A Study of Initial Status and Growth in Reading and Math Associated with Summer School Participation in Wyoming (Final Version)

Working Paper Prepared for Wyoming Department of Education by
Michael Flicek, Ed.D.

Abstract

This paper investigated the initial status and growth in reading and math test scores that were associated with summer school attendance in eight Wyoming school districts. Attending summer school was associated with significantly high growth in reading during the summer for students in grades 5 through 8 and in math for students in grades 3 and 4 and grades 7 and 8. Attending summer school was also associated with near zero growth for students in grades 3 and 4 for reading and students in grades 5 and 6 for math. As such, two of the three grade level samples in this study in each content area had significantly high growth during the summer that was associated with summer school attendance.

Introduction

Following the summer of 2007, Flicek (2007) studied the initial status and growth in reading and math skills associated with summer school participation for students in Natrona County School District (NCSD) over the summers of 2006 and 2007. The current study investigated achievement effects associated with attending summer school in 2008 with a sample that was expanded to include other Wyoming districts as will be described below. This study is intended to be one of an ongoing series of studies of summer school effects. As described in the Flicek (2007) paper, funding for summer programs was authorized in Wyoming to address the loss of academic skills that research had demonstrated to be more pronounced among students from disadvantaged background (e.g., see Cooper, Charlton, Valentine, and Muhlenbruck, 2000). Students with low achievement are currently eligible for participation in summer school programs.

Analyses completed for this study addressed the initial status and growth in reading and math that were associated with summer school participation for three samples of students in reading and three samples in math. Each sample studied was from adjacent grades. There were samples from grades 3 and 4, grades 5 and 6, and grades 7 and 8 in both reading and math. For each of the samples, the effect associated with attending summer school for one summer (i.e., summer 2008) was investigated. In all cases, students on free/reduced lunch and in special education were overrepresented in the summer school samples. This was addressed by using hierarchical linear modeling (HLM) and entering free/reduced lunch status (i.e., yes or no) and special education status (i.e., yes or no) along with summer school status (i.e., yes or no) into the initial final models for initial achievement status and for achievement growth. By entering free/reduced lunch and special education into the model when they made a significant contribution to the growth slope it was possible to identify the effect associated with summer school participation that was independent of the effects associated with these other variables. Two growth slopes were modeled. One was for the spring-to-fall-to-spring prior to summer school and the second was for the spring-to-fall during which summer school was in session. It was the effect of summer school attendance on growth evident in this second growth slope that was of interest to the principal question of this study. Specifically, was summer school attendance associated with a positive effect for growth in reading and math during the summer that students were in summer school?

Method

Samples

The total sample consisted of students from eight Wyoming school districts who were in grades 3 through 8 during the spring of 2008. Table 1 shows the total number of students from each district and the number of students from each district who were in summer school in each of the three grade level combinations that were studied. Students on free/reduced lunch were overrepresented in the summer school. In the six samples studied, from 28% to 33% of the student not in summer school were on free/reduced lunch. For students attending summer school, however, from 42% to 51% of students were on free/reduced lunch. Chi square analysis showed that in all samples the difference in proportion of free/reduced lunch students in the summer school sample was significantly greater than that in the not summer school sample (i.e., $p < .001$). Students in special education were also overrepresented in the summer school sample. In the six samples studied, from 11% to 13% of the student not in summer school were in special education. For students attending summer school, however, from 19% to 26% of students were in special education. The differences in proportion for special education students in the summer school and not summer school samples were statistically significant (i.e., $p < .001$).

Measures

The Measures of Academic Progress (MAP) tests from the Northwest Evaluation Association were used to measure reading and math achievement for this study. These tests are well suited for studying initial status (i.e., where students start) and growth in achievement over time since they are adaptive tests with a vertical scale. Adaptive tests will adjust item difficulty for individual students based upon the pattern of correct and incorrect responses that a student provides. As such, these tests have high reliability and accuracy for students at all achievement levels, including students with low achievement for their grade in school and students with very high achievement. All items on these tests are multiple choice and they are calibrated on a vertical scale so that total scores (i.e., scale scores that are referred to as RIT scores) have a comparable meaning independent of a student's grade in school. The distance between any two points on the scale are an equal so that the scale can be thought of as functioning like a ruler of reading or math skills. There is a national norm sample for the tests with more than one million students.

Analyses

To investigate the impact of summer school attendance on reading and math initial status and growth, two level HLM models were employed where test occasion *i* was at level 1 and between student *j* was at level 2. Piecewise linear models of reading and math achievement were employed which included a separate growth slope for spring '07-fall '07-spring '08 prior to the entry of the student into summer school and then another slope for spring '08-fall '08 during the time that the students were in summer school.

As recommended by Singer and Willett (2003) and Holt (2008) for both reading and math the unconditional means model was fitted first in order to partition the variance between the two levels and to serve as a baseline for future models. The model is presented in equation 1. The equation partitions the reading scale score or the math scale score, depending upon which content was entered into the model, into between-student (E) and within-student (R0) components. In the model Y is reading or math achievement for student *i* at time *j.*

Level-1 Model (1)

Y = P0 + E

Level-2 Model

P0 = B00 + R0

Next, an unconditional growth model was employed which fit a linear trajectory to each student in the data set for both growth slopes. SLOPE1, the time predictor for growth for spring '07-fall '07-spring '08 and SLOPE2 is the time predictor for growth for spring '08-fall '08. Time was coded in months with fall to spring growth set at 9 months and spring to fall growth set at 3 months. As a result the obtained initial status coefficient represented status at the first fall test and the growth coefficients represented monthly growth. Equation 2 presents the unconditional growth model with random effects.

Level-1 Model (2)

Y = P0 + P1*(SLOPE1) + P2*(SLOPE2) + E

Level-2 Model

P0 = B00 + R0

P1 = B10 + R1

P2 = B20 + R2

When a Chi-square test indicated that either or both linear growth slopes did not vary significantly across individuals, the identified slope was fixed in subsequent models. In each of the three samples for reading and three samples for math, at one of the two slopes was fixed. In reading SLOPE2 was fixed for grades 3 and 4 and SLOPE1 was fixed for grades 5 and 6 and grades 7 and 8. In math, SLOPE1 was fixed for all three grade level samples.

Next, a fully conditional model was employed that tested the relationship of summer school participation (SUMMER) with initial status and growth on both slopes controlling for free/reduced lunch (FREE) and special education (SPED). Equation 3 presents an example of the fully conditional model with SLOPE2 fixed.

Level-1 Model (3)

Y = P0 + P1*(SLOPE1) + P2*(SLOPE2) + E

Level-2 Model P0 = B00 + B01*(SPED) + B02*(FREE) + B03*(SUMMER) + R0

P1 = B10 + B11*(SPED) + B12*(FREE) + B13*(SUMMER) + R1

P2 = B20 + B21*(SPED) + B22*(FREE) + B23*(SUMMER)

In all of the grade-by-content area samples each of the three predictor variables made a significant contribution to initial status. For each of the growth slopes, however, some predictors did not make a significant contribution to growth. In these instances the predictors were removed from subsequent models. The only exception to this involved SUMMER. Since the impact of SUMMER on growth during the summer was the principal question of interest in this investigation, SUMMER was retained in SLOPE2 even when it did not make a significant contribution.

The findings of interest were the coefficients for initial status and growth for the principal predictors (i.e, SPED, FREE, and SUMMER) that were obtained from the final model. 80% confidence intervals around the SUMMER coefficient for SLOPE2 were constructed for the purpose of charting the effect of SUMMER on the change in RIT scores that occurred from the spring-to-fall test of the year that the students were in summer school. The use of 80% confidence intervals for the chart, instead of more conventional 95% confidence intervals, is consistent with the recommendation of Cohen (1990, 1992). Using this method, the nil hypotheses would be rejected when the 80% confidence interval did not capture zero. Specifically, we would conclude that there was a positive (or negative) effect associated with SUMMER when the 80% confidence interval did not capture zero. Cohen's recommendation was particularly appropriate in this type of situation since there could be a potentially high cost associated with a type II error (i.e., concluding that summer school was not effective, when, in fact, it was effective). The opportunity of having a summer school program is not likely to come around again in the near future if we were to mistakenly, because of a type II error, conclude that the summer school was not effective, when in fact it was effective. Cohen and others (e.g., Denis, 2006; Thompson, 1996) have been very critical of strict adherence to conventional significance testing practices where findings are not considered significant unless the $p < .05$ level is reached. While this traditional convention guards against a Type I error (e.g., concluding that summer school is effective, when in fact it is not), the critics of this approach have called for more researcher judgment to be employed.

As such, one strong rationale for following Cohen's recommendation is to guard against a type II error because of the potentially negative cost to students that would result if an effective summer school program was scrapped because we erroneously concluded that it was not effective. A second rationale for following Cohen's recommendation involves the issue of replicability and the multi-year nature of this ongoing study. Specifically, we are looking for a pattern of consistent findings over a number of years before we reach a final conclusion about the effectiveness of summer school. Summer offerings will, like most new programs, continue to evolve over time. As the program evolves, the intent of the refinements is to improve effectiveness. This is the reason why committing at least 3 to 5 years to new programs is advisable. Therefore, the pattern of current and future findings will reveal an appropriate conclusion about the effectiveness of the summer school over time. Ideally, we will have positive effect sizes that consistently and increasingly meet and exceed the 80% confidence interval criteria for concluding that tutoring is effective. The problem under investigation is precisely the kind of problem where accepting a slightly increased risk of type I errors to guard against type II errors makes sense.

Results

Reading

Table 2 presents results of fitting subsequent HLM models for reading initial status and growth from spring-to-fall-to-spring and from spring-to-fall for the grade 3 and 4 sample of students. Two unconditional growth models are included in Table 2. Both growth slopes were random in the first model but Chi-square tests indicated that neither had statistically significant random variation across individuals. Subsequent models fixed first SLOPE1 and then SLOPE2. The model with SLOPE2 fixed indicated that there was significant random variation present in SLOPE1. As a result SLOPE1 was left to vary randomly and SLOPE2 was fixed in all subsequent models. There was a substantial change in growth slopes from SLOPE1 to SLOPE2. SLOPE1 was associated with statistically significant positive growth. This was to be expected for reading achievement from spring-to-spring since school is in session for nine of the twelve months being modeled. SLOPE2 was associated with statistically significant negative growth in reading. A finding of less growth in reading during the summer is also not surprising since school is not in session for most students during three months from spring-to-fall.

The three predictors (i.e., SPED, FREE, and SUMMER) were then entered into an initial conditional model for initial status and both growth slopes and latent variable regression was used to estimate the coefficients for the predictors on the random slope (i.e., SLOPE1). All three predictors made a statistically significant contribution to initial status and were retained as predictors of initial status for the final model. In grades 3 and 4 for reading, SUMMER was not a significant predictor of growth for the time periods of either growth slope. Students who attended summer school had growth similar to students without any predictor characteristics (i.e., students not in summer school, not on free/reduced lunch, and not in special education) during both the school year and the summer. SPED was associated with significantly high growth during the school year and significantly low growth during the summer. FREE was not a significant predictor on either slope. Figure 1 charts the findings for SLOPE2.

Table 3 presents the findings for reading during grades 5 and 6. For reading during these grades, SLOPE1 was fixed and SLOPE2 was left to randomly vary. SLOPE1 growth was again significant and positive and SLOPE2 growth was significant and negative. LVR was used for SLOPE2. SUMMER was not a significant predictor on SLOPE1 but it was a significant predictor on SLOPE2. The monthly growth in reading associated with SUMMER was approximately 0.53 RIT points higher than that for students in the control condition. SPED was associated with significantly high growth during the school year and SPED and FREE were both associated with significantly low growth during the summer. The findings for SLOPE2 are presented in the Figure 2 chart.

Table 4 presents findings for reading during grades 7 and 8. SLOPE1 was fixed and SLOPE2 was random. LVR was used for estimating predictor coefficients on SLOPE2. SLOPE1 was significant and positive suggesting that there was positive growth during the school year as would be predicted, and there was again a change in growth pattern across the two slopes. SLOPE2 was not significant suggesting that growth during the summer did not differ from zero growth. All three predictor variables were associated with significantly low initial status and none of the three predictor variables made a significant contribution to the prediction of growth on SLOPE1. On SLOPE2 both SPED and SUMMER were associated with significantly high growth. The monthly growth in reading associated with SUMMER was approximately 0.70 RIT points. The findings for SLOPE2 for reading during these grades are presented in the Figure 3 chart.

Math

The findings for grades 3 and 4 math are presented in Table 5. In the final model SLOPE2 was fixed and LVR was used when estimating predictor coefficients for SLOPE1. There was significantly high growth on SLOPE1, as expected, and significantly negative growth on SLOPE2. All three predictors were significant and low for initial status and none of the predictors were significant on SLOPE1, suggesting that they were not associated with significantly high or low growth during the spring-to-spring interval. During the summer, on SLOPE2, SPED was associated with significantly low growth and SUMMER was associated with significantly high growth. The findings for SLOPE2 are charted in Figure 4.

Table 6 presents the findings from grades 5 and 6 math. In the final model SLOPE1 was allowed to randomly vary and SLOPE2 was fixed. LVR was used when estimating the predictor coefficients for SLOPE1. Again, all three predictors were associated with significantly negative initial status. Both SPED and FREE were associated with significantly negative growth on SLOPE1. SPED was also associated with significantly negative growth on SLOPE2. SUMMER was not a significant predictor on either slope for growth. The results for grades 5 and 6 math are charted on Figure 5.

Finally, for math in grades 7 and 8 the results are presented in Table 7. SLOPE1 was allowed to vary randomly while SLOPE2 was fixed. LVR was used to estimate predictor coefficients on SLOPE1. All three predictors were associated with significantly low initial status. Both FREE and SUMMER were associated with significantly low growth on SLOPE1. On SLOPE2, SPED was associated with significantly low growth and SUMMER was associated with significantly high growth. The SLOPE2 findings are charted on Figure 6. Figure 7 is a chart that plots the coefficients for reading and math growth that were associated with SUMMER with 80% confidence intervals. This chart is provides a view of the effect of SUMMER on achievement growth during the summer for all three grade level groups in each content area.

Discussion

Flicek (2007) investigated the effect of summer school on fall-to-fall reading and math growth for a sample of elementary school students from one large Wyoming school district. Summer school was associated with significantly positive growth in both reading and math. The current study was designed to be a follow-up and extension to the Flicek study. Instead of using a sample from just one Wyoming district, the sample for the current study included students from eight Wyoming districts. This is the second in a series of similar studies that are planned over the next few years. Ultimately, it will be the pattern of findings from different samples over a number of years that will lead to a conclusion about summer school effects. The current study further differed from Flicek's study in that a coefficient for growth from spring-to-fall (i.e., during the summer) was captured in the current study which is in contrast to capturing a fall-to-fall growth coefficient, as was done in the 2007 study. The latter is an indicator of annual growth with school year growth and summer growth combined.

In the current study, separate analyses were conducted for samples of students in grades 3 and 4, grades 5 and 6, and grades 7 and 8. In two of the three grade level samples in reading and two of the three grade level samples in math, summer school was found to have a statistically significant (i.e., $p <$ .05 or .01) and positive effect which is consistent with expectations derived from the Flicek (2007) study. In one grade level sample in reading and one in math, the effects were not significant and near zero. The current study design was not able to indicate what growth for the summer school students would have been like had the students not attended summer school. It is possible that summer growth for these students would have been significantly low given that special education and free/reduced lunch students were overrepresented in the summer school sample.

The positive findings in the current study and the previous study (i.e., Flicek, 2007) are consistent with expectations based on prior research (e.g., see the Cooper et al.,2000, meta-analysis). The current Wyoming funding model was informed by the work of Odden, Picus, Goetz, Fermanich, Seder, Glenn, and Nelli (2005). The theory of action in support of summer school that was stressed in the Odden et al. report emphasized the role of summer school in mitigating the losses know to be experienced by disadvantaged students over the summer. Odden et al. ultimately recommended summer school with at least four hours a day spent on reading and math instruction. Eligibility for summer school in Wyoming is presently based upon low achievement. Nevertheless, both free/reduced lunch students and special education students were overrepresented in the summer school samples that were studied.

Both free/reduced lunch status and special education status were, therefore, entered into the initial final model as predictors for initial status and growth on both slopes. Special education status was associated with significantly positive growth in reading on SLOPE1 and significantly negative growth in reading on SLOPE2 for grades 3 and 4 and grades 5 and 6. In grades 7 and 8 special education was associated with significantly positive growth during the summer. In math, special education status was associated with significantly low growth during the summer for all three grade level samples. Special education was not a significant predictor of math growth at any grade level grouping on SLOPE1.

Free/reduced lunch status was associated with statistically significant negative growth in reading over the summer for the sample of students in grades 5 and 6. Free/reduced lunch status was not associated with significantly high or low growth during the summer for the other two grade level samples in reading nor was it associated with significantly high or low growth in math during the summer for any of the three grade level samples studied. Free/reduced lunch status was associated with significantly low growth in math in the grades 5 and 6 and grades 7 and 8 samples during the spring-to-fall-to-spring interval prior to attending summer school, however. As such, the evidence of significantly low growth associated with free/reduced lunch status during the summer was relatively weak (i.e., it was present in just one of the six final models). Nevertheless, given the findings of the Cooper et al. (2008) meta-analysis and the findings reported in Flicek (2007); this important and relevant variable warrants continued monitoring during future years of this ongoing investigation.

The continued study of summer school effects in Wyoming is encouraged since the programs had been in place for just two or three years, depending upon the district, at the time this study was completed. As new programs mature the effects of the programs often change as well. Conducting studies of the effects of summer school on summer growth over the next couple of years will indicate the extent of any changes to effectiveness that result as the programs mature. Ultimately, a more knowledgeable conclusion about program effectiveness will emerge.

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Table 1. Total Number of Students and Number of Students in Summer School by District and Total Sample.

	Grades 3 & 4		Grades 5 & 6		Grades 7 & 8	
District	**Total *n***	**Summer *n***	**Total *n***	**Summer *n***	**Total *n***	**Summer *n***
Big Horn 2	96	19	98	11	100	16
Crook 1	131	17	158	12	167	18
Goshen	264	51	269	25	265	29
Natrona	1697	200	1681	101	1782	54
Park 1	231	53	223	38	250	35
Sheridan 1	139	32	148	22	142	13
Sweetwater 2	388	36	416	12	359	27
Teton 1	334	30	353	25	343	32
Total	3280	438	3346	246	3408	224

Table 2. Results of Fitting Subsequent HLM Models for ***Reading*** Initial Status and Growth from ***Spring-to-Fall-to-Spring*** and ***Spring-to-Fall*** for a Sample of Wyoming Students in ***Grade 3 and 4*** during Spring 2008.

		Parameter	Unconditional Means Model*	Unconditional Growth Model Random Slopes	Unconditional Growth Model Fixed SLOPE2	Final Model
Fixed Effects						
Initial Status,	Intercept	B00	198.322	191.745	191.759	196.494
	SPED	B01				-14.073***
	FREE	B02				-3.970***
	SUMMER	B03				-8.331***
Rate of Change 1	Intercept	B10		0.924	0.922	0.874***
	SPED	B11				*0.220**
Rate of Change 2	Intercept	B20		-0.257	-0.253	-0.110*
	SPED	B21				-0.799***
	SUMMER	B22				0.007
Variance Components						
Level 1	Within-person	E	76.303	43.817	45.731	45.507
Level 2	In initial status	R00	157.791	187.531	183.872	139.122
	In rate of change 1	R10		0.060	0.055	0.055
	In rate of change 2	R20		0.493		
	Correlation Initial Status					
	with Rate of Change 1			-0.676	-0.487	-0.404
	With Rate of Change 2			0.403	0.401	
	E Variance Explained			0.360		
	R00 Variance Explained					0.243
	R10 Variance Explained					0.083

Note. Coefficients in italics were obtained using latent variable regression.
**p* < .05.
***p* < .01.
****p* < .001.

Table 3. Results of Fitting Subsequent HLM Models for ***Reading*** Initial Status and Growth from ***Spring-to-Fall-to-Spring*** and ***Spring-to-Fall*** for a Sample of Wyoming Students in ***Grade 5 and 6*** during Spring 2008.

		Parameter	Unconditional Means Model*	Unconditional Growth Model Random Slopes	Unconditional Growth Model Fixed SLOPE1	Final Model
Fixed Effects						
Initial Status,	Intercept	B00	211.411	207.743	207.777	212.418
	SPED	B01				-16.673***
	FREE	B02				-5.741***
	SUMMER	B03				-6.578***
Rate of Change 1	Intercept	B10		0.519	0.516	0.490***
	SPED	B11				0.195***
Rate of Change 2	Intercept	B20		-0.387	-0.385	-0.171*
	SPED	B21				*-0.742****
	FREE	B22				*-0.285***
	SUMMER	B23				*0.534***
Variance Components						
Level 1	Within-person	E	51.816	43.817	41.685	41.550
Level 2	In initial status	R00	154.831	171.489	152.682	107.977
	In rate of change 1	R10		0.055		
	In rate of change 2	R20		0.802	0.932	0.865
	Correlation Initial Status					
	with Rate of Change 1			-0.533		
	With Rate of Change 2			0.393	0.247	0.150
	E Variance Explained					0.198
	R00 Variance Explained					0.293
	R20 Variance Explained					0.083

Note. Coefficients in italics were obtained using latent variable regression.
*$p < .05$.
**$p < .01$.
***$p < .001$.

Table 4. Results of Fitting Subsequent HLM Models for ***Reading*** Initial Status and Growth from ***Spring-to-Fall-to-Spring*** and ***Spring-to-Fall*** for a Sample of Wyoming Students in ***Grade7 and 8*** during Spring 2008.

		Parameter	Unconditional Means Model*	Unconditional Growth Model Random Slopes	Unconditional Growth Model Fixed SLOPE1	Final Model
Fixed Effects						
Initial Status,	Intercept	B00	219.934	217.688	217.693	222.232
	SPED	B01				-19.319***
	FREE	B02				-6.073***
	SUMMER	B03				-6.970***
Rate of Change 1	Intercept	B10		0.284	0.282	0.282***
Rate of Change 2	Intercept	B20		-0.025	-0.023	-0.074
	SPED	B21				*0.385**
	SUMMER	B23				*0.703***
Variance Components						
Level 1	Within-person	E	44.839	39.220	41.685	39.903
Level 2	In initial status	R00	168.703	167.758	166.795	110.086
	In rate of change 1	R10		0.011		
	In rate of change 2	R20		0.643	0.746	0.723
	Correlation Initial Status					
	with Rate of Change 1			-0.064		
	With Rate of Change 2			0.124	0.151	0.226
	E Variance Explained					0.110
	R00 Variance Explained					0.340
	R20 Variance Explained					0.031

Note. Coefficients in italics were obtained using latent variable regression.
*$p < .05$.
**$p < .01$.
***$p < .001$.

Table 5. Results of Fitting Subsequent HLM Models for ***Math*** Initial Status and Growth from ***Spring-to-Fall-to-Spring*** and ***Spring-to-Fall*** for a Sample of Wyoming Students in ***Grade3 and 4*** during Spring 2008.

		Parameter	Unconditional Means Model*	Unconditional Growth Model Random Slopes	Unconditional Growth Model Fixed SLOPE2	Final Model
Fixed Effects						
Initial Status,	Intercept	B00	203.986	195.646	195.646	199.314
	SPED	B01				-8.258***
	FREE	B02				-3.826***
	SUMMER	B03				-8.046***
Rate of Change 1	Intercept	B10		1.099	1.099	1.098***
Rate of Change 2	Intercept	B20		-0.125	-0.126	-0.118**
	SPED	B21				-0.408**
	SUMMER	B22				0.380**
Variance Components						
Level 1	Within-person	E	75.785	32.778	32.849	32.704
Level 2	In initial status	R00	138.204	150.991	151.134	128.486
	In rate of change 1	R10		0.068	0.061	0.063
	In rate of change 2	R20		0.027		
	Correlation Initial Status with Rate of Change 1			-0.099	-0.120	
	With Rate of Change 2			-0.210		0.226
	E Variance Explained					0.569
	R00 Variance Explained					0.150
	R10 Variance Explained					0.000

Note. Coefficients in italics were obtained using latent variable regression.
*$p < .05$.
**$p < .01$.
***$p < .001$.

Table 6. Results of Fitting Subsequent HLM Models for ***Math*** Initial Status and Growth from ***Spring-to-Fall-to-Spring*** and ***Spring-to-Fall*** for a Sample of Wyoming Students in ***Grade 5 and 6*** during Spring 2008.

		Parameter	Unconditional Means Model*	Unconditional Growth Model Random Slopes	Unconditional Growth Model Fixed SLOPE2	Final Model
Fixed Effects						
Initial Status,	Intercept	B00	219.305	214.142	214.142	217.652
	SPED	B01				-12.492***
	FREE	B02				-3.935***
	SUMMER	B03				-7.043***
Rate of Change 1	Intercept	B10		0.785	0.785	0.848***
	SPED	B11				*-0.094**
	FREE	B12				*-0.219****
Rate of Change 2	Intercept	B20		-0.865	-0.869	-0.805***
	SPED	B21				-0.547**
	SUMMER	B22				0.058
Variance Components						
Level 1	Within-person	E	58.057	35.677	35.849	35.751
Level 2	In initial status	R00	150.854	163.310	162.263	133.389
	In rate of change 1	R10		0.127	0.131	0.123
	In rate of change 2	R20		0.081		
	Correlation Initial Status with Rate of Change 1			-0.233	-0.158	
	With Rate of Change 2			0.740		-0.261
	E Variance Explained					0.384
	R00 Variance Explained					0.178
	R10 Variance Explained					0.061

Note. Coefficients in italics were obtained using latent variable regression.
*$p < .05$.
**$p < .01$.
***$p < .001$.

Table 7. Results of Fitting Subsequent HLM Models for ***Math*** Initial Status and Growth from ***Spring-to-Fall-to-Spring*** and ***Spring-to-Fall*** for a Sample of Wyoming Students in ***Grade 7 and 8*** during Spring 2008.

		Parameter	Unconditional Means Model*	Unconditional Growth Model Random Slopes	Unconditional Growth Model Fixed SLOPE2	Final Model
Fixed Effects						
Initial Status,	Intercept	B00	229.820	225.855	225.849	230.515
	SPED	B01				-19.541***
	FREE	B02				-6.150***
	SUMMER	B03				-8.369***
Rate of Change 1	Intercept	B10		0.577	0.577	0.621***
	FREE	B11				*-0.109***
	SUMMER	B12				*-0.121**
Rate of Change 2	Intercept	B20		-0.343	-0.347	-0.348***
	SPED	B21				-0.476**
	SUMMER	B22				0.671**
Variance Components						
Level 1	Within-person	E	54.133	36.411	36.878	36.682
Level 2	In initial status	R00	223.630	215.124	214.500	155.920
	In rate of change 1	R10		0.094	0.110	0.108
	In rate of change 2	R20		0.188		
	Correlation Initial Status with Rate of Change 1			0.148	0.152	0.066
	With Rate of Change 2			0.080		
	E Variance Explained					0.322
	R00 Variance Explained					0.303
	R10 Variance Explained					0.018

Note. Coefficients in italics were obtained using latent variable regression.
*p < .05.
**p < .01.
***p < .001.

Figure 1. Reading Growth on the NWEA MAP Test from Spring to Fall for Students in Grades 3 and 4.

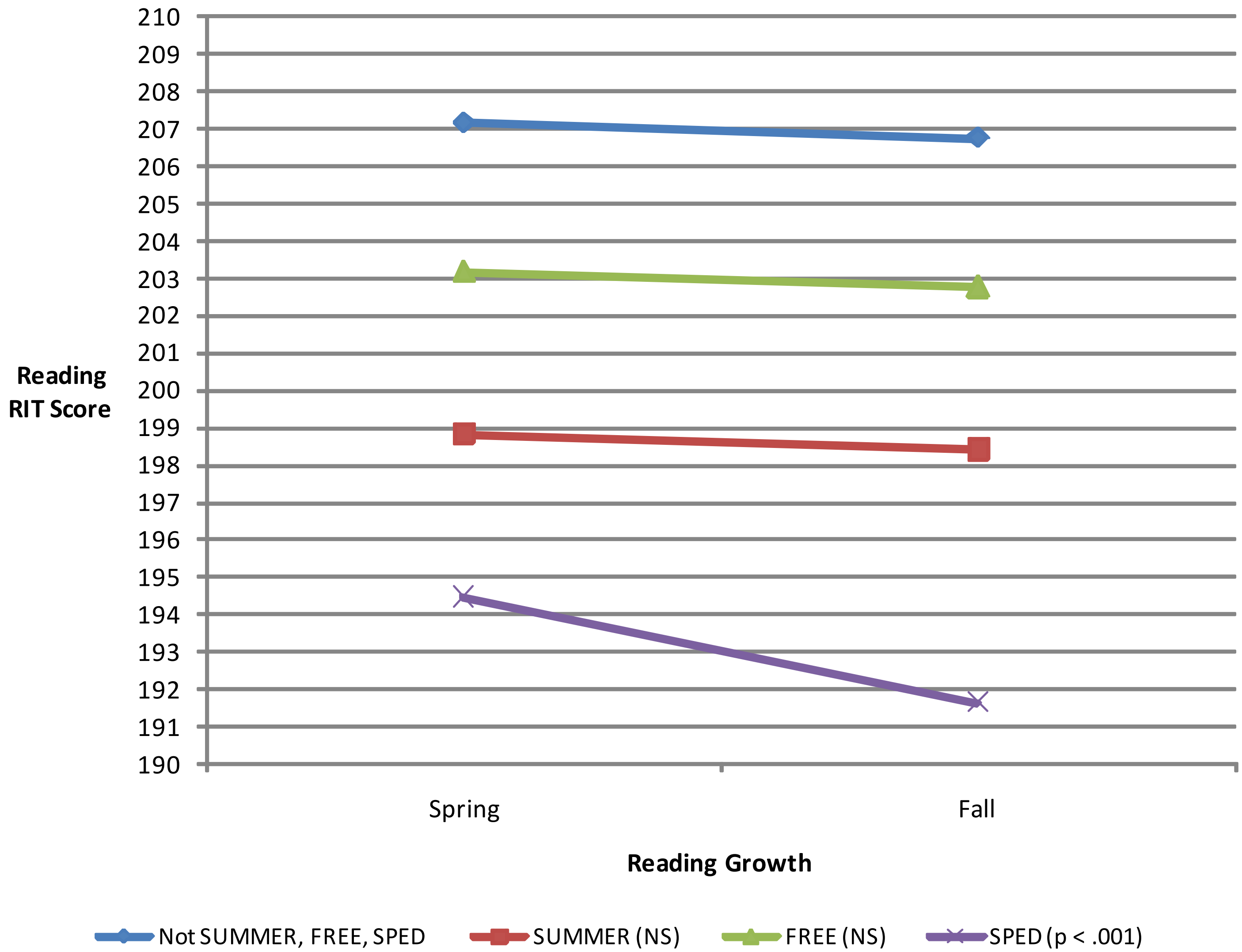


Figure 2. Reading Growth on the NWEA MAP Test from Spring to Fall for Students in Grades 5 and 6.

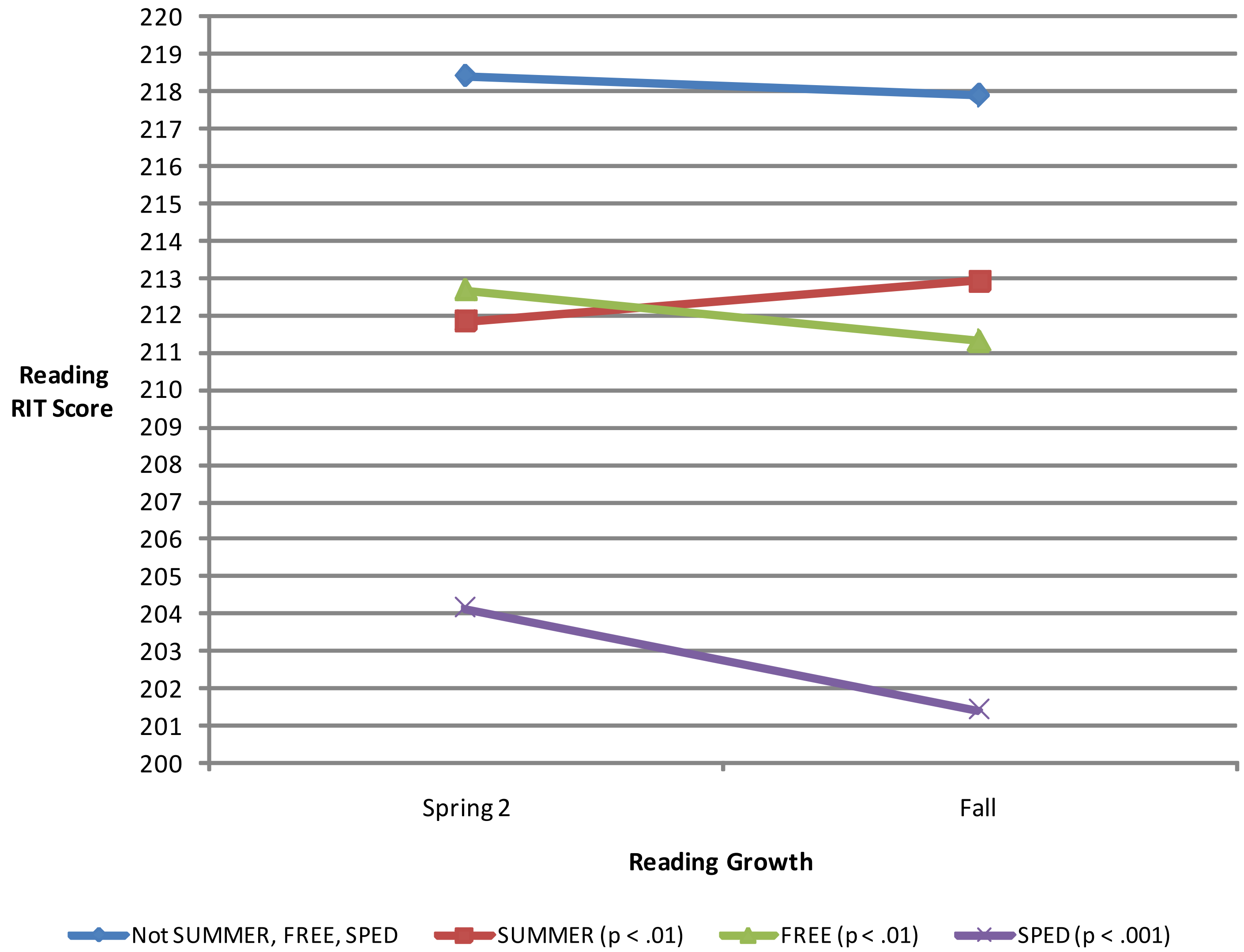


Figure 3. Reading Growth on the NWEA MAP Test from Spring to Fall for Students in Grades 7 and 8.

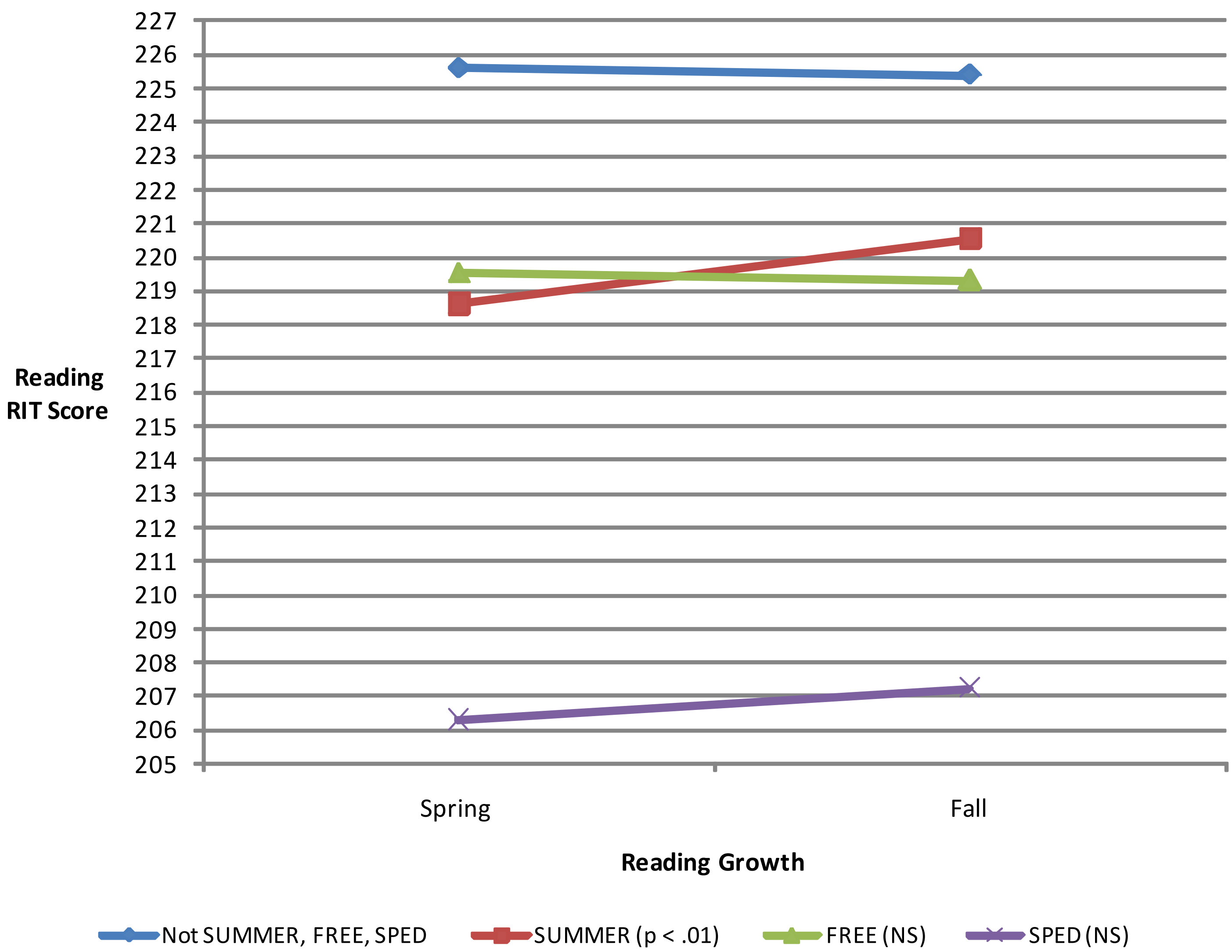


Figure 4. Math Growth on the NWEA MAP Test from Spring to Fall for Students in Grades 3 and 4.

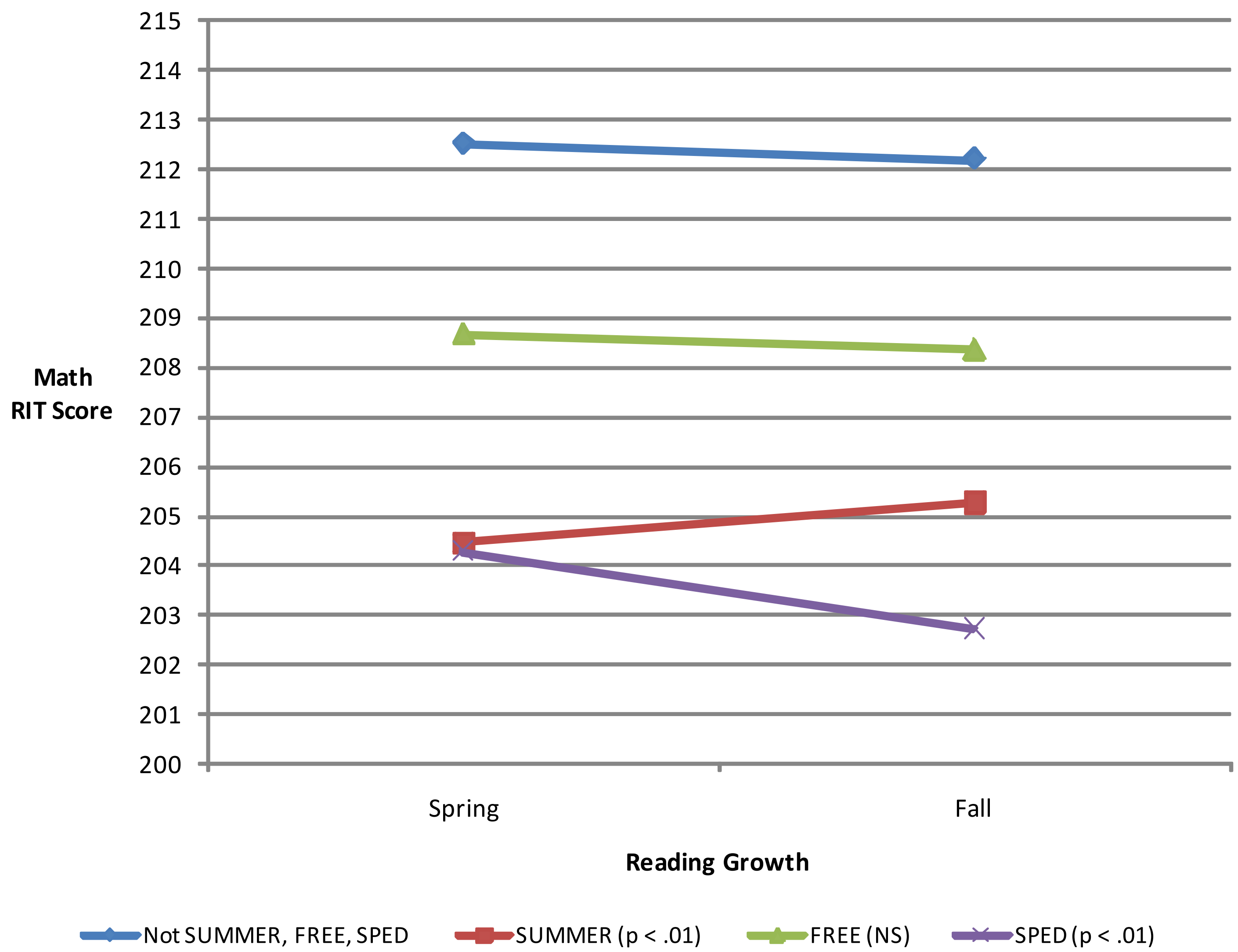


Figure 5. Math Growth on the NWEA MAP Test from Spring to Fall for Students in Grades 5 and 6.

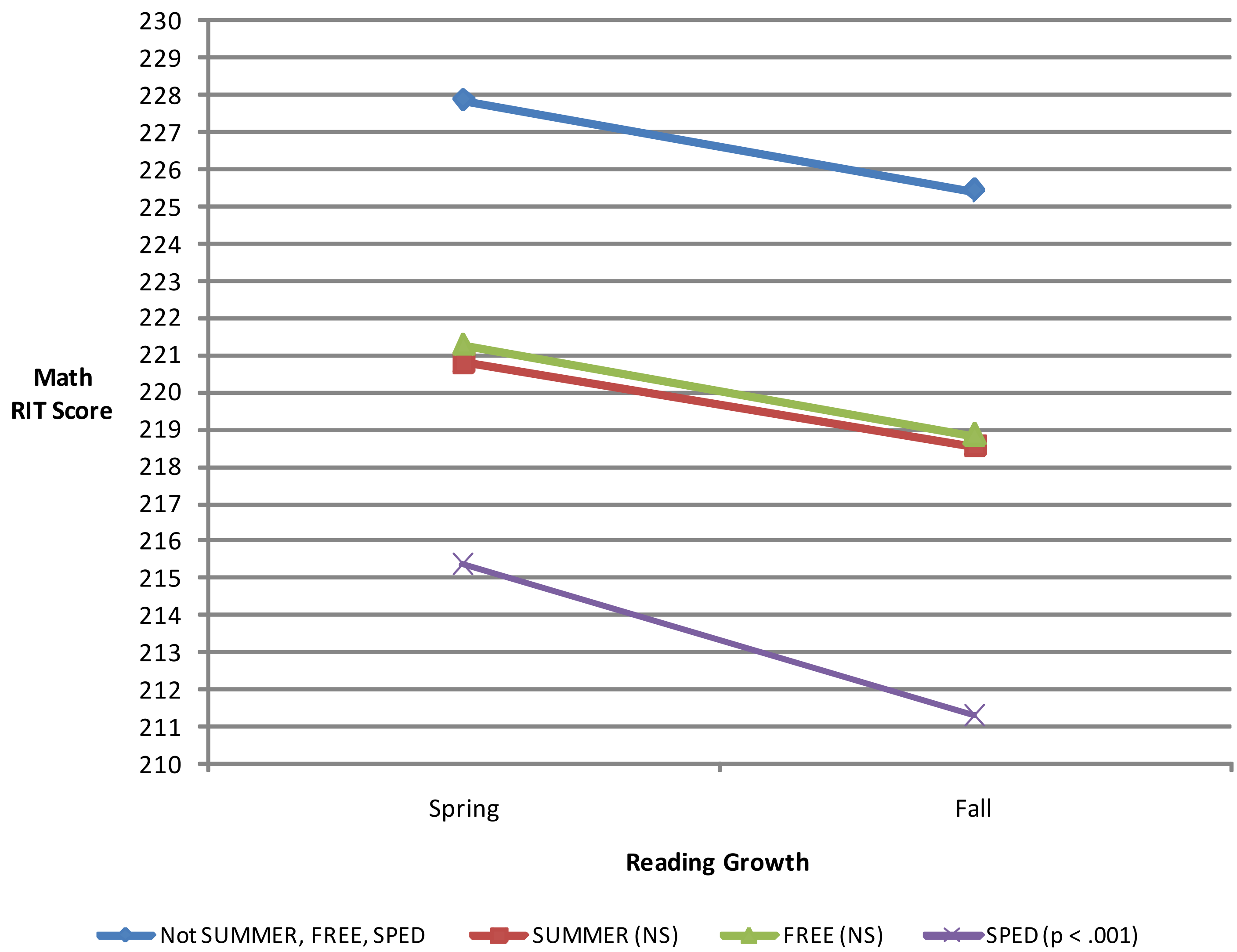


Figure 6. Math Growth on the NWEA MAP Test from Spring to Fall for Students in Grades 7 and 8.

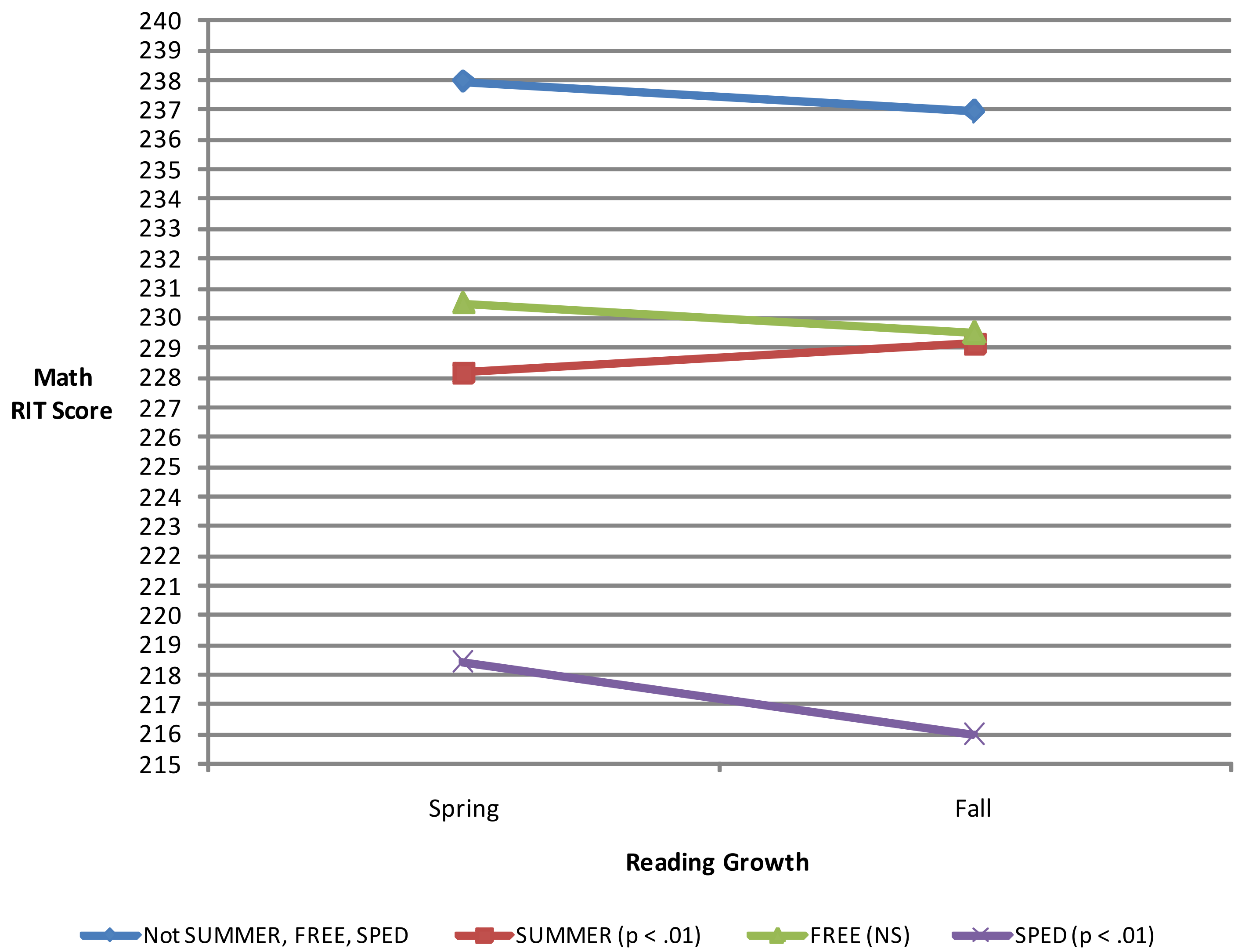
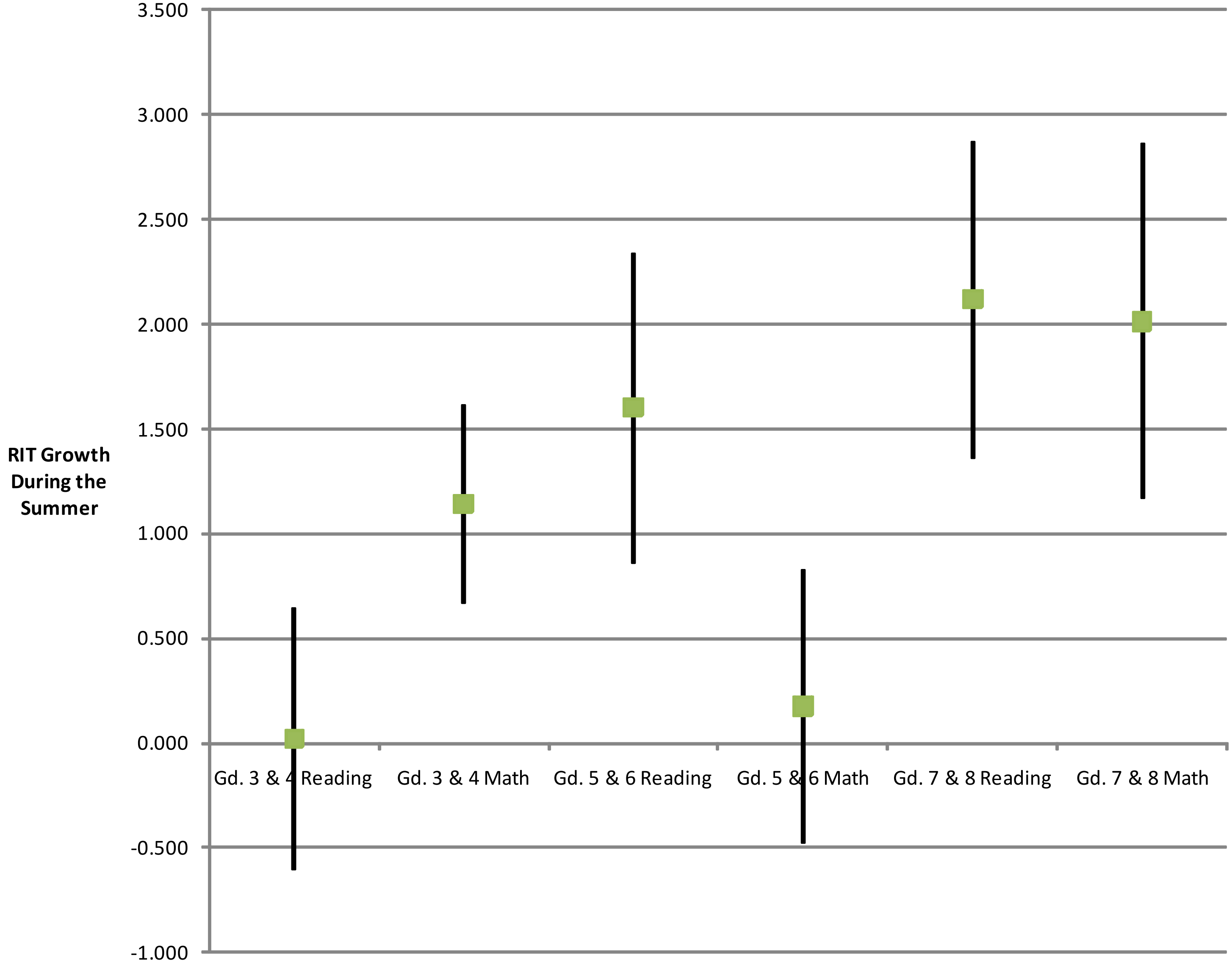


Figure 7. Estimated Coefficients for the Effect of Summer School on Reading and Math Growth Expressed as Summer RIT Score Growth with 80% Confidence Intervals



Appendix A

Final Model for Reading Grades 3 and 4 (Y = Reading RIT Score for Student *i* at time *j*).

Level-1 Model

Y = P0 + P1*(SLOPE1) + P2*(SLOPE2) + E

Level-2 Model

P0 = B00 + B01*(IDEA) + B02*(F_RLUNCH) + B03*(SUM08) + R0

P1 = B10 + B11*(IDEA) + R1

P2 = B20 + B21*(IDEA) + B22*(SUM08)

Latent Variable Regression Model

B1 = G10* + G11*(IDEA) + G12*(F_RLUNCH) + G13*(SUM08) + G14*(B0) + U1

Note. SLOPE1 is a spring-to-spring slope and SLOPE2 is a spring-to-fall (i.e., summer) slope.

Final Model for Reading Grades 5 and 6 (Y = Reading RIT Score for Student *i* at time *j*).

Level-1 Model

Y = P0 + P1*(SLOPE1) + P2*(SLOPE2) + E

Level-2 Model

P0 = B00 + B01*(IDEA) + B02*(F_RLUNCH) + B03*(SUM08) + R0

P1 = B10 + B11*(IDEA)

P2 = B20 + B21*(IDEA) + B22*(F_RLUNCH) + B23*(SUM08) + R2

Latent Variable Regression Model

B2 = G20* + G21*(IDEA) + G22*(F_RLUNCH) + G23*(SUM08) + G24*(B0) + U2

Final Model for Reading Grades 7 and 8 (Y = Reading RIT Score for Student *i* at time *j*).

Level-1 Model

Y = P0 + P1*(SLOPE1) + P2*(SLOPE2) + E

Level-2 Model

P0 = B00 + B01*(IDEA) + B02*(F_RLUNCH) + B03*(SUM08) + R0

P1 = B10

P2 = B20 + B21*(IDEA) + B22*(SUM08) + R2

Latent Variable Regression Model

B2 = G20* + G21*(IDEA) + G22*(F_RLUNCH) + G23*(SUM08) + G24*(B0) + U2

Final Model for Math Grades 3 and 4 (Y = Math RIT Score for Student *i* at time *j*).

Level-1 Model

Y = P0 + P1*(SLOPE1) + P2*(SLOPE2) + E

Level-2 Model

P0 = B00 + B01*(IDEA) + B02*(F_RLUNCH) + B03*(SUM08) + R0

P1 = B10 + R1

P2 = B20 + B21*(IDEA) + B22*(SUM08)

Final Model for Math Grades 5 and 6 (Y = Math RIT Score for Student *i* at time *j*).

Level-1 Model

Y = P0 + P1*(SLOPE1) + P2*(SLOPE2) + E

Level-2 Model

P0 = B00 + B01*(IDEA) + B02*(F_RLUNCH) + B03*(SUM08) + R0

P1 = B10 + B11*(IDEA) + B12*(F_RLUNCH) + R1

P2 = B20 + B21*(IDEA) + B22*(SUM08)

Latent Variable Regression Model

B1 = G10* + G11*(IDEA) + G12*(F_RLUNCH) + G13*(SUM08) + G14*(B0) + U1

Final Model for Math Grades 7 and 8 (Y = Math RIT Score for Student *i* at time *j*).

Level-1 Model

Y = P0 + P1*(SLOPE1) + P2*(SLOPE2) + E

Level-2 Model

P0 = B00 + B01*(IDEA) + B02*(F_RLUNCH) + B03*(SUM08) + R0

P1 = B10 + B11*(F_RLUNCH) + B12*(SUM08) + R1

P2 = B20 + B21*(IDEA) + B22*(SUM08)

Latent Variable Regression Model

B1 = G10* + G11*(IDEA) + G12*(F_RLUNCH) + G13*(SUM08) + G14*(B0) + U1