

## Relating Star Reading® and Star Math® to North Dakota State Assessment (NDSA) (Smarter Balanced) Performance



# Contents

3	Introduction
3	Main Findings
3	Study
6	Results
8	Appendix A: About Star Reading and Star Math
8	Appendix B: Smarter Balanced achievement levels
9	References

## Figures

4	Figure 1. Star Reading and Star Math scores highly correlate with Smarter Balanced assessments
6	Figure 2. Projected scores from Star Reading and Star Math highly correlate with Smarter Balanced scores

## Tables

5	Table 1. Star Reading and Star Math score equivalents for each Smarter Balanced achievement level range
7	Table 2. Proficiency forecasting using Star Reading and Star Math scores yields accurate results
8	Table B1. Smarter Balanced achievement level score ranges

# 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,<sup>1</sup> indicate which students are on track to meet later expectations (Perie, Marion, Gong, & Wurtzel, 2007).

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 succeed on the year-end summative Smarter Balanced assessments in English language arts/literacy and mathematics in grades 3 through 8.<sup>2</sup>

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

## Main Findings

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

1. Identify early in the year students likely to miss reading and math yearly progress goals in time to make meaningful adjustments to instruction well before the year-end test.
2. Forecast the percent of students at each Smarter Balanced performance level 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 end-of-year Smarter Balanced assessments in English language arts/literacy and mathematics, we began by linking the score scales for each assessment.

---

<sup>1</sup> **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.

<sup>2</sup> Technical manuals are available for Star Reading and Star Math by request to [research@renaissance.com](mailto:research@renaissance.com).

## Data collection

Using a secure data-matching procedure compliant with the federal Family Educational Rights and Privacy Act (FERPA), staff from eight large districts in four Smarter Balanced states (California, Oregon, Washington, and Connecticut) provided Renaissance with state summative test scores for students who had taken Star Reading or Star Math during the 2014–2015 school year. Each record included a student's Smarter Balanced scores and was matched with all Star scores for that year.

## Sample characteristics

Renaissance divided the Smarter Balanced data into two samples. The **concurrent** sample included students' scores for all Star tests taken within 30 days before or after the mid-date of the Smarter Balanced administration window. This sample numbered 54,777 students in grades 3–8 with matched Smarter Balanced English language arts/literacy and Star Reading scores and 50,752 students in those grades 3–8 with matched Smarter Balanced mathematics and Star Math scores. In each grade, we then set aside scores from a subset of these students—10%—as a holdout sample to use only to evaluate the scale linkage.

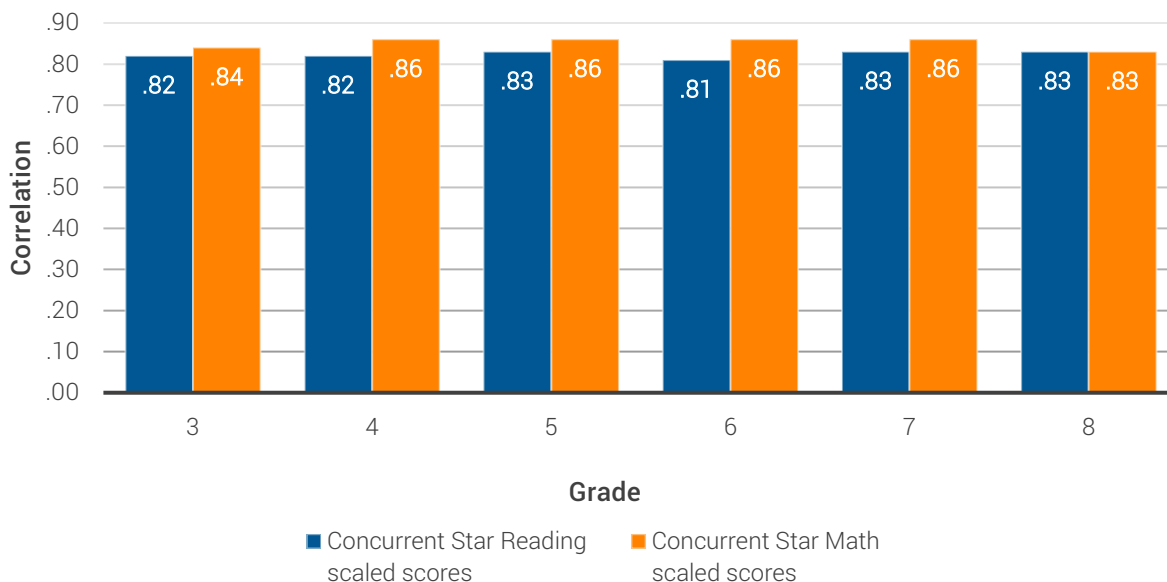
The linking analysis revealed that Star Reading and Star Math are accurate predictors of the Smarter Balanced assessments.

The **predictive** sample, which included 51,835 students for reading and 51,816 students for math, included Star scores for tests taken more than 30 days before the mid-date in the Smarter Balanced testing window.

## Correlations

Before linking Star tests with the Smarter Balanced assessments, we ensured there was a strong relationship between the test scales. As seen in figure 1, the correlations were positive, averaging .82 and .85 between Smarter Balanced and Star Reading and Star Math, respectively.

Figure 1. Star Reading® and Star Math® scores highly correlate with Smarter Balanced assessments



## Scale linkage

Renaissance then linked the score scales for the Star Reading/Star Math and the Smarter Balanced assessments in English language arts/literacy and mathematics by applying equipercntile linking analysis (Kolen & Brennan, 2004) in grades 3–8 in reading and math. 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 Smarter Balanced testing mid-date), and the result was a table of Smarter Balanced scores for each possible Star score.

The predictive sample was then used to evaluate if the linking results could accurately predict student performance on the Smarter Balanced assessment with Star data from earlier in the school year. To do so, we took students' Star scores from tests taken more than 30 days prior to the Smarter Balanced testing mid-date and used national growth norms (Renaissance, 2016a, 2016b) to project what their Star scores would be at the mid-date. Then the scale linkage table was used to look up the projected Star scores (or the average of the projected scores for students with multiple Star scores in the predictive sample) to see how they translated to the Smarter Balanced scale.

## Smarter Balanced cut scores and corresponding Star score equivalents

Smarter Balanced results are reported in scaled scores that describe each student's location on an achievement continuum ranging from 2114 to 2769 for ELA/literacy and 2189 to 2802 for mathematics and using four achievement levels: *Level 1, Level 2, Level 3, and Level 4*.

A main purpose in linking Star Reading and Star Math to the Smarter Balanced assessments was to identify Star scores approximately equivalent to the cut-off scores that separate the Smarter Balanced achievement levels. Table 1 displays these equivalent Star scores for grade 3–8 in reading and math. The corresponding Smarter Balanced cut scores can be found in the Appendix B.

Table 1. Star Reading® and Star Math® score equivalents for each Smarter Balanced achievement level range

Star Reading® cut-score equivalents				
Grade	Level 1	Level 2	Level 3	Level 4
3	0 – 332	333 – 454	455 – 561	562 – 1400
4	0 – 434	435 – 530	531 – 660	661 – 1400
5	0 – 483	484 – 599	600 – 852	853 – 1400
6	0 – 499	500 – 691	692 – 1015	1016 – 1400
7	0 – 576	577 – 772	773 – 1168	1169 – 1400
8	0 – 589	590 – 857	858 – 1249	1250 – 1400
Star Math® cut-score equivalents				
Grade	Level 1	Level 2	Level 3	Level 4
3	0 – 546	547 – 620	621 – 686	687 – 1400
4	0 – 602	603 – 695	696 – 771	772 – 1400
5	0 – 692	693 – 781	782 – 826	827 – 1400
6	0 – 716	717 – 807	808 – 859	860 – 1400
7	0 – 745	746 – 830	831 – 885	886 – 1400
8	0 – 783	784 – 851	852 – 891	892 – 1400

# Results

## Accuracy of scale linkage confirmed

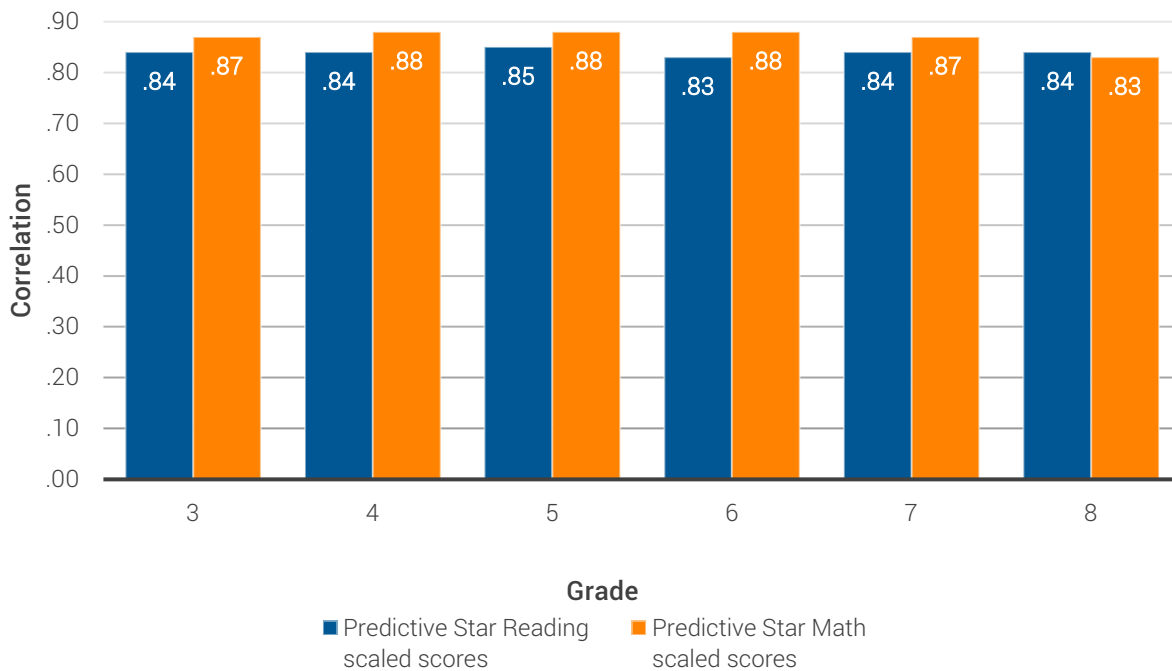
In evaluating the accuracy of the scale linkage, we used two methods to examine the differences between students' observed (actual) Smarter Balanced scores and our Star equivalents: (1) computing the RMSEL (the root mean squared errors of linking) using the scores from the linking study, and (2) applying 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.

## Predictive Star scores correlate highly with actual Smarter Balanced scores

To summarize the predictive power of Star Reading and Star Math, we calculated raw correlations between observed (actual) Smarter Balanced scores and projected Star scores. As figure 2 shows, the predictive correlation showed a strong relationship between the assessments (similar to the correlations from the concurrent sample, see figure 1, p. 4), indicating that earlier Star scores have a strong relationship with end-of-year Smarter Balanced scores. For reading, the correlations averaged .84 and for math, the associations were also high, averaging .87.

Star scores have a strong relationship with end-of-year Smarter Balanced scores.

Figure 2. Projected scores from Star Reading® and Star Math® highly correlate with Smarter Balanced scores



## Star scores discriminate well between students who score proficient or not

Using the sample of actual Smarter Balanced scores, we were able to compare how our projected Star scores aligned with the observed Smarter Balanced scores. Table 2 displays classification diagnostics about whether students were correctly or incorrectly classified as proficient or not on the Smarter

Balanced assessments using projected Star scores. On average, students were correctly classified (i.e., overall classification accuracy) 84% of the time for reading and 87% of the time for math.

For Area Under the ROC Curve (AUC), a summary measure of diagnostic accuracy, Star Reading and Star Math averaged .92 and .94, respectively (also displayed in table 2). 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 2. Proficiency forecasting using Star Reading® and Star Math® scores yields accurate results

Star Reading®						
Measure	Grade					
	3	4	5	6	7	8
Overall classification accuracy (percentage of correct classifications)	85%	84%	85%	83%	84%	84%
Area Under the ROC Curve	0.93	0.93	0.93	0.91	0.92	0.92
Star Math®						
Measure	Grade					
	3	4	5	6	7	8
Overall classification accuracy (percentage of correct classifications)	86%	86%	88%	86%	88%	86%
Area Under the ROC Curve	0.94	0.94	0.95	0.94	0.95	0.93

Other diagnostic accuracy measures studied:

- ✓ **Sensitivity** represents the percentage of proficient students that were correctly forecasted, which for Star Reading averaged 86% and for Star Math averaged 84%.
- ✓ **Specificity** represents the percentage of not-proficient students that were correctly forecasted, which for Star Reading averaged 82% and for Star Math averaged 88%.
- ✓ **Positive predictive values** indicate that when Star scores forecasted students to be proficient, they actually were proficient 84% of the time for Star Reading and 84% of the time for Star Math.
- ✓ **Negative predictive values** indicate that when Star scores forecasted students to miss proficiency, they actually weren't proficient 85% of the time for reading and 88% of the time for math.
- ✓ **Proficiency status projection error**, the difference between actual and projected proficiency rates, indicates how well scores accurately predict proficiency within each grade. Star Reading average 1% and Star Math averaged 0% (negative scores indicate under-prediction while positive scores show over-prediction).

## Appendix A: About Star Reading<sup>®</sup> and Star Math<sup>®</sup>

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—as often as weekly—when used in progress monitoring programs.

RENAISSANCE  
**Star Reading<sup>®</sup>**

RENAISSANCE  
**Star Math<sup>®</sup>**

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: Smarter Balanced achievement levels

Table B1. Smarter Balanced achievement level score ranges

Smarter Balanced achievement level score ranges: English language arts/literacy				
Grade	Level 1	Level 2	Level 3	Level 4
3	2114 – 2366	2367 – 2431	2432 – 2489	2490 – 2623
4	2131 – 2415	2416 – 2472	2473 – 2532	2533 – 2663
5	2201 – 2441	2442 – 2501	2502 – 2581	2582 – 2701
6	2210 – 2456	2457 – 2530	2531 – 2617	2618 – 2724
7	2258 – 2478	2479 – 2551	2552 – 2648	2649 – 2745
8	2288 – 2486	2487 – 2566	2567 – 2667	2668 – 2769
Smarter Balanced achievement level score ranges: Mathematics				
Grade	Level 1	Level 2	Level 3	Level 4
3	2189 – 2380	2381 – 2435	2436 – 2500	2501 – 2621
4	2204 – 2410	2411 – 2484	2485 – 2548	2549 – 2659
5	2219 – 2454	2455 – 2527	2528 – 2578	2579 – 2700
6	2235 – 2472	2473 – 2551	2552 – 2609	2610 – 2748
7	2250 – 2483	2484 – 2566	2567 – 2634	2635 – 2778
8	2265 – 2503	2504 – 2585	2586 – 2652	2653 – 2802



# 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. (2016a). *STAR Math: Technical manual*. Wisconsin Rapids, WI: Author. Available by request to [research@renaissance.com](mailto:research@renaissance.com)
- Renaissance Learning. (2016b). *STAR Reading: Technical manual*. Wisconsin Rapids, WI: Author. Available by request to [research@renaissance.com](mailto: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>