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State preferences for the ACT versus SAT complicates inferences about SAT-derived state IQ estimates: A comment on Kanazawa (2006)

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Abstract

Kanazawa [Kanazawa, S. (2006). IQ and the wealth of states. *Intelligence*, *34*, 593–600.] offered estimates of state IQ derived from SAT data. The purpose of this commentary is to argue that state preferences for the use of the ACT versus the SAT create biased estimates of SAT-derived state IQ for states where the ACT is more frequently used than the SAT. This error can be reduced by using both ACT and SAT data to estimate state IQ. An IQ estimate based on a ACT-SAT composite and a NAEP-derived state IQ estimate were compared as predictors of three wealth variables. Both IQ estimates cause one to conclude that states with higher mean IQ have larger gross state product per capita, higher median incomes, and a lower percentage of their population in poverty.

Keywords: Intelligence; IQ; State IQ; SAT; ACT

1. Introduction

Kanazawa (2006) offered a creative approach for estimating state IQ from SAT scores. He noted that his method is based on two assumptions, quoted here verbatim:

1. Students who complete high school are uniformly more intelligent than those who do not.
2. High school seniors who take the SAT are uniformly more intelligent than those who do not.

Relying on these assumptions, Kanazawa (2006) estimated mean state IQ from SAT data. An example detailing his method is provided in the appendix of his article.

2. State preference for ACT or SAT makes the SAT-derived IQ estimate differentially accurate

Kanazawa's assumptions are reasonable if states have the same level of preference for requiring the SAT for college admissions. However, this is not the case. There are two primary tests used to screen applicants for colleges in the United States, the SAT and the ACT. The last two columns of Table 1 show the percentages of 2005 high school graduates who took either the ACT or the SAT. An inspection of the table indicates that states with many students taking the SAT tend to have few students taking the ACT, and vice versa. Table 2 shows the correlation between the percent of students

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taking the SAT and the percent of students taking the ACT to be −.90.

Table 2 shows that Kanazawa's SAT-derived IQ measure is correlated .93 with the percentage of 2005 high school graduates who took the SAT and −.86 with the percentage of 2005 high school graduates who took the ACT. Thus, it appears that the SAT-derived IQ measure is primarily an indicator of the extent to which state colleges prefer to have ACT versus SAT administered to their applicants. Most would not find it reasonable for an accurate estimate of state IQ to show such a pattern of correlations.

I assert that Kanazawa's SAT-derived IQ estimate is differentially accurate by state. For those states in which the SAT is the preferred college admissions test, the estimated state IQ scores should be more reflective of true state IQ than in those states where the use of the ACT is common. This assertion was tested with two analyses. For each analysis, the states were divided into those where more than half of the 2005 high school graduates took the ACT (the "ACT states") and those where fewer than half of the students took the ACT (the "SAT states"). Each analysis also uses a National Assessment of Educational Progress (NAEP)-derived estimate of state IQ. McDaniel (in press) developed the NAEP-derived state IQ estimate using the fourth and eighth grade reading and mathematics test scores from multiple years.

The first analysis compared the SAT-derived and NAEP-derived state IQs of the 25 ACT states with the 26 SAT states (the District of Columbia is considered a state in Kanazawa's analysis). The mean SAT-derived IQ for the ACT states is 82.5 while the mean for SAT states is 105.0. This difference, expressed as a standardized mean difference, is 3.5 standard deviation units. Thus, either states that favor the use of the ACT have severely cognitively impaired residents or something is amiss with the SAT-derived IQ measure. Note that the SAT-derived IQ measure has some large outliers. Twelve states have estimated state IQs below 80. Some would argue that these state IQ values are not credible. All states with SAT-derived IQ values below 97 are ACT states. In contrast to the odd behavior of the SAT-derived IQ estimate, the NAEP-derived IQ estimate showed no meaningful mean differences between ACT and SAT states (100.32 versus 100.36) and had no outliers.

The second analysis correlated the SAT-derived and NAEP-derived estimated state IQs separately by ACT and SAT states. If SAT-derived state IQ estimates are more accurate for SAT states, the correlation between the SAT-derived IQ and the NAEP-derived IQ should be substantially higher for the SAT states than for the ACT states. For the SAT states, the correlation between the two state IQ estimates is .77. The comparable correlation for the ACT states is .36. Thus, one must conclude that the SAT-derived IQ measure is substantially inaccurate in its estimation of NAEP-derived state IQ scores in ACT states.

3. An ACT-derived IQ shows comparable problems as the SAT-derived IQ

Kanazawa's method was applied to obtain an ACT-derived IQ. The ACT-derived IQ measure shows comparable problems to the SAT-derived IQ. Table 1 shows the ACT-derived IQ for each state with the exception of Colorado and Illinois. Those two states require the ACT for all high school students and therefore are problematic for the application of Kanazawa's method. Table 2 shows ACT-derived IQ to be correlated −.84 with the SAT-derived IQ. The ACT-derived IQ shows a positive correlation with the percentage of high school graduates who take the ACT (.94) and a negative correlation with the percentage of the high school graduates who take the SAT (−.90). These correlates would not be reasonable for measures of IQ.

In a comparable manner to the SAT-derived IQ, the ACT-derived IQ is differentially accurate. For those states in which the ACT is the preferred college admissions test, the estimated state IQ scores should be more reflective of true state IQ than in those states where the use of the SAT is common. The mean ACT-derived IQ for the SAT states is 88.3 while the mean for ACT states is 109.7. As noted earlier there is no meaningful differences between ACT and SAT states for the NAEP-derived IQ (100.32 versus 100.36). I also examined the correlations between the ACT-derived IQ and the NAEP-derived IQ separately by ACT versus SAT states. For SAT states the correlation is negative (−.27), but is positive for the ACT states (.67). Thus, an ACT-derived IQ estimate has comparable problems to an SAT-derived IQ estimate.

4. An ACT–SAT-derived composite IQ and SAT-derived IQ composite

The SAT-derived IQ has a reasonable correlation (.77) with the NAEP-derived IQ in SAT states and the ACT-derived IQ has a reasonable correlation (.67) with the NAEP-derived IQ in ACT states. Given this, I developed a composite of ACT- and SAT-derived IQ. First, the ACT- and SAT-derived IQ scores were

Table 1
State IQ estimates and percent of 2005 high school graduates who took the ACT and SAT

State	Kanazawa (2006) SAT-derived IQ	ACT-derived IQ	ACT–SAT-derived composite IQ	McDaniel (in press) NAEP-derived IQ	Percent of 2005 HS graduates who took the ACT	Percent of 2005 HS graduates who took the SAT
Alabama	79.9	108.0	99.8	95.7	77	10
Alaska	103.6	91.0	99.3	99.0	26	52
Arizona	97.3	92.6	91.4	97.4	19	33
Arkansas	73.3	108.2	99.9	97.5	76	6
California	100.5	84.6	87.1	95.5	14	50
Colorado	97.6	na		101.6	100	26
Connecticut	109.4	89.3	102.2	103.1	10	86
Delaware	106.4	73.2	100.7	100.4	4	74
District of Columbia	103.1	89.7	99.1	na	29	79
Florida	103.8	101.1	99.4	98.4	41	65
Georgia	105.8	94.9	100.4	98.0	29	75
Hawaii	103.5	88.4	99.3	95.6	16	61
Idaho	92.6	107.9	99.8	101.4	58	21
Illinois	85.7	na		99.9	100	10
Indiana	105.5	93.5	100.3	101.7	21	66
Iowa	76.6	111.1	101.5	103.2	66	5
Kansas	82.6	111.9	101.9	102.8	76	9
Kentucky	83.6	108.8	100.2	99.4	76	12
Louisiana	75.2	108.9	100.3	95.3	85	8
Maine	107.0	84.9	101.0	103.4	10	75
Maryland	105.8	80.9	100.4	99.7	12	71
Massachusetts	109.9	87.8	102.5	104.3	12	86
Michigan	82.5	109.8	100.8	100.5	69	10
Minnesota	88.5	111.9	101.9	103.7	68	11
Mississippi	62.7	108.7	100.2	94.2	94	4
Missouri	78.3	110.2	101.0	101.0	70	7
Montana	99.0	108.8	100.2	103.4	57	31
Nebraska	79.9	112.3	102.1	102.3	76	8
Nevada	98.6	97.9	94.3	96.5	28	39
New Hampshire	110.3	87.3	102.7	104.2	10	81
New Jersey	108.9	74.3	102.0	102.8	6	86
New Mexico	83.6	104.6	97.9	95.7	61	13
New York	108.9	91.6	102.0	100.7	17	92
North Carolina	105.6	84.8	100.3	100.2	15	74
North Dakota	74.4	112.5	102.3	103.8	82	4
Ohio	96.3	108.9	100.3	101.8	66	29
Oklahoma	77.0	108.0	99.8	99.3	69	7
Oregon	105.4	86.1	100.2	101.2	12	59
Pennsylvania	106.2	80.0	100.6	101.5	9	75
Rhode Island	104.8	77.9	99.9	99.5	8	72
South Carolina	103.0	97.7	99.0	98.4	38	64
South Dakota	75.5	111.7	101.8	102.8	76	5
Tennessee	88.8	111.2	101.5	97.7	92	16
Texas	99.2	94.3	97.1	100.0	29	54
Utah	75.1	110.2	101.0	101.1	68	7
Vermont	106.5	91.9	100.8	103.8	16	67
Virginia	107.1	87.7	101.1	101.9	14	73
Washington	105.1	91.5	100.1	101.9	16	55
West Virginia	88.1	106.7	99.1	98.7	65	20
Wisconsin	78.4	111.5	101.7	102.9	69	6
Wyoming	86.9	110.9	101.4	102.4	69	12

Note: McDaniel (in press) did not report an estimated state IQ for the District of Columbia. ACT-derived IQ and ACT–SAT-derived composite IQ data are not available for Colorado and Illinois.

Table 2
Correlation matrix with means and standard deviations

	Mean	σ	SAT-derived IQ (Kanazawa, 2006)	ACT-derived IQ	SAT-ACT composite IQ	NAEP-derived IQ (McDaniel, in press)	Percent of 2005 HS graduates who took the ACT	Percent of 2005 HS graduates who took the SAT
SAT-derived IQ	94.0	13.05		−.84	−.10	.22	−.86	.93
ACT-derived IQ	98.32	12.00			.18	−.03	.94	−.90
SAT-ACT composite IQ	100.00	2.71				.58	.20	−.01
NAEP-derived IQ	100.34	2.71					−.14	.17
Percent taking ACT	45.61	30.64						−.90
Percent taking SAT	40.41	30.54						

standardized. Second, the ACT–SAT-derived composite IQ was set equal to the standardized ACT-derived IQ for the ACT states and set equal to the SAT-derived IQ for the SAT states. Third, to make the scores on a comparable metric to the NAEP-derived IQ, the mean was set to 100 and the standard deviation was set to 2.71. As seen in Table 2, the resulting ACT–SAT-derived composite IQ has a correlation of .58 with the NAEP-derived IQ in the 48 states for which it could be calculated (ACT-derived IQ is not available for Colorado and Illinois) and is large and positive for both SAT states (.77) and ACT states (.67). The ACT–SAT-derived composite IQ also does not show high correlations with the percentage of high school graduates who took the ACT or SAT. The correlation with the NAEP-derived state IQ, the lack of ACT state versus SAT state moderation in correlations with the NAEP-derived IQ, and the lack of correlations with the percentage of high school graduates who took the ACT or the SAT suggest that this estimated state IQ is a better estimate than either SAT-derived IQ or ACT-derived IQ. This ACT-SAT-derived composite state IQ estimate is presented in Table 1.

5. Predicting wealth from the state IQ measures

Table 3 compares the predictive value of the various IQ estimates for predicting gross state product (GSP) per capita, median income, and percent of the population in poverty. The first row of the table displays correlations drawn from Kanazawa (2006) and is based on 50 states plus the District of Columbia. McDaniel (in press) did not report a NAEP-derived state IQ for the District of Columbia and the ACT-derived IQ and the ACT-SAT-derived composite IQ are not available for the states of Colorado and Illinois. To make comparisons among the state IQ estimates, one needs the correlations between the SAT-derived IQ estimate with the three wealth variables for the 48 states containing non-missing data for all IQ estimates. Those correlations are given in the next rows of Table 3.

McDaniel (in press) documented that the NAEP-derived state IQ is downwardly biased to the extent that all children do not attend public school and that those who do not attend public schools have greater cognitive skills than those who attend public schools. NAEP data by state are only published for public school children. McDaniel developed an approximate but useful indicator of this bias by calculating the percent of White children not in public school. For some criteria, this indicator serves as a suppressor (Tzelgov & Henik, 1991) of the relationship between NAEP-derived state IQ and the criteria. In these data, suppression is indicated when the standardized beta-weight for the NAEP-derived state IQ in a two variable regression that includes NAEP-derived state IQ and the percent of White children not in public schools is larger than the zero-order correlation between NAEP-derived state IQ and the criterion. The last row in Table 3 shows the standardized beta-weight for NAEP-derived state IQ in a two variable predictor model for each of the three criteria. A suppression situation is evident in the prediction of GSP per capita and median income. A more complete description of the suppression effect is provided in McDaniel (in press).

Table 3
Predicting wealth from the SAT-derived IQ and the NAEP-derived IQ measures

IQ estimate	GSP per capita	Median income	Percent poverty
SAT-derived IQ (50 states plus DC)	.32[a]	.57	−.35
SAT-derived IQ (48 states only)	.50	.59[b]	−.38[b]
ACT-derived IQ (48 states only)	−.53	−.58	.30
SAT–ACT composite IQ (48 states only)	.10	.18	−.30
NAEP-derived IQ (48 states only)	.29	.43	−.64
NAEP-derived IQ (48 states only) standardized beta-weight in two variable regression model[c]	.59[c]	.58[c]	−.61[c]

Notes: (a) Kanazawa did not list his GSP per capita data in a table. I obtained a correlation of .30 with the SAT-derived IQ when seeking to replicate his analysis and he obtained a correlation of .32. Without his data, I cannot locate the source of this small discrepancy. Because the GSP per capita data used in this study are not identical to that used by Kanazawa, the correlations in this column may differ slightly from what Kanazawa would calculate. (b) These correlations do not appear in the Kanazawa paper and were calculated by the author. (c) McDaniel (in press) documents that the NAEP-derived state IQ measure is biased to the extent that elementary school students do not attend public schools. McDaniel (in press) calculated the percent of White children not in public education as an estimator of the bias in the NAEP-derived state IQ measure. In the prediction of some criteria, NAEP-estimated state IQ and White children not in public school create a regression suppressor situation, such that the zero-order correlation underestimates the relationship between the estimated state IQ and the criterion. This is the case for GSP per capita and median income but not for percent poverty. See McDaniel (in press) for a discussion of the NAEP-derived IQ measure, the indicator of bias in the measure, and the issue of suppression effects.

The ACT-derived IQ measure is an outlier among the IQ estimates in that it predicts the wealth variables in a manner opposite from the remaining IQ estimates. However, given that it is correlated −.84 with the SAT-derived state IQs, such correlations are expected.

For GSP per capita, the SAT-derived measure is correlated .50 with the SAT-derived state IQ, .10 with the SAT-ACT-derived composite IQ, and .29 with the NAEP-derived state IQ measure. However, that zero-order correlation for the NAEP-derived state IQ measure is suppressed due to the bias associated with not all children being in public schools. The standardized beta-weight of .59 is offered as the best estimate of the relationship between NAEP-derived state IQ and the GSP per capita.

For the median income wealth criterion, SAT-derived IQ correlates .59, the ACT-SAT-derived composite IQ correlates .18, and the NAEP-derived IQ correlates .43. Given the suppression situation, the standardized beta-weight of .58 is the best summary statistic for the relationship between NAEP-derived state IQ and median income.

For percent poverty, the correlation for the SAT-derived state IQ is −.38, the correlation for ACT–SAT-derived composite IQ is −.30 and the comparable correlation for the NAEP-derived state IQ is −.64. No suppression effect is evident.

The Spearman rho correlations for the ACT–SAT-derived composite IQ with other variables are much higher than the Pearson correlations. Specifically, the Spearman rho correlations between the ACT–SAT-derived composite IQ with NAEP-derived IQ are .75 (vs. .58, Pearson correlation), with GSP per capita .38 (vs.10), with median income .46 (vs .18), and with percent poverty –.50 (vs. –.30). Thus, the ACT–SAT-derived composite IQ might best be viewed as a rank ordering of state IQ.

In summary, excluding ACT-derived IQ estimate, all estimates yield the same direction of relationships with the three wealth variables, although the magnitude of the relationships differs. States with higher estimated IQs have greater GSP per capita, greater median income, and a lower percent of residents living in poverty. Continued research on estimating state IQ is needed to permit more precise estimates of state IQ and its correlates.

6. Conclusion

State IQ is a potentially important variable in understanding state wealth and other state variables. Kanazawa (2006) used a creative approach for estimating state IQ. If the SAT were the only major college admission test, Kanazawa's approach would likely have yielded a more accurate estimate of state IQ. His method yields a measure of state IQ that shows unreasonable correlations with the percentage of state high school graduates who took the ACT and SAT. Also, it appears to be more accurate for states where the SAT is the typical college entrance exam and much less accurate for the states where the ACT is the typical college entrance exam. We applied Kanazawa's method to create an ACT-derived state IQ estimate. It showed comparable problems to the SAT-derived IQ estimate. Specifically, it showed unreasonable correlations with the percentage of state high school graduates who took the ACT and SAT and it appeared more accurate for

ACT states than SAT states. Therefore, the SAT-derived IQ and the ACT-derived IQ estimates are not credible estimates of state IQ.

A composite of the SAT-derived IQ and the ACT-derived IQ showed more reasonable correlations with other variables. Specifically, it did not have meaningful magnitude correlations with the percentages of high school graduates who took the SAT or the ACT. Also, its correlation with the NAEP-derived IQ was not meaningfully moderated by whether the state favored use of the ACT or SAT in college admissions. In addition, it showed a reasonable pattern of correlations with wealth criteria.

Continued research on estimating state IQ is warranted to develop more precise estimates of state IQ and its correlates. The correlation between the ACT–SAT-derived IQ and the NAEP-derived IQ is .58 which is not as high as one would expect for alternative measures of the same construct. There are likely to be better methods of estimating state IQ from SAT, ACT and other IQ-related measures. Additional research on this important topic is encouraged.

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