

RENAISSANCE®

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Relating Star Reading® and Star Math® to the SAT®



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Introduction

At Renaissance we know that as an educator, chief among your responsibilities is making decisions about how to allocate limited resources to best serve diverse student needs. A good assessment system supports your efforts, by providing timely, relevant information to help address key questions about which students are on track to meet important standards and who may need additional assistance.

Assessments that identify early any students at risk of missing academic standards are especially useful, as they inform instructional decisions to improve student performance and reduce gaps in achievement. Assessments that do this while taking little time away from instruction are particularly valuable. *Interim assessments*, one of three broad categories of educational assessment,¹ indicate which students are on track to meet later expectations (Perie, Marion, Gong, & Wurtzel, 2007).

Assessments that identify early any students at risk of missing academic standards are especially useful.

This linking study applied results from two interim assessments, Renaissance Star Reading® and Renaissance Star Math®, to help you predict whether individual students are on track or need more assistance to meet the new SAT college- and career-readiness benchmarks.²

Main Findings

Results from the linking analysis revealed that Star Reading and Star Math are accurate predictors of the SAT, meaning as an educator you can use Star scores to:

1. Identify early in the year students likely to miss college- and career-readiness reading and math yearly progress goals in time to make meaningful adjustments to instruction well before the college- and career-readiness test.
2. Forecast the percent of students below the SAT college- and career-readiness benchmark to serve as an early warning system for building and district administrators and allow redirection of resources as needed.

Study

To determine if Star Reading and Star Math can predict student achievement on the SAT section tests in Evidence-based reading and writing (ERW) and mathematics, we began by linking the score scales for each assessment.

Data collection

Using a secure data-matching procedure compliant with the federal Family Educational Rights and Privacy Act (FERPA), staff from 10 districts in 4 states (CT, ID, IL, ME) provided Renaissance with SAT test scores for students

¹ **Formative assessments** are short and frequent processes, embedded in instruction, that support learning and provide specific feedback on what students know and can do versus where gaps in knowledge exist. **Summative assessments** evaluate whether students have met a set of standards, and serve most commonly as year-end state-mandated tests. **Interim assessments** represent the middle ground, in terms of duration and frequency and can serve purposes including informing instruction, evaluating curriculum and student responsiveness to intervention, and forecasting performance on high-stakes summative year-end tests.

² Technical manuals are available for Star Reading and Star Math by request to research@renaissance.com.

who had taken Star Reading or Star Math during the 2015–2016, 2016–2017, or 2017–2018 school years. Each record included a student’s SAT scores and was matched with all Star scores for that year.³

Sample characteristics

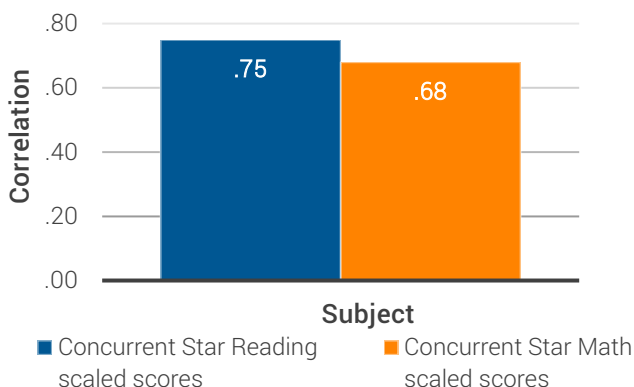
Renaissance divided the data into two samples. The **concurrent** sample included students’ scores for all Star tests taken within 30 days before or after the SAT administration. This sample numbered 2,583 tests from students in grade 11 with matched SAT ERW and Star Reading scores and 2,126 tests from students in grade 11 with matched SAT Mathematics and Star Math scores. We then set aside scores from a subset of these students—10%—as a **holdout sample** to use only to evaluate the scale linkage.

The linking analysis revealed that Star Reading and Star Math are accurate predictors of the SAT tests.

Correlations

Before linking Star tests with the SAT, we ensured there was a strong relationship between the test scales. As seen in figure 1, the correlation between SAT ERW and Star Reading was .75 and the correlation between SAT Mathematics and Star Math was .68.

Figure 1. Star Reading® and Star Math® scores highly correlate with SAT scores



Scale linkage

Renaissance then linked the score scales for the Star Reading/Star Math and the SAT sections in ERW and mathematics by applying equipercentile linking analysis (Kolen & Brennan, 2004). The concurrent sample (sans the holdout sample) was used in the linking (scores from all Star tests taken within 30 days before or after the SAT administration date), and the result was a table of SAT scores for each possible Star score.

SAT cut scores and corresponding Star score equivalents

SAT section results are reported in scaled scores that describe each student’s location on an achievement continuum ranging from 200 to 800. In addition to providing College- and Career-Readiness benchmarks, the College Board provides color-coded indicators to provide information on whether students are on track to meet

³ One additional district shared SAT data with Renaissance. Initial analysis revealed that there were no Star records concurrent to the SAT administration for this district and data from this district was not included in linking analyses.

benchmarks.⁴ Scores at the *Green* level are at or above the College- and Career-Readiness benchmark. Scores at the *Yellow* level are below the benchmark, but within one year of academic growth of meeting the benchmark. Scores at the *Red* level are below the benchmark by more than one year of academic growth. A main purpose in linking Star Reading and Star Math to the SAT was to identify Star scores at the time of the SAT that are approximately equivalent to the cut-off scores that separate SAT benchmark indicators. Table 1 displays these equivalent Star scores at the time of the SAT. The corresponding SAT cut scores can be found in table B1 in Appendix B.

Table 1. Star Reading® and Star Math® score equivalents for each College Board SAT benchmark indicator

Subject	SAT Benchmark Indicator		
	Red	Yellow	Green
Star Reading	< 917	917 – 979	≥ 980
Star Math	< 891	891 – 906	≥ 907

Some states classify achievement on the SAT using four achievement levels developed as part of a multi-state standard setting meeting in 2016.⁵ For these states, achievement at Level 3 or above represents proficiency. Table 2 displays the equivalent Star scores at the time of the SAT for these states. The corresponding SAT cut scores for states using these four achievement levels is in table B2 in Appendix B.

Table 2. Star Reading® and Star Math® score equivalents for achievement levels associated with 2016 multi-state standards

State	Subject	Achievement Level			
		Level 1	Level 2	Level 3	Level 4
CT, DE, ME, NH, RI	Star Reading	< 745	745 – 979	980 – 1343	≥ 1344
CT, DE, ME, NH, RI	Star Math	< 806	806 – 906	907 – 1001	≥ 1002

Illinois developed a series of cut scores and performance levels that correspond with mastery of Illinois Learning Standards.⁶ SAT performance at Level 3 or above reflects mastery of Illinois Learning Standards. Table 3 displays these equivalent Star scores at the time of the SAT for Illinois. The corresponding SAT cut scores for Illinois performance levels can be found in table B3 in Appendix B.

Table 3. Star Reading® and Star Math® score equivalents for performance levels associated with Illinois Learning Standards

State	Subject	Performance Level			
		Level 1 – Partially Meets Standards	Level 2 – Approaching Standards	Level 3 – Meets Standards	Level 4 – Exceeds Standards
IL	Star Reading	< 799	799 – 1225	1226 – 1344	≥ 1345
IL	Star Math	< 842	842 – 913	914 – 1031	≥ 1032

4 Additional information on the College and Career Readiness Benchmarks for the SAT and color-coded benchmark indicators can be found in an educator brief published by the College Board available at <https://collegereadiness.collegeboard.org/pdf/educator-benchmark-brief.pdf>

5 Additional information on the multi-state standard setting is available in the Delaware System of Student Assessments (DeSSA) Executive State Summary, 2016–2017 administration available at <https://www.doe.k12.de.us/cms/lib/DE01922744/Centricity/Domain/535/DeSSA%20Executive%20State%20Summary%202017.pdf>

6 Additional information on the Illinois SAT cut scores and performance levels is available at <https://www.isbe.net/Documents/Statewide-SAT-Performance-Levels-Admin-FAQ.pdf>

Additionally, West Virginia engaged in a standard-setting process to develop SAT cut scores corresponding with four achievement levels. SAT performance at Meets Standard or above represents proficiency. Table 4 displays these equivalent Star scores at the time of the SAT for West Virginia. The corresponding SAT cut scores for West Virginia performance levels can be found in table B4 in Appendix B.

Table 4. Star Reading® and Star Math® score equivalents for West Virginia SAT achievement levels

State	Subject	Achievement Level			
		Does Not Meet Standard	Partially Meets Standard	Meets Standard	Exceeds Standard
WV	Star Reading	< 707	707 – 951	952 – 1315	≥ 1316
WV	Star Math	< 806	806 – 897	898 – 948	≥ 949

Results

Accuracy of scale linkage confirmed

In evaluating the accuracy of the scale linkage, we used two methods to examine the differences between students' observed (actual) SAT scores and our Star equivalents: (1) computing the RMSEL (the root mean squared errors of linking) using the scores from the linking study, and (2) applying the holdout sample, consisting of the subset of concurrent scores not used in the linking, to the linking results. Results showed that our linking computation performed as intended.

Star scores discriminate well between students who score proficient or not

Using the holdout sample and the Star cut scores corresponding with the College Board's College- and Career-Readiness Green level/Achievement Level 3 and Illinois Level 3 – Meets Standards levels, we were able to compare how concurrent Star scores aligned with the observed SAT scores. Tables 5 and 6 display classification diagnostics about whether students were correctly or incorrectly classified as meeting/not meeting the corresponding SAT benchmark using concurrent Star scores. Students were correctly classified (i.e., overall classification accuracy) between 83% and 84% of the time for reading and between 84% and 85% of the time for math, depending upon the benchmark used.

For Area Under the ROC Curve (AUC), a summary measure of diagnostic accuracy, Star Reading and Star Math had AUCs of .91 for both benchmarks examined (also displayed in tables 5 and 6). The AUCs far exceed the .85 standard set by the National Center on Response to Intervention to indicate convincing evidence that an assessment can accurately predict another assessment result or outcome.

Table 5. Proficiency forecasting using Star Reading® scores yields accurate results

Classification Measure	Interpretation	Benchmark	
		College Board Green /Level 3	Illinois Level 3
Overall classification accuracy	Percentage of correct classifications	83%	84%
Sensitivity	Percentage of students meeting benchmark identified as such using Star	83%	78%
Specificity	Percentage of students not meeting benchmark identified as such using Star	82%	88%
Positive predictive value (PPV)	Percentage of students Star projects will meet benchmark who actually meet benchmark	86%	77%
Negative predictive value (NPV)	Percentage of students Star projects will not meet benchmark who actually do not meet benchmark	78%	88%
Observed proficiency rate (OPR)	Percentage of students who meet benchmark	57%	35%
Projected proficiency rate (PPR)	Percentage of students Star projects will meet benchmark	55%	35%
Proficiency status projection error	Difference between projected and observed proficiency rates	-2%	0%
Area Under the ROC Curve	Summary measure of diagnostic accuracy	0.91	0.91

Table 6. Proficiency forecasting using Star Math® scores yields accurate results

Classification Measure	Interpretation	Benchmark	
		College Board Green /Level 3	Illinois Level 3
Overall classification accuracy	Percentage of correct classifications	84%	85%
Sensitivity	Percentage of students meeting benchmark identified as such using Star	70%	68%
Specificity	Percentage of students not meeting benchmark identified as such using Star	87%	89%
Positive predictive value (PPV)	Percentage of students Star projects will meet benchmark who actually meet benchmark	61%	59%
Negative predictive value (NPV)	Percentage of students Star projects will not meet benchmark who actually do not meet benchmark	91%	92%
Observed proficiency rate (OPR)	Percentage of students who meet benchmark	22%	19%
Projected proficiency rate (PPR)	Percentage of students Star projects will meet benchmark	25%	22%
Proficiency status projection error	Difference between projected and observed proficiency rates	3%	3%
Area Under the ROC Curve	Summary measure of diagnostic accuracy	0.91	0.91

Appendix A: About Star Reading® and Star Math®

The computer-adaptive Star Reading and Star Math assessments serve multiple purposes including screening, progress monitoring, instructional planning, forecasting proficiency, standards mastery, and measuring growth. These highly reliable, valid, and efficient standards-based measures of student performance in reading and math provide valuable information regarding the acquisition of skills along a continuum of learning expectations. The assessments can be completed in about 20 minutes, and we recommend administering them two to five times a year for most purposes and more frequently when used in progress monitoring programs.

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Star Reading®

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Star Math®

Star Reading and Star Math are highly rated for progress monitoring by the National Center on Intensive Intervention, and received high ratings for screening and progress monitoring by the National Center on Response to Intervention.

National Center on
INTENSIVE INTERVENTION

at American Institutes for Research ■



National Center on Response to Intervention
www.rti4success.org

Appendix B: SAT achievement levels

Table B1. College Board SAT benchmark indicator score ranges

SAT Benchmark Indicator score ranges			
Section	Red	Yellow	Green
ERW	200 – 450	460 – 470	480 – 800
Mathematics	200 – 500	510 – 520	530 – 800

Table B2. SAT score ranges for achievement levels associated with 2016 multi-state standards

State	Section	Achievement Level			
		Level 1	Level 2	Level 3	Level 4
CT, DE, ME, NH, RI	ERW	200 – 410	420 – 470	480 – 620	630 – 800
CT, DE, ME, NH, RI	Mathematics	200 – 410	420 – 520	530 – 640	650 – 800

Table B3. SAT score ranges for performance levels associated with Illinois Learning Standards

State	Section	Performance Level			
		Level 1 – Partially Meets Standards	Level 2 – Approaching Standards	Level 3 – Meets Standards	Level 4 – Exceeds Standards
IL	ERW	200 – 420	430 – 530	540 – 630	640 – 800
IL	Mathematics	200 – 440	450 – 530	540 – 660	670 – 800

Table B4. SAT score ranges for West Virginia SAT achievement levels

State	Subject	Performance Level			
		Does Not Meet Standard	Partially Meets Standard	Meets Standard	Exceeds Standard
WV	ERW	200 – 400	410 – 460	470 – 570	580 – 800
WV	Mathematics	200 – 410	420 – 510	520 – 580	590 – 800

References

Kolen, M. J., & Brennan, R. R. (2004). *Test equating scaling and linking: Methods and practices*. New York, NY: Springer Science+Business Media.

Perie, M., Marion, S., Gong, B., & Wurtzel, J. (2007). *The role of interim assessments in a comprehensive assessment system*. Aspen, CO: Aspen Institute.

Renaissance Learning. (2018a). *Star Math technical manual*. Wisconsin Rapids, WI: Author. Available by request to research@renaissance.com

Renaissance Learning. (2018b). *Star Reading technical manual*. Wisconsin Rapids, WI: Author. Available by request to research@renaissance.com

Independent technical reviews of Star Reading® and Star Math®

U.S. Department of Education: National Center on Intensive Intervention. (2016a). *Review of progress monitoring tools* [Review of STAR Math]. Washington, DC: Author. Retrieved from <http://www.intensiveintervention.org/chart/progress-monitoring>

U.S. Department of Education: National Center on Intensive Intervention. (2016b). *Review of progress monitoring tools* [Review of STAR Reading]. Washington, DC: Author. Retrieved from <http://www.intensiveintervention.org/chart/progress-monitoring>

U.S. Department of Education: National Center on Response to Intervention. (2010a). *Review of progress monitoring tools* [Review of STAR Math]. Washington, DC: Author. Retrieved from <https://web.archive.org/web/20120813035500/http://www.rti4success.org/pdf/progressMonitoringGOM.pdf>

U.S. Department of Education: National Center on Response to Intervention. (2010b). *Review of progress monitoring tools* [Review of STAR Reading]. Washington, DC: Author. Retrieved from <https://web.archive.org/web/20120813035500/http://www.rti4success.org/pdf/progressMonitoringGOM.pdf>

U.S. Department of Education: National Center on Response to Intervention. (2011a). *Review of screening tools* [Review of STAR Math]. Washington, DC: Author. Retrieved from <http://www.rti4success.org/resources/tools-charts/screening-tools-chart>

U.S. Department of Education: National Center on Response to Intervention. (2011b). *Review of screening tools* [Review of STAR Reading]. Washington, DC: Author. Retrieved from <http://www.rti4success.org/resources/tools-charts/screening-tools-chart>