Purchase of Online Test Preparation: Effects for Repeat Test-Takers

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This study employed a quasi-experimental design to explore the efficacy of purchasing ACT® Online Prep (AOP) to prepare for the ACT. The results of this study highlighted the positive impact of purchase for repeat testers, though the effect tended to be smaller than what has been reported in prior studies, particularly in comparison to first-time testers. The purchase effect among repeat test-takers varied slightly across income groups, with low-income and middle-income students benefitting slightly more than high-income students. The effect of AOP purchase decreased slightly as prior ACT Composite score increased. The effects of purchasing AOP tend to be smaller than the effects of using AOP found in other studies, but larger than the effect of being granted access to AOP.

Introduction

In the modern American educational landscape, test preparation for college entrance exams encompasses a vast array of activities. We can think of test preparation activities as broadly encompassing three goals: content reinforcement/learning, test familiarization, and learning testing strategies. Through content reinforcement and learning, students are given the opportunity to review material that is typically taught in US high schools and assessed by the ACT test. Test familiarization affords students the chance to learn what to expect from the testing environment and how to navigate the test itself, including things like timing and content covered. Testing strategies include wrong answer elimination and time management. Test wiseness, which encompasses test familiarization and testing strategies, is a skill that utilizes features of the test to attain a higher score and is “logically independent of the examinee’s knowledge of the subject matter” (Millman, Bishop, & Ebel, 1965, p. 707).

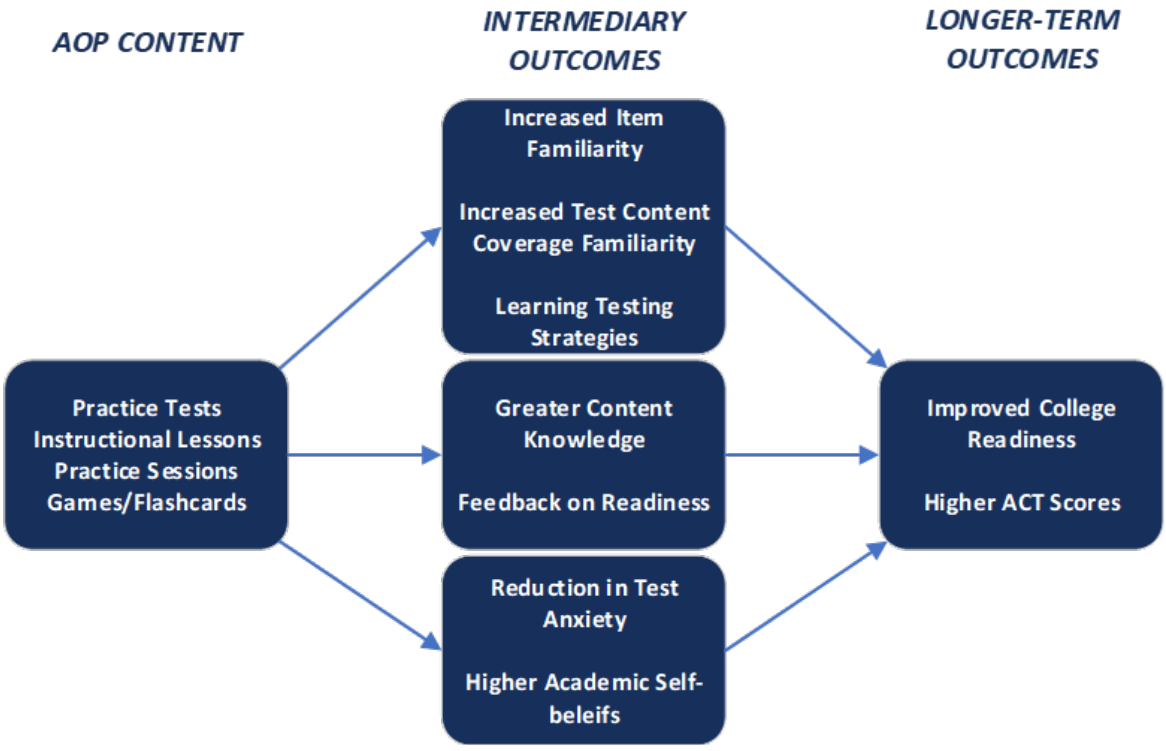
Both free and commercial test preparation programs tend to offer some balance of these activities. In this study, the use of ACT Online Prep (AOP) is examined as an example of the types of activities that test preparation programs can offer to support students. AOP is an online subscription-based program that offers over 200 hours of preparation material in four content domains (i.e. English, mathematics, science, and reading) and the essay section of the ACT test, and an introduction to the test, including testing strategies. It uses practice sessions, instructional lessons, ACT practice tests, discussion boards, educational games, and flashcards to help students prepare to take the ACT. The program offers both a structured linear and personalized learning path. The system provides predicted ACT scores from both short- and long-form practice

tests; long-form practice tests are retired ACT forms. Additionally, the practice items provide feedback on each response to help students better understand the content being covered. Students also have the ability to reset their activities, including practice tests.

Practice sessions consist of diagnostic and practice questions and include over 2,400 practice items with immediate feedback on student progress that scaffolds and facilitates students' learning. Instructional lessons are extensive reviews of the content domains assessed in the four section tests. For example, the reading lessons prepare students for topics such as Integration of Knowledge and Ideas, Key Ideas and Details, and Craft and Structure (ACT, 2019). Students who take short-form practice tests receive a limited number of untimed questions on each subject and receive a predicted ACT section test score range. Students who take a long-form practice test receive a timed test that mimics the official ACT test. Completion of the four long-form practice tests (one in each subject area) provides students with an estimated ACT Composite and section scores.

Figure 1 illustrates the conceptual framework used to examine the efficacy of the AOP program. This framework is partitioned into the program content and intermediary as well as longer-term outcomes. It is hypothesized that the program content has an impact on three types of intermediary outcomes. The first includes issues of test wiseness, the second focuses on core content knowledge and readiness, and the third is a set of affective issues including test anxiety and academic self-beliefs. It is further hypothesized that the three types of intermediary outcomes result in improved college readiness and higher ACT test scores. In the present study, an examination is made of the impact of purchasing AOP on ACT test performance.

Figure 1. Treatment Program Conceptual Framework (adapted from Sanchez & Cruce, 2019)



Analytical Sample

Program data from January 2016 to February 2018 were used in the study. This resulted in 107,650 students who purchased AOP. The control students included those who took the ACT during the same time period but did not purchase AOP. This resulted in an overall control group of 422,950 students. A subset of these two groups was used to investigate the efficacy of the test preparation program for repeat test-takers. Pre- and post-test records were subsequently identified for both the treatment and control groups. The post-test for the treatment group was selected as the ACT test closest to the end of the program license period, but no more than three months after the program license ended. For these students, the prior test was the ACT test closest to, and prior to, purchase of AOP, but no more than six months before purchase. For the control group, the most recent ACT test was used as the post-test. For these students, the prior test was a randomly selected prior exam that happened within 15 months of the post-test. Fifteen months was selected to encompass the various subscription lengths possible for the test preparation program. This resulted in an analytical sample of 24,390 treated students and 134,688 control students. Compared to the excluded students who took the ACT only once, there are more middle-income and fewer low-income students, slightly more females, and more students in the 12th grade in the repeat-tested analytical sample.

In the analytical sample, about half of students are from middle-income families, and over half are female or in the 12th grade (see Table 1). Additionally, almost half of students had a parent with a bachelor's degree or higher; most had completed mathematics coursework beyond Algebra II and declared a need for academic or career planning help; and over half had completed science coursework beyond chemistry and had taken advanced coursework in either English, mathematics, social studies, or natural science. On average, retested students had tested about five months after their most previous ACT test, tested about three times, have a HSGPA of about 3.5, and tested about thirteen months before graduation.

Table 1. Retested Student Characteristics

Characteristic	% or mean
Family Income (%)	
< $36,000	37.1
$36,000 - $100,000	49.0
> $100,000	13.9
Gender (%)	
Female	60.8
Male	39.2
Education Level (%)	
11	71.2
12	28.8
Parents' Education Bachelor's or Higher (%)	
Yes	44.6
No	55.5
Mathematics Coursework beyond Algebra 2 (%)	
Yes	82.9
No	17.1
Science Coursework Beyond Chemistry (%)	
Yes	63.6
No	36.4
Taken Any Advanced Coursework (%)	
Yes	64.6
No	35.5
Need Academic or Career Planning Help (%)	
Yes	82.8
No	17.2
Prior ACT Composite (mean)	22.2
ACT Composite (mean)	23.2
Number of months between ACT tests (mean)	5.1
Number of times tested (mean)	3.0
HSGPA (mean)	3.5
Number of months to graduation (mean)	13.6

In the study sample, low-income students are underrepresented in the treatment group because of a program offered during the study timeframe. Students who registered for the ACT with a fee waiver, many of whom were low-income, qualified to receive a premium test preparation product, ACT® Kaplan® Online Prep Live, complimentary for 12 months. As such, they were not included in the sample for this study examining AOP.

Current Study

This study employed a quasi-experimental design using inverse probability of treatment weighting using propensity scores to construct a treatment and control group wherein “the distribution of measured baseline covariates is independent of treatment assignment” (Austin, 2011, p. 408). This method allows one to make causal inferences about the effects of purchasing AOP to prepare for the ACT.

This is accomplished via a two-stage process. First, a logistic regression model is developed that predicts purchase of AOP based on student-level baseline characteristics. Average treatment effect on the treated (ATT) weighting was used in this study. ATT is the average effect of the treatment among those who ultimately receive the treatment (Austin, 2011). These weights were trimmed at the upper and lower 1% of weights. These weights were then used in a second-stage linear model that predicted post ACT scores while controlling for student characteristics such as demographics and high school coursework taken.

Statistical Analysis

Table 2 shows the stage-one logistic regression estimates and odds ratios (ORs) of program purchase for student-level characteristics. Low-income students were more likely than middle-income students (adjusted OR = 1.89) and African American and Hispanic students were much more likely than White students to enroll in the test preparation program (adjusted OR = 2.41 and 1.93, respectively). In this logistic regression, I also found that taking mathematics coursework beyond Algebra II was not a significant predictor of program purchase.

Table 2. Logistic Regression Estimates of Program Purchase

Effect	Coefficient	Std Error	Odds Ratio
Intercept	-7.27	0.29	
Female	0.09	0.01	1.10
Family Income			
Low-Income	0.64	0.01	1.89
High-Income	-0.80	0.01	0.45
Race/Ethnicity			
African American	0.88	0.01	2.41
Hispanic	0.66	0.01	1.93
Other	0.36	0.01	1.44
Taking any Advanced Coursework	0.14	0.01	1.15
Taking the ACT as a Junior	-0.31	0.02	0.73
Need Help in Educational or Career Navigation	0.12	0.01	1.13
Has a Parent with a Bachelor's Degree	0.50	0.01	1.66
Taken Mathematics beyond Chemistry	0.04	0.01	1.04
HSGPA	1.01	0.17	2.74
Square of HSGPA	-0.21	0.03	
Number of times taken the ACT	1.00	0.04	2.72
Square of number of times taken the ACT	-0.11	0.00	
Number of Months to Graduation	0.16	0.01	1.18
Square of Number of Months to Graduation	0.00	0.00	
Number of Months between tests	-0.10	0.00	0.90
Prior ACT Composite Score	0.02	0.00	1.03

Note: All retained predictors were significant at 0.0001 or lower. Taking any advanced coursework included advanced coursework in English, mathematics, natural science, and social studies.

Table 3 highlights the student characteristics in the control and treatment group both prior to, and after, applying ATT weights. This table also displays the standardized mean difference (SMD).[1] In quasi-experimental designs, a common recommendation to assure that you have attained covariate balance, i.e. mimicked random assignment, is to have an absolute SMD lower than 0.1. Large differences in student characteristics are seen between the unweighted treatment and control groups as shown by the large absolute unweighted SMDs. The weighting succeeded in reducing these differences to an acceptable level for each student characteristic shown in Table 2, i.e. less than 0.1. A dramatic example of this can be seen in the percentage of low-income students in both groups before (41.7% vs. 8.2%) and after (8.2% vs. 8.2%) weighting.[2]

Table 3. Student Characteristics Prior to and After Weighting for Repeat Testers

	Repeat Testers				
Student Characteristic	Unweighted Control	Weighted Control	Unweighted Treatment	Unweighted Standardized Difference	Standardized Difference
Family Income (%)					
< $36,000	41.7%	8.2%	8.2%	-0.84	0.00
$36,000 - $100,00	50.9%	37.0%	37.0%	-0.28	0.00
> $100,000	3.4%	54.8%	54.8%	1.38	0.00
Gender (%)					
Female	69.3%	53.6%	53.6%	-0.33	0.00
Race/Ethnicity (%)					
White	32.3%	69.6%	69.6%	0.81	0.00
African American	23.6%	6.8%	6.8%	-0.48	0.00
Hispanic	25.3%	9.5%	9.5%	-0.43	0.00
Other	18.8%	14.1%	14.1%	-0.13	0.00
Taken Advanced Coursework (%)					
Yes	64.0%	68.2%	68.2%	0.09	0.00
Student Grade Level (%)					
11	69.3%	82.9%	82.9%	0.32	0.00
Need Help in Educational or Career Navigation (%)					
Yes	84.8%	70.4%	70.4%	-0.35	0.00
Parent Completed a B.A. (%)					
Yes	39.3%	77.7%	77.7%	0.85	0.00
Taken Mathematics Beyond Algebra II (%)					
Yes	82.2%	87.2%	87.2%	0.14	0.00
Taken Science Beyond Chemistry (%)					
Yes	62.6%	69.8%	69.8%	0.15	0.00
Average ACT Composite Pre-test (mean)	19.79	22.20	22.20	0.54	0.00
Average HSGPA (mean)	3.35	3.48	3.49	0.28	0.02
Months to Graduation (mean)	11.35	13.51	13.51	0.42	0.00
Months Between Tests (mean)	5.49	5.25	5.25	-0.07	0.00
Average Number of Times Tested (mean)	2.56	2.90	2.91	0.16	0.00

Note: In ATT weighting, the treatment group is assigned a weight of 1; therefore, the unweighted and weighted treatment values in this table are identical.

Table 4 shows the estimates for the main effects model which tests for the overall effect of AOP purchase. After controlling for students' characteristics, students who

purchased AOP saw an ACT Composite score 0.36 points higher than those that did not participate in AOP. On average, students who purchased AOP had an ACT Composite score of 21.2 while students who did not purchase AOP had an average ACT Composite score of 20.8.

Table 4. Main Effect Linear Regression Estimates of Post ACT Composite Score with ATT Weighting

Effect	Coefficient	Std Error	Effect Size
Intercept	-0.52	0.05	
Treatment Group	0.36	0.01	0.06
Female	-0.18	0.01	-0.03
Family Income			
Low-Income	**-0.02**	0.02	0.00
High-Income	0.19	0.01	0.03
Race/Ethnicity			
African American	-0.35	0.02	-0.06
Hispanic	-0.18	0.02	-0.03
Other	0.05	0.01	0.01
Taking any Advanced Coursework	0.21	0.01	0.04
Taking the ACT as a Junior	**0.02**	0.01	0.00
Need Help in Educational or Career Navigation	-0.17	0.01	-0.03
Has a Parent with a Bachelor's Degree	0.20	0.01	0.03
Taken Mathematics beyond Algebra II	0.09	0.01	0.02
Taken Science beyond Chemistry	0.13	0.01	0.02
HSGPA	0.57	0.01	0.10
Times Tested	0.24	0.02	0.04
Square of Number of Times Tested	-0.02	0.00	0.00
Prior ACT Composite Score	0.91	0.00	0.16
Months Between ACT Administrations	0.10	0.00	0.02
Square of Months Between ACT Administrations	**0.00**	0.00	0.00

Note: Coefficients are significant at the <0.0001 level unless otherwise specified. * indicates significance at the <0.01 level. Nonsignificant values above 0.05 noted in bold.

Table 5 shows the factors used in the linear model for predicting post ACT Composite score, including interactions between program purchase and family income, race/ethnicity, and prior ACT Composite score. There were significant interactions between AOP purchase and family income as well as with prior ACT Composite score. This latter interaction suggests that the effect of AOP may diminish as initial ACT Composite score increases. This model also finds that the interaction effect for African American or Hispanic students is similar to that seen for White students. The effect sizes for the interactions were small.

Table 5. Linear Regression Estimates of Post ACT Composite Score with ATT Weighting with Interactions

Effect	Coefficient	Std Error	Effect Size
Intercept	-0.61	0.06	
Treatment Group	0.56	0.05	0.10
Female	-0.18	0.01	-0.03
Family Income			
Low-Income	**0.02**	0.02	0.00
High-Income	0.26	0.01	0.04
Treatment by Family Income Interaction			
Treatment * Low-Income	-0.09	0.03	-0.02
Treatment * High-Income	-0.13	0.02	-0.02
Race/Ethnicity			
African American	-0.33	0.03	-0.06
Hispanic	-0.20	0.02	-0.04
Other	**0.01**	0.02	0.00
Treatment by Race/Ethnicity Interaction			
Treatment * African American	**-0.03**	0.04	-0.01
Treatment * Hispanic	**0.05**	0.03	0.01
Treatment * Other	0.08	0.03	0.02
Taking any Advanced Coursework	0.22	0.01	0.04
Taking the ACT as a Junior	**0.02**	0.01	0.00
Need Help in Educational or Career Navigation	-0.17	0.01	-0.03
Has a Parent with a Bachelor's Degree	0.20	0.01	0.03
Taken Mathematics beyond Algebra II	0.09	0.01	0.02
Taken Science beyond Chemistry	0.13	0.01	0.02
HSGPA	0.57	0.01	0.10
Times Tested	0.23	0.02	0.04

Table 5. Linear Regression Estimates of Post ACT Composite Score with ATT Weighting with Interactions—continued

Effect	Coefficient	Std Error	Effect Size
Square of Number of Times Tested	-0.02	0.00	-0.00
Prior ACT Composite Score	0.92	0.00	0.16
Treatment * Prior ACT Composite Score	-0.01	0.00	-0.00
Months Between ACT Administrations	0.10	0.00	0.02
Square of Months Between ACT Administrations	0.00	0.00	0.00

Note: Coefficients are significant at the <0.0001 level unless otherwise specified. "*" indicates significance at the <0.01 level. Nonsignificant values above 0.05 noted in bold.

What was the Impact of Purchase of AOP?

For repeat test-takers, there is a significant effect of AOP purchase and a significant interaction with family income and prior ACT Composite score. In the interaction model, which accounts for prior ACT Composite score (Table 6), the program effects only differed slightly across income groups. For example, the treatment effect ranged from 0.33 for high-income students to 0.46 for middle-income students. Across the ACT Composite range, AOP purchase had a slightly decreasing effect as prior ACT Composite score increased. For example, the treatment effect was 0.41 for students with a prior ACT Composite score of 16 and 0.36 for students with a prior ACT Composite score of 24.

Table 6. Mean ACT Composite Score for Repeat-Tested Students

Model	Treatment	Control	Difference
Family Income			
Low-income	21.10	20.73	0.37
Middle-income	21.17	20.71	0.46
High-income	21.29	20.96	0.33
Prior ACT Composite			
16	17.54	17.13	0.41
20	21.18	20.79	0.39
24	24.82	24.46	0.36

Note: All differences were significant (p <0.0001). The ACT Composite values correspond to the 27th, 52nd, and 74th percentile of the 2018 graduating class.

Discussion

I examined the impact of purchasing an online test preparation program (AOP) on ACT test scores. This program includes over 200 hours of activities and over 2,400 practice items as well as practice sessions, instructional lessons, ACT practice tests, discussion boards, educational games, and flashcards to help students prepare to take the ACT. This program addresses all three goals of test preparation: content reinforcement/ learning, test familiarization, and learning test strategies.

The results of this study highlight the positive impact of an online test preparation program for repeat testers, though the effect tended to be smaller than what has been reported in prior studies, particularly in comparison to first-time testers. The program effect among repeat test-takers in this study was found to vary slightly across income groups; that is, low-income and middle-income students benefited slightly more than high-income students. Findings from another recent study by Sanchez and Harnisher (2018) showed that purchase of a similar product, ACT Kaplan Online Prep Live (OPL), demonstrated a greater impact for low-income students (0.98 points) than for high-income students (0.92 points). The findings of this study are consistent, but smaller in magnitude. This likely has much to do with both the make-up of the students using these two programs, differences in program curriculum, and comparisons of program users versus program purchasers. As described earlier, low-income students may be eligible to take the ACT with a fee waiver. Students who register with a fee waiver also received OPL free for twelve months. As a result, the low-income students who are users of AOP included in this study were likely students who did not take advantage of the opportunity for an ACT fee waiver which granted access to a higher-tier test preparation program.

In this study, the AOP effect among repeat test-takers was comparable between African American and Hispanic students and White students. Looking at the treatment program conceptual model in Figure 1, there are at least four areas where the impact of test preparation for repeat test-takers may be mitigated by prior testing. These include greater content familiarity, increased item familiarity, reduction in test anxiety, and higher academic self-beliefs. Research shows that when a student retakes the ACT multiple times, the gain in ACT score diminishes with subsequent retests (Andrews & Ziomeck, 1998). Repeat testing has the potential to impact subsequent scores in at least three ways: (a) Prior exposure to the test increases familiarity and comfort with taking the test, (b) Test preparation may occur between the two testing periods, and (c) Growth from learning and instruction that occurs between the two testing periods. Depending upon the timing of a first-time testing and repeat testing experience, it is possible that first-time testers may be testing earlier in their high school career, and repeat testers are testing later in their high school career, thereby having taken additional coursework that could impact their scores. As a result, it is possible that a test preparation program may not show similar score improvements for repeat test-takers as it may for first-time test-takers. Future research on test preparation programs should strive to disentangle the purposes of test preparation and identify the unique contributions of each part of a preparation program, particularly considering content exposure in school at the time of testing.

In comparison, Sanchez and Cruce (2019) found that simply providing access to AOP was not sufficient to impact ACT scores. Studies that also examined purchase of test preparation, as this study does, found an impact of test preparation on ACT Composite scores (Sanchez, in press; Sanchez, 2018; Sanchez & Harnisher, 2018). Putting the findings of this study further in context, purchasing AOP is likely to have a stronger effect on ACT scores that simply having access to AOP, but it likely has less of an impact than if students use AOP at all, in a meaningful manner, or optimally.

While the current study only compared purchasers of AOP to non-purchasers, prior studies that examined different usage levels of test preparation resources suggest stronger effects are possible with greater usage. For example, Payne & Allen (2019) found that moderate usage (e.g., six hours) of ACT Academy's quizzes and practice tests leads to an improvement in ACT test scores of 1 to 2 points. Sanchez (2019) found that students who used AOP optimally saw a 1.5-point increase in their ACT Composite score.[3] Furthermore, Sanchez (2020) found that students who used AOP for seven or more hours saw an average gain score over double that of students who did not use test preparation.

Notwithstanding these discussion points, the key takeaways from this study remain: purchase of the ACT Online Prep program helps repeat test-takers improve their scores on the ACT. Given that this study found smaller differences in effects across family income and race/ethnicity for repeat test-takers as compared to previous studies, including those for first-time testers, further research is warranted. For example, future research should investigate the specific activities that students are engaged in, e.g. content review and taking practice tests, to identify if specific activities are more efficacious for first-time versus repeat test-takers.

Notes

1. The calculations of SMD are based on the formulas in Austin and Stuart (2015).

2. This unweighted difference may be due to the sample restrictions that excluded students who tested with a fee waiver.

3. Optimal usage was defined as students using AOP for over 21 days, reviewing over 55 lessons, taking at least 16 practice sessions and at least two practice tests, and reseting the system between 6-10 times.

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