What Preparation Works to Improve ACT Scores?

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Standardized tests like the ACT® provide a common basis for comparison of students across schools and states and have been a key point of consideration in postsecondary admissions for over 60 years. Research has shown that, in general, test preparation has a small but positive effect on standardized test scores. In this study, we focused on how three different test preparation formats—in-person instruction, self-paced, and other types—related to students' ACT Composite scores. We examine whether there is a relationship between type of preparation activity and ACT Composite score and whether that relationship depends on family income or whether students are first-time or repeat ACT testers. For the total sample, we found no significant effects of test preparation on ACT Composite. We also found that the effects of the different preparation formats did not vary by family income. Furthermore, the number of times tested had an impact on ACT scores, and this effect differed by test preparation format. First-time test-takers who participated in self-paced test preparation had a lower ACT Composite score than those first-time test-takers who did not participate in a test preparation activity. This study does not align with past research that shows a small effect of test preparation on ACT scores. Our study might not have detected an effect because of the research design or the sample of students who participated in the survey. Or, heterogeneity in the quality, methodology, and modes of delivery within each test preparation format may have blurred any effects.

Introduction

Standardized tests like the ACT ensure a common basis for comparison of students across schools and states. This is one of the many reasons that the ACT has been such a key point of consideration in postsecondary admissions for over 60 years and is why many students take college entrance exams in an effort to maximize their postsecondary educational opportunities. In fact, among 2018 high school graduates, almost two million graduates took the ACT, and over 2.1 million graduates took the SAT. Of those taking the ACT, about 64% reported using some form of test preparation (e.g., study guides, online materials, practice tests, tutors, or test preparation courses).[1] Given the importance of test scores in college admissions decisions and scholarships, a multimillion dollar test preparation and tutoring industry has emerged (Barnes Report, 2017).

Test Preparation Effectiveness and Factors that Influence It

Research has shown that, in general, test preparation has a small but positive effect on standardized test scores (Briggs, 2009; Moore, Sanchez, & San Pedro, 2018; Powers, 1993; Schiel & Valiga, 2014a; Schiel & Valiga, 2014b). For example, the National Association for College Admissions Counseling (NACAC) reviewed efficacy studies on test preparation for the SAT and found minimal effects on test scores—an average gain of approximately 30 points (0.27 SD units) for subject tests and 40 points (0.20 SD units) for the total score (Briggs, 2009). For the ACT, Briggs (2001) found that students who participated in any type of test preparation scored a full point higher (0.17 SD units), on average, than those students who did not participate in test preparation.

Delivery Format. While much of the research on test preparation effectiveness has focused on group instruction, recent research by Moore et al. (2018) showed that effects are stronger for students who worked with a private tutor or consultant relative to students who engaged in other test preparation activities that were either done on their own (e.g., online test preparation program) or in a group setting (e.g., test preparation workshops; see Bloom, 1984 and Ireson, 2004 for similar findings). To the authors' knowledge, there is no prior research on whether self-paced test preparation compared to in-person instruction matters in improving students' ACT or SAT scores. We will, therefore, explore this relationship.

Retesting Effects. Test preparation that includes more practice opportunities, including re-testing, can have a positive effect on test score gains (Appelrouth & Zabrucky, 2015). For students who retook a cognitive ability test, a meta-analysis found increases in test scores that were approximately 0.25 standard deviations (Hausknecht et al., 2007). Retaking the ACT has shown a 1- to 2-point scale score increase (0.17 to 0.34 SD unit) across testing experiences (Andrews & Ziomek, 1998). Furthermore, students who first tested as a junior and retested later had an average ACT Composite score gain of 1.1 points, i.e., 0.19 SD units (Harmston & Crouse, 2016). These gains are likely due to practice effects as well as growth from high school instruction and continued learning opportunities.

Practice effects may actually work to bolster test validity. For example, when students are negatively impacted by test anxiety, their ability to demonstrate their content knowledge is impaired. Practice has the potential to alleviate the negative impact, thereby making a score more representative of domain mastery (Messick, 1982). We explore the relationship between practice opportunities and students' ACT scores by modelling the relationship of self-reported test preparation activities and ACT Composite score, separately for first-time and repeat tested students.

Socioeconomic Status. Test preparation for college entrance exams can vary in cost from free to thousands of dollars. As a result, it is no surprise that access to test preparation can vary by income, with some studies finding more affluent students more likely to participate in more expensive and more individualized test preparation programs (Buchmann, Condron, & Roscigno, 2010; Park & Becks, 2015). A recent study on paid users of ACT Online Prep (AOP), an online subscription-based test preparation program, found that lower- and middle-income students had greater odds of enrolling in the program than higher-income students (Sanchez, 2019). AOP is a less

expensive test preparation option compared to one-on-one and in-person classroom options. Buchmann, Condron, and Roscigno (2010) note that higher-income families are more likely to use more expensive and potentially more in-depth test preparation programs such as private courses and tutors relative to families with lower incomes, which make use of more economical test preparation programs such as workbooks, software, or videos. As such, it is important to examine the impact of different types of test preparation programs as well as how that effect differs by family income levels. We must be cognizant of the financial barriers that may preclude the participation of some students in certain types of test preparation. We, therefore, investigate whether the benefits of different types of test preparation activities on ACT scores varies by family income.

Goals of the Study

While there is some evidence that retesting (which includes practice opportunities) can improve test scores, there is limited research on whether individual factors, including students' grade level and family income, play a role in the relationship between different test preparation activities and ACT scores. Therefore, in this study, we seek to answer these research questions:

(RQ1) Is there a relationship between type of preparation activity and ACT Composite score?

Given the abundance of research that indicates engaging in some type of test preparation improves test scores, we expect the same to hold true in this study. Further, while there is past evidence to support that practice testing improves ACT test scores relative to no test prep at all, less is known about whether and to what degree in-person and self-paced instruction improves test scores. We hypothesize that in-person instruction will improve ACT test scores relative to no test preparation, given the customized nature and hands-on learning in-person learning offers. Self-paced preparation is expected to also improve test scores but not to the degree of in-person preparation given the wide variety of self-paced approaches, many of which depend on students' motivation in order to be used effectively.

(RQ2) Does the relationship between type of preparation activity and ACT Composite score depend on students' family income or whether students are first-time or repeat ACT testers?

Family income. We are interested to see if students who come from lower-income families may benefit more from in-person test preparation activities than students from higher-income families. It may be possible that students from lower-income families are not getting the type of instruction that resonates with them or provides the level of support needed at school, and in-person tutoring can provide the instruction to help them excel.

Repeat testing. As mentioned earlier, taking the ACT multiple times can be viewed as a form of test preparation as it is possible that the added prior testing experience might prime students on content covered, reduce test anxiety, and increase test familiarity. With retesting, students' ACT scores are expected to increase for at least three reasons: (a) Prior exposure to the test brings an increased level of familiarity and comfort with taking the test, (b) Effects of test preparation that occur between the two testing periods, and (c) Natural growth from learning and instruction that occurs between the two testing periods. In this study, we include high school GPA (HSGPA) as the measure of prior achievement in an attempt to isolate the effects of test preparation.[2] Because all students who retest may benefit from prior exposure to the test, this approach estimates practice effects with test preparation.

Methods

Sampling Strategy

An online survey was administered to a stratified random sample of students (N = 45,400) who had registered to take the ACT in February 2016. Students who self-reported as Asian, Hispanic, or African American were over-sampled. White students, those who chose two or more races, and those who did not provide race/ethnicity were under-sampled. All available American Indian/Alaska Native and Native Hawaiian/Other Pacific Islander students were included. Students who retested more than one time prior to the February test date were also over-sampled; first-time test-takers were under-sampled. This sampling method was utilized to ensure sufficient representation across all racial/ethnic groups and by number of times tested. Weights are used to analyze the data; more information on the weighting procedure will be discussed later in this section.

Survey

Email addresses for ACT test-takers were obtained from students' registration record for their February 2016 ACT test date. This contact information was then used to send out an invitation to participate in a survey about their test preparation activity prior to taking the ACT. The invitation described the purpose of the study and indicated that participation was completely voluntary and would in no way affect students' ACT scores. Survey data collection proceeded for two weeks.

The survey was administered the same day as, and approximately three hours after, the February National ACT test administration. Two reminder emails were sent to the survey sample. Approximately 16% (n=7,640) of the sample responded to the survey. No incentives were provided for participation, and the survey took, on average, about five minutes to complete.

The survey focused on three areas: student race/ethnicity (two questions), test preparation activities (nine questions), and factors influencing survey participation (two questions). In the present study, we focused on a question which asked "Which of the following test preparation activities, if any, did you use to prepare for the February 6th ACT test? (Choose all that apply.)." Table 1 provides the list of preparation activities and the percentage of students who chose that activity.

Table 1. Number and Percentage of Students by Test Preparation Activity

Test Preparation Activity	N	%
Self-paced review of the content on the ACT using paper materials (e.g., workbooks)	2,531	33.1%
Self-paced online review of the content on the ACT (excluding online videos)	967	12.7%
Self-paced online review of the content on the ACT, using online videos	539	7.1%
In-person small group instruction (less than six students)	449	5.9%
In-person large group instruction (six or more students)	855	11.2%
In-person one-on-one tutoring	900	11.8%
Online small group instruction (less than six students)	54	0.7%
Online large group Instruction (six or more students)	106	1.4%
Online live one-on-one tutoring	95	1.2%
Only practice assessments (e.g., practice tests, drills, or quizzes)	224	2.9%
Other (please explain) _____	1,375	18.0%
I have not participated in any test preparation activities	1,207	15.8%

Note: Responses were able to chose more than one test preparation activity, with a few exceptions. Respondents who chose “only practice assessments” or “I have not participated in any test preparation activities” were unable to choose another test preparation activity.

Due to the sparseness of responses and the overlapping nature of the test preparation activities provided, we collapsed responses into four categories: self-paced preparation, in-person preparation, other test preparation activities, and using no test preparation materials. Among respondents, only 1.5% said they used a form of online test preparation in small group, large group, or one-on-one formats. Furthermore, about 75% of students reported only participating in one of the following types of test preparation: in-person, self-paced, other, or no test preparation. We therefore focus on these students in our analysis. Of these 5,702 respondents, we also limited our sample to those who were not missing any of the variables used in the regression models, with the exception of family income, which was imputed. Given these constraints, we focus on 4,572 students in our analysis.

Analytical Sample

Because we administered the survey to a stratified random sample based on race and number of times tested, and because a disproportionate number of White students,

female students, and students with higher academic achievement participated in the survey, we weighted the survey responses. Weighting reduces the chances for non-response bias, corrects for the stratified sampling conducted and, subsequently, on key measures expected to relate to test preparation behavior, makes the survey respondents more representative of the 2016 February tested population to which they are being generalized. Propensity score weighting was employed. Here, a logistic regression model was estimated predicting the probability of survey participation, given population characteristics. We used students' race/ethnicity, gender, ACT Composite score, parents' education level, number of times tested, and income levels as predicators. Missing data were imputed prior to fitting the logistic regression model. The appendix provides descriptive statistics for the unweighted sample, weighted sample, and the population (see Appendix).

In the analytical sample, we see that relatively fewer students came from households with a low family income, and most students came from a middle-income family (Table 2). There were slightly more female students than male students in the sample, and the majority of students were White. Most students had not taken advanced coursework in science or mathematics but had taken a college-prep curriculum in high school and indicated needing some academic or career navigation help. Just over 40% of students came from a household whose highest parental education was less than an associate degree, and most students expected to complete at least a bachelor's degree. The February 2016 ACT test was the first test for half of the analytical sample, and over 60% of the sample were in the 11th grade. Finally, there were relatively similar numbers of students participating in each test preparation activity group.

Table 2. Demographic characteristics for the analytical sample

Variable	Total Group % (N)
Family Income	
<$36,000	18.7 (934)
$36,000–$100,000	30.0 (1,501)
>$100,000	24.6 (1,231)
Missing	26.8 (1,342)
Gender	
Female	57.6 (2,884)
Male	42.4 (2,124)
Race/Ethnicity	
African American	16.5 (825)
American Indian	3.4 (172)
White	60.0 (3,005)
Hispanic	13.2 (660)
Asian	4.7 (235)
Native Hawaiian	0.9 (47)
Two or More Races	0.7 (35)
Prefer Not/No Response	0.6 (31)

Table 2. Demographic characteristics for the analytical sample—continued

Variable	Total Group % (N)
Take Bio, Chem, Physics	
No	64.1 (3,210)
Yes	35.9 (1,798)
Taken Math Beyond Algebra II	
No	64.1 (3,210)
Yes	57.7 (2,888)
Take a College Curriculum	
No	37.4 (1,874)
Yes	62.6 (3,134)
Need Help in academic or career navigation*	
No	34.5 (1,729)
Yes	65.5 (3,279)
Highest Parental Education	
Less than Associates	42.6 (2,135)
Bachelor's degree	29.3 (1,470)
Graduate degree	28.0 (1,404)
Missing	-
Expected Educational Attainment	
Associate Degree/Voc-Tech	3.5 (176)
Bachelor's Degree	45.7 (2,287)
1-2 Yrs. of Grad Program/Professional Degree	41.8 (2,094)
Other/No Response	9.0 (452)
Number of Times Tested	
1	50.4 (2,525)
2	37.6 (1,884)
3	6.9 (344)
4	2.9 (147)
5+	2.2 (108)
Test Preparation Activity	
In-person Instruction	21.4 (1,069)
No Prep	27.4 (1,374)
Other	23.8 (1,190)
Self-Paced	27.5 (1,375)
Grade Level	
11	64.4 (3,227)
12	35.6 (1,781)

Note. *This included students' indications of need for help with deciding educational and occupational plans, expressing ideas in writing, improving reading speed and comprehension, study skills, or mathematical skills.

Table 3 summarizes characteristics of the weighted analytic sample by type of test preparation.[3] A greater percentage of students from higher-income families, as well as students who did not report family income, were more likely to report using in-person instruction in comparison to other income groups. On the other hand, more African American students reported using self-paced or other test preparation; similar numbers of Hispanic students reported using self-paced, other, or no test preparation; and more White students reported using self-paced or no test preparation. When we look at in-person test preparation, we see that more White students used this type of test preparation (23.3%) than African American students (20.4%), and both used in-person test preparation more than Hispanic students (17.2%). We can also see that fewer first-time test-takers use in-person test preparation than retesting students.

Table 3. Demographic Characteristics for the Weighted Sample

Variable	In-person Instruction % (N)	Self-Paced % (N)	Other % (N)	No Prep % (N)
Family Income				
<$36,000	13.7 (128)	31.1 (291)	27.7 (259)	27.5 (257)
$36,000–$100,000	13.3 (199)	30.9 (463)	24.3 (364)	31.6 (475)
>$100,000	28.3 (348)	25.6 (315)	19.2 (237)	26.9 (332)
Missing	29.4 (395)	22.8 (306)	24.6 (330)	23.1 (310)
Gender				
Female	19.5 (563)	28.2 (813)	24.8 (716)	27.5 (793)
Male	23.8 (506)	26.5 (562)	22.3 (475)	27.4 (581)
Race/Ethnicity				
African American	20.4 (168)	30.6 (252)	26.0 (214)	23.1 (191)
American Indian	14.9 (26)	27.2 (47)	23.3 (40)	34.6 (59)
White	23.3 (698)	26.2 (786)	21.3 (640)	29.3 (880)
Hispanic	17.2 (113)	26.7 (176)	28.2 (186)	27.9 (184)
Asian	18.2 (43)	33.6 (79)	31.4 (74)	16.9 (40)
Native Hawaiian	21.4 (10)	24.7 (12)	40.0 (19)	13.9 (6)
Two or More Races	14.5 (5)	40.0 (14)	18.7 (7)	26.8 (9)
Prefer Not/No Response'	20.9 (6)	28.9 (9)	35.4 (11)	14.8 (5)
Take Bio, Chem, Physics				
No	19.7 (631)	28.2 (905)	23.5 (754)	28.7 (920)
Yes	24.4 (439)	26.1 (470)	24.3 (436)	25.2 (453)
Taken Math Beyond Algebra II				
No	19.7 (631)	28.2 (905)	23.5 (754)	28.7 (920)
Yes	21.4 (619)	27.3 (789)	24.3 (700)	27.0 (780)
Take a College Preparatory Curriculum				
No	16.7 (314)	30.0 (562)	25.4 (475)	27.9 (523)
Yes	24.1 (756)	25.9 (813)	22.8 (715)	27.1 (851)

Table 3. Demographic Characteristics for the Weighted Sample—continued

Variable	In-person Instruction % (N)	Self-Paced % (N)	Other % (N)	No Prep % (N)
Need help in academic or career navigation				
No	25.5 (442)	26.5 (459)	21.1 (366)	26.8 (463)
Yes	19.1 (628)	27.9 (916)	25.2 (825)	27.8 (911)
Highest Parental Education				
Less than Associates	17.0 (362)	27.7 (590)	28.2 (601)	27.2 (581)
Bachelor's degree	22.1 (325)	25.6 (376)	21.4 (314)	30.9 (454)
Graduate degree	27.2 (382)	29.1 (408)	19.6 (275)	24.1 (339)
Expected Educational Attainment				
Associate Degree/Voc-Tech	22.3 (39)	38.1 (67)	21.6 (38)	18.0 (32)
Bachelor's Degree	19.5 (446)	28.7 (657)	23.4 (535)	28.4 (648)
1-2 Yrs. of Grad Program/ Professional Degree	21.3 (446)	27.2 (570)	24.1 (505)	27.4 (573)
Other/No Response	30.6 (138)	17.8 (80)	24.8 (112)	26.8 (121)
Number of Times Tested				
1	17.7 (446)	26.5 (670)	25.0 (632)	30.8 (778)
2	25.3 (477)	28.6 (539)	22.0 (414)	24.1 (453)
3	23.3 (80)	28.7 (99)	23.1 (79)	25.0 (86)
4	27.6 (41)	26.3 (39)	27.7 (41)	18.5 (27)
5+	23.2 (25)	27.0 (29)	22.5 (24)	27.3 (29)
Grade Level				
11	25.0 (806)	24.5 (791)	23.6 (761)	27.0 (870)
12	14.8 (263)	32.8 (584)	24.1 (430)	28.3 (504)

Note. *This included student's indication of a need for help with deciding educational and occupational plans, expressing ideas in writing, improving reading speed and comprehension, study skills, or mathematical skills.

Measures

Test Preparation Activity. Type of test preparation was based on responses to the survey item previously described. Responses were grouped as in-person instruction, self-paced test preparation, other test preparation, and not having used test preparation.

Student Profile Section of the ACT Registration. As part of the registration process, students self-report gender, race/ethnicity, grade level, family income, expected educational attainment, and highest parental education. Race/ethnicity was categorized as African American, American Indian/Alaska Native, Hispanic/Latino, Asian, Native Hawaiian/Other Pacific Islander, two or more races, or chose not to respond. For grade level, students were asked what grade they are currently in and were given options from 7th grade to 12th grade. Only students in 11th and 12th grade were used in this study. For family income, students are asked "please estimate the approximate total combined income of your parents before taxes last year." While family income ranges include nine categories from "less than 24,000" to "more than $150,000," for analysis purposes we collapsed the categories to three: less than $36,000, between $36,000 and $100,000, and greater than $100,000. Students are also asked "what is the highest level of education you expect to complete?" While this question asked about six educational levels, for analysis, we collapsed the categories into four: associate degree/voc-tech, bachelor's degree, 1-2 years of a graduate program/professional degree, and other/no response. This section also asks "what is the educational level of your mother/guardian 1 (or father/guardian 2)?" This section provides eight ordered response options. For analytical purposes, we collapsed these to associate degree or less, bachelor's degree, or graduate degree or higher, and we used highest parental education for either parent/guardian.

In addition to this demographic information, students are asked about their academic/career needs and interests. In our study, we made use of students' self-reported need for assistance in five specific areas. These five areas included "deciding my educational and occupational plans," "expressing my ideas in writing," "improving my reading speed and comprehension," "improving my study skills," and "improving my mathematics skills." In the current study, if a student responded affirmatively to any of the five items, they were classified as having a self-identified need for support.

Course Grade Information Section of the ACT Registration. In this section of the ACT Registration, students are asked about the specific courses they either have taken or plan to take. They are also asked to provide grades for each of the courses they have taken up to the point of registering for the ACT. HSGPA, as used in this study, is based on students' self-report of grades from up to 23 high school courses in English, mathematics, social studies, and natural science. Additionally, we used course-taking information to identify students' mathematics and science coursework patterns. We identify whether students had taken mathematics coursework beyond Algebra II and if students had taken at least Biology, Chemistry, and Physics. Finally, students were asked to indicate whether they were taking a college preparatory curriculum in high school.

Number of Times Tested. ACT test records were reviewed for all instances of a student taking the ACT exam on or before February 2016, the national test date students were asked to report their test preparation approach about. The number of times a student had taken the ACT was calculated from these data.

Analysis

Income was a focus in our analyses, and since this variable was missing for 29% of cases, we utilized multiple imputation for missing values (Rubin, 1987). Here, imputed values replace the missing values to create a dataset with no missing data on family annual income. Imputation is conducted multiple times, in this case five times, to create multiple data sets that vary on the imputed income. The imputed values were estimated using variables that were correlated with ACT Composite score. The multiple imputation model included students' expected education level; the number of years of English, mathematics, social science, and natural science coursework; HSGPA; gender; race/ethnicity; family income; and highest parental education. It is worth noting that the intent of multiple imputation is not to guess an individual respondent's data point; rather, the intent is to analyze data that maintains the variability and relationship of all the variables in the model.

Linear regression was used to model the relationship between different types of test preparation and ACT Composite score, controlling for academic and demographic factors (RQ1). To evaluate the interaction between types of test preparation activities and family income on ACT Composite score, the model was fit separately for lower-, middle-, and higher-income students (RQ2). Then, the model was run separately for first-time and repeat testers to estimate the interactive effects of test preparation activity type and number of times tested on ACT Composite score (RQ2). As a reminder, we refrained from adding students' prior ACT scores as covariates when modeling repeat test-takers. Instead, we used HSGPA as a control variate for students' academic achievement. Weights were used in all regression models.

Table 4. Model Rregression Ccoefficients Predicting ACT Composite Score

	Total Group		Low-Income		Middle-Income		High-Income		First-time Testers		Repeat Testers	
Predictor	**Est**	**Std Err**	**Est**	**Std Err**	**Est**	**Std Err**	**Est**	**Std Err**	**Est**	**Std Err**	**Est**	**Std Err**
Intercept	**9.3**	**0.5**	**12.9**	**1.0**	**8.5**	**1.1**	**6.0**	**1.6**	**9.0**	**0.7**	**11.1**	**0.8**
HSGPA	**3.3**	**0.1**	**2.2**	**0.2**	**3.6**	**0.2**	**4.0**	**0.3**	**3.4**	**0.2**	**3.1**	**0.2**
Race Ethnicity												
African American	**-2.4**	**0.2**	**-3.0**	**0.2**	**-2.5**	**0.3**	-1.8	0.5	**-2.5**	**0.3**	**-2.2**	**0.2**
American Indian	**-0.7**	**0.3**	**-1.4**	**0.4**	**-0.6**	**0.5**	-0.4	0.7	-0.8	0.4	**-0.4**	**0.4**
White	**0.0**	**0.0**										
Hispanic	**-1.3**	**0.2**	**-2.3**	**0.3**	**-1.3**	**0.3**	-0.1	0.5	**-1.4**	**0.3**	**-1.3**	**0.2**
Asian	0.9	0.3	-0.4	0.5	1.0	0.5	1.6	0.5	0.9	0.4	0.8	0.4
Native Hawaiian	0.8	0.6	0.2	1.4	-0.4	0.9	2.4	1.0	0.8	0.7	0.6	1.2
Two or More Races	2.1	0.6	0.9	1.4	**2.4**	**1.0**	1.7	1.3	0.7	1.4	**2.6**	**0.7**
Prefer Not to Respond	1.4	0.7	-0.4`	5.3	-0.2	2.2	2.3	1.9	1.3	1.4	1.4	0.8
Family Income												
< $36,000	-0.4	0.2	-	-	-	-	-	-	-0.2	0.3	-0.6	0.2
$36,000–$100,000			-	-	-	-	-	-				
> $100,000	0.3	0.1	-	-	-	-	-	-	**0.5**	**0.2**	0.2	0.2
Gender												
Female	**-0.8**	**0.1**	**-0.8**	**0.2**	**-0.8**	**0.2**	**-0.8**	**0.2**	**-0.7**	**0.2**	**-0.9**	**0.2**
Student Expected Education Attainment												
Associates Degree/Voc-Tech												
Bachelor's Degree	**0.7**	**0.3**	**0.8**	**0.4**	0.3	0.5	1.5	1.4	0.7	0.4	0.4	0.5
1-2 Yrs. of Grad Program/ Professional Degree	**1.7**	**0.3**	**2.1**	**0.4**	1.1	0.5	2.5	1.4	**1.7**	**0.4**	**1.4**	**0.5**
Other/No Response	0.2	0.4	0.0	0.6	-0.2	0.8	1.2	1.7	0.6	0.5	-0.5	0.6
Highest Parental Education												
Less than Associates												
Bachelors	0.0	0.2	0.2	0.3	-0.2	0.2	0.3	0.4	0.0	0.2	0.1	0.2
Graduate	**1.3**	**0.2**	1.1	0.5	**1.4**	**0.3**	1.3	0.4	**1.1**	**0.3**	**1.4**	**0.2**

Table 4. Model Rregression Ccoefficients Predicting ACT Composite Score—continued

	Total Group		Low-Income		Middle-Income		High-Income		First-time Testers		Repeat Testers	
Predictor	**Est**	**Std Err**	**Est**	**Std Err**	**Est**	**Std Err**	**Est**	**Std Err**	**Est**	**Std Err**	**Est**	**Std Err**
Need Help with Educational or Occupation Planning												
Yes	**-1.4**	**0.1**	**-1.3**	**0.3**	**-1.3**	**0.2**	**-1.4**	**0.2**	**-1.4**	**0.2**	**-1.3**	**0.2**
Taking a College Curriculum												
Yes	**0.9**	**0.1**	**0.5**	**0.2**	**1.0**	**0.2**	**1.1**	**0.3**	**1.0**	**0.2**	**0.7**	**0.2**
Taken Mathematic Beyond Algebra II												
Yes	**1.6**	**0.1**	**1.3**	**0.2**	**1.7**	**0.2**	**1.6**	**0.2**	**1.5**	**0.2**	**1.7**	**0.2**
Taken Biology, Chemistry, & Physics												
Yes	**1.0**	**0.1**	**0.8**	**0.3**	**1.0**	**0.2**	**1.2**	**0.2**	**0.9**	**0.2**	**1.2**	**0.2**
Type of Test Preparation												
In-person instruction	0.1	0.2	-0.4	0.3	0.1	0.3	0.5	0.3	0.3	0.2	0.0	0.2
Self-paced	-0.2	0.1	-0.5	0.3	-0.2	0.3	-0.1	0.3	**-0.5**	**0.2**	0.0	0.2
Other	-0.1	0.2	-0.3	0.3	-0.3	0.3	0.0	0.3	-0.1	0.2	-0.1	0.2
No prep												
Grade Level												
12	**-1.7**	**0.1**	**-1.7**	**0.2**	**-1.7**	**0.2**	**-1.7**	**0.3**	**-1.3**	**0.2**	**-2.0**	**0.2**
Number of Times Tested	**0.3**	**0.1**	**0.4**	**0.1**	**0.5**	**0.1**	**0.1**	**0.1**	-	-	-	-

Note: Values in the table in bold font indicate significant at the 0.05 level.

Results

(RQ1) Is there a relationship between type of preparation activity and ACT Composite score?

As shown in Table 4, the regression model for the total group found that HSGPA; race/ethnicity; gender; students' expected educational attainment; highest parental education; needing help with educational or career planning; taking a college-prep curriculum; taking mathematics beyond Algebra II; taking at least Biology, Chemistry, and Physics; grade level; and the number of times taking the ACT were all significant predictors of student performance on the ACT. For the total group, ACT Composite score did not vary by type of test preparation.

(RQ2) Does the relationship between type of preparation activity and ACT Composite score depend on students' family income or whether students are first-time or repeat ACT testers?

Looking first at students from low-income families, type of test preparation was not a significant predictor of ACT Composite score (see Table 4). The same was true for students from both middle- and high-income families. This suggests that the effect of test preparation does not differ between family income groups.[4]

Assessing whether the effects of test preparation varied for first-time and repeat testers, we see that first-time test-takers who participated in self-paced test preparation had a lower ACT Composite score than those first-time test-takers who did not participate in a test preparation activity (see Table 4). There was no predictive power of preparation activities on ACT Composite score for those who took the test more than once.

Discussion

Because the ACT test can have important consequences for postsecondary access, students often elect to participate in a wide variety of test preparation activities. In the current study, we focused on how three different test preparation formats—in-person instruction, self-paced, and other types—related to students' ACT Composite scores. Furthermore, we investigated whether the effects of these types of test preparation differed by family income and repeat testing status.

We found that in the income subgroup models, ACT Composite score did not vary by test preparation activity. This is interesting to note because there is a concern that higher-income families may be afforded greater opportunities for more impactful test preparation. The present study did not suggest that to be the case. Notwithstanding this finding, this is an area that deserves consideration because we know that longer-term learning opportunities that parallel in-class instruction can have an impact on student's scores by bolstering core content knowledge (Appelrouth & Zabrucky, 2015; ACT, 2005).

If test preparation mirrors in-depth learning opportunities, there is a greater opportunity for both short-term benefits in the form of increases in standardized test scores as well as long-term benefits in content mastery and coursework performance. These types of in-depth learning opportunities are typically more expensive and less utilized by lower-income families (Buchmann, Condron, & Roscigno, 2010; Park & Becks, 2015). Previous research on test preparation shows a connection between the use of test preparation and an increase in ACT scores. It would be worthwhile to further investigate whether the use of test preparation is also accompanied by longer-term content mastery as demonstrated by high school course performance.

In our study, we examined retest effects (e.g., benefit of taking the ACT at least once prior to current test) by modeling the effect of number of prior ACT tests. We found that number of times tested had an impact on ACT scores and the effect of test preparation format differed for first-time and repeat test-takers.

This study is not without its limitations. We examined general categories of test preparation, and examination of test preparation activities as in-person, self-paced, or other incorporates many types of activities under each of those three categories. Types of activities in any one category can vary by intensity, duration, quality, content covered, mode of delivery and pacing, among other attributes. This provides for an estimate of the average effect for these classes of test preparation; however, there is probably great variability in effects within each group. The time allocation and pacing of test prep has important implication for the potential efficacy of any program. It is possible that the aggregation conducted in this study is masking true underlying effects for specific subtypes of activities or for specific, particularly effective, programs. It is important to operationalize test prep in a way that captures the many considerations in self-selecting to use test preparation, how students use test preparation, and considers all the types of preparation students use.

Moreover, we utilized an “other” category of test preparation. Specifically, this included 1,375 students who had some type of unidentified test preparation. One reason so many students classified their test preparation as “other” is that the descriptions of the types of test preparation may not have been sufficiently interpretable to allow students to identify as having participated in that type of test preparation. Another possible reason is that there may be some types of test preparation we did not capture. Both possibilities present analytical challenges. In the first case, if students with the same type of test preparation self-identify in different types of test preparation, it is more difficult to isolate the effect of that type of test preparation. The second possible reason means students who self-identified as other may have been more appropriately classified in the named test preparation activities. It is also possible that if they were accurately classified the effect for that named group would have been more precise. This presents an interesting perspective into the understanding of test preparation as well. These large numbers of “other” respondents present a learning opportunity to better understand common test preparation efforts.

Finally, given the cross-sectional design and the self-selection of students into the test preparation activities, we cannot make causal statements about test preparation

and ACT performance. The results of this study, based on traditional regression techniques, should not be overinterpreted to say that test preparation has no effect on ACT Composite scores. Rather, what we can say from the present study is that when we aggregate self-reported test preparation into three broad types of test preparation, i.e. in-person instruction, other test preparation, and self-paced test preparation, an association between test-preparation and ACT Composite scores was not found.

Our research does not align with past research that shows a small effect of test preparation on ACT scores. Our study might not have detected an effect because of the research design or the sample of students who chose to participate in the survey. Likewise, when we aggregate types of test preparation into very broad categories, we may be losing the ability to find efficacy of specific types of test preparation activities and programs. Therefore, specific test preparation programs and activities need to be evaluated to identify high efficacy activities and programs. Students were instructed to choose all test preparation activities that they engaged in, and, accordingly, students were not in mutually exclusive test preparation types. Utilizing a model with all test preparation activities together helps isolate the effects of multiple, simultaneously engaged in, test preparation activities. Collapsing the test preparation activities as we had allowed us to put students into one activity and run a parsimonious number of models.

Notes

1. On national 2018-2019 ACT test dates, students were asked “Did you prepare for the ACT® test using any test preparation materials (for example, *The Official ACT Prep Guide*, other study guides, online materials, practice tests, tutors, or test prep courses)?” This percentage is based on students who responded to the question.

2. It would also be possible to utilize a prior ACT Composite score to account for prior achievement. If that prior achievement measure were used, however, it would necessitate the use of repeat tested students only.

3. Characteristics for the national February 2016 ACT test-taking population are presented in the Appendix.

4. An alternative analytical approach to conducting separate models for each level of family income would be to run a single model with an interaction between family income and type of test preparation. To evaluate if model choice would result in different conclusions, we ran the interaction model and found that the interaction was not significant at the .05 level.

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Appendix

Table A1. Unweighted, Weighted, and Total Population Demographics—continued

Variable	Unweighted Sample % (N)	Weighted Sample % (N)	February 2016 Tested population % (N)
Family Income			
<$36,000	23.2 (1,159)	18.7 (934)	18.7 (58,930)
$36,000-$100,000	28.2 (1,414)	30.0 (1,501)	29.6 (93,377)
>$100,000	20.9 (1,046)	24.6 (1,231)	23.8 (75,017)
Missing	27.7 (1,388)	26.8 (1,342)	28.0 (88,550)
Gender			
Female	65.2 (3,262)	57.6 (2,884)	55.2 (174,332)
Male	34.9 (1,745)	42.4 (2,124)	44.8 (141,542)
Race/Ethnicity			
African American	15.4 (769)	16.5 (825)	15.7 (49,718)
American Indian	4.1 (205)	3.4 (172)	0.7 (2,249)
White	26.8 (1,344)	60.0 (3,005)	58.1 (183,472)
Hispanic	19.9 (997)	13.2 (660)	12.5 (39,343)
Asian	31.3 (1,566)	4.7 (235)	4.6 (14,595)
Native Hawaiian	1.1 (57)	0.9 (47)	0.2 (589)
Two or More Races	0.7 (36)	0.7 (35)	3.8 (11,908)
Prefer Not/No Response'	0.7 (33)	0.6 (31)	4.4 (14,000)
Take Bio, Chem, Physics			
No	57.1 (2,861)	64.1 (3,210)	64.8 (204,636)
Yes	42.8 (2,144)	35.9 (1,798)	35.2 (111,034)
Missing	0.0 (2)	0.0 (0)	0.1 (204)
Taken Math Beyond Algebra II			
No	57.1 (2,861)	64.1 (3,210)	64.8 (204,636)
Yes	64.1 (3,210)	57.7 (2,888)	57.2 (180,778)
Missing	0.0 (2)	0.0 (0)	0.1 (203)
Take a College Curriculum			
No	38.2 (1,913)	37.4 (1,874)	37.1 (117,051)
Yes	61.8 (3,094)	62.6 (3,134)	62.9 (198,823)
Need Help in academic or career navigation			
No	33.4 (1,672)	34.5 (1,729)	36.4 (115,060)
Yes	66.6 (3,335)	65.5 (3,279)	63.6 (200,814)
Highest Parental Education			
Less than Associate	44.8 (2,241)	42.6 (2,135)	33.6 (53,103)
Bachelor's Degree	25.7 (1,286)	29.3 (1,470)	25.6 (106,035)
Graduate Degree	29.6 (1,480)	28.0 (1,404)	24.0 (80,966)
Missing	-	-	16.8 (53,103)

Table A1. Unweighted, Weighted, and Total Population Demographics—continued

Variable	Unweighted Sample % (N)	Weighted Sample % (N)	February 2016 Tested population % (N)
Expected Educational Attainment			
Associate Degree/Voc-Tech	2.9 (144)	3.5 (176)	3.2 (10,234)
Bachelor's Degree	38.0 (1,902)	45.7 (2,287)	46.3 (146,247)
1-2 Yrs of Grad Program/ Professional Degree	49.5 (2,478)	41.8 (2,094)	40.9 (129,224)
Other/No Response	9.7 (483)	9.0 (452)	9.6 (30,169)
Number of Times Tested			
1	52.7 (2,640)	50.4 (2,525)	54.6 (172,596)
2	37.5 (1,879)	37.6 (1,884)	26.8 (84,497)
3	5.7 (284)	6.9 (344)	10.7 (33,692)
4	2.6 (128)	2.9 (147)	4.5 (14,047)
5+	1.5 (76)	2.2 (108)	3.5 (11,042)
Test Preparation Activity			
In-person Instruction	18.9 (946)	21.4 (1,069)	-
No Prep	24.1 (1,207)	27.4 (1,374)	-
Other	27.5 (1,375)	23.8 (1,190)	-
Self-Paced	29.5 (1,479)	27.5 (1,375)	-
Grade Level			
11	68.2 (3,414)	64.4 (3,227)	59.5 (188,057)
12	31.8 (1,593)	35.6 (1,781)	40.5 (127,817)
ACT Composite score, mean	23.1	21.7	21.7
HSGPA, mean	3.5	3.4	3.4

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