Test-Related Behaviors and Performance on the ACT

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Introduction

Students exhibit a variety of test-related behaviors before and during the ACT® test. For example, before the test, students might engage in such preparatory activities as completing practice tests, using web-based test preparation programs, taking test preparation courses, and/or working with a tutor. During the test, they might use a calculator when answering math questions, choose to have a snack at break time, or feel anxious.

Previous ACT research has identified associations between test-related behavior and ACT test performance. For example, test preparation has been shown to be associated with modest ACT Composite score gains on the second ACT testing occasion (Moore, Sanchez, & San Pedro 2019). In addition, students who took the test a second time and reported such physical and emotional experiences as not feeling very stressed or anxious, eating breakfast before the test, having no trouble finding the test site, or sleeping 7-9 hours the night before the test experienced somewhat larger average ACT Composite score gains from the first to the second test than did students who did not report these experiences (Schiel & Valiga 2014).

This study builds on previous research, using recent data on student test-related behavior. It examines the relationship of such behavior with test performance using statistical modeling, a method that allows the relationship between a single test-related behavior and ACT performance to be examined while statistically controlling for other test-related behaviors and relevant student characteristics (e.g., self-reported family income, race/ethnicity, and course-taking behavior).

Method

In the spring and fall of 2017, ACT surveyed 99,131 students who had taken the national ACT test once and had registered to take it a second time. These students had either (a) tested for the first time in late summer or fall 2016 and had registered for a second test in spring 2017 (n = 42,533), or (b) tested for the first time in spring 2017 and had registered for a second test in fall 2017 (n = 56,598).

Students were surveyed within a few hours after the national ACT tests ended, and 18,235 of them responded (response rate = 18%). Although all students in the study had registered to take a second ACT test, a small number of those who responded to the survey had in fact not retested and their data were therefore omitted (n = 161). A total of 18,074 student survey records were retained for analysis purposes.

In the survey, students were asked questions about test preparation activities.

They were also asked questions about other behaviors that might have affected their test performance, such as using a calculator or experiencing noteworthy anxiety or stress while taking the test.

The survey responses of each student were combined with their ACT test record and registration data, which include test scores and self-reported background characteristics, such as race/ethnicity, parental education level, and high school course work. Standard statistical methods for imputing missing values were used to ensure that data from all 18,074 students were represented in the analysis.

Several variables that had a strong likelihood of being related to ACT test performance were examined in this study. Many of these had been examined previously in the context of test preparation and had been shown to be related to ACT test performance. A recent study, for example, statistically controlled for 13 student characteristics (e.g., race/ethnicity, gender, grade level, expected educational attainment) and found positive relationships between participation in a test-preparation program and ACT Composite score gains (Sanchez 2019).

In the present study, multiple linear regression was used to model the change in ACT Composite score from the first to the second test as a function of student background characteristics and behaviors reported by students to have occurred either before or during the second test (Table 1).

Table 1. Background Characteristics and Test-Related Behaviors

Student Background Characteristics (primarily self-reported, collected when students register for the ACT test)	Student Test-Related Behaviors (self-reported, collected via the survey)
Race/ethnicity Gender Grade level Expected educational attainment* Having taken math courses beyond geometry Having taken biology, chemistry, and physics* Highest level of parental education Family income High school GPA Whether or not a fee waiver was used for the ACT* First ACT Composite score	Whether or not the student: • Prepared for the 2nd test • Had adequate sleep the night before 2nd test* • Had breakfast before the 2nd test* • Had a snack during the 2nd test's break time • Experienced notable stress/anxiety during 2nd test • Used a calculator during 2nd test

Notes:

1. Descriptive statistics for these background characteristics and test-related behaviors are provided in Table A1 of the appendix.

2. All student background characteristics listed are self-reported, except for fee waiver usage and first ACT Composite score.

*Not statistically significant; omitted from final regression model

Two of the test-related behaviors (whether the student had adequate sleep the night before the second test or not, whether the student had breakfast before the second test or not) and three of the background characteristics (whether a fee waiver was used for the ACT test or not; expected educational attainment; having taken biology, chemistry, and physics) were not statistically significant and were therefore omitted from the final regression model. Regression statistics for the final model are provided in Table A2 of the appendix.

Two variables were available as measures of family income: whether or not a fee waiver was used and the student-reported, ordinal measure of family income. As expected, students who reported relatively low family incomes were more likely to have used a fee waiver. When the family income variable was replaced by the fee waiver variable in the final regression model, the latter was statistically significant. Nevertheless, family income was included in the final model because it was a stronger predictor than the fee waiver variable.

Students who took biology, chemistry, and physics were more likely to have taken math courses beyond geometry. When the biology, chemistry, and physics variable was substituted in the final regression model for the math-beyond-geometry variable, the former was statistically significant, but it was not as strong a predictor as the latter. Consequently, having taken math beyond geometry was included in the final model.

Similarly, students' expected educational attainment was somewhat related to the highest level of education held by either parent. The latter predictor was the stronger of the two, was statistically significant, and was therefore included in the final model.

Results

Although having breakfast before the second ACT test and getting adequate sleep the night before had both been shown to be related to average ACT Composite score gains in a previous study (Schiel & Valiga 2014), these factors did not demonstrate similar, meaningful relationships in the present study. In the Schiel and Valiga (2014) study, statistical controls like those of the present study were not used to examine relationships between test-related behaviors and ACT Composite score gains. When considering the substantive influence of relatively strong predictors of second ACT Composite score, such as first ACT Composite score and high school GPA, it is not surprising that some of the test-related behaviors that were weaker predictors (e.g., having breakfast before the test) were not statistically significant.

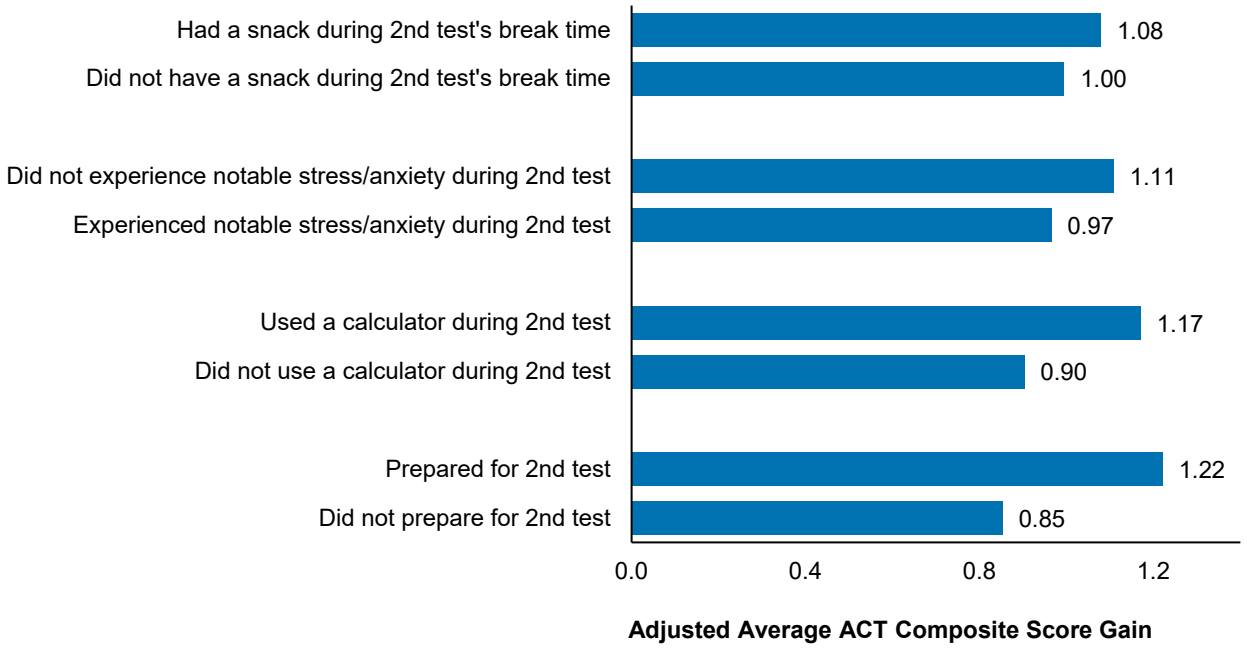
Only a small percentage of students (less than 3%) reported that they had relatively little sleep (i.e., less than four hours) the night before the second test. Despite trying several different categorizations in multiple regression models of the sleep variable (e.g., four hours or more of sleep vs. less than four hours; seven hours or more vs. less than seven hours), it was not statistically significant, indicating that adequacy of sleep did not have a noteworthy effect on ACT Composite score gain given the control variables employed in the models.

Average ACT Composite score gains from the first to the second test were computed for several statistically significant test-related behaviors. The average score gains,

which reflect statistical adjustments for the background characteristics and test-related behaviors included in the final regression model, are displayed in Figure 1. This figure illustrates several findings about how students' behavior might affect their ACT test performance. Recommendations based on these findings are described below.

When interpreting the findings and considering the recommendations, it is important to know that this study, although implying that the observed differences in ACT Composite score gains represent causal effects of test-related behaviors, does not provide conclusive evidence of causality. For example, although having a snack at break time during the second test was found on average to be related to ACT Composite score gains from the first to the second test, doing so was not unequivocally shown in this study to *cause* such gains. Of course, other, unobserved factors could be associated both with the test-related behaviors and ACT Composite score gains. Such factors could account for some of this study's observed effects.

Figure 1. Adjusted Average Composite Score Gains of Students Who Took the ACT Twice



Recommendations

Have a Snack During the ACT Test's Break Time

Students were asked in the survey if they had a snack during the second ACT test's break time. Those who said "yes" to this question experienced adjusted ACT Composite score gains of 1.08 points on average. Those who said that they did not have a snack experienced somewhat smaller adjusted score gains (1.00 points).

Try to Minimize Stress and Anxiety While Taking the ACT Test

Students who reported feeling so stressed or anxious while taking the second test that they believe it affected their performance had somewhat smaller adjusted average ACT Composite score gains (0.97 points) than did those who reported not feeling this way (1.11 points). A similar anxiety/test performance relationship was observed in another recent study, in which anxiety was determined to be related primarily to feelings of test unpreparedness (Steedle 2018a, 2018b). The study's author recommended that, to reduce anxiety, examinees should take courses that cover the content measured by the test and further prepare by becoming familiar with its format and length.

Use a Calculator While Taking the ACT Test

Students were asked if they used a calculator to answer some or all questions on the math portion of the second ACT test. On average, the adjusted Composite score gains of calculator users were larger than those of non-users (1.17 points vs. 0.90 points, respectively).

Not surprisingly, calculator users experienced score gains on the ACT mathematics test. A separate ACT mathematics score multiple regression model was developed to assess change in mathematics score from the first to the second testing, while statistically controlling for nearly the same student background characteristics and test-related behaviors as did the ACT Composite score model. The mathematics score model differed in that first ACT mathematics score was used in place of first ACT Composite score, and having a snack during the test's break time was omitted because it was not statistically significant. The results indicated that the average adjusted ACT mathematics score gains of calculator users were larger than those of non-users (0.87 points vs. 0.20 points, respectively).

Prepare for the ACT Test

Students were asked in the survey if they participated in any specific test preparation activities or used any test preparation materials, outside of normal classroom participation, prior to taking the second test. Examples include working through the practice test included in ACT's free booklet, *Preparing for the ACT*; using web-based test-preparation programs; using test-preparation workbooks; taking a commercial test-preparation course; etc.

As shown in Figure 1, adjusted average ACT Composite score gains were larger for students who reported that they prepared for the second test, compared with those who did not prepare (1.22 points vs. 0.85 points, respectively). This finding suggests that preparation is generally associated with

a positive effect on ACT test performance. A recent study that estimated the effects of test preparation on ACT Composite score gain while statistically controlling for student background characteristics supports this, its findings indicating that students who prepared for a second ACT test earned Composite scores that were on average 0.71 points higher than the scores of those who did not prepare (Moore et al. 2019). In that study, unobserved factors could likewise have been related to student characteristics and ACT Composite score gain, thereby contributing to some of the observed effects.

Conclusion

This study's findings suggest that second-time ACT test-takers who engage in such test-related behaviors as having a snack during break time, keeping stress and anxiety levels as low as possible, using a calculator, and preparing for the test are likely to experience somewhat larger ACT Composite score gains, on average, than are students who do not engage in these behaviors. These findings hold true irrespective of students' race/ethnicity, gender, family income, and several additional characteristics (grade level, parental education level, ACT Composite score earned on the first test, high school grade point average, and whether high school math courses beyond geometry were taken or not).

From a research perspective, the differences between adjusted average ACT Composite score gains observed in this study could be considered relatively small, with effect sizes[1] ranging from 0.04 (having a snack during the second test's break time) to 0.19 (preparing for the second test). Nevertheless, it is important to consider the practical implications of the findings. For example, an additional ACT Composite score gain of approximately one point, which would be predicted for students who demonstrated all the recommended behaviors, might not seem particularly large but could have some bearing on college admissions decisions. Students who plan to retest with the ACT are therefore encouraged to consider the recommendations of this study.

Notes

1. An effect size expresses a difference between two averages in terms of standard deviation units and is useful for determining if that difference is substantively meaningful.

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Appendix

Table A1. Descriptive Statistics for Student Background Characteristics and Test-Related Behaviors

	Percent* (or mean)	N*
Race/ethnicity		
American Indian/Alaska Native	0.8%	141
Asian	7.0%	1,259
Black/African American	8.9%	1,612
Hispanic/Latino	17.4%	3,139
Native Hawaiian/Other Pacific Islander	0.2%	28
White	57.9%	10,466
Two or more races	3.8%	693
Prefer not to respond	4.1%	736
Gender		
Female	64.9%	11,734
Male	35.1%	6,340
Grade Level		
8th	0.0%	3
9th	0.2%	45
10th	3.6%	643
11th	52.1%	9,420
12th	43.6%	7,872
HS Graduate	0.1%	27
College Student	0.2%	44
Other	0.1%	20
Expected Educational Attainment		
Business/technical school or certificate program	0.7%	119
Associate degree	1.5%	279
Bachelor's degree	42.0%	7,590
One or 2 years of graduate study (MA, MBA, etc.)	25.6%	4,625
Doctorate or professional degree (PhD, MD, JD, etc.)	29.5%	5,328
Other	0.7%	133
Having Taken Math Courses Beyond Geometry		
No	32.7%	5,906
Yes	67.3%	12,168
Having Taken Biology, Chemistry, and Physics		
No	63.5%	11,480
Yes	36.5%	6,594
Highest Level of Parental Education		
Less than high school	5.3%	951
High school graduate/GED	9.7%	1,755
Business/technical school or certificate program	2.8%	500
Some college, no degree or certificate	8.9%	1,606
Associate's degree	8.2%	1,485
Bachelor's degree	31.2%	5,646
One or 2 years of graduate study (MA, MBA, etc.)	22.0%	3,976
Doctorate or professional degree (PhD, MD, JD, etc.)	11.9%	2,154

	Percent* (or mean)	N*
Family Income		
Less than $24,000	11.9%	2,146
About $24,000 to $36,000	9.6%	1,726
About $36,000 to $50,000	8.8%	1,596
About $50,000 to $60,000	6.4%	1,165
About $60,000 to $80,000	10.3%	1,866
About $80,000 to $100,000	11.5%	2,076
About $100,000 to $120,000	10.6%	1,920
About $120,000 to $150,000	9.6%	1,727
More than $150,000	21.3%	3,853
High School GPA		
(D- to D) 0.5-0.9 or lower	0.0%	0
(D to C-) 1.0-1.4	0.1%	14
(C- to C) 1.5-1.9	0.4%	72
(C to B-) 2.0-2.4	2.2%	396
(B- to B) 2.5-2.9	6.4%	1,153
(B to B+) 3.0-3.4	20.1%	3,631
(A- to A) 3.5-4.0 or higher	70.9%	12,809
Fee Waiver Used for the ACT		
No	77.8%	14,054
Yes	22.2%	4,020
Prepared for the 2nd Test		
No	66.4%	12,001
Yes	33.6%	6,073
Hours of Sleep the Night Before 2nd Test		
0	0.7%	129
1-3	2.1%	377
4-6	27.5%	4,962
7-9	65.9%	11,907
10 or more	3.9%	699
Had Breakfast Before the 2nd Test		
No	22.2%	4,006
Yes	77.8%	14,068
Had a Snack During the 2nd Test's Break Time		
No	51.6%	9,332
Yes	48.4%	8,742
Experienced Notable Anxiety/Stress During 2nd Test		
No	52.8%	9,545
Yes	47.2%	8,529
Used a Calculator During 2nd Test		
No	5.8%	1,042
Yes	94.2%	17,032
First ACT Composite Score (Mean)	22.7	18,074
ACT Composite Score Gain (Mean)	1.1	18,074
First ACT Mathematics Score (Mean)	22.4	18,074
ACT Mathematics Score Gain (Mean)	0.8	18,074

*Each percentage in this table is a mean percentage, computed over all imputations. Similarly, the n-counts corresponding to each of the percentages are mean n-counts over imputations. Due to rounding, the n-counts for some characteristics/behaviors might not sum to 18,074, and the corresponding percentages might not sum to 100%.

Table A2. Regression Statistics for Modeling ACT Composite Score Change as a Function of Student Background Characteristics and Test-Related Behaviors

Independent variable	Regression coefficient	Std. error	*t*
Intercept	0.64	0.14	4.42
Prepared for second test (1=yes, 0=no)	0.37	0.03	12.58
Had a snack during the 2nd test's break time (1=yes, 0=no)	0.08	0.03	2.77
Experienced notable anxiety/stress during 2nd test (1=yes, 0=no)	0.14	0.03	4.94
Used a calculator during 2nd test (1=yes, 0=no)	0.27	0.08	3.41
Female (1) vs. male (0)	-0.20	0.03	-6.83
Grade 10 (1) vs. grade 11 (0)	-0.21	0.08	-2.71
Grade 12 (1) vs. grade 11 (0)	-0.76	0.03	-23.48
All other grades (1) vs. grade 11 (0)	-0.46	0.16	-2.90
Minority (1) vs. White (0)	-0.21	0.04	-5.71
Asian (1) vs. White (0)	0.08	0.06	1.46*
Two or more races (1) vs. White (0)	-0.12	0.07	-1.67*
All other races (1) vs. White (0)	0.02	0.07	0.27*
Family income	0.04	0.01	5.76
Highest level of parental education	0.06	0.01	5.96
Having taken math courses beyond geometry (1=yes, 0=no)	0.14	0.04	3.44
First ACT Composite score	-0.09	0.00	-24.13
High school GPA	0.28	0.02	12.79

*Although these variables were not statistically significant (*p*-values of 0.14 for Asian vs. White, 0.10 for two or more races vs. White, and 0.79 for all other races vs. White), they were part of a series representing racial/ethnic group membership and were included for control purposes.