at home and more than three-fourths (76%) were homeschooled during elementary, middle and high school.

To incentivise participation, students were offered the chance to be entered in a drawing for a $5 campus gift card for completing the survey. Students choosing to enter the drawing were provided with a link to a separate survey after completion of the initial survey and were asked to provide their name. Two-thirds of respondents opted to enter the drawing, suggesting that the incentive was at least somewhat effective in eliciting responses from the student population.

2.5. Variables

Responses from the survey were used to construct the variables used in the empirical analysis of this study. Table 1 describes and provides summary statistics for all of the variables used in this study.

2.5.1. Dependent variable

Survey respondents indicated their overall *GPA* (to 2 decimals) for the Fall 2014 semester. *GPA* is a continuous variable and is used as the measure of academic performance in the current study. *GPA* is the dependent variable in the regressions.

2.5.2. Independent variables

The main variables of interest in this study are homeschool background, time use, personality type and parental education.

Survey respondents were asked to indicate if they were homeschooled during: (i) elementary school; (ii) middle school; and (iii) high school. We used this information to create a dummy variable equal to one if a student responded affirmatively to all three questions, and zero otherwise. The resulting variable, *Home,* is our measure of homeschool background. More than three-fourths of the sample (76%) were homeschooled during elementary, middle and high school.

Additionally, survey respondents were asked several questions related to their time use during the Fall 2014 semester, including: (i) number of credit hours enrolled for the semester (*Credit*); (ii) typical number of hours spent on extracurricular activities per week (*Extra*); (iii) typical number of hours spent working a job per week (*Work*); (iv) typical number of hours spent sleeping per night (*Sleep*); and (v) whether the student was single, married or in a

Table 1. Variable descriptions and summary statistics.

Variable	Mean	SD	Min	Max	*N*	Description
GPA	3.54	0.46	1.92	4.00	109	Fall 2014 grade point average
Home	0.76	0.43	0.00	1.00	109	Dummy variable = 1 if homeschooled in elementary, middle and high school
Time use variables						
Extra	8.26	6.74	0.00	30.00	109	Average number of hours spent per week on extracurricular activities during Fall 2014
Work	10.63	10.94	0.00	60.00	109	Average number of hours worked per week in a job during Fall 2014
Sleep	6.76	1.09	4.00	11.00	109	Average number of hours slept per night during Fall 2014
Credit	15.72	2.01	7.00	21.00	109	Number of credit hours enrolled for during Fall 2014
Single	0.68	0.47	0.00	1.00	109	Dummy variable = 1 if single (not married and not in a romantic relationship) during Fall 2014
Parental education variables						
Dad_college	0.84	0.36	0.00	1.00	109	Dummy variable = 1 if father completed a bachelor's degree or more
Mom_college	0.72	0.45	0.00	1.00	109	Dummy variable = 1 if mother completed a bachelor's degree or more
Control variables						
ACT	30.29	3.01	22.00	36.00	109	Score on ACT test. Some students reported SAT score. Converted to ACT using College Board concordance table
Judge	0.85	0.36	0.00	1.00	109	Dummy variable = 1 if scored as a Judging type on the Myers-Briggs personality test
Campus	0.91	0.29	0.00	1.00	109	Dummy variable = 1 if living on campus during Fall 2014
Class_fre	0.28	0.45	0.00	1.00	109	Dummy variable = 1 if student a freshman during Fall 2014
Class_soph	0.25	0.43	0.00	1.00	109	Dummy variable = 1 if student a sophomore during Fall 2014
Class_jun	0.24	0.43	0.00	1.00	109	Dummy variable = 1 if student a junior during Fall 2014
Class_sen	0.24	0.43	0.00	1.00	109	Dummy variable = 1 if student a senior during Fall 2014
Major_eba	0.09	0.29	0.00	1.00	109	Dummy variable = 1 if an Economics & Business Analytics major
Major_gov	0.56	0.50	0.00	1.00	109	Dummy variable = 1 if an American Politics & Policy, International Politics & Policy, Political Theory, Strategic Intelligence, or General Government major
Major_lib	0.30	0.46	0.00	1.00	109	Dummy variable = 1 if a classical liberal arts, history or literature major
Major_jou	0.05	0.21	0.00	1.00	109	Dummy variable = 1 if a journalism major

relationship (*Single*). Responses to (i) – (iv) were used to construct continuous variables, while *Single* was constructed as a dummy variable equal to one if the respondent indicated that they were single, and zero if either married or in a relationship.

Survey respondents were also asked to select the highest level of education achieved by both their father and mother from the following list: (i) High school; (ii) Some college; (iii) Bachelor's degree; (iv) Master's degree; (v) Ph.D. We used this information to construct educational attainment dummy variables for each parent equal to one if the parent earned a bachelor's degree or higher, and zero otherwise. The correlation between the two parental education variables, *Dad_college* and *Mom_college,* is only 0.3, so we include both variables simultaneously in the regressions.[4]

2.5.3. Control variables

The survey asked a number of additional questions that were used to construct control variables that potentially impact academic performance. These variables include:

- *ACT*: ACT-equivalent standardised admissions test score[5];
- *Judge*: dummy variable equal to one if Judging personality type[6];
- *Campus:* dummy variable equal to one if lived on campus during Fall 2014;
- *Class_fre*: dummy variable equal to one for freshmen;
- *Class_soph*: dummy variable equal to one for sophomores;
- *Class_jun*: dummy variable equal to one for juniors;
- *Class_sen*: dummy variable equal to one for seniors;
- *Major_eba*: dummy variable equal to one if an Economics and Business Analytics major;
- *Major_gov*: dummy variable equal to one if an American Politics & Policy, International Politics & Policy, Political Theory, Strategic Intelligence or General Government major;
- *Major_lib*: dummy variable equal to one if a classical liberal arts, history or literature major; and
- *Major_jou*: dummy variable equal to one if a journalism major.[7]

2.6. Data analysis

We used the programme *Stata* to perform the statistical analysis. OLS regression was selected as the most appropriate multivariate method to analyse the determinants of academic performance for several reasons:

(1) The data-set is cross-sectional in nature;
(2) The dependent variable is continuous;
(3) We assume that the population model is linear in its parameters;
(4) The data were collected using a random sampling technique, as discussed in the Sample selection sub-section above;
(5) There is no multi-collinearity between any of the independent variables; and
(6) The independent variables are assumed to be exogenous.

The satisfaction of conditions 3–6 ensures that the OLS estimator is unbiased (Woolridge 2013). Because we are testing whether the impact of homeschool background on college academic performance is conditional on parental education and whether the impact of pre-college admission test scores on college academic performance is moderated by homeschooling background, it is assumed that the variance in the error term of the model is conditional on the independent variables. We correct for this heteroskedasticity using robust standard errors (White 1980).

Equation 1 describes the baseline model used to estimate the determinants of academic performance, measured by Fall 2014 GPA, where:

- E is a matrix of dummy variables indicating educational attainment of parents;
- T is a matrix of the time use variables;
- C is a matrix of dummy variables for class status;
- M is a matrix of dummy variables for academic major;
- α_0, α_1, α_2, α_3 and α_4 are scalar partial effects;

- β_1, β_2, μ, γ and δ are vectors of partial effects; and
- e is an idiosyncratic error.

$$\begin{aligned} GPA =& \alpha_0 + \alpha_1 ACT + \alpha_2 Home + \alpha_3 Judge \\ &+ E'\beta_1 + (E' \times Home)\beta_2 + \alpha_4 (ACT' \times Home) \\ &+ T'\mu + C'\gamma + M'\delta + e_i \end{aligned} \tag{1}$$

The two interaction terms, $E' \times Home$ and $ACT' \times Home$, are included to test null hypotheses H_3 and H_4, respectively. A failure to reject H_3 suggests that there is no difference in academic performance between homeschooled students with college-educated parent(s) and homeschooled students whose parents do not have a college education, whereas a rejection of H_3 suggests the opposite, that homeschooled students with college-educated parent(s) perform better academically in college than their homeschooled peers whose parent(s) do not have a college education. Similarly, H_3 suggests that there is no difference in the effect of standardised tests scores on academic performance between homeschooled and traditionally schooled students, whereas a rejection of H_4 suggests the opposite, that the effect of standardised test scores on academic performance is moderated (or enhanced) for students who were homeschooled.[8]

As discussed by Brambor, Clark, and Golder (2006), we cannot draw meaningful statistical inference about null hypotheses H_3 and H_4 from the standard errors associated with the respective interaction terms in isolation. This is because we are interested in the partial effects for *Home,* or $\frac{\delta GPA}{\delta Home} = \alpha_2 + E'\beta_2$, and *ACT*, or $\frac{\delta GPA}{\delta ACT} = \alpha_1 + \alpha_4 Home$. As such, we test the joint significance of the partial effects (Woolridge 2013), as further discussed in the results section below.

2.7. Limitations

As with all empirical studies, ours has several limitations. First, the results should be viewed as correlational and not causal because of the potential endogeneity of some of the independent and control variables. Second, the results may suffer from omitted variable bias as we are unable to directly control for ability or intelligence. We believe that parental education and admissions test results serve as decent proxies, so this bias is likely small. Third, our study only examines time use and academic performance for a single semester so the results may differ across time periods. Lastly, given the uniqueness of the institution and its student body, the results of the sample are likely not generalisable to the U.S. student population.

3. Literature review

3.1. Student time use and academic performance

How a student chooses to allocate her time while in college may impact her academic performance. Time is a scarce resource so the more time that a student spends on non-academic activities such as dating, extracurricular activities, sleep and work, the less time that she will have to devote to homework and studying, which could lead to poorer academic performance. The concept of diminishing marginal returns suggests that rather than academic performance being a linear function of time spent on coursework, the marginal impact of studying declines the more one does it. The standard microeconomic assumption of convex

utility suggests that individuals prefer a mixture of goods and services. Because time is a binding constraint that a student must allocate across activities, it follows that students should prefer to expend their time "consuming" a mixture of activities. To achieve higher levels of satisfaction, a student is faced with a smaller supply of time to allocate towards studying and may therefore either face a trade-off between schoolwork and other activities, hindering academic performance, or develop more efficient study habits and/or better time management skills, resulting in better academic performance. Study time may even exert a negative burnout effect for students who consistently burn the symbolic midnight oil, sacrificing sleep and other activities that provide them with satisfaction. Previous empirical research on student time use and academic performance has produced mixed results.

Academic success in college is linked to student retention, for it requires staying enrolled. Two theories from the education literature guide research here (Danbert et al. 2014). First is the theory of departure, which suggests that student retention is closely tied to student integration with an institution and its members (Tinto 1975). Next is the student involvement theory, which posits that the more involved a college student, the greater his learning and personal development (Astin 1999). Based on these theories, the level of student involvement – "investment of physical and psychological energy in various objects" – affects academic success, usually measured by college GPA (Astin 1999, 519), which is the best predictor of degree completion (Kuh et al. 2006; Pascarella and Terenzini 2005).

Zacherman and Foubert (2014) found that low and medium levels of activities per week are both associated with higher GPA, with the former exhibiting a larger effect, while high levels are associated with lower GPA. Zehner (2011) found that among students with similar SAT scores, highly engaged students out-performed the less-engaged regardless of class level, although upperclassmen tended to have higher GPAs regardless of engagement. More physically active students tend to have better alertness, time management skills and less stress (Neubert 2013; Zehner and Zelaya 2014), so GPA may also be related to physical fitness and wellness. Neubert (2014) provided evidence that academic performance is higher among students frequenting the fitness centre at Purdue University, and Danbert et al. (2014) documented that freshmen and sophomores at Michigan State University with fitness centre memberships exhibit higher GPAs and retention rates. In the current study, we estimate the impact of extracurricular activities on GPA among PHC students during the Fall 2014 semester.

Sleep habits also affect one's wellness, and sleep-related problems are prominent among college students (Gilbert and Weaver 2010). Trockel, Barnes, and Egget (2000) found that sleep habits, especially weekday and weekend wake-up times, affected first-year GPA more than other health-related factors. Kelly, Kelly, and Clanton (2001) found that short sleepers (6 or fewer hours) averaged significantly lower GPAs than long sleepers (9+ h), while the GPA of average sleepers (7–8 h) did not significantly differ from that of long or short sleepers. Taylor et al. (2013) found that later bedtimes and wakeup times, longer time awake after rising and inconsistent sleep habits are all related to lower cumulative GPA. Gilbert and Weaver (2010) found a negative correlation between the GPA of non-depressed college students and self-reported sleep quality (2010). In the current study, we estimate the impact of average number of hours slept on GPA among PHC students during the Fall 2014 semester.

Having a job may also affect a student's academic performance. Working reduces the amount of time available to study, so work may be associated with lower grades. Although

some studies have found that hours worked are negatively associated with academic performance (Brennan et al. 2005; DeSimone 2008; Kalenkoski and Pabilonia 2010; Stinebrickner and Stinebrickner 2003), some have found that only working more than 20 h a week has a detrimental effect, and others that students working a limited number of hours actually perform better than students who do not work at all (Dundes and Marx 2006/2007; Light 2001). Ehrenberg and Sherman (1987) meanwhile found no relationship between student work and GPA among male college students, and Astin (1975) provides evidence that on-campus jobs are positively associated with GPA, possibly because they entail greater involvement with the institution (Elling and Elling 2000). In the current study, we estimate the impact of average work hours per week on GPA among PHC students during the Fall 2014 semester.

The number of credits that a student takes can also affect their grades. Students taking larger course loads have less time to spend studying for each course, so they may receive lower average grades than a similar student taking a lighter course load. Two studies have found, however, that students taking more credits tended to earn higher GPAs, regardless of academic department or major (Khouj et al. 1982; Szafran 2001). In the current study, we estimate the impact of the number of credit hours taken on GPA among PHC students during the Fall 2014 semester.

A student's relationship status could influence their academic performance. There is substantial empirical evidence that being married or in an intimate relationship is associated with better physical and psychological well-being (e.g. Coombs 1991; Dolan, Peasgood, and White 2008). Braithwaite, Delevi, and Fincham (2010) provide evidence of a link between romantic relationships and well-being among college students. Two theories of why people in relationships experience better well-being, social support (Coombs 1991) and behavioural regulation (Litwak et al. 1989), could also serve as mechanisms linking student relationship status to academic performance. However, students in serious romantic relationships may have greater external demands on their time than single students, leading to less time available to study, hindering academic performance. In the current study, we estimate the impact of relationship status on GPA among PHC students during the Fall 2014 semester.

3.2. Homeschool background and academic performance

Cogan (2010) provided evidence that homeschooled students score higher on standardised tests and earn higher GPAs than traditionally schooled students. Jones and Gloeckner (2004), however, found no statistical difference in first-year GPA between homeschooled and traditionally schooled students. Snyder (2013), meanwhile, observed a significant difference in overall GPA between homeschooled and public-schooled students and between homeschooled and Catholic-schooled students. However, neither major GPA nor core GPA significantly differed between homeschooled and public-schooled or Catholic-schooled students. In the current study, we estimate the impact of the number of credit hours taken on GPA among PHC students during the Fall 2014 semester.

First-generation college students have lower persistence and graduation rates due to factors like poorer high school records, lower educational aspirations, different priorities and goals and less college-related knowledge and experience (Kuh et al. 2006; Pike and Kuh 2005). Warburton, Bugarin, and Nuñez (2001) found them less likely to be as academically prepared than second-generation students, meaning generally lower GPAs. However,

first-generation students with high school educations comparable to that of second-generation students did not significantly differ in first-year GPAs. Studies by Ray (2000), Rudner (1999) and Collom (2005) found that students homeschooled by more educated parents perform better academically. In the current study, we also test if the impact of homeschooling background on academic performance is conditional on parental educational attainment.

Pre-college academic preparation is a good predictor of academic performance in college. For instance, SAT scores are positively correlated with college GPA (Betts and Morell 1999; Zehner 2011), although some researchers have found that the positive effect of aptitude tests on GPA diminishes after accounting for involvement in campus activities (Kuh et al. 2008; Sackett et al. 2009). In the current study, we control for the impact of ACT score on GPA among PHC students during the Fall 2014 semester. Additionally, we test if homeschool background has a moderating impact on the effect of standardised tests on academic performance.

3.3. Other determinants of academic performance

Academic performance may also be affected by non-cognitive factors such as personality type. Research suggests that Judging types have, on average, higher GPAs and retention rates than Perceiving types (Barrineau 2005; DiRienzo et al. 2010; Sanborn 2013; Schurr and Ruble 1986, 1988). Differences in academic performance between personality types have been linked to differences in learning styles, responses to teaching styles and project time management styles (Beckham 2012; Schurr and Ruble 1986). In the current study, we control for the impact of Judging vis-à-vis Perceiving personality type on GPA among PHC students during the Fall 2014 semester.

Academic performance differs by major at many colleges and universities. For instance, Rask (2010) found that students with the lowest average GPAs majored in subjects such as chemistry, math, economics, psychology and biology; students majoring in subjects such as education, language, English, music and religion exhibited the highest average GPAs. Grades can provide a powerful incentive regarding course choices. Rask (2010) also found that some students majoring in the STEM fields become discouraged by their grades – which were significantly lower than those of their peers majoring in other areas of study – to the point of changing majors. Because many colleges and universities have high- and low-grading departments, this can hinder students from knowing their relative strengths and weaknesses. It also makes grades and various proxies of ability (e.g. SAT score or parental education) less accurate or poor predictors of grades in high-grading departments (Sabot and Wakeman-Linn 1991). In the current study, we control for the potential impact of major on academic performance. We also control for the potential impact of a student's class on academic performance because most students follow a very similar course sequence at PHC during their first two years of college, but their field of study determines their course sequence during their final two years.

Additionally, we control for whether a student lived on or off-campus during the Fall 2014 semester because on-campus living has been linked to better academic performance (Araujo and Murray 2010; Thompson, Samiratedu, and Rafter 1993).

4. Results

Table 2 reports the OLS regressions estimates of Equation 1 for the full sample, with heteroskedastic-robust standard errors in parentheses. Model 1 omits the interaction terms depicted in Equation 1 and serves as the baseline model. Model 2 introduces the *Home* × *ACT* interaction term to the baseline model. Model 3 adds the *Home* × *Dad_college* and *Home* × *Mom_college* interaction terms to the baseline model. Model 4 simultaneously includes all three interaction terms. Models 5 and 6 re-estimate Model 4 for the samples of underclassmen and upperclassmen,

Table 2. OLS regression results.

	GPA is dependent variable in all models					
	(1)	(2)	(3)	(4)	(5)	(6)
Home	0.083	1.380	−0.047	1.545	0.818	3.120*
	(0.110)	(1.027)	(0.303)	(1.129)	(1.253)	(1.807)
Parental education variables						
Dad_College	0.185	0.177	0.149	0.095	0.198	−0.605**
	(0.143)	(0.145)	(0.309)	(0.298)	(0.399)	(0.259)
Mom_College	0.041	0.041	−0.058	−0.132	−0.291	−0.425
	(0.105)	(0.106)	(0.271)	(0.304)	(0.359)	(0.360)
Time use variables						
Work	−0.004	−0.003	−0.004	−0.004	−0.018*	0.000
	(0.004)	(0.004)	(0.004)	(0.004)	(0.010)	(0.005)
Extra	−0.021***	−0.021***	−0.021***	−0.021***	−0.029**	−0.018*
	(0.008)	(0.008)	(0.008)	(0.008)	(0.013)	(0.010)
Sleep	−0.030	−0.020	−0.035	−0.025	0.018	−0.032
	(0.037)	(0.037)	(0.038)	(0.038)	(0.057)	(0.066)
Credit	0.017	0.017	0.017	0.017	0.083	0.011
	(0.016)	(0.016)	(0.016)	(0.016)	(0.050)	(0.023)
Single	−0.159*	−0.151*	−0.155*	−0.139*	−0.122	−0.108
	(0.085)	(0.085)	(0.079)	(0.080)	(0.134)	(0.113)
Control variables						
ACT	0.069***	0.103***	0.069***	0.114***	0.093**	0.187***
	(0.013)	(0.032)	(0.013)	(0.038)	(0.039)	(0.062)
Judge	0.306**	0.332**	0.308**	0.343**	0.724***	0.113
	(0.141)	(0.142)	(0.139)	(0.136)	(0.207)	(0.137)
Campus	0.154	0.171	0.154	0.177	0.311	0.200
	(0.115)	(0.117)	(0.115)	(0.116)	(0.297)	(0.172)
Interaction terms						
Home × ACT		−0.035		−0.049	−0.022	−0.137*
		(0.033)		(0.039)	(0.041)	(0.069)
Home × Dad_college			0.070	0.118	0.075	0.913**
			(0.330)	(0.323)	(0.398)	(0.396)
Home × Mom_college			0.150	0.235	0.292	0.584
			(0.269)	(0.305)	(0.354)	(0.375)
Other statistics						
N	109	109	109	109	57	52
F	4.468	3.857	4.360	3.813	4.370	.
Adj. R^2	0.339	0.346	0.328	0.342	0.336	0.412
p(ACT)		0.000		0.000	0.004	0.001
p(Home)		0.393	0.684	0.508	0.779	0.112
p(Dad)			0.287	0.325	0.250	0.050
p(Mom)			0.636	0.393	0.720	0.235
ACT(Home)		0.060		0.057	0.058	0.049

Notes: Fall 2014 GPA is dependent variable in all models. Heteroskedastic-robust standard errors reported in parentheses. All models include a constant term and a set of major and class dummy variables as controls, but these results omitted for space. Models 5 and 6 restrict sample of underclassmen and upperclassmen, respectively. p(ACT), p(Home), p(Dad) and p(Mom) are *p*-values from joint tests of significance of the partial effects of *ACT*, *Home*, *Dad_college* and *Mom_college*, respectively. ACT(Home) is the partial effect of *ACT* for homeschooled students. Statistical significance levels: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 3. OLS regression results – restricted sample.

	GPA is dependent variable in all models					
	(1)	(2)	(3)	(4)	(5)	(6)
Home	0.098	1.150	−0.062	1.312	0.418	3.089
	(0.110)	(1.014)	(0.301)	(1.123)	(1.181)	(1.878)
Parental education variables						
Dad_College	0.188	0.181	0.134	0.089	0.183	−0.609**
	(0.143)	(0.145)	(0.313)	(0.302)	(0.405)	(0.264)
Mom_College	0.048	0.047	−0.062	−0.126	−0.273	−0.426
	(0.111)	(0.113)	(0.270)	(0.305)	(0.368)	(0.365)
Time use variables						
Work	−0.003	−0.003	−0.003	−0.003	−0.018*	0.000
	(0.004)	(0.004)	(0.004)	(0.004)	(0.010)	(0.006)
Extra	−0.02**	−0.021**	−0.021**	−0.021**	−0.029**	−0.018*
	(0.008)	(0.008)	(0.008)	(0.008)	(0.013)	(0.010)
Sleep	−0.026	−0.018	−0.032	−0.024	0.015	−0.037
	(0.036)	(0.037)	(0.037)	(0.037)	(0.056)	(0.069)
Credit	0.014	0.014	0.015	0.015	0.067	0.012
	(0.016)	(0.016)	(0.016)	(0.015)	(0.044)	(0.024)
Single	−0.151*	−0.146*	−0.144*	−0.132*	−0.092	−0.104
	(0.087)	(0.087)	(0.081)	(0.082)	(0.139)	(0.115)
Control variables						
ACT	0.077***	0.104***	0.076***	0.115***	0.097**	0.186***
	(0.012)	(0.032)	(0.012)	(0.039)	(0.039)	(0.064)
Judge	0.317**	0.337**	0.318**	0.346**	0.737***	0.120
	(0.143)	(0.144)	(0.140)	(0.138)	(0.211)	(0.139)
Campus	0.158	0.171	0.156	0.173	0.310	0.196
	(0.126)	(0.128)	(0.127)	(0.127)	(0.312)	(0.184)
Interaction terms						
Home × ACT		−0.035		−0.049	−0.022	−0.137*
		(0.033)		(0.039)	(0.041)	(0.069)
Home × Dad_college			0.070	0.118	0.075	0.913**
			(0.330)	(0.323)	(0.398)	(0.396)
Home × Mom_college			0.150	0.235	0.292	0.584
			(0.269)	(0.305)	(0.354)	(0.375)
Other statistics						
N	105	105	105	105	55	50
F	4.607	4.068	4.615	3.987	5.597	.
Adj. R^2	0.365	0.367	0.356	0.365	0.386	0.397
p(ACT)		0.000		0.000	0.000	0.002
p(Home)		0.393	0.684	0.508	0.779	0.112
p(Dad)			0.258	0.290	0.117	0.056
p(Mom)			0.587	0.395	0.712	0.255
ACT(Home)		0.069		0.066	0.075	0.049

Notes: Fall 2014 GPA is dependent variable in all models. Heteroskedastic-robust standard errors reported in parentheses. Sample excludes the 4 students who reported an SAT score less than 1500 – see Note 5 for details. All models include a constant term and a set of major and class dummy variables as controls, but these results omitted for space. Models 5 and 6 restrict sample of underclassmen and upperclassmen, respectively. p(ACT), p(Home), p(Dad) and p(Mom) are *p*-values from joint tests of significance of the partial effects of *ACT*, *Home*, *Dad_college* and *Mom_college*, respectively. ACT(Home) is the partial effect of *ACT* for homeschooled students. Statistical significance levels: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

respectively. Table 3 re-estimates the same models as Table 2, excluding observations for which the student reported an SAT score between 1500 and 1600 (see Note 5 for details).

In the below analysis, statistical significance is tested at the 10% level. We find a positive and statistically significant association between GPA and the control variable *ACT* throughout Tables 2 and 3. With the exception of model 6, Judge also enters positively and significantly throughout both Tables. These results are consistent with previous research that has found entrance exams (Betts and Morell 1999; Zehner 2011) and judging personality types

(Barrineau 2005; DiRienzo et al. 2010; Sanborn 2013; Schurr and Ruble 1986) to be a strong predictor of academic performance. We also find that journalism majors have higher GPAs, all else equal, but this result only holds for the full sample. We do not find statistically significant results for the remaining control variables. Findings with respect to the null hypotheses outlined above are discussed in the following sub-sections.

4.1. Some uses of time hinder academic performance

Among the time use variables, only *Extra* and *Single* are statistically significant in the baseline estimates (Model 1). The coefficient for *Extra* is negative, suggesting that, inconsistent with null hypothesis H_1, PHC students who spend more time on extracurricular activities perform worse academically, all else equal. This result holds and the coefficient is stable when the interaction terms are introduced in Models 2–4, although the magnitude of the effect is slightly higher for underclassmen (Model 5) than upperclassmen (Model 6) in both Tables 2 and 3. This result contributes to the literature on extracurricular activities and academic performance, which has produced somewhat mixed results (Zacherman and Foubert 2014; Zehner 2011).

The coefficient for *Single* is negative and relatively stable in Models 1–3 of both Tables 2 and 3. The coefficient remains negative when the samples are restricted to underclassmen and upperclassmen in Models 5 and 6, respectively, but it is no longer statistically significant. The negative effect of being single on academic performance suggests that, all else equal, students at PHC in serious romantic relationships performed better academically than their single counterparts. This provides some corroboration for the social support (Coombs 1991) and behavioural regulation (Litwak et al. 1989) hypotheses discussed in the literature review section.

Meanwhile, the other time use variables (*Credit, Work* and *Sleep*) are not statistically significant in any of the models in Table 2, providing some support for null hypothesis H_1 that time spent on non-academic activities has no effect on academic performance.

4.2. Homeschooling does not influence academic performance

Home is positive but is not statistically significant in the baseline estimates (Model 1) of either Table 2 or 3, suggesting that, consistent with null hypothesis H_2, there is no difference in academic performance between homeschooled and traditionally schooled students at PHC.

Model 2 introduces the *ACT* × *Home* interaction term, so we must test the joint significance of the interaction term and the constituent term, *Home*, as discussed in Section 2.6. The *p*-value from this test is reported as *p(Home)*. The results suggest that the partial effect of homeschooling background is not statistically significant in Model 2.

Similarly, Model 3 introduces the *Home* × *Dad_college* and *Home* × *Mom_college* interaction terms to the baseline model. We test the joint significance of *Home* and the two interaction terms, reporting the *p*-value from this test as *p(Home)*. The results indicate that the partial effect of *Home* is not statistically significant. Meanwhile, Model 4 simultaneously includes all three interaction terms, so we test the joint significant of *Home* and all three interaction terms. Once again, the partial effect of *Home* is not statistically significant, as indicated by *p(Home)*. Finally, Models 5 and 6 restrict the sample to underclassmen and

upperclassmen, respectively. Once again, *Home* is not statistically significant in either model, as indicated by *p(Home)*.

Overall, the results from Tables 2 and 3 suggest that, consistent with H_2, there is no difference in academic performance between homeschooled students and traditionally schooled students at PHC. These findings are consistent with those of Jones and Gloeckner (2004), but inconsistent with those reported by Cogan (2010) and Snyder (2013).

4.3. Homeschooling by college-educated parents (largely) does not influence academic performance

The null hypothesis H_3 suggests that there is no difference in academic performance between homeschooled students with college-educated parents and homeschooled students whose parents do not have a college education. As mentioned above, Models 3–6 include two interaction terms, *Home* × *Dad_college* and *Home* × *Mom_college*. The inclusion of these two interaction terms allows us to test H_3 by examining the partial effect of *Home*. As discussed in Section 4.2, the partial effect of *Home* is not statistically significant in any of these models, suggesting that parental education does not influence the effect of homeschooled students' academic performance at PHC.

Additionally, we separately examine the partial effects of *Dad_college* and *Mom_college* by testing the joint significance of each parental education constituent term and its interaction with *Home*. These results are reported as *p(Dad)* and *p(Mom)*, respectively, but neither is statistically significant in Models 3–5 in either Table 2 or 3. The partial effect of *Dad_college* is statistically significant when the sample is restricted to upperclassmen only (Model 6), suggesting that homeschooled upperclassmen whose father completed a college education performed better academically than homeschooled students whose father did not complete a college education.

Overall, the results discussed in this section are largely consistent with H_3. Homeschool background does not impact academic performance of PHC students, irrespective of whether a student's parents completed a college education. The findings also largely indicate that parental education is not a good predictor of academic performance, regardless of whether a student was homeschooled or not, although we do find that homeschooled upperclassmen whose father has a college education perform better academically, all else equal.

4.4. Entrance exams better predict academic success for traditionally schooled students

The null hypothesis H_4 suggests that the impact of pre-college entrance exams on academic performance is not conditional on whether a student was homeschooled. As mentioned above, Model 2 and Models 4–6 include the *ACT* × *Home* interaction term, allowing us to test H_4 by examining the partial effect of *ACT*. As before, this involves testing the joint significance of the constituent term, *ACT*, and interaction term, *ACT* × *Home*. The former term enters positively and the latter negatively, and the *p*-value for the joint test of their significance suggests that the partial effect of *ACT* is statistically significant.

These results suggest that we reject H_4 and conclude that the impact of *ACT* scores on *GPA* is lower for homeschooled than traditionally schooled students at PHC. The coefficient for the constitutive term, *ACT*, represents the effect for traditionally schooled students, while the sum of the coefficients for the constitutive and interaction terms represents the effect for homeschooled students. The latter is reported as *ACT(Home)*.

5. Conclusion

Previous studies have produced mixed results regarding the impact of homeschooling on collegiate academic performance (Cogan 2010; Jones and Gloeckner 2004; Snyder 2013). This study contributes to this line of literature by examining the determinants of academic performance during Fall 2014 at PHC, a private selective Christian liberal arts college that predominantly serves homeschooled students. As discussed in the methods section, PHC provides a well-controlled environment for such a study because of the relative homogeneity in terms of religious beliefs and educational background of the student population, as well as relative homogeneity of the coursework and residency status of students.

We conducted an anonymous and voluntary survey of PHC students to gather data about their GPA and time use during the Fall 2014 semester, as well as information about their homeschool background, parental education level, personality type, class rank and major. Our sample consists of one-third of the student population at PHC. Using OLS regression analysis, we tested four research questions.

First, we examined whether student time use impacts academic performance. We tested the effect of numerous factors, including time spent on extracurricular activities, paid work and sleeping, as well as relationship status and the number of credit hours enrolled. The results suggest that students who spend more time on extracurricular achieve lower GPAs. Additionally, students not involved in a romantic relationship perform worse than students in a relationship.

Second, we tested whether there is a difference in academic performance between homeschooled and traditionally schooled students at PHC. The results suggest that, all else equal, there is no difference in the GPAs of homeschooled and traditionally schooled students. This result holds when we condition the effect of homeschooling on parental education, which is the third hypothesis tested. The latter result was particularly surprising, given that previous research has found that students homeschooled by more educated parents perform better academically (Collom 2005; Ray 2000; Rudner 1999). The finding that homeschooled students do not perform differently academically than traditionally schooled students at PHC should not be viewed as a detrimental finding regarding the academic achievement of homeschooled students because PHC is a selective institution. Rather, it suggests that homeschooled students perform as well as their traditionally schooled peers who also entered college well-prepared academically.

Finally, we test if homeschooling background moderates the effect of college entrance exam scores on academic performance. This question is important because previous research has found that homeschooled students perform as well as or better than traditionally schooled students on academic achievement tests (Ray 1997, 2016; Rudner 1999). ACT and SAT test scores are routinely used by college admissions officers as a means to assess the likelihood for academic success of a prospective student. Our results indicate that the partial

effect of ACT-equivalent scores on GPA is higher for traditionally schooled than homeschooled students at PHC, potentially suggesting that college entrance exam scores may not be as accurate a predictor of collegiate academic success for homeschooled students.

Notes

1. Collom (2005) provides a review of research on parental motivations to homeschool. Among the most common reasons are: dissatisfaction with public schools; academic and pedagogical concerns; religious values; and family needs.
2. Romanowski (2006) discussed several other common criticisms of homeschooling.
3. The email solicitation generated 38 responses, while 71 students responded to the Facebook posts.
4. The results are both qualitatively and quantitatively similar when including only one parental education variable in the baseline interaction model. Results omitted for space.
5. Respondents were asked to indicate their ACT or SAT score. 37 of the 109 respondents reported ACT scores and the remaining 76 students reported SAT scores. Of the latter group, 55 reported a score above 1600, so these scores are unambiguously on the 2400-point scale. The remaining SAT scores ranged from 1150 TO 1600, leaving some ambiguity as to whether these scores were on the 1600 or 2400-point scale. Through discussions with the admissions department at PHC, we learned that the school rarely admits students with an SAT score below 1000 (on the 1600 scale) and enrolls numerous students with SAT scores above 1500 every year. It was therefore assumed that the SAT scores less than or equal to 1600 were on the 1600-point scale, although we flagged observations of 1500 and above to test the sensitivity of our results to this assumption. SAT scores were converted to ACT-equivalent scores using the College Board's concordance table.
6. The Myers-Briggs Type Indicator (MBTI) instrument, which uses self-reported answers of easily recognised reactions to identify people's basic preferences regarding Perception and Judgment, is commonly used as a barometer of personality. As of Fall 2014, all PHC students were required to take the MBTI assessment during their first year as part of the college's "Wisdom and Eloquence Portfolio" course. The MBTI assessment is administered by the college each year for incoming students and the results included in each student's portfolio. Survey respondents were asked to indicate their personality type from the PHC-administered MBTI assessment. These data were used to construct a dummy variable, *Judge*, equal to one if a student indicated that they were Judging type, and zero if they indicated that they were Perceiving type.
7. As of the time of the survey, PHC only offered 10 different majors. Because of the limited sample size and concern over degrees of freedom in the regression analysis, we grouped the majors into the four categories described above.
8. The null hypothesis requires a two-sided test, so the effect could plausibly be enhanced by homeschool background as well.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix. Student Survey Questions

(1) What was your SAT or ACT score?
(2) Were you homeschooled?

- Yes, during elementary school
- Yes, during middle school
- Yes, during high school
- No

(3) What is your father's highest level of education?

- High school
- Some college
- Bachelor's degree
- Master's degree
- Ph.D.

(4) What is your mother's highest level of education?

- High school
- Some college
- Bachelor's degree
- Master's degree
- Ph.D.

(5) What is your current class standing?

- Freshman
- Sophomore
- Junior
- Senior

(6) What is your Myers-Briggs personality type?
(7) What was your GPA for the Fall 2014 semester (2 decimal places)?
(8) How many credit hours did you take in the Fall 2014 semester?
(9) What was your living situation in the Fall 2014 semester?

- On-campus
- Off-campus

(10) What was your relationship status during the Fall 2014 semester?

- Single
- In a relationship
- Married

(11) How many hours/week did you typically work during the Fall 2014 semester?
(12) How many hours/week did you spend in extracurricular activities during the Fall 2014 semester? (e.g. hobbies, working out, etc. – do not include activities such as debate that you received credit for)
(13) How many hours did you typically sleep (during a 24-hour period) during the Fall 2014 semester?
(14) What is your intended major?

- Literature
- History
- Political Theory

- Strategic Intelligence
- American Politics and Policy
- International Politics and Policy
- General Government
- Classical Liberal Arts
- Economics and Business Analytics
- Journalism