Mathematics Predictors on the Algebra Performance of Undergraduate University Students: Year 1 Results

Sarah R. Powell
The University of Texas at Austin

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Abstract

This white paper investigated which academic skills predicted algebra performance. The sample included 133 undergraduates at a four-year university. All participants completed a survey of mathematics anxiety and measures of rational numbers, reading fluency, spelling fluency, mathematics fact fluency, and algebra. In the final regression model, the only significant predictor of algebra performance was performance on an assessment of rational numbers. This accounted for 48% of the variance in algebra performance, and this finding indicates the importance of strong understanding of fractions, decimals, and percentages for performing well with algebraic items.

Keywords: mathematics, algebra, rational numbers, fluency, anxiety

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During elementary and secondary education, algebra is often described as a gatekeeper between arithmetic and higher-level mathematics (Bryant & Bryant, 2017). That is, students who successfully complete algebra in high school experience greater postsecondary access and graduation rates (National Mathematics Advisory Panel, 2008). As improved college graduate rates are related to better economic outcomes in adulthood, (Baum, Ma, & Payea, 2013), it is important to understand which academic skills might influence algebra performance. Gaining an understanding of important precursor skills could have implications for mathematics instruction in elementary, secondary, and postsecondary settings.

With this project, we collect data from undergraduates at a traditional, four-year university and a two-year community college from 2014 through 2017. We assess the algebra and rational numbers performance of these students along with mathematics fluency (i.e., arithmetic facts), reading fluency, and spelling fluency. In addition to the measures of mathematics, reading, and spelling, we collect demographic and background information, along with mathematics anxiety scores, to understand which variables might influence algebra and rational numbers performance.

In this white paper, I present preliminary data from the Year 1 cohort. These data were collected during the 2014-2015 school year.

Algebra

Algebra is the manipulation of numbers and symbols to solve for an unknown(s). Algebra is often considered the next step beyond arithmetic (i.e., adding, subtracting, multiplying, and dividing; McNeil, Rittle-Johnson, Hattikudur, & Petersen, 2010), and competence in algebra is believed to be an important part of real-life problem solving (Elliott, Oty, McArthur, & Clark, 2001). Formal algebra instruction often begins in high school, although some students, typically higher-performing mathematics students, begin formal algebra instruction in late middle school (Spielhagen, 2006). Organizations and standards, however, emphasize the need for algebra instruction as early as kindergarten (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010).

Students often experience difficulty with algebra because of the symbols (e.g., numerals, operator symbols, letters) used to represent algebra (Linchevski & Livneh, 1999). At the elementary level, students might have trouble solving equations or functions (Powell, Driver, & Julian, 2015). Students might also have trouble with translating information from word problems into algebraic equations (Powell & Fuchs, 2010) and using computation related to algebra (Fuchs et al., 2012). At the secondary level, students continue to demonstrate difficulty with solving equations and using algebra as a problem-solving tool (Nathan & Koedinger, 2000). Across elementary and secondary levels, students often struggle with understanding algebraic concepts and performing algebraic procedures (Impecoven-Lind & Foegen, 2010; Zhang, Katsiyannis, & Kortering, 2007).

Predictor Variables of Algebra Performance

Algebra performance is often linked to success with understanding fractions (Brown & Quinn, 2007; Siegler et al., 2012), and fractions are one of the components of *rational numbers*. Booth and Newton (2012) described fraction performance as the gatekeeper to success with algebra. Similarly, Bailey, Hoard, Nugent, and Geary (2012) determined that competency with understanding fractions (i.e., one component of rational numbers) predicted later mathematics achievement. As part of the National Math Panel, Hoffer, Venkataraman, Hedberg, and Shagle

(2007) surveyed algebra teachers and learned teachers of algebra stated that fractions were the most difficult part of algebra for students. To understand the connection between rational numbers and algebra with university students, we included a measure of rational numbers.

Mathematics fact fluency might influence algebra performance because of the necessity to use mathematics' fact knowledge to set up and solve equations. For example, students with improved mental arithmetic demonstrated better algebraic understanding (Britt & Irwin, 2008). Recently, Geary, Hoard, Nugent, and Rouder (2015) determined that errors in mathematics fact fluency were related to algebra outcomes. As computational fluency was a strong predictor of algebra achievement (Tolar, Lederberg, & Fletcher, 2009), we included a measure of mathematics fluency as a predictor variable.

Another predictor of algebra performance might be *mathematics anxiety*. In the elementary grades, students with higher mathematics anxiety demonstrated lower mathematics performance (Rubinsten & Tannock, 2010). At the university level this trend continued with students with lower mathematics performance reported as experiencing higher mathematics anxiety (Betz, 1978; Jameson & Fusco, 2014). Mathematics anxiety as an important factor in mathematics performance is so prevalent that researchers have developed several mathematics anxiety scales (e.g., Betz & Hackett, 1983; Hopko, 2003; Núñez-Peña, Guilera, & Suárez-Pellicioni, 2014; Suinn & Winston, 2003). We used one of these measures to index mathematics anxiety.

Reading, as measured by *reading fluency*, has been closely linked to overall mathematics competence (Hart, Petrill, Thompson, & Plomin, 2009), and this was especially true for students who experience difficulty with mathematics (Branum-Martin, Fletcher, & Stuebing, 2012; Wilson et al., 2015). Although not often investigated, *spelling fluency* might also contribute to variance in algebra performance. Interestingly, for adults with learning disabilities assessed 25 years after initial assessments, reading, spelling, and mathematics scores were still low with mathematics scores being the lowest (Morris, Schraufnagel, Chudnow, & Weinberg, 2009). This finding indicated that students who experience mathematics difficulty might also have difficulty with reading and spelling. Both reading and spelling rely on alphabetical characters. Algebra is also a symbolic language – the language of understanding numerals, mathematical symbols, and alphabetical symbols. For these reasons, we also included measures of reading and spelling fluency as predictor variables.

Purpose and Research Questions

The purpose of this white paper was to explore which, if any, variables significantly predicted algebra performance. I focused on algebra because of the connection between algebra performance and postsecondary and algebra outcomes. For this analysis, I used academic skill predictor variables and mathematics anxiety as an additional predictor variable. In subsequent analyses, I will include demographic and background variables as moderator variables.

For this analysis, I asked the following research questions:

1. What are the correlations among algebra performance, rational numbers performance, reading fluency, spelling fluency, mathematics fluency, and mathematics anxiety?
2. How do rational numbers performance, reading fluency, spelling fluency, mathematics fluency, and mathematics anxiety predict algebra performance?

Method

Participants

Participants ($N = 133$) were undergraduate students enrolled at a traditional four-year university in the Southwest. Participants volunteered for the project by responding to an advertisement placed in the "Research Opportunities" section of a daily email distributed to all faculty, staff, and students at the university. The advertisement read:

Undergrads: Earn $15 by doing math!

We are looking for undergraduates to answer questions about algebra and fractions. We want to learn whether math skill with algebra and fractions is influenced by other factors. The study will take 1.5 hours and, upon completion, you receive a $15 gift card. Go to (website) or scan the QR code to sign up!

Participants registered online using Google Form (www.google.com/forms/about). Registration involved providing a name, email address, and availability for a testing sessions within the following two-week span. A team of three research assistants generally responded to participants within 48 hours. The research assistants scheduled a 1.5 hour in-person testing session and distributed a survey, via Research Electronic Data Capture (RedCap; Harris et al., 2009). Participants filled out the survey before showing up for the in-person testing session.

This project was funded by a private foundation as a three-year research study. Over the past several years, the foundation has funded several research projects focused on postsecondary preparation, access, persistence, and completion. This project was funded for school years 2014-2015, 2015-2016, and 2016-2017. Therefore, data collection is ongoing. In this report, we focused on data collection during the 2014-2015 school year. More specifically, data was collected between November 2014 and May 2015, and participants tested during this time frame comprised the Year 1 cohort.

Informed Consent

In May 2014, I obtained exempt status from the Institutional Review Board at the university. This exempt status was granted until May 22, 2017. The granting of exempt status still required the protection of human subjects by assuring all research assistants were trained in ethical principles, relevant federal regulations, and institutional policies regarding human subject research. Exempt status also mandated that participants received information via a consent form and voluntarily consented to participate in the research project. Finally, exempt status required confidentiality of the subjects and the research data.

Prior to participation in the in-person testing session, participants reviewed a two-page informed consent form. This consent form provided an introduction of the study and explained the purpose of the study. The consent also outlined what the participants would do, whether there were risks or benefits for study participation, and how the participants would be compensated. The consent form described how privacy and confidentiality would be protected and whom to contact with questions about the research study or the Institutional Review Board process. After reading the informed consent, each participant printed their name, provided a signature, and wrote the data of consent. The research assistant conducting the testing session then signed the informed consent form as the representative of the study.

Data Collection

All data were collected by a team of undergraduate research assistants. One of the assistants was a sophomore and majoring in education. The other two research assistants were seniors, both majoring in the health sciences with the intention of attending medical school. Two research assistants were Hispanic and one was Caucasian. Of the three, two were female and one was male. Each research conducted approximately one-third of the in-person testing sessions.

All in-person testing sessions were conducted in an academic building on the campus of the university. The project had designated office space with four desks. All testing materials were stored in the designated office space. Any confidential materials were stored in locked cabinets.

Measures

Before the in-person testing session, the participants completed an online survey. This survey asked about demographic information and mathematical experiences in school. A survey of mathematics anxiety was included at the end of the survey. After completion of the survey, the participant participated in a 1.5 hour in-person testing session. The order of measures during the in-person testing session was as follows: consent form, computer rational number tasks, rational numbers measure, reading fluency, spelling fluency, mathematics fluency, and algebra measure. Upon completion of the in-person testing session, each participant received a $15 gift card to a local restaurant or grocery store.

Participant survey. The participant survey was administered via RedCap. The participants answered several pages of questions, and the program compiled responses into database form. Participants provided the following information: date of birth, gender, race/ethnicity, college grade level (i.e., freshman, sophomore, junior, senior), disability status, whether English was the native language, family income bracket, whether the participant was a first-generation college student, highest educational degree of father and mother, whether attended kindergarten, whether skipped a grade level, whether retained during a grade level, year of high school graduation, grade point average upon high school graduation, college entrance exam (e.g., ACT, SAT) scores, number of colleges applied to, number of colleges accepted to, number of colleges attended, major and minor in college, and college grade point average. The survey also asked students about whether algebra was taken in eighth grade, all the mathematics courses taken in high school, and all the mathematics courses taken in college.

For this report, we present demographic information about the participants, but we did not use information from the survey in the data analysis.

Mathematics anxiety. To understand the mathematics anxiety of participants, we administered the abbreviated *Mathematics Anxiety Rating Scale (MARS*; Suinn & Winston, 2003). Participants answered 25 items on a 5-point Likert scale (i.e., not at all = 0, a little = 1, a fair amount = 2, much = 3, or very much = 4). Participants rated mathematics anxiety on items such as “study for a math test,” “realizing you have to take a certain number of math classes to fulfill requirements,” “reading a cash register receipt after your purchase,” and “walking into a math class.”

Participants scored a 0, 1, 2, 3, or 4 for each item. The 25 individual item scores were summed for a total score of mathematics anxiety. Higher scores indicated greater mathematics anxiety. Scores ranged from 0 to 100. Cronbach’s α for this sample was .957.

The MARS was not administered during the 1.5-hour testing session. Instead, the MARS was administered via RedCap at the end of the participant survey.

Rational numbers. We administered two computer-based tasks in which participants placed rational numbers on number lines or compared rational numbers. Both accuracy and latency information was gathered via the computer task. We do not use these computer tasks in the current report; therefore, we do not describe the measures further.

After administration of the two computer tasks, research assistants administered a paper-and-pencil rational numbers measure. The *Rational Numbers Measure* (Powell, 2014b) was a 35-item assessment with questions about rational numbers (i.e., fractions, decimals, and percentages). I developed item prompts by pulling from several resources, including the Rational Numbers Project (www.cehd.umn.edu/ci/rationalnumberproject/). Of the 35 items, 23 involved fractions. Participants solved fractions problems using all four operations (i.e., addition, subtraction, multiplication, and division). Participants also determined common denominators, common factors, equivalent fractions, reciprocals, and identified fractions within pictorial representations (i.e., number line, set model). Eight of the problems involving fractions asked the participants to solve word problems. Of the 35 items, six required an understanding of decimals. Students worked with decimals by adding, subtracting, multiplying, dividing, placing on a number line, and solving within a word problem. Three items used percentages, and participants determined a percentage or solved within a word problem. Finally, three items asked students to convert among fractions, decimals, and percentages.

The research assistants introduced the measure by reading the following from the testing protocol:

> *This is a measure of rational numbers. That means fractions, decimals, and percentages. There are 35 items, and you'll have 25 minutes to solve as many of these problems as you can. Try the easier problems first, and then go back and try the harder problems. For each item, you can do any work on the page. If you need more space, you can use this yellow paper. For each item, however, please write your answer on the original measure and circle your answer. You may not use a calculator for any items. Do you have any questions? (Answer questions.) Are you ready? (Pause.) Begin.*

Upon completion of reading the directions, the research assistant set a timer for 25 min. Participants worked for 25 min or until noting that they completed the measure.

Participants received 1 point for each correct answer. One item had three separate answers, and four other items had two separate answers. Each separate answer was given an independent score; therefore, maximum score was 41. Cronbach's α for this sample was .884.

Reading fluency. To understand the reading fluency of each participant, we administered the *Test of Silent Word Reading Fluency* (Mather, Hammill, Allen, & Roberts, 2014). With this assessment, participants drew lines to separate words. For example, the assessment included a line that read: bigtwolookhegreenmylikeblueupwecar. Participants drew vertical lines to separate each real word. No pseudo-words were included on the measure, but the words became more difficult as the assessment progressed (e.g., questroostefficiencycoy…). According to the authors, test-retest reliability was .84 to .91.

Research assistants introduced the reading fluency measure by explaining the following:

> *This is a measure of silent word reading fluency. Words run together, and your job is to draw a line between each word.*

At this point, the research assistant showed an example, from the test developers, that showed how lines were drawn between words. Then, the research assistant prompted the participant to do a practice page:

> *First, you'll do a practice page. If you draw a line in the right place, a real word will be on each side of the line with no extra letters in between them. The line will be between two words. None of the words will be names or people or places. You'll have 1 minute to find as many words as you can. When I say, "Begin," start here (point to the upper left corner) and keep going until you reach the end of the row. When you complete a row, go to the next one. Don't skip any rows, and don't draw a line at the beginning or end of the row. If you don't see a word you know, keep going until you do see a word you know. Remember to work as fast you can without making mistakes. If you do draw a line in the wrong place, don't try to erase it. Just put a cross through the top of the wrong line and draw a new line where you think it should go. Keep working until I say, "Stop" or you come to the end of the test. Are you ready? (Pause.) Begin.*

The participant worked for one minute on the practice page. At the end of one minute, the research assistant stated:

This time you'll have 3 minutes to find as many words as you can. When I say, "Begin," work as fast as you can without making mistakes. Keep working until I say, "Stop," or you come to the end of the test. Turn over the page. (Pause.) Begin.

The research assistant timed the participant's work for three minutes.

Participants received 1 point for each correct separation of words. Maximum score was 220. It was not possible to calculate Cronbach's α for the reading fluency measure because the score entered into the database was the total score; no item-by-item scoring was conducted.

Spelling fluency. To understand whether spelling fluency influenced mathematics performance, we administered *Spelling Fluency* (Powell, 2014c). On Spelling Fluency, participants spelled 20 words read aloud by the research assistant. I selected 10 words from a list of commonly misspelled words, and the other 10 words came from a list of common words on a test for graduate school admission. The words on the assessment were: acquiesce, aesthetic, ameliorate, anachronism, bedraggle, bourgeoisie, cacophony, connoisseur, corroborate, embarrassment, hemorrhage, inchoate, magnanimous, misanthrope, miscellaneous, reconnaissance, obsequious, sacrilegious, sanguine, and supersedes.

The research assistant introduced Spelling Fluency by stating:

I'm going to say some words, and I'd like you to spell the word. If you want the definition and a sentence using the word, just let me know.

The research assistant then stated the word (e.g., "connoisseur"). If requested, the research assistant would state the definition and an example sentence (e.g., "An expert judge in matters of taste. She was a connoisseur of music.").

Spelling Fluency was scored according to correct letter sequences. With correct letter sequences, every correct pair of letters that appeared together was marked with a carat. If the first letter was correct, a carat was placed before the letter, and if the last letter was correct, a carat was placed after the letter. The number of carats was the score for the word. The maximum number of correct letter sequences was the number of letters in the word plus one. For example, if a participant spelled sanguine as "sangine," the participant received seven carats and a score of seven for the work. Cronbach's α for this sample was .876.

Mathematics fluency. We measured mathematics fact fluency with the Woodcock Johnson III (WJIII) *Math Fluency* (Woodcock, McGrew, & Mather, 2001). On Math Fluency, students solved addition, subtraction, and multiplication mathematics facts (i.e., single-digit addends, minuends, subtrahends, and factors). As reported by Woodcock et al. (2001), split-half reliability is .90.

Research assistants introduced Math Fluency by reading the following from the testing protocol:

> *This is a measure of math fact fluency. You will have 2 minutes to answer as many facts as you can. When I say, "Begin," work as fast as you can without making mistakes. Keep working until I say, "Stop," or you come to the end of the test. Ready? Begin.*

The research assistant set a timer for two min. Please note, this timing is a deviation from the Woodcock-Johnson testing directions. Usually, participants had three min to answer as many mathematics facts as possible. With a university-level sample, we piloted the measure and determined that two min was more appropriate. That is, no participants could finish the measure in two min; several pilot participants finished in three min.

For scoring, participants received 1 point for each correct answer. Maximum score was 160. Cronbach's α for this sample was .970.

Algebra. The *Algebra Measure* (Powell, 2014a) was a 25-item assessment with a variety of algebraic questions. These questions were collected from other algebra assessments and textbooks. The first 10 items asked participants to simplify expressions, solve equations, and answer questions related to slope. The following 15 items were slightly more complex; students worked on simplifying expressions, solving equations, finding domains, intercepts, and asymptotes in addition to working on problems with absolutely value, exponents, logarithms, and quadratics.

The research assistants introduced the measure by reading the following from the testing protocol:

> *This is a measure of algebra. There are 25 items, and you'll have 40 minutes to solve as many of these problems as you can. Try the easier problems first, and then go back and try the harder problems. For each item, you can do any work on the page. If you need more space, you can use this yellow paper. For each item, however, please write your answer on the original measure and circle your answer. You may not use a calculator for any items. Do you have any questions? (Answer questions.) Are you ready? (Pause.) Begin.*

The research assistant set a timer for 40 min. The participant worked for 40 min or until he or she noted that he or she had finished the measure.

Participants received one point for each correct answer. During database entry, we noted that one item had an error in the item prompt; therefore, this item was deleted from this analysis. For the Year 1 cohort, maximum score was 24. Cronbach's α for this sample was .856.

Results

Table 1 presents the demographic variables for the 133 students in the Year 1 cohort. As explained earlier in this white paper, we did not use demographic variables as moderators in the current analysis. We present the information to understand the characteristics of the sample.

To answer the first research question, we ran Pearson correlations among all the measures. Table 2 displays the correlation coefficients, as well as the means, standard deviations, and ranges of scores. The algebra measure shared significant correlations with all the other measures: mathematics anxiety, reading fluency, spelling fluency, mathematics fact fluency, and rational numbers. The strongest correlation for algebra was the correlation with rational numbers, followed by mathematics anxiety and mathematics fact fluency. Mathematics anxiety only shared significant correlations with algebra and rational numbers. Reading fluency was significantly related to algebra, spelling fluency, mathematics fact fluency, and rational numbers. Not following the same trend, spelling fluency was only significantly correlated with algebra, reading fluency, and rational numbers. Finally, mathematics fact fluency shared significant correlations with algebra, reading fluency, and rational numbers.

To answer the second research question, we ran regression analyses and loaded specific variables into the model in a step-wise fashion. Table 3 shows the three models and the coefficients, standard errors, and *t* scores for each outcome or predictor variable. Because mathematics anxiety only shared a significant correlation with algebra and rational numbers, we loaded mathematics anxiety into the first model. Algebra was the outcome measure. Mathematics anxiety was not a significant predictor variable. When loaded into the model, it only explained 13.8% of the variance in algebra performance.

We loaded the three fluency measures (i.e., reading, spelling, and mathematics fact) into the second model, keeping mathematics anxiety in the model. An additional 12% of the variance was explained with the addition of these three fluency predictor variables. Mathematics anxiety become a significant predictor of algebra performance. The only other significant predictor was mathematics fact fluency.

We kept all predictor variables in model three and added in the rational numbers measure. When we included rational numbers in the model, all the other predictor variables became nonsignificant. Rational numbers proved the only significant predictor variable, and this model explained 48% of the variance in algebra performance.

Discussion

The purpose of this white paper was to explore which academic skills predicted algebra performance. I also included mathematics anxiety as a predictor variable due to its constant link to deviations in mathematics performance. This exploration with the Year 1 cohort will set the stage for subsequent analyses.

With the first research question, I investigated the correlations among measures. Interestingly, the algebra measure was significantly correlated to all predictor variables, even the reading and spelling fluency measures. These significant correlations demonstrate that a variety of academic skills relate to algebraic understanding. Because algebra is a mix of alphabetical and numerical characters, it might not be surprising that alphabetical-based skills, such as reading and spelling fluency, correlated with algebra. The same pattern of correlations was present for the rational numbers measure. All other measures exhibited significant correlations with rational numbers. Rational numbers might be more based in numerals and mathematical symbols, but it is important to note that several items on the *Rational Numbers Measure* were word problems – presented with alphabetical characters.

For the other mathematics measure, mathematics fact fluency, the correlation patterns were different. As stated, mathematics fact fluency shared significant correlations with algebra and rational numbers, with the rational numbers correlation being stronger. Mathematics fact fluency was not correlated with mathematics anxiety. This finding is of interest and should be explored further. Perhaps mathematics facts, which require more memorization than reasoning, do not cause anxiety in students; perhaps mathematical reasoning and problem solving are the root cause of mathematics anxiety. Mathematics fact fluency was correlated with reading fluency but not spelling fluency. Future investigations should aim to understand the connections among these variables and the driving forces behind fluency performance.

Mathematics anxiety only shared significant correlations with the algebra and rational numbers measures. As these measures involve higher-level mathematics, reasoning, and problem solving, students who experience greater mathematics anxiety might also have more difficulty with such tasks. Mathematics fact fluency, which was not significantly correlated, might classify as a different type of mathematics task than solving problems with algebra and rational numbers.

Of the two non-mathematical tasks (i.e., reading fluency and spelling fluency), reading proved a more consistent predictor variable with significant correlations to all the mathematical tasks, except mathematics anxiety. Spelling fluency was only significantly correlated with algebra and rational numbers. Given the amount of reading and word interpretation in mathematics tasks, especially with higher-level mathematics, it is important to understand how reading and spelling fit into the picture of mathematics competence.

With the second research question, I investigated which predictor variables explained significant amounts of variance in algebra performance. On its own, mathematics anxiety was not a significant predictor of algebra performance. Perhaps mathematics anxiety is a component of mathematics performance, but the weight of this component alters with mathematical content. When the three fluency measures were added into the regression model, mathematics anxiety and mathematics fact fluency proved significant predictor variables. The amount of variance in algebra performance increased with the addition of these variables, but the amount of variance explained (i.e., 26%) was still quite small. It was only when rational numbers were added as a predictor variable that the explained variance increased 22% to a level that has implications for instruction. With the third model, the only significant predictor of algebra performance was rational numbers performance. This model explained 48% of the variance in algebra performance. This result demonstrates the necessity for strong rational numbers understand for algebraic competence.

In future analyses, I plan to delve into the other 52% of the variance in algebra performance. By investigating demographic and background characteristics into statistical models, I hope to learn which, if any, of these characteristics explain additional variance in algebra performance. I also plan to investigate which characteristics might contribute to rational numbers performance. This information could be used to inform elementary and secondary mathematics instruction, as well as efforts to provide mathematics support to students who experience difficulty with mathematics.

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Table 1

Demographic Information

	n	%
Gender		
Male	33	24.8
Female	100	75.2
Race/ethnicity		
African American	15	11.3
Asian	56	42.1
Caucasian	39	29.3
Hispanic	15	11.3
Biracial	7	5.3
Other	1	0.7
University level		
Freshman	42	31.6
Sophomore	27	20.3
Junior	24	18.0
Senior	38	28.6
Not specified	2	1.5
Family income		
<$20,000	4	3.0
$20,001-$35,000	12	9.0
$35,001-$50,000	23	17.3
$50,001-$75,000	20	15.0
$75,001-$100,000	24	18.0
$100,001-$150,000	26	19.5
$150,001-$200,000	16	12.0
>$200,001	8	6.0
Other factors		
Diagnosed disability	5	3.8
Non-native English speakers	26	19.5
First-generation college	27	20.3
Retained during K-12	3	2.3
Skipped a grade during K-12	5	3.8

Note. K = kindergarten.

Table 2

Means, Standard Deviations, and Correlations

			Raw Score		Correlations				
	Variables	Range	*M*	*(SD)*	1	2	3	4	5
1	Algebra	2 - 21	10.17	(4.63)	–				
2	Mathematics anxiety	1 - 100	30.96	(19.10)	.372**	–			
3	Reading fluency	NA	179.71	(20.34)	.237**	.138	–		
4	Spelling fluency	89 - 223	172.03	(24.33)	.173**	.053	.625**	–	
5	Mathematics fact fluency	48 - 155	106.86	(19.90)	.365**	.077	.328**	.151	–
6	Rational numbers	10 - 41	30.84	(6.82)	.684*	.408**	.347**	.222*	.505**

Note. * $p < .05$; ** $p < .01$.

Table 3

Regression Analyses

	Model 1			Model 2			Model 3		
Variable	*b*	*SE*	*t*	*b*	*SE*	*t*	*b*	*SE*	*t*
Constant (Algebra)	15.21**	1.16	13.09	2.74	3.65	0.75	-2.26	3.15	-0.72
Mathematics anxiety	-0.09	0.02	-4.59	-0.08**	0.02	-4.42	-0.03	0.02	-1.71
Reading fluency				0.01	0.02	0.31	-0.01	0.02	-0.44
Spelling fluency				0.02	0.02	0.90	0.01	0.02	0.58
Mathematics fact fluency				0.07**	0.02	3.91	0.01	0.02	0.68
Rational numbers							0.42**	0.06	7.30
R^2	.138			.264			.481		

Note. *$p < .05$. **$p < .01$.