STAR Reading and STAR Math growth among Students Attending Alternative Schools across the US

A RESEARCH STUDY

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Background
The RLI Research department was asked by Momentum Strategy and Research to investigate what growth looks likes among students in non-traditional educational programs. The request was facilitated by Carolyn Denny. Momentum would like to better understand achievement and growth for students who might have dropped of school, but returned, and those whom are at high-risk of dropping out in the future.

Ways to measure student growth
Decile based growth norms
Since it is important to measure students' growth on academic achievement over their school career, STAR assessments were constructed to provide a vertical scale that can be used to follow student growth both within an academic year and across contiguous academic years. STAR was designed specifically to allow educators to follow students' growth over time.

Because STAR Reading and Math assessments are so widely used, Renaissance Learning has data for millions of testing events. With these scores, we are able to calculate growth norms. In other words, we can approximate how much growth is typical for students of different achievement levels in different grades from one time period to another. Renaissance Learning first incorporated growth modeling into STAR Math reporting in 2008 via decile-based growth norms, allowing for norm-reference comparisons of student absolute growth.

Growth norms in the STAR assessment were developed for each grade by following students across the entire academic year, ranging from August to June (depending on the specific schedule for each school). Students were tested both at the beginning and end of the school year (during the fall and spring semesters, respectively), allowing the student growth estimates to be computed across the academic year. To normalize differences in time between the initial test and the final test at the end of the school year, the measure of growth (change in score from fall to spring testing) was divided by the number of weeks between the assessment occasions to obtain an estimate of typical growth per week for all students.

Growth rates of students should be compared to students of similar academic achievement levels; otherwise, there is the potential to expect too much or too little growth from certain students. To account for differences in student growth, both across grades and within grades during an academic year, growth norms were developed by using information about grade and level of performance to construct homogeneous student groupings for comparison. The within-grade groupings were done by partitioning students into decile groups based on their initial Percentile Rank scores within a school year. STAR growth norms were constructed by following students within each decile of each grade across the entire academic year. This provided a means to compute a distribution of growth scores for every decile group for all grades, i.e. 10 decile groups for each grade will each have their own growth norms distribution. The growth norms are thus conditional on both grade and decile level of student initial performance during the academic year. Since students develop academic skills at different rates as they mature and move across the grades, they also develop and grow at different rates within each grade depending on where they score in the overall distribution of performance. Students who score in

the top decile for a grade do not (and should not be expected to) grow at the same rate across the academic year as students in the middle or lower deciles, and vice versa.

Student Growth Percentiles

Student Growth Percentiles (SGPs) represent the latest advancement in helping educators understand student growth. SGPs are a normative quantification of individual student growth derived using quantile regression techniques. An SGP compares a student's growth to that of his or her academic peers nationwide. SGPs from STAR Math provide a measure of how a student changed from one STAR testing window[1] to the next, relative to other students a similar starting STAR score. SGPs range from 1–99 and interpretation is similar to that of Percentile Rank scores; lower numbers indicate lower relative growth and higher numbers show higher relative growth. For example, an SGP of 70 means that the student's growth from one test to another exceeds the growth of 70% of students in the same grade with a similar beginning (pretest) STAR score.

The calculation of SGPs in STAR required the incorporation of time into the SGP model. Taking this approach varies from the typical SGP approach in that it uses a combination of a student's pretest score along with his or her weekly rate of growth, instead of simply pre- and posttest scaled scores. Quantile regression was applied to characterize the bivariate distribution of students' initial scores and weekly rates of growth. Students were grouped by grade and subject, and then quantile regression was used to associate every possible initial score and weekly growth rate combination with a percentile corresponding to the conditional distribution of weekly growth given the initial score.

The result of these analyses was the creation of a look-up table in which initial STAR scores along with weekly growth rates are used as input to define a Student Growth Percentile (Time-Adjusted Model) for each grade, subject, and time period (e.g., fall to winter, winter to spring, fall to spring). The use of quantile regression techniques makes construction of such tables possible even though not all possible initial and ending score combinations were observed in the student data. In general, the quantile regression approach can be viewed as a type of smoothing in which information from neighboring score values (initial scores and weekly rates of growth) can be used to inform percentiles for hypothetical score combinations not yet observed.

As such, application of the methodology allows us to look up any score combination to obtain the percentile cut-points for the weekly growth rate conditional achievement distribution associated with the given initial score. These cut-points are the percentiles of the conditional distribution associated with the student's prior achievement. Specifically, using the quantile regression results of the sixth-grade STAR weekly growth rate on fall scores, we can calculate estimates for the 1st, 2nd, 3rd,…99th percentiles of growth from fall to spring can be calculated. Using each of these cut-points, we are able to calculate a Student Growth Percentile (Time-Adjusted Model) for every subject, grade, and score combination.

In applying the SGP (Time-Adjusted Model) approach to STAR data, Renaissance Learning has worked closely with the lead developer of SGP, Dr. Damian Betebenner, of the Center for Assessment, as well as technical advisor Dr. Daniel Bolt, an expert in quantitative methods and educational measurement from the University of Wisconsin–Madison.

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[1] STAR assessment data for SGPs is collected during three different time periods: fall (Aug 1 – Nov 30), winter (Dec 1 – Mar 31), and spring (Apr 1 – July 31).

Sample Information

Unfortunately, identifying students as being at high-risk of dropping out of school is not possible through our internal data. Because of the lack of student level data on their risk status, we had to rely on schools' categorization as an alternative school as a proxy for student risk. as RLI relies on an externally purchased database of school level characteristics to retrieve this information and has no control over which schools were and were not flagged as "alternative." The criteria used for categorizing schools as Alternative is not clearly defined; However, Momentum Strategy & Research has collected lists of alternative schools from state departments of education websites (based on each state's definition) and was able to cross reference RLI's list of Alternative schools with their own.

For purposes of this research, Momentum filtered out schools that specialized solely in serving special education students; such as schools for deaf and blind students, or schools serving autistic students, and only included schools that maintained a mission to serve "high-risk" students. (High-risk students are defined as those that are over-age and under-credited, prior dropouts, pregnant or parenting students, students the have been expelled or chronically suspended, students with a history of truancy, criminal activity, drug or alcohol abuse, and the like). The initial list of schools consisted of over 300 schools. Momentum returned a list of 208 schools that they confirmed as being alternative.

Data analyses

We analyzed STAR Reading and STAR Math data from all the alternative schools over the past 3 school years (2011-12, 2012-13, and 2013-14). The number of students using STAR Reading or STAR Math during any of those school years is displayed below, in Table 1.

Table 1. Number of students using STAR at Alternative schools during 2011-12, 2012-13 or 2013-14

Grade	STAR Reading			STAR Math		
	2011-12	2012-13	2013-14	2011-12	2012-13	2013-14
K	11	4	3	10	6	2
1	130	134	182	188	163	153
2	148	188	206	216	183	179
3	357	443	421	434	456	424
4	430	403	458	519	419	467
5	471	508	453	554	539	478
6	417	657	754	532	724	756
7	818	1,063	1,246	1,011	1,180	1,246
8	1,265	1,839	1,928	1,529	1,865	1,978
9	4,327	5,403	6,155	5,047	5,731	6,217
10	4,571	6,048	7,248	5,354	6,422	6,974
11	3,780	5,070	6,372	4,532	5,781	6,633
12	3,236	4,029	5,369	4,029	4,996	5,871
Total	19,961	25,789	30,795	23,955	28,465	31,378

Weekly growth rates

Each year we analyze millions of STAR records to describe the expected or typical growth pattern for students in different grades with different Fall scores. We know that students develop at different rates within each grade and depending on where they score in the overall distribution of performance, students whose Fall score is at a high percentile rank do not, and should not be expected to, grow at the same rate across the academic year as students with percentile ranks in the middle or lower range, and vice versa. We split students into deciles based on their Fall percentile rank score. Students with percentile ranks between 1 and 10 are in the first decile, students with percentile ranks between 11 and 20 are in the second decile, and so on. Once students are grouped by subject, grade, and decile we look at all STAR records and determine the median weekly growth rates among each group and call these our typical or expected rates of growth. Figures 2 through 5 on the following pages compare these expected rates of growth to the median rates of growth seen among students at Alternative schools. Growth among students at Alternative schools in grades 1 to 6 for both STAR Reading and Math tended to grow near expected rates. However, the growth for students in grades 7 to 12 tended to be more variable and lower than the expected rates.

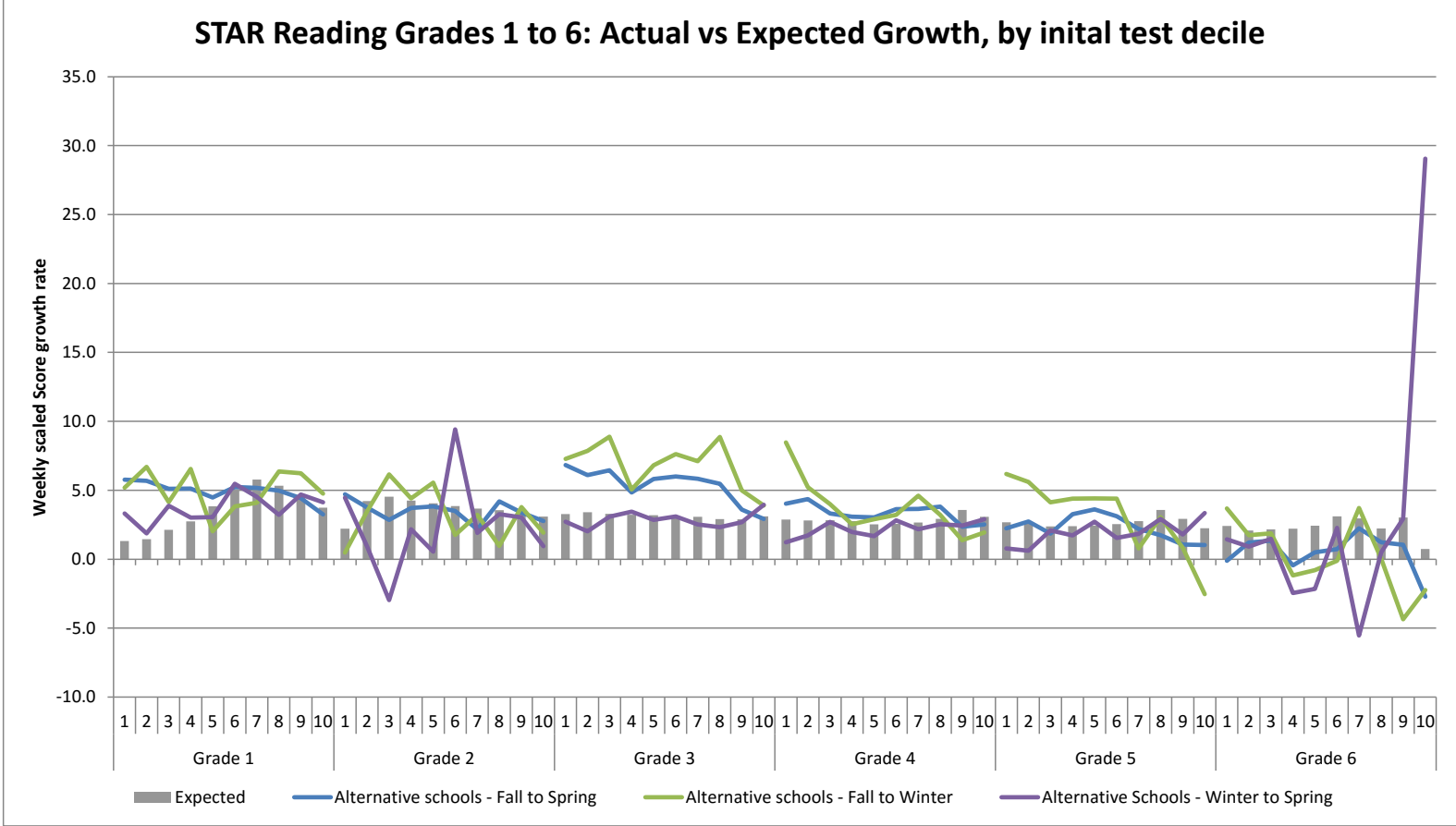STAR Reading Grades 1 to 6: Actual vs Expected Growth, by inital test decile

Figure 3. STAR Reading median growth rate at Alternative schools compared to expected growth rates, Grades 7 through 12

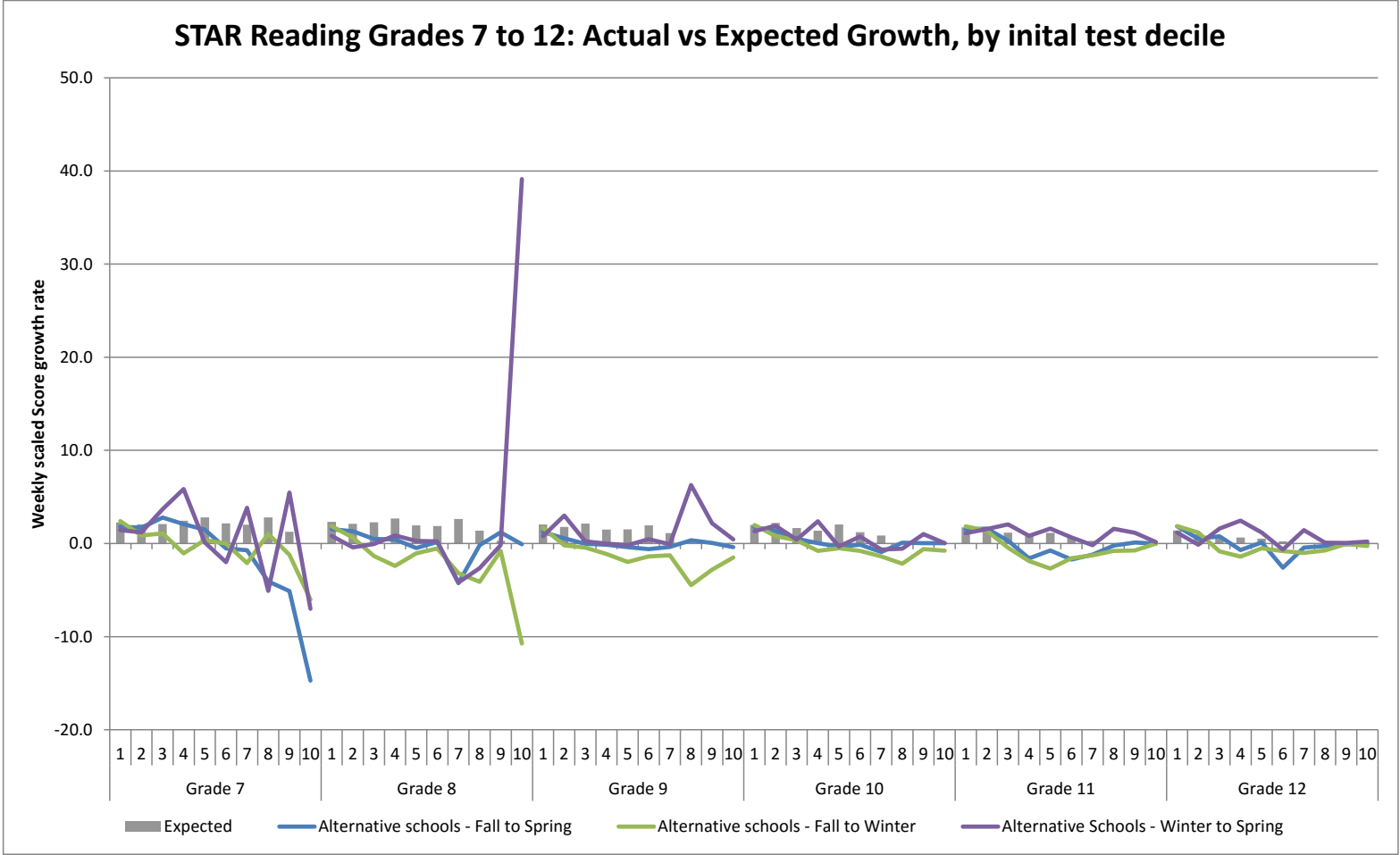**STAR Reading Grades 7 to 12: Actual vs Expected Growth, by inital test decile**

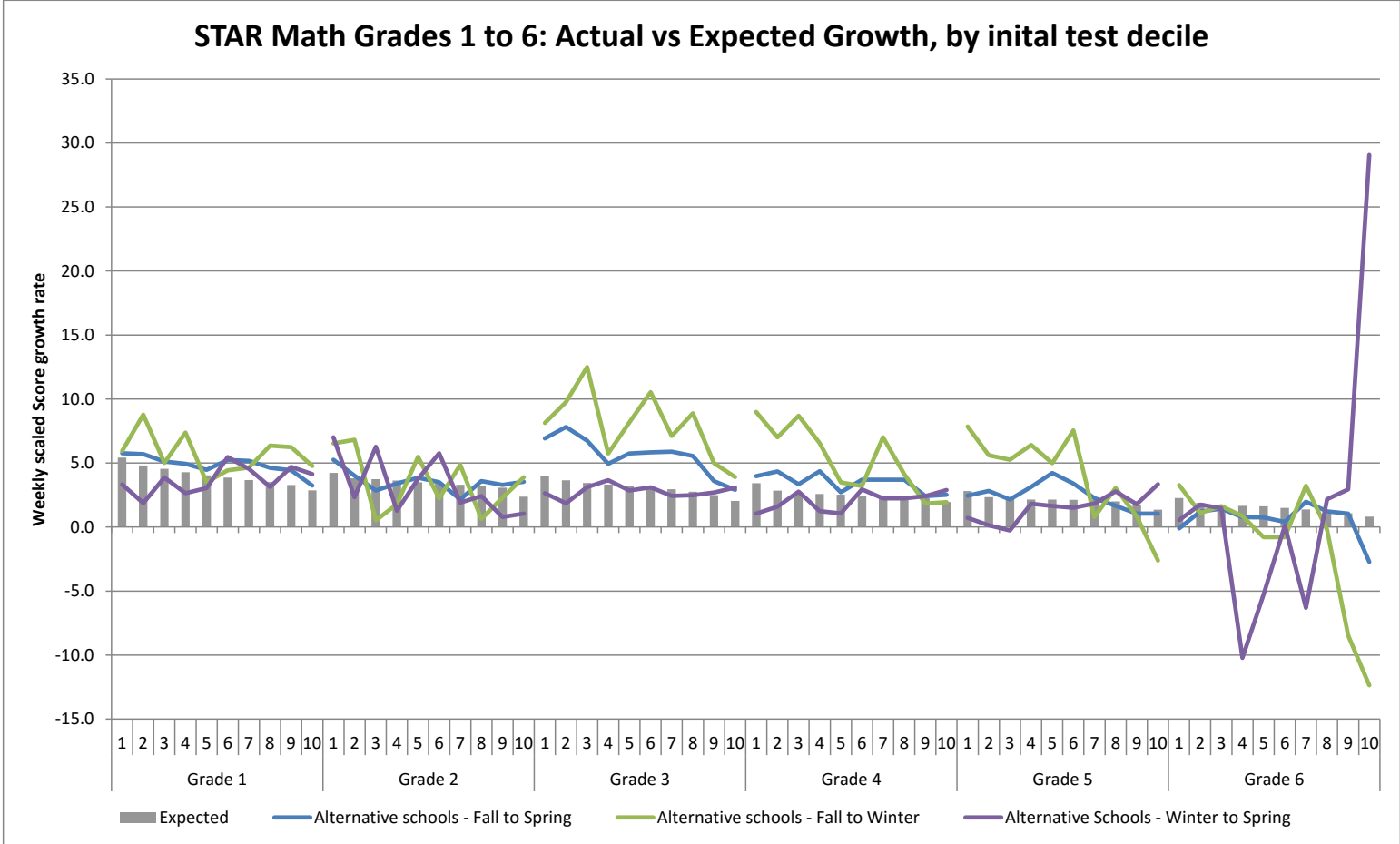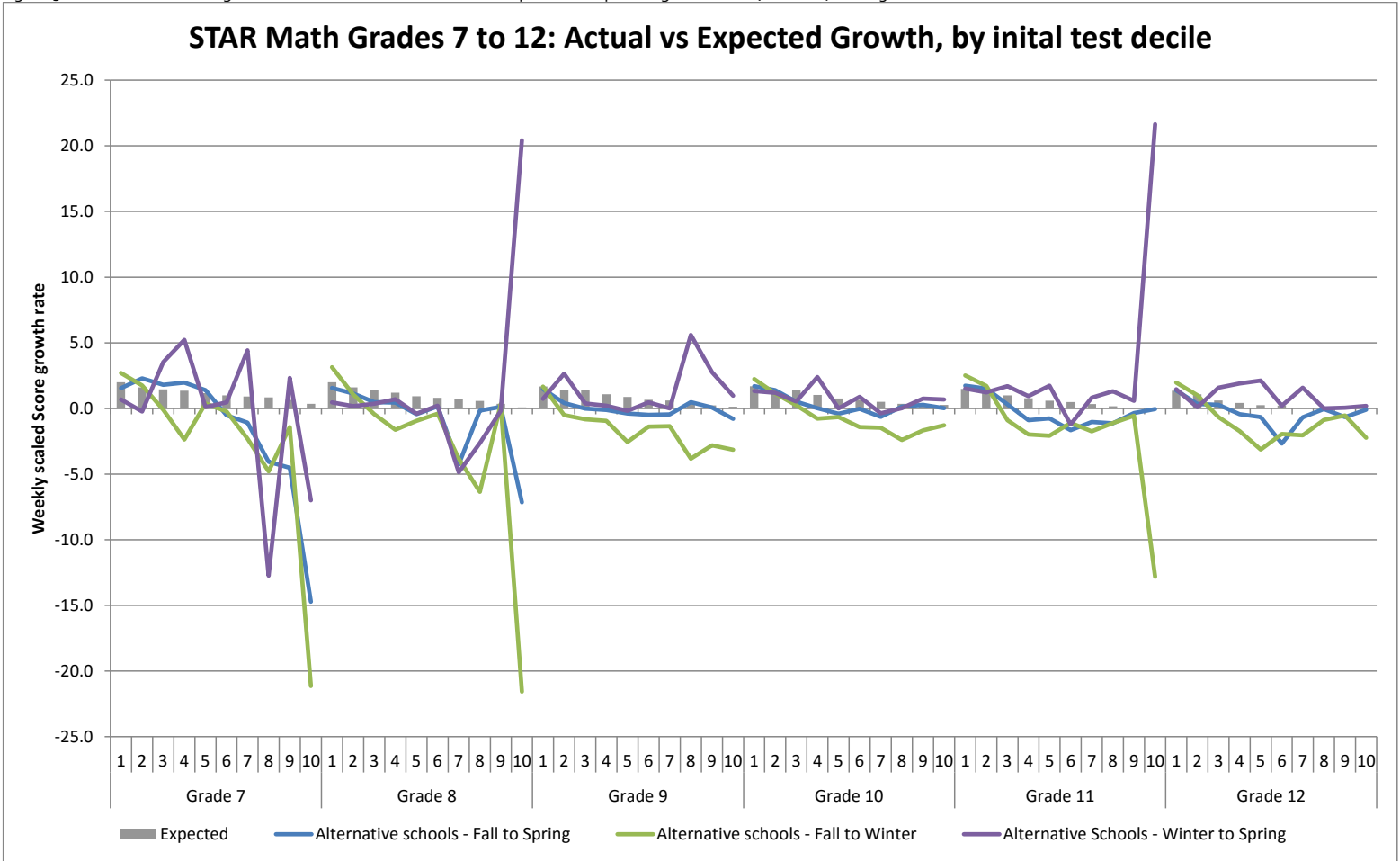Figure 4. STAR Math median growth rate at Alternative schools compared to expected growth rates, Grades 1 through 6

STAR Math Grades 1 to 6: Actual vs Expected Growth, by inital test decile

STAR Math Grades 7 to 12: Actual vs Expected Growth, by inital test decile

Student Growth Percentiles (SGPs)

At the Alternative schools we looked at, the majority of the students (60%, n=96,740) only took 1 STAR Reading or STAR Math assessment during a given school year. 21% (n=33,328) of the students took two STAR Reading or STAR Math tests in a school year, 11% (n= 17,271) took three STAR Reading or STAR Math tests in a school year. Overall, 40% (n=63,603) of the students took two or more STAR Reading or STAR Math tests in a school year. Of these students with two or more STAR tests 15,149 (24%) tested in both the Fall and the Spring of the school year, allowing them to receive an SGP for their growth from Fall to Spring. 21,468 (34%) students tested in both the Fall and the Winter of the school year, allowing them to receive an SGP for their growth from Fall to Winter. 26,295 (41%) students tested in both the Winter and the Spring of the school year, allowing them to receive an SGP for their growth from Winter to Spring.

Tables 2, 3 and 4 on the following pages display the number of students with SGPs in each timeframe by grade along with some descriptive information about their STAR test scores and their SGPs. The average NCE scores of the students tended to decrease as grade increased, with high schools students also showing the lowest Fall, Winter, and Spring achievement levels.

Table 2. Number of students with Fall and Spring scores using STAR at Alternative schools during 2011-12, 2012-13 or 2013-14

Grade	STAR Reading						STAR Math					
	N	Avg Fall Scaled Score	Avg Fall NCE	Avg Spring Scaled Score	Avg Spring NCE	Median SGP	N	Avg Fall Scaled Score	Avg Fall NCE	Avg Spring Scaled Score	Avg Spring NCE	Median SGP
1	211	238	42.5	416	59.6	68	209	239	42.4	417	59.4	67
2	132	327	46.5	473	51.8	50	123	371	46.9	517	53.9	56
3	654	372	41.0	579	51.9	82	636	375	41.1	586	52.3	83
4	431	477	42.7	616	52.0	54	380	489	42.9	633	53.1	54
5	415	589	46.6	680	48.5	41	378	601	47.0	698	49.6	43
6	230	655	42.4	682	40.8	30	198	678	42.8	704	41.4	32
7	378	604	31.6	651	34.3	39	335	643	33.4	692	36.9	39
8	503	676	31.4	691	30.4	35	494	690	32.2	703	31.0	35
9	1,356	698	28.9	710	27.3	39	1,364	699	28.9	714	27.7	39
10	1,526	743	31.2	779	32.5	43	1,505	742	31.4	777	33.1	43
11	1,034	808	32.5	813	32.0	44	923	787	31.6	799	32.2	45
12	902	818	31.2	840	31.7	52	832	778	28.6	800	29.5	50
Total	7,772	-	-	-	-	45	7,377	-	-	-	-	45

Table 3. Number of students with Fall and Winter scores using STAR at Alternative schools during 2011-12, 2012-13 or 2013-14

Grade	STAR Reading						STAR Math					
	N	Avg Fall Scaled Score	Avg Fall NCE	Avg Winter Scaled Score	Avg Winter NCE	Median SGP	N	Avg Fall Scaled Score	Avg Fall NCE	Avg Winter Scaled Score	Avg Winter NCE	Median SGP
1	176	200	45.1	308	54.2	55	140	232	45.3	362	58.5	63
2	85	200	38.3	269	38.6	40	46	360	41.6	428	45.8	46
3	601	351	39.2	487	50.2	77	552	361	39.9	504	51.8	81
4	341	468	41.6	564	48.7	57	284	487	41.9	595	50.7	66
5	246	535	42.0	601	43.3	55	206	554	42.9	633	45.6	60
6	204	611	38.3	618	35.2	39	146	620	35.0	620	31.4	38
7	447	603	30.6	609	29.6	40	385	627	29.8	631	29.2	41
8	747	643	29.3	643	27.8	39	677	662	29.6	667	28.8	41
9	2,112	692	28.5	690	27.7	43	1,955	696	28.5	693	27.8	43
10	2,530	741	30.8	754	31.6	45	2,446	743	31.5	755	32.5	46
11	1,966	792	31.7	788	31.0	47	1,727	783	32.0	779	31.9	47
12	1,879	816	30.7	817	30.5	50	1,570	794	29.7	789	29.8	49
Total	11,334	-	-	-	-	46	10,134	-	-	-	-	47

Table 4. Number of students with Winter and Spring scores using STAR at Alternative schools during 2011-12, 2012-13 or 2013-14

Grade	STAR Reading						STAR Math					
	N	Avg Winter Scaled Score	Avg Winter NCE	Avg Spring Scaled Score	Avg Spring NCE	Median SGP	N	Avg Winter Scaled Score	Avg Winter NCE	Avg Spring Scaled Score	Avg Spring NCE	Median SGP
1	200	341	57.9	401	60.1	57	215	353	57.7	409	58.7	53
2	160	413	52.3	455	51.8	54	151	457	53.1	499	53.2	53
3	739	494	51.3	579	51.8	60	722	499	51.5	584	52.0	60
4	858	592	53.8	642	54.4	51	809	601	54.3	651	54.8	51
5	765	644	51.2	676	49.5	46	724	651	51.7	683	49.8	46
6	345	664	40.6	685	41.3	45	326	674	40.0	691	40.6	44
7	483	641	32.4	663	32.6	44	468	659	32.6	673	32.2	43
8	789	691	31.6	698	30.0	42	785	692	31.1	695	29.8	41
9	2,344	698	28.1	703	27.0	43	2,280	704	28.6	707	27.6	43
10	2,858	756	31.6	777	32.9	46	2,840	756	32.2	777	33.6	45
11	2,205	800	31.9	812	32.0	46	1,984	791	32.3	801	32.4	46
12	1,686	826	31.2	839	31.8	50	1,559	803	30.1	819	31.2	50
Total	13,432	-	-	-	-	47	12,863	-	-	-	-	47

Figures 1, 2 and 3 below, and on the following pages depict the median SGPs for each grade and subject and timeframe. The blue bars represent the median SGPs among students at the Alternative schools. The grey band represents what is considered the "typical" range for SGPs; 35 to 65 (this is the range identified by the majority of states who have adopted SGP usage). For the vast majority of grade and subject combinations the SGPs of students at Alternative schools fell within the "typical" band.

Figure 1. Median Fall to Spring STAR SGPs among students at Alternative schools.
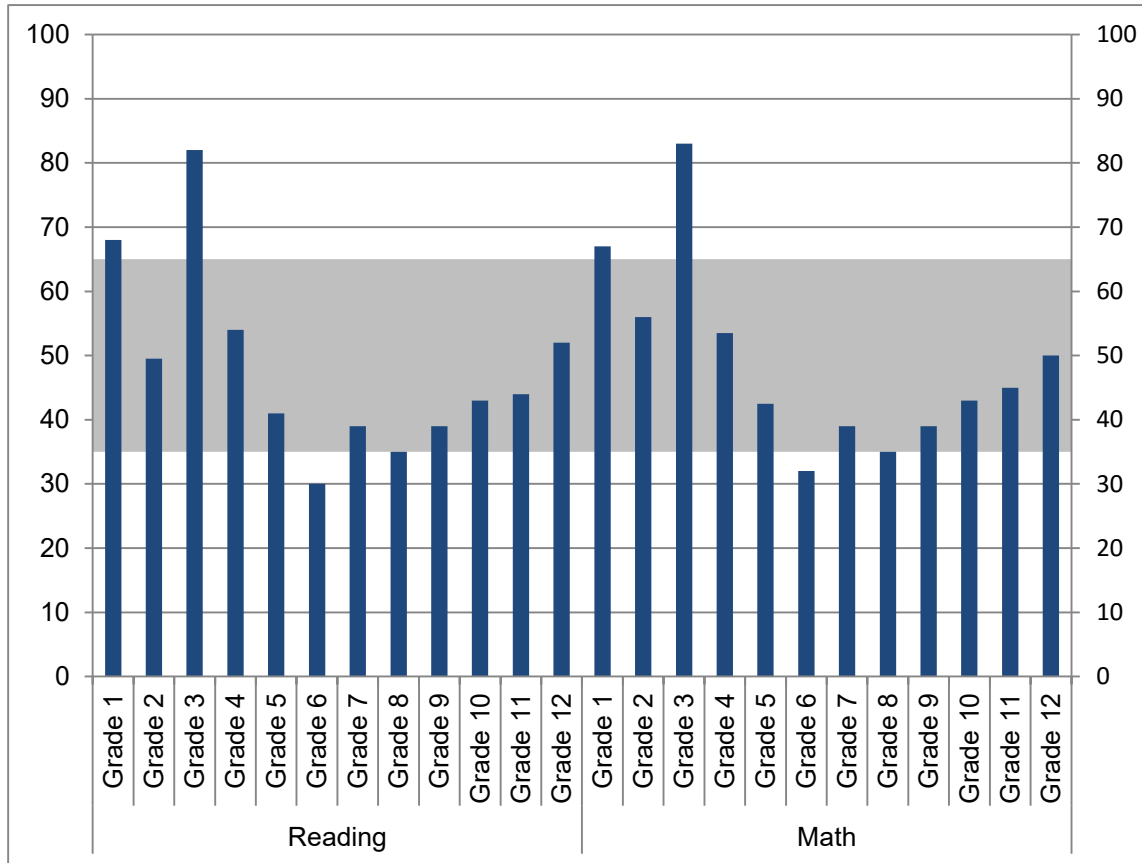
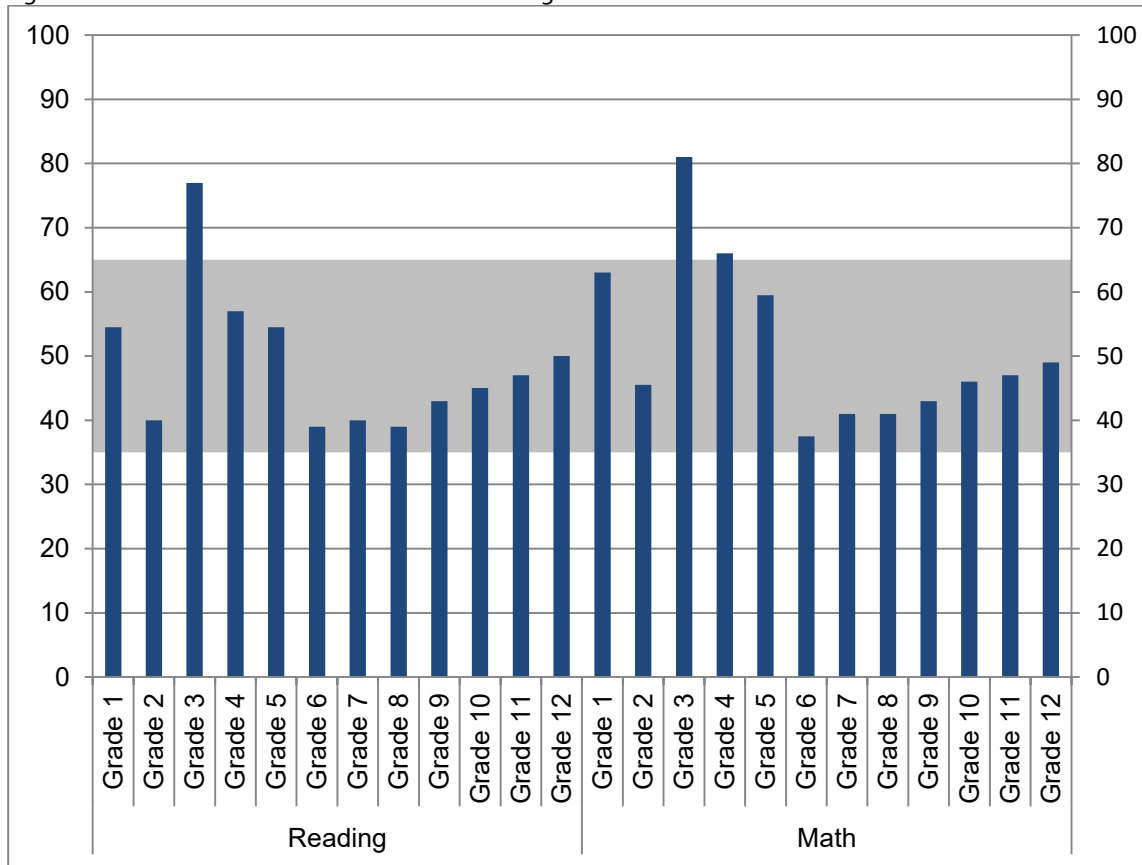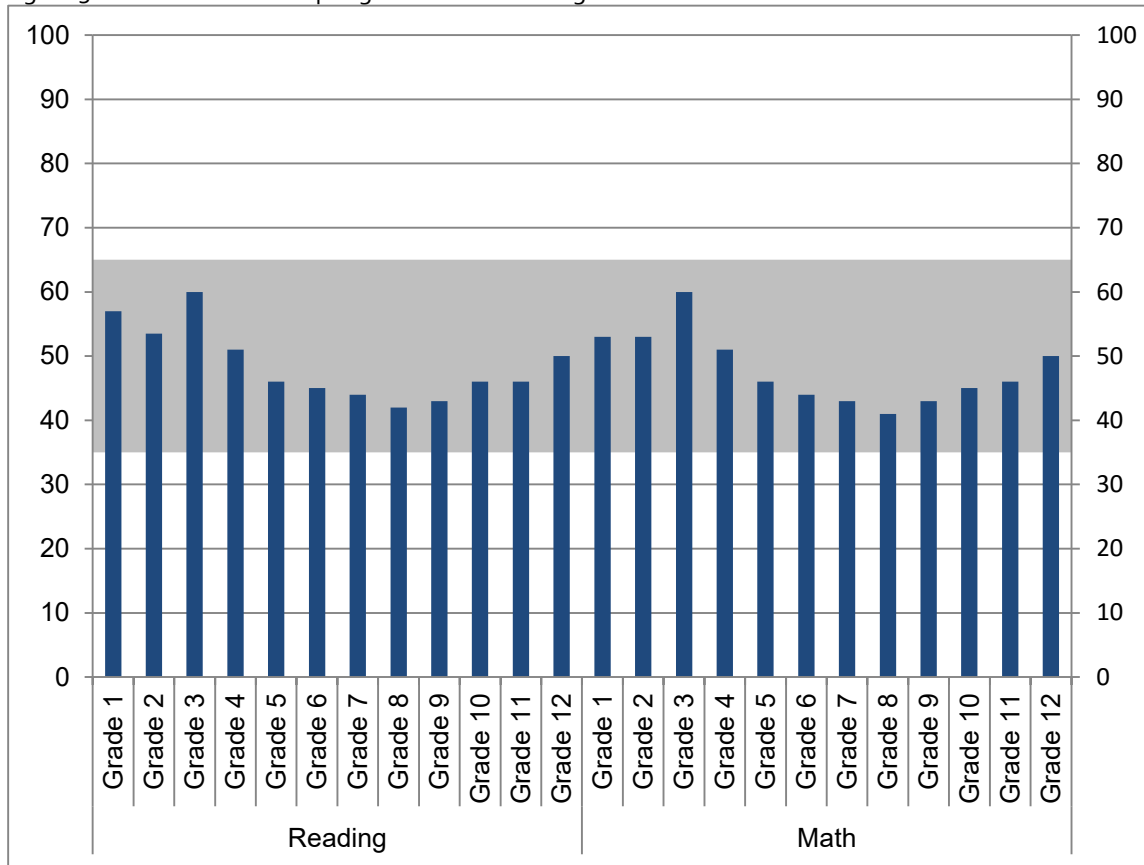Figure 2. Median Fall to Winter STAR SGPs among students at Alternative schools.

Figure 3. Median Winter to Spring STAR SGPs among students at Alternative schools.

Potential Implications

Though the students attending alternative schools do grow at "typical" rates, there is a tendency for these students to have lower median growth percentiles than their same grade peers for whom we have STAR math and reading data. These results are similar to research previously conducted by Momentum's vice president of research and policy analytics, Dr. Jody Ernst, using both state standardized assessments in Colorado and Arizona and another nationally normed assessment of mathematics and reading.

For schools serving high proportions of high-risk students, schoolwide growth expectations may need to be adjusted—particularly when schools' results are being used for high-stakes decisions such as charter school renewal or school accreditation. Further research on median growth at the school level would inform to what extent, if at all, goals for schools' growth results need to be adjusted.

If high-risk students are growing at a slower rate, on average, there may also be implications impacting the amount of instructional time high-risk students require to keep up with the peers.

Limitations

Due to the transient nature of students enrolled in alternative programs, the analyses outlined above includes only those students that remained at the same school for at least half of a school year and had at least two assessment results. This resulting sub-sample is a very small fraction of all students represented in the overall sample of students for whom STAR has at least one assessment result. Therefore, the sub-sample is not likely to be representative of all students, and the results presented in this report should be used with caution.

As stated in the body of the report, we relied on a purchased list of schools that identified schools as alternative. These schools were cross referenced, by Momentum, against a list of alternative schools obtained from state department of education websites. Momentum was conservative in its inclusion of schools. As a result, it is possible that alternative schools were left out because the nature of the schools mission and/or target student population was not clear. It is less likely, though possible, that schools that are not alternative were included in the analysis.