Personality Traits and Prior Academic Learning as Predictors of Student Success in High School Math Courses

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PERSONALITY TRAITS AND PRIOR ACADEMIC LEARNING AS PREDICTORS OF STUDENT SUCCESS IN HIGH SCHOOL MATH COURSES

by

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ABSTRACT

Academic institutions continue to find that the cost of a student’s failure of a core class has significant implications for that student’s overall academic success, from middle school through university level programs. Many intervention programs are retroactively planned as they are activated after the student has failed a number of core classes. This research investigated three measures of self-control, grit, and attitude toward math as possible predictors of student performance in a math class. Surveys were administered toward the beginning of the trimester to 46 high school students enrolled in four different geometry and algebra courses at a rural Oregon high school. Pearson’s correlations along with multiple regression analysis of these measurements were analyzed against the students’ final grades in the math classes. Research instruments closely followed those used and developed by prior researchers (Duckworth, Tapia, and Tangney.) Static measures used for comparison included student GPA, prior average math grades, and student scores on a math pre-test. This research demonstrated moderate to high positive correlations with all independent variables when compared to each student’s final grade in the math class, though statistical significance varied. Implications of this study are that the character traits do have promise as predictors of student academic progress, specifically in a high school math course, but are not as robust predictors as traditional available student data such as GPA and prior math grades.
ACKNOWLEDGMENTS

One of George Fox’s attributes which makes it an outstanding institution is the careful selection of, and retention of, great faculty. The “servant” attitude of all the professors stands in stark contrast to that of other institutions, and made my journey an “easy burden.” The Christian qualities coupled with academic rigor came into sharp focus as Dr. Gary Tiffin humbly encouraged, guided, and taught me throughout the dissertation process. His leadership epitomizes the values and endearing place of the Christian institution of higher learning as a vital part of the community.

I much needed Dr. Addleman’s insightful questions, direction and feedback, all of which were of invaluable worth in sorting through the myriad choices as this paper developed. Also, I offer my heartfelt thanks to Dr. Samek, who encouraged me to keep my eyes on the goal and write about other areas of interest later. I came to appreciate the wisdom of doing a few things well.

Finally, I give thanks to my wife Debby for her 40 years of encouragement and belief in the “good plans” of our God.

Wilson Morris
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Chapter 1

Background

Only one personality trait will guarantee prosperity, affluence and health. The first line of a *Business Insider* article claimed that this one personality trait is the indicator and predictor of success (Baer, 2014). The article goes on to cite the unanimous and consistent findings of various researchers who found that people who possess more of the trait of conscientiousness succeed in almost every area of life. Those areas of achievement include higher academic accomplishment, higher salaries, better employment status, better health, and better marriages. In fact, the article claims research confirmed that conscientiousness is a cradle-to-grave winner that affects how people face challenges, meet deadlines, utilize goal planning, and keep their lives organized (Baer, 2014). Reliable measures of a trait such as conscientiousness that could statistically predict a person’s future professional success or academic performance would be of great interest to human resource directors, teachers and admissions departments. Research in the last 25 years has confirmed that personality measurement tools can identify specific personality traits which in turn correlate to specific behavior patterns (Barrick, 1991). Research, as cited in the *Business Insider* article, has confirmed the importance to academics of components of conscientiousness, such as persistence, motivation, and self-discipline (Vianello, 2010). This is good news for educators, as there is the need for more reliable predictors of student success in K-12 classes as well as college admissions (Balfanz, 2007; Chamorro-Premuzic, 2003; Mackenzie, 2014; Vivo, 2008). With ever increasing accountability for student performance in state tests in the K-12 arena and four-year completion rates for colleges and universities, teachers and administrators need reliable tools that will identify struggling students before those students get behind (Jerue, 2014; Shia, 1998).
Identifying and helping students early, before they fail a class, will increase those students’ odds of finishing school (Neild, 2007). The more students stay on track and graduate, the better the results for those students’ economic futures and the economic future of this country (Neild, 2007; Rouse, 2005). The relationship of earning power to the level of educational attainment is one way society recognizes and rewards success in education. A worker with no high school diploma averages an annual salary of $27,000 while every educational milestone afterwards (high school graduation, associate’s degree, and bachelor’s degree) results in annual salary increases of around $17,000 (U.S. Department of Labor, 2011).

Public K-12 schools can be a springboard or a barrier to higher educational attainment and earning potential. If students are placed in an environment where they can succeed, then schools can be a gateway to the next educational milestone. If high schools fail to pre-assess students’ predispositions and abilities in core subjects, then those schools allow students to set early patterns of failure which increase the probability of dropping out (Heppen, 2008). Strong early indicators are needed of a student’s tracking and disposition toward success or failure. One such indicator is how middle and high school students handle core classes. In one long term study of Philadelphia junior high students, only 19% of those who failed a math class in sixth grade graduated within one year of their target graduation date (Balfanz, 2007). Similarly, only 17% of sixth graders in this study who failed English graduated. Though other factors such as behavior and attendance showed some predictive power regarding students’ graduation rate, yet none are as telling as a failure of a core class in a student's middle grades. In a similar study involving Chicago high school students, every course a student failed dropped his or her likelihood of graduating by 15%. If more than 3 core classes were failed, then the student had less than a 33% chance of graduating (University of Chicago, 2007).
Overall, more than 25% of American students drop out of public high school every year (U.S. Department of Education, 2007). Continuing on with the 75% that do graduate, 68% will continue on to some college or university according to 2010 statistics (U.S. Department of Labor, 2011). Of the 68% of students who start some undergraduate program, less than 60% of them will actually finish a 4-year degree in 6 years. (2008). Putting the figures together leaves the fact that less than a third of students who start high school actually finish a four-year college degree in 6 years. Though multiple factors in elementary school affect overall graduation, yet there is ample evidence that much attention is needed in the junior high and high school setting to help all students be successful in reaching for higher education goals, and in the long run, helping reduce drop-out rates, and increase a successful educational journey for all students.

In working to address high school failure rates, Chicago schools adopted a tracking system focused on ninth grade performance and attendance (Easton, 2005). More than one failure in a core class is a red flag calling for attention. Though this early identification system helps, a more logical approach would be to identify students who are at risk of failure before they fail a class, even looking at junior high performance as an early warning system (McCallumore, 2010; Neild, 2007). For the teacher of a core freshman class, some early warning measurement tool of student ability would be invaluable. There is currently no consensus or common measurement tool in K-12 public education specifically designed to identify students with a high statistical probability of failing a core high school class before they take it, specifically high school math classes such as geometry and algebra.

This quantitative research set out to examine research-backed measurement tools that were developed with academics in mind, and could be applicable to measuring student academic success in a high school math classroom. Many of these instruments have proven reliable in
college settings, but there is not enough current research into reliable predictors of success for high school math students. The most promising indicators (or instruments) proven in other academic settings were tested at a rural public Oregon high school for their ability to predict student performance in that classroom.

In the long run, the goal was to not only identify groups of students that might struggle in math, but also to utilize an effective intervention program to keep them on track. Some programs have showed promise in helping specific at-risk students, such as the Coca-Cola Valued Youth Program, and the Achievement for Latinos through Academic Success. Both have proved statistically effective in helping at risk Latino students stay in school (Fashola, 1997).

Targeting the motivation of eighth grade students from a low socio-economic neighborhood in Illinois, researchers found that increased parental involvement and cooperative learning groups made a positive difference in measured student motivation for school success. Waiting until a student is hopelessly behind, or has already failed a core class to begin intervention is not an effective approach to students at risk. A better method is to pre-test a student’s ability to be successful in a class and then make resources available to help those that need intervention while avoiding overt labeling or other segregating groupings.

This paper proposed to compare, contrast, and evaluate key measurement tools to help in identifying students’ future performance at the beginning of a math class. If students at risk are identified early, and effective mediation can be employed to help those students pass core classes and stay on track, then schools have the possibility to not only help those students’ self-esteem and confidence, but also to help them perform at a higher level on today’s state testing, graduate from high school on time, and hopefully continue on in their education to be more productive members of society with higher earning power. Again, clear measurements of student academic
abilities and predictors of student success would help identify those students who need more attention.

**Statement of the Problem**

The purpose of this correlational study was to examine three student personality traits of self-control, grit, and attitude as potential predictors of academic performance in high school math, and compare the reliability of those characteristics against static measures of student achievement such as GPA, prior math grades, and a math pre-test.

**Research Questions**

Because of the prior lead of researchers such as Ridgel (2004), Duckworth (2005, 2006, 2007), Tapia (2000), Tangney (2004), and Allen (2008) in establishing positive associations between personality traits and performance (academic, and career), the following questions will drive this research.

*Research Question #1*

What is the association, if any between each student’s level of self-control as measured by a self-control survey instrument developed by Tangney (2004) and that student’s final grade in math?

*Research Question #2*

What is the association, if any between each student’s grit as measured by a survey instrument developed by Duckworth (2007) and that student’s final grade in math?

*Research Question #3*

What is the association, if any between each student’s attitude toward math as measured by a math survey instrument (based on shared dimensions with existing theories and scale factors from Tapia (2000)) and that student’s final grade in math?

*Research Question #4*
What is the association, if any between each student’s prior academic learning, as measured by academic measures such as GPA, prior high school math class grades, and math pre-test grades and that student’s final grade in math?

**Key terms**

**Prior academic learning** is defined in this paper is the student’s past school performance, and amount of skills and knowledge that student has at the beginning of the trimester of this study. The prior knowledge and performance is measured by the student’s cumulative high school GPA at the beginning of the trimester, prior high school math grades, and evidence of prior learning as measured by a math pre-test. In some research, these measures are tied closely to student IQ.

**Student success** is measured in this paper as the student’s final numeric grade in the high school math course ranging from 0 to 100. The components of that grade are weighted as follows: 50% based on unit tests, 30% based on class assignments, 5% based on quizzes and 15% based on the course final.

**Student self-control** is defined as a personality trait that is a combination of both self-regulation and deferred gratification (Tangney, 2004).

**Student grit** is defined as a personality trait which is a combination of self-control and persistence (Duckworth, Peterson, Matthews, & Kelly, 2007). It is manifest by habits such as being on time, perseverance, continuing a task in the face of challenges and setbacks. Other names used in the literature for this characteristic include work drive, focus, self-discipline, dutifulness, time on task, and achievement striving.

**Student attitude** is defined as a measure of a student’s feelings toward academics, math, and includes evaluating a measure of the amount of self-esteem and self-confidence, especially as
related to a propensity for academics, and confidence level related to embracing math challenges (Tapia, 1996).

**Limitations and Delimitations**

One limitation of the study was that by only looking at four broad aspects of the student, namely prior academic learning, self-control, grit, and attitude, the study could have missed other controlling facets of a student’s academic capabilities, such as IQ, or socio-economic data. Also, by conducting a quantitative correlational study, the depth of information could have suffered as student feelings, struggles and nuances are lost to short survey questions. In other words, in looking for associations, this research could have possibly missed actual causes of student performance in the public school system.

One delimitation was the choice to use a small rural school for this research. Not only was the sample size small, but the findings might not be consistent with the culture and issues faced by larger urban schools. A limitation that comes with the smaller school is that the students were not randomly assigned to the four math classes that were a part of this study. Since other constraining factors go into the students’ assignment to the four math classes, there were possibly many factors that could limit the accurateness, or validity of this study. Possible factors of the non-random scheduling include: the time of day, energy level of student and teacher, time since the students last ate, and multiple other factors related to the natural biological rhythms that affected students’ ability to focus and learn throughout the school day. Selection bias could be another limitation that results from the division of students who actually took the survey from those students who did not participate. Students who did not turn in a permission slip, or who chose not to participate could represent a relevant and important part of the student population that will not be represented in the overall results.
Another delimitation is the choice to only compare predictors of academic success to the final outcome of a math class. The final grade as the dependent variable could be too specific, and too erratic a variable of student success because of the technical nature of math. Another delimitation is the increased possibility of response set bias with the decision to do self-reporting surveys as opposed to personal surveys or third party measures of student characteristics. A fourth delimitation is the choice to use classes in this research that are taught by the researcher. Though a teacher does impact the learning and final grade of every student, yet it is hoped that the professional classroom demeanor, and pedagogy of this researcher were a positive aspect of consistency across the four classrooms in this study, rather than a confounding factor.

Another limitation is that the labels of self-control and attitude used for the surveys might not fully explore the depths of those personality traits. There are multiple facets to personality, and though research has pointed to the overall trait of conscientiousness that envelops the traits of self-control, grit and attitude, there could be numerous other underlying factors that are missed or just mislabeled. The ambiguity of many of the labels is not addressed in depth in this paper. Instead, this paper focuses on the predictive abilities of the measurement tools as related to student success. Still another limitation of this study was the actual measurement instrument labeled attitude. Though this instrument contains some questions from other tested instruments, yet the majority of the questions were developed for this study based on the concepts of measuring student attitude toward school and their success in school. There is the possibility that this instrument has little validity in regards to its label.
Chapter 2 Literature Review

There are many stakeholders interested in student achievement, regardless of the institution. Finding indicators of student academic performance after a student has failed is easier than finding predictors of their academic performance before they fail. In reviewing the literature, two main student characteristics that deserve attention as possible predictors of academic success are intellectual characteristics such as IQ and GPA, and non-intellectual characteristics such as the personality trait of self-control.

Intellectual Traits as Predictors of Student Success

Historically, a person’s IQ has been the prevailing leading indicator of academic success, specifically in math (Ruiz, 2014; Watkins, 2000). There appears to be ten times the amount of research dealing with academic success and intelligence compared to academic success and self-discipline (Duckworth & Seligman, 2005). Because of these historical precedents, the relationship of intelligence to student academic achievement bears review, especially because of its relationship to the student grade point average, or GPA.

The use of the Binet-Simon Intelligence Scale for measuring the IQ of school children was proposed as early as 1916 by Lewis Terman (Terman, 1916). It was assumed by some to be a predictor of student ability and capability. In relation to actually comparing student IQ to student grades in large groups, the growing availability of computers in research and larger memory storage capacity has allowed researchers such as Coleman (2009) and Allen (2008) to access widespread archival data on large student populations. Such larger studies have helped refine IQ as a measurement of and significant predictor of student success. One study used Raven’s Standard Progressive Matrices to compare IQ to student success as related to their grade point average (Laidra, 2007). In this large study of 3,618 Estonian primary and secondary
students, Laidra, Pullmann and Allik found positive correlations between students’ higher scores on the IQ test, and higher grade point average scores (Laidra, 2007). The interesting trend was that the correlations were fairly consistent from first grade to middle school at about r=0.5. The correlations then began to decline to r=0.32 for seniors (Laidra, 2007). Other research has found the opposite trend with a correlation factor of r=0.728 when focused narrowly on the numerical reasoning aspect of IQ and academic performance in science and math (Ruiz, 2014).

The largest accumulation of student testing data as related to IQ was done in Britain. This research study of 70,000 English middle and high school children was undertaken over five years in which IQ was correlated not to GPA, but to the students’ standardized 10th grade test called GCSE (Deary, 2007). IQ was shown by the research to be a strong predictor of the students’ GCSE (their final General Certificate in Secondary Education score) with a correlation of r=0.69, and especially as related to the math strand with a correlation of r=0.77. The lowest correlation of the IQ to their GCSE score of all twenty-five strands of this final exam was r=0.43 between IQ and the category of Art and Design (Deary, 2007).

Other researchers also support high correlations between measured IQ and school performance. Some of this recent research includes Furnham’s study of 212 British students with correlations of 0.68 with English scores and IQ, and 0.66 with math and IQ (Furnham, 2009), Freburg’s study of special education students with correlations of 0.65 for reading, and 0.75 for math (Freberg, 2008), and Rowe’s study of gifted children with an IQ correlation of 0.59 to reading, and 0.47 to math (Rowe, 2010).

In reviewing the literature, two studies found significant but lower correlations of IQ as a predictor of student success. One study by Duckworth found that IQ as measured by the Otis Lennon School Ability Test only correlated to GPA at r=0.32 (Duckworth & Seligman, 2005).
Another study by Ridgell found that first year college students’ grades in one class of psychology showed a correlation of $r=0.4$ with the students’ individual IQ scores (Ridgell, 2004).

The downward trend of correlation of IQ to academic performance as students get closer to their senior year in Laidra’s study (2007), and the lower correlation results between IQ and academic achievement found by other research hint that other factors besides IQ may affect student academic performance. In fact, one research project found that self-discipline was a more robust predictor of student success than IQ (Duckworth & Seligman, 2005). Finally, some researchers discount the division of intellectual, and non-intellectual traits as semantics, and instead see a closer congruence of intellect and character tendencies called trait complexes (Ackerman, 1997). In fact, one of the big-five personality traits discussed below called openness is connected directly to intelligence by some researchers, thus further negating the distinction (Digman, 1990).

These findings lend further empirical evidence for the use of IQ, or its corollaries, as a possible predictor of student success. In light of the current study, student GPA can be seen as a result of intellect, or personality traits, or both. Accordingly, this research will evaluate student GPA as a possible predictor of student success in math as stated in research question four. It was disclosed in the limitation section that other factors, such as student intelligence, classroom setting, and time of day could be confounding factors.

A feature of mastery learning called pre-testing is used many times by teachers as a gauge to ascertain how much foundational knowledge their students have, and the extent or pre-teaching needed (Guskey, 2010). In fact, when introducing the key aspects of mastery teaching back in the 1960’s, Bloom (1968) talked about using pre-tests to gauge the learner’s aptitude for
learning. He also noted the ability of pre-tests to predict student final grades, specifically in math, with a correlation factor of .7. Of course, Bloom continued the discourse regarding the pre-test results, and student final results, and argued that students who scored lower on the pre-test would simply need more time to master the subject at hand (Bloom, 1968). Other research points to math pre-tests in earlier elementary school grades as significant predictors of math placement results in 8th grade (Faulkner, 2013). Pre-tests have also been significant predictors of middle school students’ performance on state tests (Meylani, 2014). So, for purposes of this research, the math pre-test should be checked against other predictors for significance in predicting student math-grade outcomes.

Prior math grades have also been shown to be important predictors of student success in successive math courses. Specifically, studies tracking success in algebra have noted the specific significant correlation between prior math grades, and success in algebra (Rotman, 1991). Other research noted that prior math grades were more reliable predictors of 9th grade boys’ future math grades, whereas self-belief and intentions were a more reliable predictor of 9th grade girls’ future math grades (Crombie, 2005). Others might argue that lower grades in prior math courses might be associated with higher math anxiety, a negative effect on math success (Meece, 1990). Still others point to specific prior math skills, such as mastery of fractions, division, and whole numbers as unique predictors of success in high school math classes (Bailey, Siegler, & Geary, 2014; Siegler, 2012). Based on this research, prior math grades should at least be included in any data analysis of predictors of student success in a math class.

**Non-intellectual Traits as Predictors of Student Success**

The underlying assumption of current personality-trait theory research is that behavior is controlled by, or is an important co-factor and corollary of certain universal personality traits
Barrick, 1991; McCrae, 1997). This is in contrast to theories held earlier last century that gave more prominence to the situation as a predictor of performance that personality (Digman, 1990; Milgram, 1963).

Though recent research has paid more attention to the manner in which personality inventories correlate to academic achievement (Meyer, 2009) and professional achievement (Sutin, 2009) there is still a shortage of specific research into reliable predictors of student academic performance in high school math classrooms. Research has pointed to motivational traits and personality characteristics as predictors of specific achievements in specific domains (Duckworth & Seligman, 2005). Therefore, current literature will be examined for trends and measurement tools used that may be statistically significant as a co-factor, or predictor of student success in a high school math classroom.

Research has found that a student’s attitude toward math correlates significantly with that student’s academic progress in math. This relationship of a student’s attitude toward math and that student’s academic outcome in math has been show over a wide range of studies, particularly a meta-analysis of 118 independent studies showing an average significant correlation coefficient of .6 (Ma, 1997). A more current study compared 193 university students’ attitude toward math scores to those students’ final grade in a research and design course and found it to correlate significantly to student success (Núñez-Peña, 2013). Many of these studies measuring student attitude use a 40-scale instrument developed by Martha Tapia (1996) to measure student feelings toward math. Seeing the need for an attitude toward math instrument, she sought to measure the sense of security, value, motivation, and enjoyment of math in middle school students. This instrument was successfully evaluated for internal reliability coefficient of .95 and validity (Tapia & Marsh, 2000). The validity of the instrument
was confirmed statistically and by individual secondary teachers who confirmed test question construct. This instrument holds promise as a reliable predictor.

Research appears to point to one broad personality trait that demonstrates itself in predictable patterns in work success, and in academic achievement. This trait is given its own spin and nickname by the various researchers who have explored its usefulness and robustness in correlating to human behavior. Though potentially confusing, this one trait is called conscientiousness (Digman, 1990; Vianello, 2010), academic ethic, (Rau, 2000), work drive (Ridgell, 2004), self-control (Mansfield, 2009), motivation (Coleman, 2009), and grit ((Duckworth, et al., 2007). Though each of these could be called a facet of conscientiousness or a sub-group, yet a quick review of recent literature will explain the prominence of this trait, how it was defined and measured, and how it relates to this study concerning predictors of student success. Figure 1 depicts one way to view the connection of these terms.

<table>
<thead>
<tr>
<th>Figure 1. Map of Personality Traits</th>
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<tr>
<td><strong>Big 5 Personality Traits</strong></td>
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<tr>
<td>(1) extraversion (2) agreeableness</td>
</tr>
<tr>
<td>(3) <strong>conscientiousness</strong> (4) Neuroticism (5) openness (IQ)</td>
</tr>
<tr>
<td>Academic ethic</td>
</tr>
<tr>
<td>*attitude</td>
</tr>
<tr>
<td>work drive</td>
</tr>
<tr>
<td>*grit</td>
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<tr>
<td>*self-control</td>
</tr>
<tr>
<td>motivation</td>
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<tr>
<td>subsequent sub-groups of conscientiousness</td>
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<td>* used in this research</td>
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During the last twenty years, researchers have pared down which personality traits act as valid predictors of various performance criterion such as academic success measured by GPA, and achievement of difficult goals in military training. Digman (1990) is one of the main researchers who drew interest to the Big Five personality traits as having validity for psychological measurements. These Big Five personality traits were identified broadly as (1)
extraversion/introversion (2) agreeableness (friendliness/hostility) (3) conscientiousness (4) Neuroticism / emotional stability and (5) intellect or openness (Digman, 1990, p. 424). The importance of this study was to re-affirm the five-factor model, or five dimensions as identifying universally recognized and measurable personality traits. For purposes of this study, dimension III, conscientiousness is the trait of interest. Digman lists the historical synonyms of this trait in chronological order as: will to achieve, dependability, conscientiousness, task interest, superego strength, thinking introversion, will to achieve, prudence, conscientiousness, work, impulsivity, constraint, and self-control (Digman, 1990, p. 423). He defined this trait as “will to achieve”, or “monitor factor,” though he concedes that the term conscientiousness is the term of general choice to describe this personality trait (Digman, 1990, p. 424). The tool used to measure conscientiousness and the other factors is the NEO Personality Inventory comprised of over 200 items (McCrae, 1985). Digman concludes his paper by noting a robust correlation of .70 of conscientiousness to the aggregate measure of school student grade point average in elementary and intermediate school settings. He does not disclose the scale items of the instrument he used to measure conscientiousness. This research will follow this personality trait labeled conscientiousness, and further evaluate its application to the high school classroom.

The next year, Barrick and Mount through a meta-analysis of 162 studies showed that only one of the traits had significant correlation to job performance (Barrick, 1991). These two authors found that across occupations ranging from professionals, managers, sales, and skilled/non-skilled workers, conscientiousness, as defined, constructed, and measured by prior research was the only trait of the Big Five that correlated consistently with job proficiency as measured mainly by worker training. This breakthrough meta-analysis encouraged further research of these traits, specifically in the field of education.
A few years later, Chamorro and Furnham (2003) applied the above findings to academics at the University College London. They compared 247 undergraduate academic scores on five major three-hour exams (taken over a three-year period) against personality measures of the Big Five personality traits. They found positive correlations with conscientiousness and negative correlations with neuroticism and extraversion. They did further analysis to identify the extent to which certain sub-categories of the trait of conscientiousness correlated to academic achievement. The findings helped narrow future research. Overall, these factors were responsible for 45% of the academic variation. The contributing factors are listed in Appendix A. Again, this shows further confirmation that personality traits hold promise as reliable predictors.

Research by Ridgell and Lounsbury measured conscientiousness in a narrowly defined manner as they defined it as “an enduring motivation to expend time and effort to finish projects, meet deadlines, be productive and achieve success” (Ridgell & Lounsbury, 2004, para. 6). Significant correlation was found between participants measurement scores on this sub-group of conscientiousness and academic success as measured by a single course grade, and self-reported GPA. The study involving 140 college first-year undergraduate students found statistically significant correlation found between this narrow sub-set of conscientiousness and academic success with little correlation measured to the other Big Five factors. The focus on sub-categories of conscientiousness was to continue.

Tangney defined the sub-group of conscientiousness of self-control as one’s self-capacity “to inhibit its antisocial impulses and conform to the demands of group life” (Tangney, 2004, p. 272). She portrayed self-control as highly related to conscientiousness, and developed an instrument that reflected scales to measure the important sub-factors, including moral emotions,
interpersonal relationships, adjustment, and impulse control. The 36-question survey showed adequate internal reliability with Cronbach’s alpha of .89. Survey validity was determined by comparing results to standard psychological surveys that measured factors of self-control, such as impulsivity related to eating disorder, and anger response. The significant negative correlations of Tangney’s survey to these psychological inventories demonstrated the survey validity in regards to self-control. She compared university students’ overall self-control score to their academic performance as measured by GPA, finding a bivariate correlation coefficient of 0.39. Because this instrument was developed for use in young adults, and was developed with the intent of comparing results to academic performance, Tangney’s instrument was included in this study.

Duckworth and Seligman furthered the research by studying another facet of conscientiousness in middle school children (Duckworth & Seligman, 2005). These two authors used extensive testing of eighth grade students for a facet of conscientiousness called self-discipline, as measured by the Eysenck 1.6 Junior Impulsiveness Subscale, and Tangney’s self-control scale (Eysenck, 1984; Tangney, 2004). The authors defined the independent variable as a composite self-discipline score from the above measures, and the dependent variables as students’ academic performance as recorded on their report card along with standardized test scores. In this longitudinal, predictive study of 140 eighth graders, the authors predicted that the students’ measure of self-control would predict their academic outcomes, as referenced above. The results of the study were that the self-control score predicted variation in all academic outcomes with a correlation coefficient of 0.67, compared to a modest correlation of 0.32 between student IQ and academic success. These positive correlations between self-discipline and academic success have been replicated in several studies since. These results lend more
credence to considering some of these instruments for predictive utility in this research related to a high school math classroom, and the students’ academic outcomes.

Finally, one aspect of conscientiousness was tested for predictive validity in multiple fields including educational attainment. The study examined the academic outcomes of 138 Ivy League graduates, cadet retention of 1218 West Point cadets, and the final ranking of 175 participants in a national spelling bee (Duckworth, et al., 2007). The authors defined this attribute of “grit as perseverance and passion for long term goals” (Duckworth, et al., 2007, p. 1087). Though the authors admit that grit overlaps with the achievement aspect of conscientiousness, they propose that grit focuses more on long-term stamina, and persistence. Accordingly, the authors developed a 12-scale survey instrument to measure grit by asking survey questions such as, “I have achieved a goal that took years of work” (Duckworth, et al., 2007, p. 1090). They worded the Likert-scale questions so they would be applicable to academics as well as professional and technical environments. The instrument showed adequate internal consistency and validity as it was compared to, and correlated significantly to participant scores of self-control, and participant completion of rigorous training programs that needed a high degree of self-control. Of all the measures, it appears that grit had the highest correlation to academics, specifically grade point average. Accordingly, grit as a viable predictor of academic success is of high interest for use in this current study.

Interestingly, a recent publication from King’s College appears to show that many of the above personality traits that affect student success in secondary school are hereditary (Shakeshaft, 2013). In studying over 11,000 twins and their scores on the British GCSE final high school exam, they found that heritability accounted for 55% of the variation in student scores. These findings would appear to detract from the current “one-size-fits-all” approach that
is prevalent in current state and government legislation, and would lend credence to the early identification of potential struggling students.

Further research linked lower student scores of measured personality characteristics of self-efficacy and motivation to higher propensity for dropping out of high school (Alivernini, 2011). In a longitudinal study of 429 secondary students in Italy, the authors gave the students a self-efficacy-motivation survey, and compared their scores to self-reported tendencies to drop out of school. High levels of motivation correlated significantly and with low levels of intentions of dropping out of school, and high levels of academic success as measured by school grades. Similar to other measures of personality traits, the measures of self-efficacy and motivation correlate significantly to student intentions (whether the student considered dropping out of school) and actions regarding effort toward academics.

In most of the research cited, the precedents used in handling the data were to standardize the data, check for normality, list descriptive statistics of the data, compare results by any subgroups of participants, (age, gender, class), perform a reliability analysis, eliminate survey items with lower alpha coefficients, and finally run Pearson correlation tests comparing predictor to criterion variables (Chamorro-Premuzic, 2003; Kyttälä, 2008; Laidra, 2007; Meyer, 2009; Vianello, 2010; Waschull, 2005).

In summary, these research findings lend credence to a personality-trait theory of behavior that infers internal traits, in contrast to situational effects show strong correlation to individual performance. Specifically, the measure of certain personality factors, such as attitude, conscientiousness, and grit show historical enough validity in an academic setting to be considered for further research as to viability as a predictor of student success in the high school
math classroom. The literature is less clear as to the reliability of these instruments in regards to predicting student success in a high school math class setting.
Chapter 3 Methods

Because the multiple factors that influence positive academic performance have been of great interest to educators, they merit further examination as specifically related to math performance (Duckworth & Seligman, 2005). One factor that has resurfaced as a broad area of interest in predicting academic success is the influence of personal traits. This affected the decision in this study to focus on personal traits as opposed to intelligence, or other skills or abilities. Though the theories of the formation of these traits in individual students is beyond the scope of this paper, yet the research shows that these innate traits influence on a statistical basis, the future performance of individuals in academics and on the job (Barrick, 1991; Deary, 2007). This research narrowed the focus, and attempted to determine the relation of high school students’ innate personality traits to those students’ performance in math class. The goal of this research was to determine if any student character traits or prior student academic benchmarks were valid predictors of student academic performance. In light of the various models and settings illuminated in available research, certain tools and methods hold promise as reliable predictors of student outcomes. The goal, once again was to eliminate tools that are not valid, and hopefully condense and focus on measurement tools that directly relate to student success in math so they can help early identification of students that need intervention.

Setting and Participants

The participants in this research project were high school students at an Oregon Title 1 public high school of approximately 750 students with a predominantly (88%) white student population and a small (10%) Hispanic population. The school currently realizes a 99% graduation rate with a student to teacher ratio of 22:1. Around 15% of the student population is ranked below poverty level. The participants (n=46) were ages fourteen to seventeen, 46% male,
54% female, with about 60% in geometry and 40% in algebra 2 comprised of about a third ninth graders, a fourth tenth graders, and the rest eleventh graders. The classes met over the trimester starting from December 2014 to March 2015 with seventy-five minute periods. Students that had turned in their parental permission slips were informed that their participation in the survey was voluntary.

**Research Design and Sampling Strategy**

This study utilized a correlational design combining existing student data comprised of student GPA, prior math scores, and course pre-test scores with primary survey data in order to confirm the significance of these instruments regarding their ability to predict the student’s ultimate performance in a math class. Since the goal of this research was to determine the presence of student personality traits as indicators or predictors of their academic outcomes, two of the three survey tools used were kept in their original format in which they were both validated and checked for reliability. Once data were collected, they were evaluated for predictive significance as indicated by the student’s final math grade at the end of the trimester.

Since Oregon students are required to pass three years of rigorous math to graduate, the geometry and algebra 2 classes are usually the main hurdle for students to remain on track for graduation. Thus, each student’s final grade in math class is the criterion. The predictor variables included student GPA, student prior high-school math grade averages, course pre-test scores, student self-control scale, student grit scale and student attitude scale. A separate bivariate correlation analysis was performed for each factor to determine whether or not it displayed practical significance as a predictor variable of the final math score. Student assignment to the four classes was not random, but was the result of school scheduling constraints, other student elective choices (such as band, choir, welding), and other classes being
full. Therefore, it is conceded that these four classes were not a random sample of the general student population, and could be a biased sample for multiple reasons. Because of this limitation, differences in the students’ final grades could have been affected by the multiple factors connected to the actual class period such as the time of day, time since the student last ate, energy level of the student or teacher, and multiple other factors. Most design criteria for research advocates random assignment of persons to the study groups so as to minimize confounding factors, so this research study falls outside those guidelines (Gall, 2003). Because random assignment was not possible in this study, careful comparison of results between classes was done in the data analysis to look for any influences of the selection of class on the actual student results.

All four classes were taught by the author of this research paper at a rural Oregon high school. All four classes in this study were non-traditional flipped classrooms in which students first encounter the basic course material outside of class by taking notes from a pre-recorded web-based video lesson. The classroom setting had traditional seating in rows, with a second set of computer desks available in the back of the class for further student learning options.

Collection of data through the survey instruments was by voluntary participation by all the students in these four classes, based upon the corresponding receipt of parent permission slips for each student. Parent permission slips were stored electronically with collected data.

Increasing research is validating personality traits as short term and long term indicators of increased scholastic scores and job performance (Allen, 2008; Barrick, 1991; Coleman, 2009; Duckworth & Seligman, 2005; Ridgell, 2004). This research focused on those traits that appeared in the research to yield the most predictive ability as relates to academic success.

Measures
The first survey tool chosen is a measure of a construct called grit. As shown previously in chapter 2, grit is a descendent and a sub-scale of conscientiousness. Grit was defined by Duckworth (2007) as perseverance for long-term goals. The instrument is a 12-question validated tool measuring combined qualities of conscientiousness ($r=0.77$) and self-control ($r=0.63$) (Duckworth, et al., 2007). The instrument was developed and tested to be used for measurement in both vocational fields and in academic settings. The connection of grit to academic performance was tested in relation to the grade point average of undergraduate students (Duckworth, et al., 2007). Because the only factor of the big five that was significantly related to academic performance was conscientiousness, and because grit is a more recent derivative of this trait, and because the grit instrument was developed with academic performance in mind, and because grit had been shown to be a statistically significant predictor of academic success, grit is one of the personality trait measures included in this study.

The second survey instrument chosen deals with self-control. The basis of the 36-question instrument is to measure a person’s capacity to control impulses (Tangney, 2004). This instrument was verified for reliability and validity by the lead authors, Tangney, Baumeister and Boone (2004), and was further validated in subsequent research by Duckworth (2005). The instrument was used with undergraduate students to show a 0.39 correlation coefficient with grade point average (Tangney, 2004). Because core high school classes, such as math, science, English require a great deal of self-control, and because this instrument was developed for use with young adults in an academic setting, and because the instrument had been shown to be statistically significant in correlating to student academic accomplishments, this measure was included in this study.
The third survey instrument was a 19-question self-report measure designed to capture student attitudes toward math, toward their schooling, and their motivation to excel at schooling. Six of the math-attitude questions (2, 5, 6, 11, 14, and 15) came directly from Martha Tapia’s 40-question attitudes survey (Tapia, 1996; Tapia & Marsh, 2000). Three questions (4, 10, 20) were based on a psychological inventory of motivation and achievement (Schuler, 2004). The remaining 10 questions were developed to assess student self-efficacy and student self-motivation to exert effort toward academics, in line with overall existing theoretical constructs of motivation and self-efficacy research (Alivernini, 2011; Allen, 2008; Breen, 2002; Broussard, 2004; Coleman, 2009; Curtis, 2006; Kitsantas, 2008; Kover, 2010; Meyer, 2009; Miller, 1995; Schuler, 2004; Shia, 1998; Sian H. T., 2010; Skaalvik, 2009; Thelk, 2009; Waschull, 2005). As noted in the limitations section, this instrument compiled from multiple existing constructs was not validated by any other measurement tools. Though test-retest, and inter-item reliability measures were performed on this instrument, no claim is made that any survey results actually measure a personality trait called attitude.

**Research ethics**

Initially, this research design was evaluated by the George Fox Internal Review Board for consistency with current practice and participant confidentiality. The parent permission slip used is included in the Appendix B.

Most of the collected data resides electronically on a password protected computer. The files themselves storing the data are password protected, to ensure the integrity of any personal information that is gathered during the course of this research. The initial data identifier field consisted of the student name, and a consecutive participant number. Once the final grade from the math courses were collected, then, data identifiers involving the student names were deleted,
leaving only non-traceable consecutive participant identifier numbers one through forty-six. Letters of consent and survey responses are stored at home in a secure file. Finally, after three years, all letters of consent and records will be deleted.

**Data Collection and Analytical Procedures**

The administration of the surveys took place in the students’ math classroom during class time. Students logged into their school account, answered a few general questions, and then took the surveys using Google forms as the basis for recording and collecting student data. Resultant answers were initially coded into excel spreadsheets with specific questions reverse coded so that all answers were consistent. Student names were kept until the final trimester grade was recorded, after which, the student names were replaced with a data number based on the record’s position in the data file.

In accordance with the original measurement instruments, a consistent five point Likert scale was employed, with clear, consistent intervals between survey choices. The five possible Likert-scale choices included: 1 representing 0% of the time or never, 2 representing 25% of the time with sometimes, 3 representing 50%, 4 representing 75% and 5 representing 100% of the time. When data were found to be normally distributed, then because of these consistent implied numerical intervals in the scale structure and design of these survey instruments, data was treated as continuous for parametric analysis in line with many educational research precedents (Chamorro-Premuzic, 2003; Duckworth & Seligman, 2005; Laidra, 2007; Meyer, 2009; Vianello, 2010).

The first statistical test performed was a principal components analysis to check for survey questions that account for the most variability in relation to other questions on the same survey. Next, an analysis of each of the survey instruments yielded a Cronbach’s alpha as a
measure of the survey internal reliability (Barnard, 2009; Laidra, 2007). This gauged the internal consistency of the survey questions and, along with the principal components analysis shed light on any scales that were not in conformity with other questions in the survey instrument. The second step was to multiply survey results times a constant so that descriptive statistics showed similar ranges. These scaled results made it easier to compare basic survey scores to basic final grade scores. Using the scaled data, descriptive statistics could be displayed, and any discrepancies between population sub-groups, or class periods could be explored, using independent-samples t tests to distinguish population differences (Vianello, 2010). Next, the data from each instrument was individually analyzed against the criterion by bivariate correlation yielding a Pearson correlation coefficient as an indicator of the strength of the relationship (DeBerard, 2004). Finally, because there are multiple predictor variables, a multiple regression analysis was used to yield information about any relationships between the individual predictor variables, and any subscales (Chamorro-Premuzic, 2003; Gall, 2003). Each predictor variable, as spelled out in the research questions was individually analyzed with bivariate correlation analysis by comparing the fluctuation of each of those independent measurements to the fluctuation of the student final grades.

**Role of the researcher**

The first goal is to test meaningful predictors of student success in the arena of four high school math classes, and measure them against student outcomes as measured by the student’s final numeric grade. As the math instructor of those four classes at the participating Oregon high school, I was directly involved in first administering the initial surveys, and secondly in teaching the research participants in the specific math classes and assigning their final grades based on their performance.
The researcher is also a doctoral student at George Fox University with a strong desire to uncover reliable predictors that allow schools to be more effective in teaching students. According to the university ethics, I am committed to conducting this research according to the highest ethical standards possible along with ensuring that private student information is kept secure.

**Research Variables**

It was the proposal of this paper to test and identify practical, valid and reliable tools that have been uncovered by prior research to help identify struggling students before they begin a core course, namely high school math. The following are the variables used in this research, with the survey instruments listed in Appendix C.

**Predictors.**

The predictors (or independent variables) are:

- prior academic learning including: student high school grade point average (GPA) as recorded for each student in the high school database, student prior high school math as an average of all prior high school math class grades as recorded in the school database, a student math pre-test as a 20 question test given to all math students the first day of class
  - grit (as defined by prior research as a combination of self-control and conscientiousness) measured by a 12-question self-reporting survey
  - self-control as measured by a 36 question self-control instrument
  - attitudes as measured by a 19 question survey developed uniquely for this research

**Criterion.**
The sole criterion (or dependent variable) is each participant’s final grade as a number from 0 to 100 for the trimester in a math class, as measured according to school norms and policies based on student work completed and student test grades achieved.

It was the null hypothesis that there is no significant association between any of the predictors and the criterion.

In summary, basic classical survey design and prior research have paved a clear path as to the methods and analysis needed for this current research, with little to no unique obstacles that should hinder meaningful results, other than the limitations and delimitations previously listed.
Chapter 4 Results

Of the 71 students enrolled in the 4 math classes involved with this study, 67 parent permission slips were obtained, and 46 of those 67 students volunteered to take part in the survey during the first half of the trimester. Survey data from each of the three instruments were found to be normal as depicted in Figures 2 and 3. Q-Q Plots of pre-test, prior math grade, GPA and final grade are found in Appendix A.

Figure 2. Normality for grit, self-control, and attitude

Figure 3. Normal Q-Q plots of grit, self-control, and attitude

Overall test re-test reliability was high as seven students retook the survey approximately a month after the first sample with over 75% of their secondary answers matching their first responses exactly. A principal components analysis of all three surveys showed that 59 of the original 67 scale items were sufficiently consistent to be used in further analysis. Question 13
asked “If I had (because I have) younger brother(s) and/or sister(s), I would be (am) a role model for them to apply themselves to school work.” These questions, along with a few others were dropped from further analysis because of inconsistent results.

Table 1. Internal Reliability

<table>
<thead>
<tr>
<th>Measures</th>
<th>Cronbach's Alpha</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grit</td>
<td>.79</td>
<td>10</td>
</tr>
<tr>
<td>Self-Control</td>
<td>.87</td>
<td>33</td>
</tr>
<tr>
<td>Attitude</td>
<td>.88</td>
<td>16</td>
</tr>
</tbody>
</table>

After removing poorly worded questions, the internal reliability measures as depicted in Table 1 were found to be adequate with Cronbach alpha values at or above .8. This not only agreed with the original researchers' findings of reliability on the grit and self-control scales, but also confirmed that the constructed attitude scale, after dropping three questions, showed itself uniform to itself in measuring the trait of attitude toward math. Each student’s scores for the Likert scales were then multiplied times a constant scale factor to yield a range from 0 to 100 for easier face comparison to other factors, such as a comparison to the final grade, math pre-test, and prior math grades, all of which were also on a scale of 0 to 100.

Table 2. Descriptive Statistics of all measurements

<table>
<thead>
<tr>
<th></th>
<th>N=46</th>
<th>Self-Control</th>
<th>Grit</th>
<th>Attitude</th>
<th>Pre-Test N=43</th>
<th>Prior Math Grade</th>
<th>GPA</th>
<th>Final Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>78.86</td>
<td>75.65</td>
<td>72.44</td>
<td>50.84</td>
<td>87.60</td>
<td>3.40</td>
<td>83.80</td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>79.45</td>
<td>75.90</td>
<td>75.62</td>
<td>53.00</td>
<td>90.00</td>
<td>3.67</td>
<td>90.00</td>
<td></td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>10.96</td>
<td>12.70</td>
<td>13.32</td>
<td>15.69</td>
<td>8.92</td>
<td>.66</td>
<td>15.30</td>
<td></td>
</tr>
<tr>
<td>Kurtosis</td>
<td>.52</td>
<td>-.12</td>
<td>.03</td>
<td>2.09</td>
<td>-.41</td>
<td>-.12</td>
<td>3.82</td>
<td></td>
</tr>
<tr>
<td>Std. Error of Kurtosis</td>
<td>.68</td>
<td>.68</td>
<td>.68</td>
<td>.71</td>
<td>.68</td>
<td>.68</td>
<td>.68</td>
<td></td>
</tr>
</tbody>
</table>

Their adjusted mean scores, as seen in Table 2 match closely with the median scores, thus further demonstrating symmetry. In further examining the skewness and kurtosis of the data as
shown in table 2, again, most of the data appear within normal bounds. The exception is the final grade which is definitely skewed left. This is a favorable and desirable outcome of student grades.

Table 3. Summaries by Math Class

<table>
<thead>
<tr>
<th></th>
<th>Self-Control</th>
<th>Grit</th>
<th>Attitude</th>
<th>Pre-Test N=43</th>
<th>Prior Math Grade</th>
<th>GPA</th>
<th>Final Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometry B</td>
<td>79.42</td>
<td>76.41</td>
<td>72.73</td>
<td>52.04</td>
<td>87.22</td>
<td>3.42</td>
<td>83.70</td>
</tr>
<tr>
<td>N=27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Algebra 2 A</td>
<td>78.06</td>
<td>74.56</td>
<td>72.03</td>
<td>49.00</td>
<td>88.15</td>
<td>3.36</td>
<td>83.95</td>
</tr>
<tr>
<td>N=19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>78.86</td>
<td>75.65</td>
<td>72.44</td>
<td>50.84</td>
<td>87.60</td>
<td>3.40</td>
<td>83.80</td>
</tr>
</tbody>
</table>

Also, there was no significant difference between the geometry classes’ scores and the algebra classes’ scores as depicted in Table 3, with the highest t value from the independent-samples t test of 0.48 for grit. It was expected to discover higher measures of these personality traits from the more advanced algebra 2 classes, but the data showed no statistical difference.

Also, an initial concern was that because students were not randomly assigned to the classes, students might learn, and perform differently at different times of the day. This possible confounding effect would have skewed the results based on the period of the day when they took the math class.

Table 4. Summaries by Class Period

<table>
<thead>
<tr>
<th></th>
<th>Self-Control</th>
<th>Grit</th>
<th>Attitude</th>
<th>Pre-Test N=43</th>
<th>Prior Math Grade</th>
<th>GPA</th>
<th>Final Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (8:00-9:15)</td>
<td>75.80</td>
<td>73.95</td>
<td>69.32</td>
<td>49.15</td>
<td>83.07</td>
<td>3.09</td>
<td>77.23</td>
</tr>
<tr>
<td>2 (9:25-10:40)</td>
<td>76.94</td>
<td>74.75</td>
<td>69.50</td>
<td>50.00</td>
<td>88.50</td>
<td>3.30</td>
<td>84.90</td>
</tr>
<tr>
<td>3 (10:45-12:00)</td>
<td>80.53</td>
<td>74.11</td>
<td>74.72</td>
<td>50.75</td>
<td>87.22</td>
<td>3.36</td>
<td>83.00</td>
</tr>
<tr>
<td>5 (1:55-3:10)</td>
<td>81.99</td>
<td>78.85</td>
<td>75.98</td>
<td>52.93</td>
<td>91.42</td>
<td>3.77</td>
<td>89.64</td>
</tr>
<tr>
<td>Total</td>
<td>78.86</td>
<td>75.65</td>
<td>72.44</td>
<td>50.84</td>
<td>87.60</td>
<td>3.40</td>
<td>83.80</td>
</tr>
</tbody>
</table>
The data do show differences in all measures based on class period, as depicted in table 4. Because the differences are across all measures, including measures of prior performance and learning, and because the differences appear to be positive in their correlations to each other, (higher GPA, higher attitude scores generally appear in classes with higher final grade average), it appears that the time of day, or class period is not specifically the cause of the fluctuation, since it could not affect prior GPA and prior math grades. Additionally, the lowest average final grade (1st period) has the lowest of all other predictor scores, and the highest average final grade (5th period) also has the highest average of all predictor variables. It is possible that the innate qualities that the students themselves brought to class are the main cause of the fluctuation. If, on the other hand, any number of the predictor measurements did not fluctuate, but the final grade alone fluctuated by class period, then that finding would justify exploring the time of day as a potential significant confounding factor of the survey results.

Table 5 and Table 6 also show significant differences in all average scores by age and grade level, which warrants further discussion. Figure 4 shows the relative quartiles of the final grade when grouped by age.

<table>
<thead>
<tr>
<th></th>
<th>Self-Control</th>
<th>Grit</th>
<th>Attitude</th>
<th>Pre-Test N=43</th>
<th>Prior Math Grade</th>
<th>GPA</th>
<th>Final Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>81.40</td>
<td>81.42</td>
<td>77.33</td>
<td>60.00</td>
<td>91.00</td>
<td>3.73</td>
<td>91.40</td>
</tr>
<tr>
<td>10</td>
<td>78.06</td>
<td>72.91</td>
<td>71.75</td>
<td>47.68</td>
<td>88.25</td>
<td>3.49</td>
<td>85.25</td>
</tr>
<tr>
<td>11</td>
<td>76.85</td>
<td>72.76</td>
<td>67.04</td>
<td>44.00</td>
<td>81.81</td>
<td>2.78</td>
<td>70.82</td>
</tr>
<tr>
<td>Total</td>
<td>78.86</td>
<td>75.65</td>
<td>72.44</td>
<td>50.84</td>
<td>87.60</td>
<td>3.40</td>
<td>83.80</td>
</tr>
</tbody>
</table>
Table 6. Summaries by Age

<table>
<thead>
<tr>
<th>Age</th>
<th>Self-Control</th>
<th>Grit</th>
<th>Attitude</th>
<th>Pre-Test N=43</th>
<th>Prior Math Grade</th>
<th>GPA</th>
<th>Final Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>82.31</td>
<td>79.98</td>
<td>77.63</td>
<td>58.38</td>
<td>90.55</td>
<td>3.67</td>
<td>90.33</td>
</tr>
<tr>
<td>15</td>
<td>75.81</td>
<td>72.70</td>
<td>69.79</td>
<td>52.06</td>
<td>88.88</td>
<td>3.53</td>
<td>87.39</td>
</tr>
<tr>
<td>16</td>
<td>81.49</td>
<td>79.42</td>
<td>75.58</td>
<td>44.93</td>
<td>86.00</td>
<td>3.23</td>
<td>79.80</td>
</tr>
<tr>
<td>17</td>
<td>74.92</td>
<td>64.97</td>
<td>60.93</td>
<td>53.33</td>
<td>81.25</td>
<td>2.77</td>
<td>68.00</td>
</tr>
<tr>
<td>Total</td>
<td>78.86</td>
<td>75.65</td>
<td>72.44</td>
<td>50.84</td>
<td>87.60</td>
<td>3.40</td>
<td>83.80</td>
</tr>
</tbody>
</table>

Table 7 displays that all predictor variables show statistically significant lower scores for students who did not pass the class compared to those students that did pass. The average scores of those who failed are about one standard deviation below their peers, with failing students coming into class with a GPA more than three standard deviations below passing students’ average GPA.
Table 7. Summaries by Pass, Fail

<table>
<thead>
<tr>
<th></th>
<th>Self-Control</th>
<th>Grit</th>
<th>Attitude</th>
<th>Pre-Test N=43</th>
<th>Prior Math Grade</th>
<th>GPA</th>
<th>Final Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass (n=43)</td>
<td>79.16</td>
<td>76.16</td>
<td>73.37</td>
<td>52.00</td>
<td>88.72</td>
<td>3.50</td>
<td>86.81</td>
</tr>
<tr>
<td>Fail (n=3)</td>
<td>74.57</td>
<td>68.23</td>
<td>59.16</td>
<td>35.33</td>
<td>71.66</td>
<td>1.90</td>
<td>40.67</td>
</tr>
<tr>
<td>Total ave.</td>
<td>78.86</td>
<td>75.65</td>
<td>72.44</td>
<td>50.84</td>
<td>87.60</td>
<td>3.40</td>
<td>83.80</td>
</tr>
<tr>
<td>Independent-samples t test</td>
<td>1.2</td>
<td>.7</td>
<td>1.6</td>
<td>.9</td>
<td>8.2</td>
<td>9.6</td>
<td></td>
</tr>
</tbody>
</table>

Research Questions and Results

Multiple regression analysis on all three survey forms yielded an adjusted R square of 0.214. This result demonstrates that the three surveys account for, or explain about 21% of the total variance of the final grade, with a $p$ value of 0.004, meaning that there is less than a 4 in 1000 chance that these results were random. Further analysis run on the 3 prior measurements of student learning including GPA, prior math grades, and the math pre-test showed an adjusted R square of 0.804, with a $p$ value less than 0.001. Both multiple regression summaries and anova tables are found in Appendix A. The null hypothesis is that these predictor variables have no explanatory power in predicting any variation in the final grade. The data show strong evidence to reject the null hypothesis for predictor variables as a group.

Research Question #1

What is the association, if any between each student’s level of self-control as measured by a self-control survey instrument developed by Tangney (2004) and that student’s final grade in math?

The Self-control instrument results as depicted in Table 8, appear to correlate positively with students’ final grade in math, accounting for over 14% of the variation in student achievement in the absence of any other variables. Figure 5 displays a scatterplot of the actual loose correlation grouping between self-control data and final grade data, signifying weak
practical significance. Multiple regression analysis depicted in Table 9 shows that when the other survey instrument readings are held constant, self-control is deemed not significant with a \( p \) value of 0.745. In other words, the research appears to show that when the other variables are taken into account and held constant, the quality of both self-regulation and deferred gratification as measured by this survey have no statistical significance, and little practical significance in predicting a student’s final grade. The \( B \) value of -0.1 further suggests that for every point gain in self-control, there is a decrease of about 1/10 of a point in the final grade, thus confirming the instrument’s poor strength as a predictor.

Table 8. Bivariate Correlations of Surveys

<table>
<thead>
<tr>
<th></th>
<th>Self-Control</th>
<th>Grit</th>
<th>Attitude</th>
<th>Final Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Control</td>
<td>Pearson Correlation</td>
<td>1</td>
<td>.629**</td>
<td>.795**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.009</td>
</tr>
<tr>
<td>Grit</td>
<td>Pearson Correlation</td>
<td>.629**</td>
<td>1</td>
<td>.754**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.002</td>
</tr>
<tr>
<td>Attitude</td>
<td>Pearson Correlation</td>
<td>.795**</td>
<td>.754**</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>Final Grade</td>
<td>Pearson Correlation</td>
<td>.380**</td>
<td>.442**</td>
<td>.506**</td>
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<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.009</td>
<td>.002</td>
<td>.000</td>
</tr>
</tbody>
</table>

N=46 ** Correlation is significant at the 0.01 level (2-tailed)

Figure 5. Scatterplot of self-control
Table 9. Multiple Regression Analysis Coefficients

<table>
<thead>
<tr>
<th></th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
</tr>
<tr>
<td>(Constant)</td>
<td>40.714</td>
<td>15.549</td>
</tr>
<tr>
<td>Attitude</td>
<td>.521</td>
<td>.297</td>
</tr>
<tr>
<td>Self-Control</td>
<td>-.100</td>
<td>.305</td>
</tr>
<tr>
<td>Grit</td>
<td>.175</td>
<td>.243</td>
</tr>
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</table>

a. Dependent Variable: Final Grade

Research Question #2

What is the association, if any between each student’s grit as measured by a survey instrument developed by Duckworth (2007) and that student’s final grade in math?

The ability to persist and continue in the face of challenges, (which would be a good descriptor of a math class), appears to help students achieve a higher grade in math, as depicted in Table 8. Again, it would appear obvious that character traits of tenacity and perseverance should help a student stay on task longer, and thus do a better job at mastering a core subject such as math. Examining the scatterplot in Figure 6 again shows loose grouping, hinting at less than ideal correlation. Multiple regression analysis depicted in Table 9 shows that when the other survey instrument readings are held constant, grit is found to be not significant with a p value of 0.476. In other words, there is almost a 50% chance that the grit results could be random. For every point gain in a student’s grit score, there appears to be about a .2 gain in the final score.

Figure 6. Scatterplot of grit
Research Question #3

What is the association, if any between each student’s attitude toward math as measured by a math survey instrument (based on shared dimensions with existing theories and scale factors from Tapia (2000)), and that student’s final grade in math?

The attitude survey results, as depicted in Table 8, appear to correlate positively with students’ final grade in math, accounting for over 25% of the variation in the students’ achievement. This attempt to capture students’ attitudes and motivation toward math, and confidence in their math ability appears to be a reliable predictor of those students’ achievement in math class. Though cross validation procedures (such as parent or peer questionnaires) were not used to confirm that the instrument actually measures the trait of attitude toward math, yet the structure of the questions were in line with existing research dealing with attitude and motivation. Attitude survey regression results depicted in Table 9 appear to show the best results of the three surveys as related to predictability. Technically, though the multiple regression p value of 0.087 is slightly higher than the required 0.05 threshold for statistical significance, yet in light of all the other statistical descriptors, this survey results appear to show practical significance. The scatterplot in figure 7 also shows better grouping which agrees with the statistical results. Accordingly the data appear to show that students’ feelings toward school work and math as measured by this instrument can be a predictor of those students’ achievement in math class.

Figure 7. Scatterplot of attitude
Table 10. Bivariate Correlations of Prior Academic Learning Measures and Grade Level

<table>
<thead>
<tr>
<th></th>
<th>Pre-Test N=43</th>
<th>Prior Math N=46</th>
<th>GPA N=46</th>
<th>Grade level N=46</th>
<th>Final Grade N=46</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test</td>
<td>1</td>
<td>.327*</td>
<td>.438**</td>
<td>-.398**</td>
<td>.511**</td>
</tr>
<tr>
<td>N=43</td>
<td></td>
<td>.032</td>
<td>.003</td>
<td>.008</td>
<td>.000</td>
</tr>
<tr>
<td>Prior Math</td>
<td>.327*</td>
<td>1</td>
<td>.860**</td>
<td>-.378**</td>
<td>.791**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.032</td>
<td></td>
<td>.000</td>
<td>.010</td>
<td>.000</td>
</tr>
<tr>
<td>GPA</td>
<td>.438**</td>
<td>.860**</td>
<td>1</td>
<td>-.521**</td>
<td>.888**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.003</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>Grade level</td>
<td>-.398**</td>
<td>-.378**</td>
<td>-.521**</td>
<td>1</td>
<td>-.494**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.008</td>
<td>.010</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>Final Grade</td>
<td>.511**</td>
<td>.791**</td>
<td>.888**</td>
<td>-.494**</td>
<td>1</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01 level (2-tailed).

Table 11. Multiple Regression Coefficients

<table>
<thead>
<tr>
<th></th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
</tr>
<tr>
<td>(Constant)</td>
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<td>13.009</td>
</tr>
<tr>
<td>Pre-Test</td>
<td>.158</td>
<td>.077</td>
</tr>
<tr>
<td>Prior Math Grade</td>
<td>.214</td>
<td>.248</td>
</tr>
<tr>
<td>GPA</td>
<td>16.612</td>
<td>3.534</td>
</tr>
</tbody>
</table>

a. Dependent Variable: Final Grade

Research Question #4

What is the association, if any between each student’s prior academic learning, as measured by academic measures such as GPA, prior high school math class grades, and math pre-test grades and that student’s final grade in math?
As depicted in Table 10, the measures of students’ prior academic learning correlate positively with students’ final grade in math. The math pre-test accounts for over 26% of the variation of students’ final grades. Though a smaller variation coefficient than the 49% touted by Bloom (1968), yet the pre-test was as robust as the most significant personality trait measurement of attitude. According to Table 10, prior math grades accounted for over 62% of the variation in students’ final grades. This is in comparison to Crombie’s results (2005) that showed prior math grades only accounting for about 37% of the variance, though his study only included 9th grade students. Table 11 shows that when compared to the other measures, the prior math grade was statistically insignificant in predicting the final math grade. Again, as mentioned previously in chapter 2, these correlations could be caused by multiple other factors, such as math anxiety, or the self-fulfilling prophecy of “I’m not good at math,” based on past experience with math. As above, it does seem obvious, that with no particular specific intervention in a student’s academic life (such as intense tutoring, or counseling), that a student would continue to address math class, math challenges, and math homework in a similar manner used in the past, and realize similar results. Both measures scatterplots are depicted in Figures 8 and 9.

Figure 8. Scatterplot of pre-test

Figure 9. Scatterplot of prior math grade
GPA accounts for over 78% of the variation in a student’s final grade. This finding is in line with prior research that indicated GPA’s robust status as a predictor of future student academic performance. Specifically, high school GPA was found to be the best predictor of college academic achievement (Geiser, 2007; Saupe, 2010). According to Table 11, for every unit increase of a student’s GPA, there was about a 16 point increase in that student’s final math grade. A student’s study habits would most likely permeate to all subjects. The GPA scatterplot in Figure 10 depicts the most linear pattern of grouping showing the strongest correlation tendencies of all the measures.

Figure 10. Scatterplot of GPA

The relationships between the predictor variables and criterion as depicted in Table 8 and Table 9 allow a 99% confidence level to reject the null hypothesis for the criterion variables as a whole. Individually, the predictor variables showed mixed effects. Table 8 and Table 9 give the numerical answer to each of the 4 research questions. Just looking at the individual survey measures depicted in Table 2, it appears that students with higher self-reported grit, self-control, and attitude earned higher grades than those reporting lower scores on these surveys, in line with the underlying notion that these traits are positively correlated to academic performance. Further
multiple analysis revealed that the effects are mitigated in light of evaluating the surveys together. Though the correlation of $r=0.38$ between self-control and final grade scales matched Tangney’s (2004) correlation to academic achievement exactly, yet the multiple regression analysis showed no statistical significance between self-control and the final grade. The individual correlation between grit (which measures the components of self-control and persistence) and final grade scales was significant, $r(44) = 0.44$, $p<.01$, yet the multiple regression analysis demonstrated it to be insignificant in light of the other variables. Finally, the correlation between attitude and final grade scales was significant, $r(44) = 0.51$, $p<.01$. The static predictors of prior learning, (GPA and pre-test scores) showed significantly large effects, with GPA accounting for more than 75% of the variation in the final math grade as shown in Table 9. A graph showing the ascending placement of all predictors is shown in Figure 11.

Figure 11. Relative Correlations of All Factors With Final Grade
Chapter 5 Analysis and Conclusion

Problem Statement Revisited

The purpose of this correlational study was to examine student innate character traits and student prior academic performance as possible predictors of future student performance in a high school math course as stated in the research questions. Bivariate correlation analysis showed significant results, whereas multiple regression analysis showed mixed results as to the statistical significance of the various variables for predicting a student’s final math grade.

Research Questions Answered

Research Question #1

What is the association, if any between each student’s level of self-control as measured by a self-control survey instrument developed by Tangney (2004) and that student’s final grade in math? Our data show that there is a medium positive association (r=0.38) between a student’s self-control score, and that student’s final grade in math, though statistically insignificant.

Research Question #2

What is the association, if any between each student’s grit as measured by a survey instrument developed by Duckworth (2007) and that student’s final grade in math? Data show that there is a medium positive association (r=0.44) between a student’s grit score, and that student’s final grade in math, though analysis showed the findings statistically insignificant.

Research Question #3

What is the association, if any between each student’s attitude toward math as measured by a math survey instrument (based on shared dimensions with existing theories and scale factors from Tapia (2000)) and that student’s final grade in math? Data show that there is a large
positive association \((r=0.51)\) between a student’s attitude score, and that student’s final grade in math, though technically statistically insignificant.

**Research Question #4**

What is the association, if any between each student’s prior academic learning, as measured by academic measures such as GPA, prior high school math class grades, and math pre-test grades and that student’s final grade in math? Data show that there is a large association between a student’s pre-test, \((r=0.51)\) and that student’s final grade. The data also showed a large, but statistically insignificant association between a student’s prior high school math grade average, \((r=0.79)\) and their final grade. Finally, data demonstrated a large association between a student’s overall high school GPA, \((r=0.89)\) and that student’s final grade.

**Discussion**

This research set out to find reliable predictors of students’ future performance in a math class. The data appeared to confirm three of measures to be practically and/or statistically significant predictors including GPA, math pre-test and attitude. These can be used individually or together to predict future student performance in a math class with a similar student population.

Though data results are only statistically applicable to a similar grouping of students in a similar school setting, overall trends in this data could be useful in identifying students in other settings who might need more support. The 19-question constructed attitude survey in particular appeared to yield close enough correlation to warrant further exploration as a measurement tool, once validated for this purpose.

This research initially expected to discover a significant correlation between grit and the final math score, namely because of the tenacity needed for more rigorous classes such as math
and science. The short, twelve-question grit survey left doubt as to how deep it was able to reach into the participants' propensity for tenacity. Besides the shortness of the survey, a second misgiving was that some of the questions appeared slanted toward adult generalities. One such question is, “I have achieved a goal that took years of work.” Though some teenagers may have pursued a specific challenge for years, such as sports, band, or a foreign language, yet, most teenage high school years, in my opinion, involve new pursuits and interests as students mature. If this instrument were to be used again, it would probably be used in an expanded form of about 20 questions that address issues in teenagers’ lives which could sift out a teenagers’ propensity for tenacity or discontinuity.

The self-control survey was the longest measurement tool, and yet yielded the least significant predictability coefficient of all the measurements. Because it centered on habits, dealing with temptation, and the ability of the participant to control what is said, I would have thought this trait would have a stronger association with the ability of students to bring their faculties (such as attention, time, and environment) under control to complete necessary tasks, such as math. I now see that what I was looking for was the ability to focus, and what I was measuring was self-control; two distinct character traits. Again, in considering this type of research a second time, I would consider a different type of measurement tool that would instead measure the ability of a student to shut out peripheral noise, and to focus narrowly on a task.

The attitude results accounted for more than 25% of the variance in student performance. In hindsight, as most teachers could attest, a student’s positive attitude will overcome multiple obstacles and deficiencies such as gaps in prior learning. The initial concept started by Tapia deserves further attention and analysis to expand its ability to capture students’ attitude toward math, schooling, and themselves.
Unsurprising was the fact that prior math grades and GPA would so strongly predict a student’s final math grade. Colleges, along with other researchers have found that high school GPA appears an excellent predictor of future student academic achievement, particularly college achievement (Geiser, 2007; Long, 1993; Mattson, 2007; Saupe, 2010). Good student study habits appear to permeate all subjects in all settings.

One concern in the initial survey design was that the non-random assignment of students could adversely affect research results. Because of the different times of the different classes, the thought was that students might perform differently. It appears that the non-random assignment of students to classes did affect the outcomes by class. Even though the results by class period did show significant differences in the students’ final grade, yet, those differences were mirrored in the students’ other predictor traits that they brought to class, thus the limitation of non-random assignments, but nullifying class period as a factor in the results. One moderating affect in comparing different class periods could be that all four classes were taught by the same teacher, utilizing the same methods, thus minimizing other confounding factors.

The glaring differences in all measures between those students who passed the class, and those who failed the class as measured by all the predictor variables listed in Table 7 lends credence to the premise of this paper. That premise is that certain measures of student personality and prior learning can highlight specific students who might be in danger of struggling, or failing a math class. With this specific study in this setting with these particular students, it appears that all six indicators were valid in predicting a noticeable overall score difference that could have been used to identify students at risk.

An anomaly of concern is the pronounced decline in GPA and final grade based on the grade level (Table 5) and age (Table 6) of the student. It can be surmised that older students in
the class were taking the math class one or two years later than their peers. Two possible reasons could be that they were either behind their peers in their math level, or that they had failed a core math class. The biggest survey age disparity of 17 points was on the attitude survey. Possible causes include a “jaded upper class attitude” toward school, or a sour attitude towards schooling because these students have struggled academically in the past, and continue to struggle at the time of this study. This trend corresponds to decreased IQ showings from middle school to senior year mentioned earlier in chapter 2 (Laidra, 2007). This finding is in opposition to the noted trend in the larger Austin Independent School District that saw ninth grade as the lowest overall academic performance year of all grades one through twelve (Texas Office of Research and Evaluation, 1987). This pattern appears quite distinctly in this sample, and so warrants further exploration. One study found that being overage in a class by 2 or more years was a major predictor of dropping out (Gleason, 2002). This finding draws attention to one goal of this research, which is to find ways to keep students on track with their peers by early identification utilizing some of the predictors tested in this study.

Conclusions and Recommendations

So, in reference to Figure 11, factors with higher correlation coefficients deserve more attention, and further testing in other school settings for their possible predictive ability. Overall, the results do show that these 3 surveys together hold some value as predictor instruments of student performance in high school math classes, namely accounting for over 21% of the final grade variance. Though the multiple regression analysis showed some of the surveys to be out of bounds to qualify for statistical significance, yet the bivariate correlation coefficients along with the Q-Q plots appear to reveal practical significance in line with the goals of this research. These surveys, along with math pre-test and GPA could be used to identify students
who might struggle, and to possibly identify those students that have a high probability of failing. Then, intervention could be activated to help ensure that these students are given the tools, tutoring and direction to successfully pass the class the first time. In contrast to waiting until a student flunks a core class for support to be offered, these types of instruments allow for support and alternative services to be made available at the beginning of a class, when at-risk students may be identified. There is a need for more research on the most successful intervention strategies to allow at risk students to stay on track in core classes.

It appears that personal character traits will continue to be found as a moderate predictor of future behavior, especially in education. But, more importantly, recent academic achievements and overall grade averages appear to be much stronger indicators of how a student will perform in a present class. In comparing surveys to static prior learning benchmarks, it appears that recent student habits and/or approaches to academic studies as measured by recent grades reveal more about a student’s predilection for mastering of a current course than self-reporting surveys. So, one possible approach to helping struggling students is to teach them how to change poor study habits and break cycles of failure.

Figure 12. Factors Affecting Student Academic Performance
Figure 12 is one attempt to condense prior research and current findings regarding the various factors affecting student performance in math. Though the percentage of variance for each of the four main contributors to student learning is certainly debatable, research appears to demonstrate that each factor plays a significant role in student academic outcomes.

Another instrument that might warrant exploration as a predictor of student success is a motivation scale that has been previously tied to student achievement (Thelk, 2009).

There is a need for effective early intervention programs that will help at-risk students to succeed after they have been identified. One intervention study focused on 250 first year psychology students, and found success in helping those students at risk of dropping out to reflect on their progress, and decide the types of self-regulation needed for success (Lizzio, 2013). Other research has confirmed the finding that intervention, or remedial math programs actually help lower the drop-out rate in college students (Lesik, 2007). Successful intervention programs mentioned earlier in this paper included the Coca-Cola Valued Youth Program, and the Achievement for Latinos through Academic Success (Fashola, 1997). Another successful intervention for at-risk students included increasing student motivation by employing cooperative learning, increased parental involvement, and aiding learning modes by utilizing multiple intelligences (Miller, 1995).

Some detractors show evidence that personality traits are not as effective predictors of dropping out of school compared to absenteeism and being overage by 2 or more years (Gleason, 2002). But because research has clarified that personality traits direct individual choice, and level of persistence in sticking with tasks, it could be argued that the traits are behind students’ choice to drop out (Chamorro-Premuzic, 2003). Overall, based on the data in this study, and other research findings, it appears that personality traits, such as motivation, self-control, or
attitude can be used with other primary data, such as GPA, absenteeism or courses failed to create a fuller picture, and, hopefully a more robust predictor of students’ possible future academic outcomes, specifically in math.
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Investigation with Middle School Students.


Appendix A

Components of Conscientiousness

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<th>Correlation</th>
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<tr>
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</tr>
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<td>Self-discipline</td>
<td>.22</td>
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Neuroticism (emotional stability), Extraversion

<table>
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<tr>
<th>Component</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxiety</td>
<td>-.29</td>
</tr>
<tr>
<td>Impulsiveness</td>
<td>-.26</td>
</tr>
<tr>
<td>Activity</td>
<td>-.24</td>
</tr>
</tbody>
</table>

Chart of Components of Big-5 and their Correlation to Exam Scores
Chamorro and Furnham (2003)

Normal Q-Q plots of pre-test, prior math grade, and GPA
Normal Q-Q plot of final grade

### Model Summary of Multiple Regression

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.516(^a)</td>
<td>0.266</td>
<td>0.214</td>
<td>13.570</td>
</tr>
</tbody>
</table>

*a. Predictors: (Constant), Grit, Self-Control, Attitude*

### Multiple Regression ANOVA

<table>
<thead>
<tr>
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<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
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</thead>
<tbody>
<tr>
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<td>5.084</td>
<td>.004(^b)</td>
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<tr>
<td></td>
<td>Residual</td>
<td>42</td>
<td>184.158</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>45</td>
<td>10543.239</td>
<td></td>
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</tbody>
</table>

*a. Dependent Variable: Final Grade*

*b. Predictors: (Constant), Grit, Self-Control, Attitude*

### Model Summary of Multiple Regression

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
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<td>0.904(^a)</td>
<td>0.818</td>
<td>0.804</td>
<td>6.949</td>
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</table>

*a. Predictors: (Constant), GPA, Pre-Test, Prior Math Grade*

### Multiple Regression ANOVA

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
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</thead>
<tbody>
<tr>
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<td>Regression</td>
<td>3</td>
<td>2817.525</td>
<td>58.342</td>
<td>.000(^b)</td>
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<tr>
<td></td>
<td>Residual</td>
<td>39</td>
<td>48.293</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Total</td>
<td>42</td>
<td>10336.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*a. Dependent Variable: Final Grade*

*b. Predictors: (Constant), GPA, Pre-Test, Prior Math Grade*
Appendix B

Letter of Consent January 2015

Dear Parent,

My name is Wilson Morris, your student’s math teacher at Cascade High School as well as a doctoral student of education at George Fox University. I am, as always, seeking ways to help students be more successful in school, specifically in math. The research that I am proposing involves measuring students’ conscientiousness and attitudes toward learning and comparing those measures to their actual final math grade. Hopefully, with your permission, the research will shed more light on ways to identify and help struggling students early in their course work, and find ways to allow them to be more successful in school, and after school. Specifically, I am asking your permission to have your student take a survey in class, and then allow me to use that survey along with your student’s academic record for this research project. As you should expect, no personal identifiers will be used with the final research paper. Thanks in advance for allowing me to help Cascade students now and in the future.

Wilson Morris

If you have any questions regarding this research, please contact me at (503) 749-8200 extension 2023, or email wmorris@cascade.k12.or.us

If you agree for your son / daughter to participate, please sign below.

| Student name: __________________________ |
| **Giving permission: Parent signature__________________________ Date______ |
Appendix C

Math Survey

Please type your first and last name *

Gender  Mark only one oval.  Male    Female

Grade level *  Mark only one oval.
- 9
- 10
- 11
- 12

1. in school I try my best *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

2. Math assignments and/or math tests are a pleasant challenge. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

3. I believe I can do anything I set my mind to do. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

4. I am easily irritated by those “A+” students who put out the extra effort, and always finish their assignments. All they are doing is just making everyone else look bad. *
Mark only one oval.
- always bothered by that type of student (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never feel that way (not at all like me)

5. I am confused in math class. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)
6. Math is boring, and mostly useless. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

7. In school work, I try to gauge the minimum that is needed to pass the class, then I do that minimum amount of work. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me, not my philosophy)

8. When I try harder by putting more effort into my studies, I rarely see any change in my grades. *
Mark only one oval.
- yes, I see little return for my increased effort
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- not at all like me, I see results for my effort

9. I will look back fondly on my high school experience. *
Mark only one oval.
- always (very much like me)(good memories)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me) more a nightmare

10. The determination of my success in school and life is / will be *
Mark only one oval.
- Luck
- 50/50
- Hard Work

11. I am confident in my math abilities. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

13. If I had (because I have ) younger brother(s) and/or sister(s), I would be (am) a role model for them to apply themselves to school work. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

14. My mind goes blank when I have to answer a math question in class, or on a test. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

15. I am good at math. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

16. I think schooling is the key to my future career and success *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

17. When a subject or assignment does not interest me, I put little effort into completing it *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

18. I enjoy helping others understand how to solve math problems *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

19. My future will be better because of the effort I put in at school *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
20. Most of my friends know that I am serious about school work. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 1. I am good at resisting temptation. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 2. I have a hard time breaking bad habits. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 3. I am lazy. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 4. I say inappropriate things. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 5. I allow myself to lose control *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 6. I do certain things that are bad for me if they are fun. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 7. People can count on me to keep on schedule *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 8. Getting up in the morning is hard for me. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 9. I have trouble saying no. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 10. I change my mind fairly often *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 11. I blurt out whatever is on my mind *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 12. People would describe me as impulsive *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 13. I refuse things that are bad for me. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 14. I spend too much money *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 15. I keep everything to myself. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 16. I am self-indulgent *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 17. I wish I had more self-discipline than I have now. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 18. I am reliable. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 19. I get carried away by my feelings *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 20. I do many things on the spur of the moment. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 21. I keep secrets very well. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 22. People would say that I have iron self-discipline *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 23. I have stayed up all night preparing for tests or for last minute assignments that I could have done earlier. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 24. I am easily discouraged *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

SC 25. I’d be better off if I stopped to think before acting more than I do now. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
• never (not at all like me)

SC 26. I engage in healthy practices *
Mark only one oval.
• always (very much like me)
• a lot of the time (mostly like me)
• 50/50 (somewhat like me)
• sometimes (rarely like me)
• never (not at all like me)

SC 27. I eat healthy foods *
Mark only one oval.
• always (very much like me)
• a lot of the time (mostly like me)
• 50/50 (somewhat like me)
• sometimes (rarely like me)
• never (not at all like me)

SC 28. Pleasure and fun sometimes keep me from getting work done *
Mark only one oval.
• always (very much like me)
• a lot of the time (mostly like me)
• 50/50 (somewhat like me)
• sometimes (rarely like me)
• never (not at all like me)

SC 29. I have trouble concentrating *
Mark only one oval.
• always (very much like me)
• a lot of the time (mostly like me)
• 50/50 (somewhat like me)
• sometimes (rarely like me)
• never (not at all like me)

SC 30. I am able to work effectively toward long-term goals *
Mark only one oval.
• always (very much like me)
• a lot of the time (mostly like me)
• 50/50 (somewhat like me)
• sometimes (rarely like me)
• never (not at all like me)

SC 31. Sometimes I can’t stop myself from doing something, even if I know that it is wrong *
Mark only one oval.
• always (very much like me)
• a lot of the time (mostly like me)
• 50/50 (somewhat like me)
• sometimes (rarely like me)
• never (not at all like me)

SC 32. I often act without thinking through the alternatives. *
Mark only one oval.
• always (very much like me)
a lot of the time (mostly like me)
50/50 (somewhat like me)
sometimes (rarely like me)
ever (not at all like me)

SC 33. I lose my temper too easily. *
Mark only one oval.
always (very much like me)
a lot of the time (mostly like me)
50/50 (somewhat like me)
sometimes (rarely like me)
ever (not at all like me)

SC 34. I often interrupt people *
Mark only one oval.
always (very much like me)
a lot of the time (mostly like me)
50/50 (somewhat like me)
sometimes (rarely like me)
ever (not at all like me)

SC 35. I binge in excess (over-indulge) to the point of later regret with any of these: My favorite foods, sweets, alcohol, soda pop, video games, television, internet browsing *
Mark only one oval.
always (very much like me)
a lot of the time (mostly like me)
50/50 (somewhat like me)
sometimes (rarely like me)
ever (not at all like me)

SC 36. I am always on time. *
Mark only one oval.
always (very much like me)
a lot of the time (mostly like me)
50/50 (somewhat like me)
sometimes (rarely like me)
ever (not at all like me)

G 1. I have overcome setbacks to conquer an important challenge. *
Mark only one oval.
always (very much like me)
a lot of the time (mostly like me)
50/50 (somewhat like me)
sometimes (rarely like me)
ever (not at all like me)

G 2. New ideas and projects sometimes distract me from previous ones. *
Mark only one oval.
always (very much like me)
a lot of the time (mostly like me)
50/50 (somewhat like me)
sometimes (rarely like me)
- never (not at all like me)

G 3. My interests change from year to year *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

G 4. Setbacks don’t discourage me. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

G 5. I have been obsessed with a certain idea or project for a short time, but later lost interest. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

G 6. I am a hard worker *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

G 7. I often set a goal but later choose to pursue a different one. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

G 8. I have difficulty maintaining my focus on projects that take more than a few months to finish. *
Mark only one oval.
- always (very much like me)
- a lot of the time (mostly like me)
- 50/50 (somewhat like me)
- sometimes (rarely like me)
- never (not at all like me)

G 9. I finish whatever I begin. *
Mark only one oval.
• always (very much like me)
• a lot of the time (mostly like me)
• 50/50 (somewhat like me)
• sometimes (rarely like me)
• never (not at all like me)

G 10. I have achieved a goal that took years of work. *
Mark only one oval.
• always (very much like me)
• a lot of the time (mostly like me)
• 50/50 (somewhat like me)
• sometimes (rarely like me)
• never (not at all like me)

G 11. I become interested in new pursuits every few months. *
Mark only one oval.
• always (very much like me)
• a lot of the time (mostly like me)
• 50/50 (somewhat like me)
• sometimes (rarely like me)
• never (not at all like me)

G 12. I am diligent. *
Mark only one oval.
• always (very much like me)
• a lot of the time (mostly like me)
• 50/50 (somewhat like me)
• sometimes (rarely like me)
• never (not at all like me)