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Dress Rehearsal:

The Worcester Class of 2002 Experience with the MCAS

Seung Kim
Paul Reitchel
Anthony Velez

Advisor: John Wilkes

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Introduction:

The goal of this study is to determine whether there is a significant correlation between standardized achievement test scores and the various dimensions of learning style. By doing statistical analysis on data obtained from Worcester area high schools, trends in achievement test scores relative to personality type may make it possible to accurately predict which students will need extra assistance in order to perform at acceptable levels. Since 1998 one achievement test in particular has been a point of concern for the teachers, parents and students of Massachusetts. The reason for such interest is due to the fact that as of the class of 2003 the MCAS performance of each individual student determines their eligibility for high school graduation. The Massachusetts Comprehensive Assessment System (MCAS) was created with the intent of making the students of high schools receiving state funds accountable for information presented in the public school curriculum.

The cause for widespread concern is the nature of such a test and the consequences of high failure rates, which has prompted interest in better understanding the MCAS and its relationship to the diversity of students that are required to take it. The MCAS is considered by the academic community to be a criterion based achievement test, meant to measure the level of proficiency an individual has in given subject areas. As such, it differs from tests like the SAT and PSAT, which are considered to be measuring aptitude rather than expertise in various subjects.

In order to classify learning style, participating students in Worcester area high schools were administered the Myers-Briggs Type Indicator. Using data obtained through the administration of this test, comparing MCAS scores in different subject areas with the learning styles of the students may show high correlation in certain areas. If the correlation is substantial, high schools administering the MBTI to incoming students would have an early indication of future MCAS performance.

Learning style data was obtained from the following city of Worcester public secondary schools:

- Burncoat High School
- Dohherty High School
- North High School
- South High School
- Worcester Vocational High School

The results of the MBTI assessments are contained in a database of 811 entries, each entry includes specific learning style information about a given student. The MCAS database contains 1266 entries, each with information pertaining to the MCAS performance of individual 10^{th} grade students. A transcript database was also provided, containing information about courses and grades for each student. With these three databases combined a total of 604 complete entries exist, each with information about MCAS, MBTI and high school performance. Combining these data sets provides a single database, allowing analysis of MCAS scores to be done. Analysis was done using SPSS

software; (company, program information) an advanced data mining and statistical analysis package. Data will be presented in a combination of tables and graphs with appropriate explanations.

Through analysis of this data set, correlation between learning style and MCAS should be observed, giving educators and students alike more insight into the test that strives to bring a sense of accountability for the usage of state funds. By better understanding the relationship between the MCAS, past academic performance and the learning style of the students taking it the validity and reliability of this assessment could be significantly increased.

Executive Summary

The primary goal of the project was to investigate whether there is a correlation between MBTI personality types and MCAS scores obtained from Worcester Public High schools; and if so, which MBTI types are most proficient in the core areas of the MCAS examination. The project team used data provided by the Worcester Public Schools System in order to examine the relationships between MCAS, personality type and past academic performance. The information that was gathered provided a basis for how to analyze and compare the MBTI categories with the MCAS score distribution amongst the various schools.

The Worcester Public School System is at a pivotal point in its educational success or possible failure. Since the introduction of the MCAS as an academic assessment, students have failed to meet expectations, leading many to believe the test itself may not be an accurate assessment of their proficiencies. Now, starting with the Class of 2002, Massachusetts has required that the 10^{th} grade MCAS exam score be used to determine if a given student can graduate when they finish 12^{th} grade. The project team felt that it was important to perform a study on the various MBTI types to see which types if any performed significantly better or worse relative to others. The results of the study could be of use to the Worcester Public Schools. Through analysis of the results, teachers are able to address those students that are having more problems than others. This identification process should take place early in the student's academic career so that they are fully prepared for the exam by the time they are required to take the MCAS.

Acknowledgements

Throughout the project, the project team faced many obstacles, and database issues. Nevertheless, without the support of others, this project would not have reached its goal. We would like to recognize those individuals who helped make our project a success.

First and foremost, the project team would like to thank our advisor, Professor John Wilkes. His time and effort spent meeting with us helped improve the quality of the project, and gave us the guidance necessary to make our project worth-while. All of his support was greatly appreciated.

The project team would also like to recognize Will Zuidema of the CCC. His assistance in providing us with a final, sorted transcript data set and linking it to MBTI and MCAS databases was vital to the success and completion of our project. Without his help, the project team would have been forced to take a much more arduous approach to linking the datasets, and could have been costly to the project itself.

Special thanks go out to the participating staff in the Office Of Pupil and Personnel Services at the Worcester Public Schools, who gathered the MBTI data and provided to the project team. Dr. Patricia Mostue's efforts to provide the MCAS and class records of the class of 2002 are also greatly appreciated. Without their assistance, the project would not have been possible.

With the help of these people, the project team was able to complete a challenging project that we are very proud of. Thank you to all who contributed to the project, and for making it an enjoyable experience and enjoyable research effort.

Literature Review

Massachusetts Comprehensive Assessment System (MCAS)

In response to the Education Reform Law of 1993 the MCAS was created to measure the proficiency of students in various subjects covered by the Massachusetts public school curriculum. The Reform law required that an assessment would be created with the following characteristics:

- Test virtually all public school students across the Commonwealth, including students with disabilities and students with limited English proficiency.
- Be administered annually in at least grades 4,8 and 10.
- Measure performance based on the Massachusetts curriculum framework learning standards.
- Report on performance of individual students, schools and districts.
- Serve as one basis of accountability for students, schools and districts (for example, beginning in 2001, grade 10 students must pass the grade 10 tests as one condition of eligibility for a high school diploma.)

(MCAS facts www.andoverpublicschools.com)

The MCAS itself is comprised of three subjects, each considered an integral part of the Massachusetts curriculum, and makes use of open ended, short answer and multiple choice questions. Currently, students are responsible for: Mathematics, Science

and Technology, and English Language Arts. Subjects such as History/Social Science and Foreign language are to be included in the MCAS in coming years. (MCAS and NAEP, www.doe.mass.edu) The results of the MCAS are reported in the form of four distinct performance ratings that indicate the level of expertise an individual has in a given subject area.

- Advanced – Score range: 260 - 280
    - Student demonstrates an in depth understanding of required subject matter and displays an ability to solve complex problems.
- Proficient – Score range: 240-259
    - Student demonstrates an understanding of challenging subject matter and provides solutions for a variety of problems.
- Needs Improvement – Score range: 220 - 239
    - Student demonstrates a partial understanding and has the ability to solve less complex problems.
- Failing – Score range: 200 - 219
    - Student does not demonstrate a significant level of understanding consistent with the "Needs Improvement" rating.

Competency levels are determined by a points scale; the Pass/Fail cut off is determined on a yearly basis. For the graduating class of 2003 Students who scored 220 points or more are considered competent and eligible for receiving a high school diploma.

These ratings assist students, parents, teachers and administrators in determining the success of the curriculum. (MCAS and NAEP www.doe.mass.edu)

Students are classified into 3 distinct groups, allowing for accurate testing while reducing the portion of students that would otherwise be exempt.

- Regular: Students who do not meet the requirements for Students with Disabilities or Limited English status.
- Students with Disabilities: Students who have an Individualized Education Plan (IEP) or a plan of instructional accommodations.
- Limited English Proficient: Students for whom English is a second language and cannot perform ordinary classroom work using English.

In order to assess the eligibility of all students the Education Reform act of 1993 also mandates that students with disabilities be tested. The rationale behind this being that if students with disabilities are excluded from assessment, a significant portion of students will not be represented, thus lessening the accountability of schools and districts for those students. Disabled students and those with Limited English requiring an alternate assessment are *not* included in the determination of scaled scores and performance cut offs. (Summary MCAS, http://www.doe.mass.edu/charter/mcas/00/interp.html)

The MCAS results are used in a variety of ways to improve the Massachusetts education system.

- Improvements in curriculum
    - Allows for standardized monitoring of student progress with respect to the current curriculum.
    - Local administrators can use results to pin point potential weaknesses and strengths in instruction and curriculum.
- Accountability
    - Board of Education intends to use MCAS as a measure of performance to determine if districts are improving or failing to improve their academic programs.
    - Students in the graduating class of 2003 must pass the 10^{th} grade MCAS to earn a high school diploma. This is on top of local requirements; students are allowed to retake the MCAS multiple times if necessary. (MCAS Facts, www.andoverpublicschools.com)

The No Child Left Behind Act (NCLB) of 2001 allocates funds for developing required assessments to all states, and funding to improve pre-existing assessments such as the MCAS. Currently all states with the exception of Iowa have state wide standardized testing. The number of states using standardized testing as part of the high

school diploma requirement is steadily rising and approaching half of the country. (http://www.publiceducation.org/pubs/mailings/intro_0300.htm)

As national interest in holding schools and students accountable for their curricula through standardized assessment increases, ensuring that these assessments are fair and accurate also becomes a priority.

In the case of the MCAS, it is essential to determine if students of certain learning styles are prone to score in the same ranges in various subjects. Understanding how learning style affects one's ability to perform on the MCAS may make for more accurate assessments in the future and explain the high failure rates that have been observed thus far. In order to understand why the MCAS is significant and unique from other assessments such as the SAT, knowledge of how achievement tests differ from aptitude tests is key.

Aptitude vs. Achievement Tests:

Source used: http://ericae.net/pare/getvn.asp?v=2&n=5

- ***Aptitude Tests:*** Tests that predict an individual's ability to learn a particular skill or what the individual can accomplish with training.
- ***Achievement Tests:*** Tests that measure what a person has learned or the skills the person has mastered through their experience.

Aptitude tests, in their simplest form, are intended to indicate a student's overall performance, covering a wide range of mental challenges. Some of the abilities needed to take such an exam are verbal and numerical skills. The test results are typically used

to predict scholastic performance in the educational programs that the student is about to undertake. Aptitude testing is like an intelligence test; however it is different than most intelligence or achievement tests. Aptitude covers a much broader area of activity. Academia for example, focuses on a wide range of experiences. It does not necessarily reflect the curriculum or academic experiences that the student may have already been exposed to. Rather, the test will present challenges to the student and expects them to improvise and come up with a solution, without necessarily having previous experience with the particular situation.

According to Gayle Macklem of the American Institutes for Research: "The difference between aptitude and achievement tests is sometimes a matter of degree." Aptitude and achievement tests are very similar in the fact that the higher a student goes through the course of their education, the more the student begins to see a resemblance between the content of both tests. They are more likely to succeed at their test taking experience once they have reached higher educational levels.

Aptitude tests are considered by many to be accurate at predicting scholastic achievements and the future progression of a student's educational career. They provide a basis for comparison with the performance of other students in the same situation. They are also used for grouping similar students together, which is arguably beneficial to a higher learning experience. The primary benefit of Aptitude testing is that it is extremely helpful in making program and curriculum decisions in schools and school systems. Guidance counselors may also use the information to help students and their parents develop expectations for the students' future academic performance. It is a test based on proper training with similar material, not with previous course experience, and

that is where college prep courses and counseling come in as vital resources to benefit the cause.

Achievement testing is used to challenge the student to use their previous experience in coursework to evaluate problems that are of the same nature. It is fairly similar to an aptitude test, but most of the problems have been formally presented to the student once or more throughout the course of their educational career. Achievement test results are important to educators and students and their families. Unlike aptitude tests, the achievement test is a study to see what the student has learned so far, and the results tend to hold the education system accountable if they are not favorable. The results will provide all with the students strengths and weaknesses, but the blame falls more on the educators, because the material covered in an achievement test is basically, testing the student on skills that have been covered before.

Achievement

- measures what has been acquired (terminal)
- selection purposes
- Basis for ACT testing
- group or individually administered

Aptitude

- predicts future performance or ability
- decisions about future
- group or individually administered

There has been much discussion over which form of testing is more useful and more accurate, Aptitude or Achievement. According to Richard Atkinson, "Aptitude tests such as the SAT I have a historical tie to the concept of innate mental abilities and the belief that such abilities can be defined and meaningfully measured." The SAT is a measure of the student's mental ability and its future progression. An achievement test can do some of the same things, but it goes about it a different way. Atkinson writes that the Academic Senate's Board of Admissions and Relations with Schools (BOARS) launched a study that compared the SAT and achievement tests (SAT II), regarding their ability to predict student performance. The study showed that the ***achievement*** tests proved a more useful predictor of student success when compared to the SAT, in coordination with school grades and when compared as an individual tool. But they need not be compared as to which is better really, because both tests proved to be equally beneficial. As a result of the study, the University of California began to require SAT I, and SAT II achievement tests.

Sometimes, achievement tests are not considered as heavily as aptitude tests, if considered at all, when it comes to college admission. But with proof from studies such as the one above, schools have begun to realize the equal importance of achievement testing. Colleges would prefer to see both scores when looking at admission candidates, not to mention course grades and other extra-curricular information. Atkinson argues that based on the study findings, the best single predictor of student performance ended up as the SAT II writing test. This section, as part of the achievement test, tests what the student has learned but does not involve just multiple-choice questions. Rather, it is a

good test of student ability in the future, based upon writing skills at a college level, which will classify as a good predictor for freshman year performance.

Learning Style and the Myers Briggs Type Indicator (MBTI)

The MBTI is a relatively quick, effective means of determining personality type. The test can be administered to large groups of people using only paper and pencil, rather than each subject undergoing hours of in depth interviews. This makes the MBTI an ideal measure when the subjects are multiple high school students in different schools and districts. In order to appreciate the significance of learning style and its impact it is necessary to understand the theory behind the test.

The concept of psychological types was originally developed by Carl Jung. Jung believed that human behavior follows identifiable patterns, and through evaluations these patterns can be determined. Jungian theory is based on the belief that an active human mind is doing one of two things: Judging or Perceiving. These two thought processes are inherent to all humans, but the way in which individuals tend to differ in using them is believed to be based on preference. Jung believed that when humans perceive or judge information and events there are different basic orientations their minds may take. For both Judgment and Perception there are fundamental ways in which humans tend to approach issues.

- Judgment
    - Thinking: Using logic and careful analysis to arrive at conclusions, focusing on cause and effect.
    - Feeling: Using a more subjective approach, feeling types tend to be more interested in what is important or valuable
- Perception
    - Sensing: Those of this orientation tend to be concerned about the tangible aspects of the world and the present moment.
    - Intuition: Intuitive types are primarily interested in what can be imagined rather than what already exists around them, and more often look ahead and focus on the future.

(CAPT MBTI profile of results explaination)

Inherent preferences for these different ways of judging and perceiving give way to extremely unique learning styles. Jung also identified two ways in which individuals interact with the world around them, allowing for even more specific profiling.

- Introversion: Introverts prefer to focus their energy inwardly, holding ideas and thoughts rather than sharing them with others.
- Extroversion: Extroverts prefer to take an active role in the world around them, focusing their energies outwardly.

The differences in interaction between an introvert and extrovert tend to be noticeable, and contribute heavily to learning style and possibly test taking. Jung believed that as a person developed with a natural preference for the different ways of interpreting the world around them they would begin to more reliably use that preference. (http://www.aptcentral.org/apttype.htm) One of the key points to Jungian theory is the dynamic interaction of all these attributes. Jung felt that one of the preferences (Thinking, Feeling, Intuition, Sensing) provides the core of an individual's personality, affecting all decisions and acting as a core identity. (http://www.aptcentral.org/aptdyn.htm)

The Myers Briggs Type Indicator is based heavily on Jungian theory, and uses these personality types and tendencies to classify learning style. The MBTI was developed by Isabel Briggs Myers and Katharine Cook Briggs to assess the learning styles of individuals as quickly and accurately as possible. By utilizing the findings of Jung and further developing his theories, the indicator was created using 4 different preferences:

- Introversion/Extroversion
- Intuition/Sensing
- Thinking/Feeling
- Judgment/Perception

This differs from Jung's original theory in that it also categorizes individuals with preferences for using judgment rather than perception or vice versa. Subjects are also assessed on a basis of introversion and extroversion. Using the 4 different preference

indicators, the end result is a 4 letter sequence which describes certain learning styles and tendencies. The sequence is determined by the results of an administered MBTI test and adheres to the following layout: I/E, N/S, T/F, J/P. For example, a result of ENTP would indicate an individual who's preferences include: Extroversion, Intuition, Thinking and Perception. The MBTI itself typically takes around 30 minutes to complete and currently consists of 93 items scored for type. Given the short nature of the test, the results are not infallible but in depth interviews of an entire region's graduating class would not be realistic. The different possible arrangements of the 4 variables in the MBTI offer 16 distinct personality types, each with their own particular characteristics and tendencies. A very brief overview of these types and tendencies is included below. The strongest mental process for each type is indicated by a bold letter in MBTI sequence.

- EN**T**J: Intuitive, innovative *organizers.*
- ES**T**J: Fact oriented, practical *organizers.*
- IS**F**P: Observant, loyal helpers.
- IN**F**P: Imaginative, independent helpers.
- ES**F**J: Practical, tend to work well with people.
- EN**F**J: Imaginative, tend to work well with people.
- IN**T**P: Inquisitive, analyzers.
- IS**T**P: Practical, analyzers.
- E**S**TP: Realistic adapters with material things
- E**S**FP: Realistic adapters with human relationships
- I**N**FJ: People oriented innovators.
- I**N**TJ: Logical, critical innovators.

- ENTP: Inventive, tend to initiate change.
- ENFP: Enthusiastic, tend to initiate change.
- ISFJ: Sympathetic managers of facts and details.
- ISTJ: Analytical managers of facts and details.

Using the MBTI we intend to explore the connection between learning style and performance on the MCAS. If the correlation is high, the benefits of such research are substantial, allowing for earlier, more efficient identification of students that may need assistance in passing the MCAS. A specific connection would also yield clues as to how to best approach those most likely to under perform on the MCAS.

Methodology

The project plan was discussed and proposed to the team prior to the acquisition of any data. Originally, the project group selected 4 different types of tests for the analysis; SAT, MCAS, MBTI, and ACT. The ACT had been studied only once before, since it is not used in Worcester, however, the necessary cooperation from Fitchburg and Westboro was not forthcoming due to turnover in administration since the last study. Hence the MCAS experience in Worcester was a more feasible issue to look into, Worcester had administered both the MBTI and MCAS and needed a data organization and analysis team. Since there have been studies done of SAT versus ACT, which explore the correlation between aptitude tests and achievement tests, the project team considered the "new," a more interesting topic. No one had ever tried to correlate the MCAS and MBTI before a WPI team attempted it with the results of the first 1998 version of the test. WE would get the results of the 3rd (2000) and forced (dress rehearsal) version of the test, which went into effect for the next class (tested in 2001), the class of 2003. The MCAS had spawned a debate that provided clearer goals for the project as well. The important question of "why" this study might be useful was clear to us. If there is a high correlation between a student's personality based on learning style assuming he or she answered questions honestly on MBTI) and MCAS, it would theoretically be possible to predict with some degree of accuracy how a student will do in school or on an assessment like the MCAS in advance of the test and see if it is equally fair to all the different types of learners or had a cognitive bias. If there was a bias

coaching revision curriculum change or pedagogical responses involving how the material is delivered all seemed possible.

Collecting Data

The first step of the project once the main objectives were clarified was how the data should be collected. Electronic copies of MCAS scores (from students who graduated in May of 2002) from 5 different public high schools (Worcester Public, Burncoat, Doherty, North, and South High) around the Worcester area had to be unified into a single database. The raw material seemed to have been assembled haphazardly. We got a much better sample of MBTI data and the semifinal version of the test to work with – for students who had really been taught using the revised curriculum from 3 to 4 years. In a sense, the prior study was too soon to have it be a criterion based "achievement test," which it was designed to be. There may have been a different character limit for each file so that the putting-together process resulted in hundreds of cut off or truncated names. Each entry contained a unique identification number, however, these numbers were not consistent across all three (English, Math and Science Test) files and could not be used as reliable reference points. The group was left with no choice but going through every data entry and fixing the truncated names by hand. In order to fix the names in the MCAS file, it was necessary to use a file that shared the same names with a higher degree of integrity. The group understood that some portion of the data set would be eliminated during the matching process because only those students who have their names in all three files (MCAS, MBTI, and Transcript) could be used for

the analysis. This process had to be repeated for the MBTI which truncated all the names at 13 characters and if the last names were next entered first a case could easily be ambiguous. – About one student in 5 had failed to follow this key instruction and there were no district ID numbers on the MBTI results to fall back on. However, because there were so many cases of poor data entry and misspelled names, losing more data than was initially predicted was inevitable. Originally, the MCAS and MBTI files had 1266 and 811 data entries, respectively. Therefore, the group already knew that at least 455 MCAS entries would be eliminated. Each member in the group was distributed copies of both MCAS and MBTI files and assigned to match and fix the names. Each member worked on at least 400 entries. As the fixing and matching process continued, the group ran into even more difficulties, many names were backwards and/or misspelled on top of the truncation. So the group could not tell which name in which file is in fact correct name. Some might ask, "What difference does that make? As long as they are consistent, it would not matter." This would be true if the group was dealing with only MCAS and MBTI files. The MCAS and MBTI files also needed to be matched to a separate student transcript database, which tended to have exact and precise name at full length. Since the group had not been given this file, it was not possible for them to decide how they should make the names consistent. All these factors resulted in a significantly smaller database than expected. There were only 605 unique entries left to use for analysis, which equates to more than 50% data loss of the MCAS data and 25% of the MBTI data.

Analysis Tools

Even though Microsoft Access and Excel provided moderate capabilities for database analysis, they are not truly adequate when it comes to performing a comprehensive analysis. It was recommended that the group to use a well-known database analysis software: Statistical Product and Service Solutions, (SPSS.) A regular Window version of SPSS also handles larger quantity of variables (maximum of 32,768) and cases (maximum of 2.15 billion). Microsoft Word, Excel, and Access can import their databases to an SPSS file by applying a conversion program. One of the most important and useful features of SPSS is that it allows users to make visual summaries of an analysis, including tables, charts, and graphs.

Personality versus standardized assessments sounds like a reasonable choice for finding correlations. But the more important question is how much correlation there is to make a statement that one factor (personality) affects the other (MCAS) and that is where SPSS's powerful analysis tools have been used, including 'Gamma' testing to answer this particular question. The SPSS Gamma test sets its base value to + or – 1 and if a cross tabulation analysis calculates the Gamma value between (+ or -) 0.4 to 1, there is considered to be significant correlation. The closer the number is to + or - 1, the higher the correlation is. Our cross tabulation analysis consists of 4 parts; Case processing summary, Categorical cross tabulation, Chi square test, and Symmetric measures.

Case Processing Summary

Case Processing Summary displays the total number of students who participated in that particular cross tabulation analysis, the number of entries that were not used in analysis because of missing data, and finally, the total number of all students who were in the SPSS file, which is a constant 605.

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
MBTITYPE * eperflev Catagorical	592	97.9%	13	2.1%	605	100.0%

Figure 1.1

Cross tabulation

As shown in figure 1.2, the cross tabulation analysis shows the number and percentage of students and the data source. Entries are spread out according to their rows (e.g. type of personality) and columns (e.g. categorized MCAS performance).

MBTI Type vs. MCAS Math Categorical Crosstabulation

			mperflev Categorical				
			F	NI	P	A	Total
MBTITYPE	ENFJ	Count	7	4	3	1	15
		% within MBTITYPE	46.7%	26.7%	20.0%	6.7%	100.0%
		% within mperflev Categorical	2.5%	2.6%	2.9%	1.8%	2.5%

(**F** – Failed, **NI** – Needs Improvement, **P** – Proficient, **A** – Advanced)

Figure 1.2

In order to make such categorized columns, it was necessary to assign a certain range of values for each variable. Otherwise, there would be students with different scores disseminated too widely, making it difficult to see how and where certain numbers of students are populated within what range of scores. We categorized students' average grades, MCAS, English and Math performance and different types of learning styles as indicated by the MBTI.

Chi-Square Tests

Statistical Chi-Square tests are significant tests that basically indicate if a generalization can be made from the sample at hand to the universe from which it was drawn so as to represent. It operates by selecting a certain range of segments or samples from a data set. The Chi-Square value represents the chances of getting the same (or similar) results when another, probably larger sample is used. In other words, it is possible to collect an independent sample that may vary each time it is tested. So the calculation gives you the odds that your sample is so bad that if you believe a difference visible in your data is real – you will be wrong. (As the odds of a bogus or misleading sample is never zero, one has to select a level of uncertainty acceptable for your research. The traditional cut off of 1 in 20 chances of being wrong (.05) was adopted for this study.) Therefore, a reliable Chi-Square test is another important factor determining the statistical significance of conclusions. Chi-Square data is arranged as seen in the table below:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.076	3	.807
Likelihood Ratio	.068	3	.809
Linear-by-Linear Association	.124	1	.725
N of Valid Cases	572		

a. 0 cells(.0%) have expected count less than 5. The minimum expected count is 8.61.

Figure 1.3

Although this is an example of not very significant finding, it still helps us to note certain important facts about the tests. "Asymp. Sig" is the SPSS calculation of the p value, the level at which our calculated chi-square is statistically significant. Because SPSS calculates this value to only 3 decimal places, the .000 actually means that the value is less than .0005 (which gets rounded to .000by SPSS). If the value of this is less than .05, it indicates a statistically significant relationship and in this case the 81 chance (.807) in 100 of being wrong if the finding is taken as real – of finding it in the larger universe of MCAS test takers means that was not a significant finding.

Analysis

The MCAS is an achievement test and many of its questions are based on the material students are expected to learn in their public high school. It is logical to think that the students who do well in school are likely to do well on the MCAS as well. The table shown below appears to be in agreement with this logic. The student distribution from left corner (Failing average grades with failing MCAS Math Performance) to the bottom right (A grades with advanced level score on MCAS) is neatly consistent with the previous assumption indicating that there is a very strong correlation between the two factors.

Average grade vs. MCAS Math Categorical Crosstabulation

			mperflev Categorical				
			F	NI	P	A	Total
Average grade All courses Catagorical	F	Count	10				10
		% within avgerage grade cat	100.0%				100.0%
		% within mperflev Categorical	3.8%				1.8%
	D	Count	24	2	1		27
		% within avgerage grade cat	88.9%	7.4%	3.7%		100.0%
		% within mperflev Categorical	9.1%	1.4%	1.1%		4.9%
	C	Count	169	54	20	2	245
		% within avgerage grade cat	69.0%	22.0%	8.2%	.8%	100.0%
		% within mperflev Categorical	64.3%	38.6%	21.1%	3.9%	44.6%
	B	Count	56	78	53	22	209
		% within avgerage grade cat	26.8%	37.3%	25.4%	10.5%	100.0%
		% within mperflev Categorical	21.3%	55.7%	55.8%	43.1%	38.1%
	A	Count	4	6	21	27	58
		% within avgerage grade cat	6.9%	10.3%	36.2%	46.6%	100.0%
		% within mperflev Categorical	1.5%	4.3%	22.1%	52.9%	10.6%
Total		Count	263	140	95	51	549
		% within avgerage grade cat	47.9%	25.5%	17.3%	9.3%	100.0%
		% within mperflev Categorical	100.0%	100.0%	100.0%	100.0%	100.0%

Table 1

Statistical Significance Tests:

Gamma Value: Correlation	0.744
Chi-Square Value:	0.000

Table 2

The Gamma value of 0.744 for this analysis proves that there is a strong correlation between these two factors. The Chi- Square value of 0.000 also indicates that there is a statistically significant relationship. The variables are not independent but vary with one another.

Judging Perceiving vs. Math Performance (MCAS)

All people use both judging (thinking and feeling) and perceiving (sensing and intuition) processes to store information, organize their thoughts, make decisions, take actions and manage their lives. A clear correlation between the students' personalities and their performance on the MCAS is observed within this analysis. The students with an INTJ learning style tend to do better on MCAS and have higher average grades. The next step is to determine whether or not it is possible to pinpoint a specific preference from the MBTI combination that is strongly related to math performance. This analysis separates personality type J and P and cross tabulates them against math performance.

Judging/Perceiving vs. MCAS English Categorical Crosstabulation

			eperflev Catagorical				
			F	NI	p	A	Total
JP Categorical	J	Count	67	75	45	10	197
		% within JP Categorical	34.0%	38.1%	22.8%	5.1%	100.0%
		% within eperflev Catagorical	33.0%	36.2%	32.8%	40.0%	34.4%
	p	Count	136	132	92	15	375
		% within JP Categorical	36.3%	35.2%	24.5%	4.0%	100.0%
		% within eperflev Catagorical	67.0%	63.8%	67.2%	60.0%	65.6%
Total		Count	203	207	137	25	572
		% within JP Categorical	35.5%	36.2%	24.0%	4.4%	100.0%
		% within eperflev Catagorical	100.0%	100.0%	100.0%	100.0%	100.0%

Table 3

Statistical Significance Tests:

Gamma Value:	-0.040
Chi-Square Value:	0.953

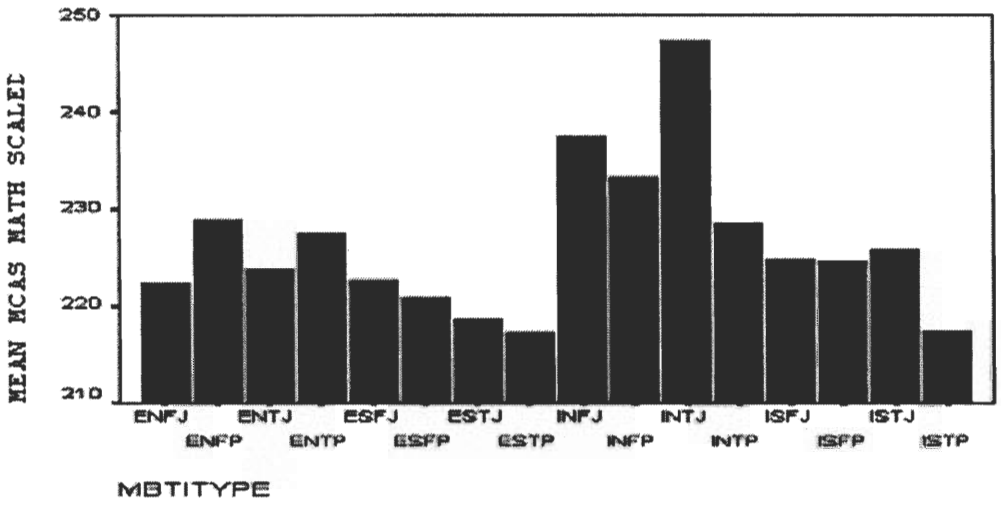
Table 4

The students' distribution of J and P are almost identical. Close to 50 percent of the students of both types score below the failing level. Does this mean that these two MBTI types share very similar effects when it comes across testing math? The answer is too subtle to tell. This analysis has a very low Gamma value of -.040, indicating that there isn't a significant correlation, and a high Chi-square value of .953 indicates that the J-P dimension is independent of math performance; therefore it is difficult to make any conclusions. The conclusion is there is no relationship as the data above indicates.

Judging and Perceiving vs. English performance (MCAS)

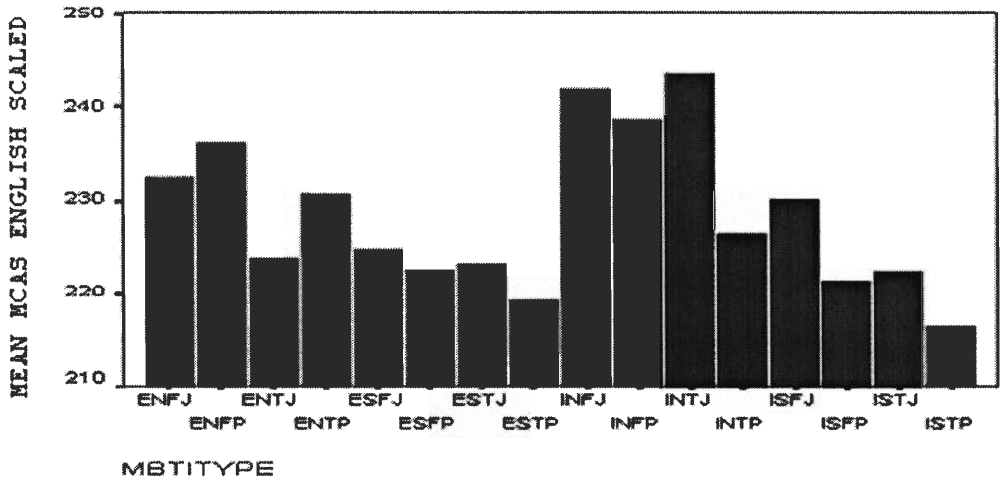
Would it be different if J and P were cross tabulated with English performance? Even though linguistic skills require a slightly different thinking process from mathematics, when comparing the graphs 1.1 and 1.2, students who do well on math tend to do well on English and vice versa. To be more specific, the students with IN types tend to do well in both English and Math sections while the students with EN types generally tend to score higher on English than Math but less consistently than IN types.

Mean Math MCAS vs. MBTI type



Graph 1.1

Mean English MCAS vs. MBTI type



Graph 1.2

Therefore, it would not be incorrect to predict that J and P versus English will produce very similar results as J and P versus Math. The tables below support this assumption. Even though there are fewer students who have failing grades, the overall distribution resembles the previous analysis and is consistent with the above graphs.

Judging and Perceiving MBTI type vs. MCAS English Performance Categorical Crosstabulation

			eperflev Catagorical				
			F	NI	p	A	Total
JP Categorical	J	Count	67	75	45	10	197
		% within JP Categorical	34.0%	38.1%	22.8%	5.1%	100.0%
		% within eperflev Catagorical	33.0%	36.2%	32.8%	40.0%	34.4%
	p	Count	136	132	92	15	375
		% within JP Categorical	36.3%	35.2%	24.5%	4.0%	100.0%
		% within eperflev Catagorical	67.0%	63.8%	67.2%	60.0%	65.6%
Total		Count	203	207	137	25	572
		% within JP Categorical	35.5%	36.2%	24.0%	4.4%	100.0%
		% within eperflev Catagorical	100.0%	100.0%	100.0%	100.0%	100.0%

F - Failed, NI - Needs Improvement, P - Proficient, A - Advanced

Table 5

No relationship is observed between MCAS English performance and the J-P dimension.

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Gamma	-.023	.070	-.324	.746
	Spearman Correlation	-.014	.042	-.323	.747[c]
Interval by Interval	Pearson's R	-.015	.042	-.352	.725[c]
N of Valid Cases		572			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

Table 6

Sensing and Intuition vs. Math Performance and English (MCAS)

This personality dimension involves how one processes information and it is a generally known fact that intuitive perceiving ability is useful in learning mathematics. We suspect that there will be some correlation between S and N versus math performance.

Sensing and Intuition MBTI Type Categorical vs. MCAS English Performance Categorical Crosstabulation

			eperflev Catagorical				Total
			F	NI	P	A	
SN Catagorical	S	Count	160	112	51	9	322
		% within SN Catagorical	46.6%	34.8%	15.8%	2.8%	100.0%
		% within eperflev Catagorical	70.8%	52.3%	36.2%	36.0%	54.4%
	N	Count	62	102	90	16	270
		% within SN Catagorical	23.0%	37.8%	33.3%	5.9%	100.0%
		% within eperflev Catagorical	29.2%	47.7%	63.8%	64.0%	45.6%
Total		Count	212	214	141	25	592
		% within SN Catagorical	35.8%	36.1%	23.8%	4.2%	100.0%
		% within eperflev Catagorical	100.0%	100.0%	100.0%	100.0%	100.0%

F - Failed, NI - Needs Improvement, P - Proficient, A - Advanced

Table 7

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Gamma	.428	.058	7.098	.000
	Spearman Correlation	.276	.039	6.976	.000[c]
Interval by Interval	Pearson's R	.270	.039	6.811	.000[c]
N of Valid Cases		592			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

Table 8

Sensing and Intuition MBTI type Categorical vs. MCAS Math Performance Categorical Crosstabulation

			mperflev Categorical				Total
			F	NI	P	A	
SN Catagorical	S	Count	179	80	46	19	324
		% within SN Catagorical	55.2%	24.7%	14.2%	5.9%	100.0%
		% within mperflev Categorical	62.8%	52.6%	45.1%	33.9%	54.5%
	N	Count	106	72	56	37	271
		% within SN Catagorical	39.1%	26.6%	20.7%	13.7%	100.0%
		% within mperflev Categorical	37.2%	47.4%	54.9%	66.1%	45.5%
Total		Count	285	152	102	56	595
		% within SN Catagorical	47.9%	25.5%	17.1%	9.4%	100.0%
		% within mperflev Categorical	100.0%	100.0%	100.0%	100.0%	100.0%

F - Failed, NI - Needs Improvement, P - Proficient, A - Advanced

Table 9

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Gamma	.294	.061	4.598	.000
	Spearman Correlation	.185	.040	4.590	.000[c]
Interval by Interval	Pearson's R	.189	.040	4.685	.000[c]
N of Valid Cases		595			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

Table 10

Students with the Sensing preference have a significantly higher failure rate in both English and Math as compared to those with a preference for Intuition. The N type students' overall performance is much better. Even though the Gamma value of the analysis is not as strong as was expected, it still is far stronger than the cross tabulations between Judging and Perceiving and MCAS. Using .05 as the cutoff point for distinguishing reliable samples and unreliable samples, we cannot conclude that this is a fairly reliable sample. Graphs 1.1 and 1.2 highlight the differences between the learning styles in relation to MCAS performance. EN students generally have higher scores in both the English and Math sections than ES students and the IN students also scored higher than IS students in both English and Math.

MBTI type Vs. Math performance (MCAS)

The case processing summary provides an overview of the data used in the following analysis. The database consists of 605 unique entries of which 595 were valid for analysis. A total of 98.3% of the entries were analyzed, yielding the following results:

MBTI Type vs. MCAS Math Performance Categorica Crosstabulation

Top 4 MBTI types that have the lowest percentage of Failed rate

		mperflev Categorical				
		F	NI	P	A	Total
INFJ	Count	3	3	4	2	12
	% within MBTITYPE	25.0%	25.0%	33.3%	16.7%	100.0%
	% within mperflev Categorical	1.1%	2.0%	3.9%	3.8%	2.0%
INTJ	Count	3		1	5	9
	% within MBTITYPE	33.3%		11.1%	55.6%	100.0%
	% within mperflev Categorical	1.1%		1.0%	9.9%	1.5%
INFP	Count	7	11	3	6	26
	% within MBTITYPE	26.9%	42.3%	11.5%	19.2%	100.0%
	% within mperflev Categorical	2.5%	7.2%	2.9%	8.9%	4.4%
ENFP	Count	32	30	23	8	93
	% within MBTITYPE	34.4%	32.3%	24.7%	8.6%	100.0%
	% within mperflev Categorical	11.2%	19.7%	22.5%	14.3%	15.6%

Bottom 4 MBTI types that have the highest percentage of Failed rate

		mperflev Categorical				
		F	NI	P	A	Total
ISFP	Count	11	2	2	3	18
	% within MBTITYPE	61.1%	11.1%	11.1%	16.7%	100.0%
	% within mperflev Categorical	3.9%	1.3%	2.0%	5.4%	3.0%
ISTP	Count	26	12	4	2	44
	% within MBTITYPE	59.1%	27.3%	9.1%	4.5%	100.0%
	% within mperflev Categorical	9.1%	7.9%	3.9%	3.6%	7.4%
ESFP	Count	23	9	6	2	40
	% within MBTITYPE	57.5%	22.5%	15.0%	5.0%	100.0%
	% within mperflev Categorical	8.1%	5.9%	5.9%	3.6%	6.7%
ESTP	Count	44	18	9	2	73
	% within MBTITYPE	60.3%	24.7%	12.3%	2.7%	100.0%
	% within mperflev Categorical	15.4%	11.8%	8.8%	3.6%	12.3%

F - Failed, NI - Needs Improvement, P - Proficient, A - Advanced

See Appendix to see the entire table

Table 11

Statistical Significance Tests:

Gamma Value:	-0.071
Chi-Square Value:	0.007

Table 12

The learning style of the group with the lowest failure rate is INFJ with 25%. The 2 other groups with the lowest failure rates are INFP and INTJ, with 27% and 33% respectively. The groups with the highest failure rates were ESTP, ESTJ and ISTP with 60%, 56% and 59% respectively. The results for those groups with a significantly higher or lower percentage scoring in the Advanced range are in agreement with the failure statistics above. INFP, INTJ and INFJ represented the top three groups scoring at the advanced level with 19%, 56%, and 17% respectively. Once again ESTP, ESTJ and ISTP represented the low scoring population, with an average of 3.7% in the advanced range. These findings would indicate that those with Introverted and Intuitive (IN) tend to score in the higher ranges on the math section of the MCAS. Feeling Types tend to score higher than Thinking types, while Sensing types appear to be at a disadvantage. No correlation between MCAS math scores and Perception/Judgment could be determined. This may be due in part to the small size of the data set, as MBTI type does appear to affect MCAS Math scores. Because of the randomness (the MBTI types and Failed rates were not ranked in order) the analysis resulted such small Gamma value. The Chi-Square test value was .007, indicating that statistical significance is existent. There is a high probability that these findings would be consistent given a larger sample population. In

conclusion it is evident that learning style affects the ability of students to perform on the Math section of the MCAS.

MBTI type Vs. English performance (MCAS)

Of the original 605 entries 592 were valid for this analysis, a total of 97.9% of the available data set was analyzed to yield the following results:

MBTI Type vs. MCAS English Performance Categorical Crosstabulation

Top 4 MBTI types that have the lowest Failed rates

		eperflev Catagorical				Total
		F	NI	P	A	
INFJ	Count	1	3	7	1	12
	% within MBTITYPE	8.3%	25.0%	58.3%	8.3%	100.0%
	% within eperflev Catagorical	.5%	1.4%	6.0%	4.0%	2.0%
INFP	Count	1	14	11		26
	% within MBTITYPE	3.8%	53.8%	42.3%		100.0%
	% within eperflev Catagorical	.5%	6.5%	7.8%		4.4%
INTJ	Count	1	2	4	2	9
	% within MBTITYPE	11.1%	22.2%	44.4%	22.2%	100.0%
	% within eperflev Catagorical	.5%	.9%	2.8%	8.0%	1.5%
ENFP	Count	15	37	35	6	93
	% within MBTITYPE	16.1%	39.8%	37.6%	6.5%	100.0%
	% within eperflev Catagorical	7.1%	17.3%	24.8%	24.0%	15.7%

Bottom 4 MBTI types that have the highest Failed rates

		eperflev Catagorical				Total
		F	NI	P	A	
ISTP	Count	26	12	5		43
	% within MBTITYPE	60.5%	27.9%	11.6%		100.0%
	% within eperflev Catagorical	12.3%	5.6%	3.5%		7.3%
ISFP	Count	9	4	3	1	17
	% within MBTITYPE	52.9%	23.5%	17.6%	5.9%	100.0%
	% within eperflev Catagorical	4.2%	1.9%	2.1%	4.0%	2.9%
ESTP	Count	39	23	10	1	73
	% within MBTITYPE	53.4%	31.5%	13.7%	1.4%	100.0%
	% within eperflev Catagorical	18.4%	10.7%	7.1%	4.0%	12.3%
ESFP	Count	19	11	8	2	40
	% within MBTITYPE	47.5%	27.5%	20.0%	5.0%	100.0%
	% within eperflev Catagorical	9.0%	5.1%	5.7%	8.0%	6.8%

F - Failed, III - Needs Improvement, P - Proficient, A - Advanced

Table 13

See Appendix for the entire table

Statistical Significance Tests:

Gamma Value:	-0.184
Chi-Square Value:	0.000

Table 14

The learning style of the groups with the lowest failure rates are INTJ, INFJ, and INFP with 11%, 8% and 3% respectively. The three groups with the highest failure rate are ISTP, ESTP, and ISFP; all between 50% and 60% failure rates. Groups with high percentages scoring in the advanced range were INTJ, INFJ and INTP, with 22%, 8% and 9% respectively. ISTP, ESTP and ISTJ learning styles had the lowest percentages for advanced with 0%, 1.4% and 2.3% in that order. These results would indicate that similar to the math results, those with Introverted Intuition tend to do significantly better than other types. Groups with Sensing and Thinking as learning style preferences tend to do poorly, with an average of 52% failure rate. Again, correlation between the Judgment/Perception preferences and scores is low. The Chi-Square test yielded a value of 0, allowing for a high degree of confidence that this sample population is representative of a larger population. In conclusion, the data would suggest that learning style does affect MCAS English section performance. Here, again, The Gamma value is very low due to the randomness of the order in the table that was mentioned before. However, the important thing to notice is that the Failed rates between the top 4 and the bottom 4 have a very significant difference. There is about 40% gap between the two.

Even though the ranking orders are slightly different from the MBTI versus MCAS Math performance, the same MBTI types are in both the top and bottom 4. It is possible that the people who have Sensing personality relatively did better on the English than the Math part in MCAS test, however, the table clearly shows that their performance is far behind the students with Intuition (MBTI notation, "N).

Average Grade Categorical vs. Math and English Performance

Of the original 605 entries 546 were valid and linked with transcripts for this analysis, a total of 90.2% of the data set was used to yield the following results:

Average grade vs. MCAS Math Categorical Crosstabulation

			mperflev Categorical				
			F	NI	P	A	Total
Average grade All courses Catagorical	F	Count	10				10
		% within avgerage grade cat	100.0%				100.0%
		% within mperflev Categorical	3.8%				1.8%
	D	Count	24	2	1		27
		% within avgerage grade cat	88.9%	7.4%	3.7%		100.0%
		% within mperflev Categorical	9.1%	1.4%	1.1%		4.9%
	C	Count	169	54	20	2	245
		% within avgerage grade cat	69.0%	22.0%	8.2%	.8%	100.0%
		% within mperflev Categorical	64.3%	38.6%	21.1%	3.9%	44.6%
	B	Count	56	78	53	22	209
		% within avgerage grade cat	26.8%	37.3%	25.4%	10.5%	100.0%
		% within mperflev Categorical	21.3%	55.7%	55.8%	43.1%	38.1%
	A	Count	4	6	21	27	58
		% within avgerage grade cat	6.9%	10.3%	36.2%	46.6%	100.0%
		% within mperflev Categorical	1.5%	4.3%	22.1%	52.9%	10.6%
Total		Count	263	140	95	51	549
		% within avgerage grade cat	47.9%	25.5%	17.3%	9.3%	100.0%
		% within mperflev Categorical	100.0%	100.0%	100.0%	100.0%	100.0%

Table 15

Statistical Significance Tests:

Gamma Value: Correlation	0.744
Chi-Square Value:	0.000

Table 16

Average Grade vs. MCAS English Performance Categorical Crosstabulation

			eperflev Catagorical				
			F	NI	P	A	Total
avgerage grade cat	F	Count	9	1			10
		% within avgerage grade cat	90.0%	10.0%			100.0%
		% within eperflev Catagorical	4.7%	.5%			1.8%
	D	Count	20	6	1		27
		% within avgerage grade cat	74.1%	22.2%	3.7%		100.0%
		% within eperflev Catagorical	10.5%	3.0%	.8%		4.9%
	C	Count	121	93	28	2	244
		% within avgerage grade cat	49.6%	38.1%	11.5%	.8%	100.0%
		% within eperflev Catagorical	63.4%	46.7%	21.4%	8.0%	44.7%
	B	Count	38	94	69	6	207
		% within avgerage grade cat	18.4%	45.4%	33.3%	2.9%	100.0%
		% within eperflev Catagorical	19.9%	47.2%	52.7%	24.0%	37.9%
	A	Count	3	5	33	17	58
		% within avgerage grade cat	5.2%	8.6%	56.9%	29.3%	100.0%
		% within eperflev Catagorical	1.6%	2.5%	25.2%	68.0%	10.6%
Total		Count	191	199	131	25	546
		% within avgerage grade cat	35.0%	36.4%	24.0%	4.6%	100.0%
		% within eperflev Catagorical	100.0%	100.0%	100.0%	100.0%	100.0%

Table 17

These results do not take into account the average course difficulty level of the students

Statistical Significance Tests:

Gamma Value:	0.689
Chi-Square Value:	0.000

Table 18

The results of this analysis are as expected; students with higher average grades tend to do better on the both MCAS Math and English sections. Individuals who had an average of F (Failing) scored only in the Failing and Needs Improvement levels, with a distribution of 90% Failing on English and 100% Failing on Math, 10% Needs Improvement on English. An interesting thing to notice is that although there are about 4% difference between the A average grade students' performance on Math and English (83% Proficient or Advanced on Math and 87% Proficient or Advanced on English), the students generally tend to do better on English than Math on MCAS. The important question, again, is asking how reliable this result is. One might ask, "How about those A average grade students who failed on the Math or English section on MCAS test?" That is the "million dollar" question. What happened to them? It is hard to think that the students with such high grades still get failing grades on MCAS. With the sources that are presented above, the answer is "We are not too sure." In order to make any conclusion about these students, there has to be a reasonable variance. In other words, when the Gamma value of Average Grade vs. English Performance, 0.689 gets squared, it becomes about 0.5. This means that only 50% of the 5.2% of the variation in MCAS score can be explained by grades. In other words, 50% percent of the overall variance

observed is accounted for by unknown variables. It is certainly possible that these students may have automatically received the lowest scores on MCAS due to their being absent on the test day.

Conclusion

The data and analysis would suggest that there is some correlation between learning style and standardized test scores. By using the MBTI to evaluate learning style and the MCAS as a standardized achievement test, the group was able to explore this relationship. The analysis goes much farther than simply comparing MCAS scores to MBTI type, the two portions of the test are compared separately to different dimensions of learning style. Though there is a definite relationship observed throughout the analysis, the statistical significance of the relationships varies.

When MCAS math scores are compared to average grades, the expected relationship is observed. With a gamma value of 0.744, this analysis demonstrates a statistically significant relationship between the two, indicating that the variables are not independent of one another. Students who do better in their classes are prone to scoring higher on the MCAS than those who do not. While this correlation is intuitively expected, there is now evidence to support the assumption that students with higher marks perform better on standardized achievement tests. The bulk of the analysis' is comprised of MBTI dimensions vs. MCAS scores in both Math and English. Of the following relationships tested:

Judging/Perceiving vs. MCAS Math performance
Judging/Perceiving vs. MCAS English performance
Sensing/Intuition vs. MCAS Math & MCAS English
MBTI Type (All dimensions) vs. MCAS Math
MBTI Type (All dimensions) vs. MCAS English

The following were found to have correlation. However, correlation can be observed and still fail to be statistically significant if the Gamma and Chi-Square values are outside of their respective ranges.

Sensing/Intuition vs. MCAS Math & English
MBTI Type vs. MCAS Math
MBTI Type vs. MCAS English

Sensing/Intuition Categorical vs. MCAS Math Performance

			MPERFN10				
			1.00 A	2.00 P	3.00 NI	4.00 F	Total
SNCAT	.00 N	Count	37	58	71	108	270
		% within SNCAT	13.7%	20.7%	26.3%	39.3%	100.0%
		% within MPERFN10	66.1%	54.9%	47.0%	37.2%	45.5%
	1.00 S	Count	19	46	80	179	324
		% within SNCAT	5.9%	14.2%	24.7%	55.2%	100.0%
		% within MPERFN10	33.9%	45.1%	53.0%	62.8%	54.5%
Total		Count	56	102	151	285	594
		% within SNCAT	9.4%	17.2%	25.4%	48.0%	100.0%
		% within MPERFN10	100.0%	100.0%	100.0%	100.0%	100.0%

Table 19

Statistical Significance Test

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Gamma	.293	.061	4.578	.000
N of Valid Cases		594			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Table 20

Sensing/Intuition Categorical vs. MCAS English Performance

			EPERFN10				
			1.00 A	2.00 P	3.00 NI	4.00 F	Total
SNCAT	.00 N	Count	16	89	102	62	269
		% within SNCAT	5.9%	33.1%	37.9%	23.0%	100.0%
		% within EPERFN10	64.0%	63.6%	47.7%	29.2%	45.5%
	1.00 S	Count	9	51	112	150	322
		% within SNCAT	2.8%	15.8%	34.8%	46.6%	100.0%
		% within EPERFN10	36.0%	36.4%	52.3%	70.8%	54.5%
Total		Count	25	140	214	212	591
		% within SNCAT	4.2%	23.7%	36.2%	35.9%	100.0%
		% within EPERFN10	100.0%	100.0%	100.0%	100.0%	100.0%

Table 21

Statistical Significance Test

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Gamma	.425	.056	7.045	.000
N of Valid Cases		591			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Table 22

When the Sensing/Intuition dimension is cross tabulated with both Math and English MCAS scores, a definite relationship is observed. Extroverted Students with Intuition as their stronger dimension tend to do better on both the Math and English sections of the MCAS than Sensing students. While it is expected of Intuitive persons to score higher on mathematical tests, their performance on the English section was also significantly better than Sensing types. Graphs 1.1 and 1.2 highlight the differences in performance for both Math and English, and it is immediately evident that Intuitive students tend to score higher. As shown in the above tables, there is an observed relationship between Sensing/Intuition and both Math and English MCAS scores. Although the gamma values for these crosstabulations are outside of the acceptable

range, they are very close to being statistically significant. This would indicate the sample is not fairly reliable, and consequently the observed relationship is not statistically significant.

MBTI Type vs. MCAS Math scores yield a more significant correlation when crosstabulated. Through observation of this particular analysis it is evident that when all dimensions of MBTI are analyzed against MCAS Math scores, there is a strong relationship. Once again, the Judgment/Perception dimensions vs. MCAS Math yields inconclusive results, while statistical significance is observed within the relationships between the other dimensions and Math scores. Introverted Intuitive students represented the top three groups, while the lowest scoring three groups all had the Sensing dimension in common. It was also observed that Feeling types tend to score higher than those with the Thinking dimension, and once again Sensing types appear to be at a disadvantage. The Chi-Square value for this analysis indicates that given a larger sample population the results would still be conclusive.

A similar analysis was done on selected MBTI dimensions vs. MCAS English, and yielded results akin to those for the Math analysis. Once again there is no relationship observed between the Judging/Perceiving dimension and MCAS scores. Noteworthy of this analysis was the large gap between the top scoring groups and the low scoring groups. There is a 40 point gap in score between the three groups representing the top scorers on the English section and the lowest scoring three groups. The reason for this is unknown and may possibly be explained by the low number of IN type students in the

sample population. Intuitive types scored significantly better on average than Sensing types, on the other hand, Sensing types did score higher on the English section that on the Math.

Through close examination of these analysis' a relationship between learning style and MCAS scores has been observed. The question for this study, however, concerns statistical significance. A trend may be observed but through analysis proved to be too weak a connection to consider significant. While many trends were observed only a small number of the observed relationships proved to be statistically significant. Those that did not prove significant can not be considered as evidence to support the hypothesis that learning style affects achievement test performance. From the analysis' that proved to be significant we can conclude that on both English and Math sections individuals showing a strong Intuitive preference tend to score higher than those with a Sensing preference. Sensing individuals scored significantly lower than Intuitive individuals on both sections. Also Feeling types with respect to the Feeling/Thinking dimension tend to do better in math, but the gap is much less drastic. Overall it appears that Introverted Intuitive students tend to score higher than Extroverted and Introverted Sensing students. While the Feeling/Thinking dimension has much less influence than the S/N dimension there is evidence to support it's affect on MCAS Math scores.

What was both observed and significant suggests a definite relationship between MBTI type and MCAS scores, but more reliable data and further research would be necessary in order to come to a solid conclusion about the nature of such a relationship.

In conclusion, it is apparent that a relationship does exist and is significant enough to warrant further exploration, a more in depth study with a larger, more accurate data set would likely yield significantly higher correlations than were determined to exist.

Appendix A

MCAS (Massachusetts Comprehensive Assessment System) The standardized exam that High school Students who receive state funded education have to take and pass in order to graduate.

SAT (Scholastic Aptitude Test) The purpose of the SAT is to predict how well you will succeed during your freshman year in college. Colleges and universities use SAT scores to determine eligibility for admission, scholarships, and special academic programs.

PSAT Practice SAT

MBTI (Myers-Briggs Type Indicator) An instrument for determining personality types for the general population. It was developed by Isabel Briggs-Myers building on the work of her mom, Katherine Briggs, with help from her son, Peter Myers, and is based on the theories of C.G. Jung. It basically divides the human population into 16 different personality types.

NCLB (No Child Left Behind) **Act** It redefines the federal role in K-12 education and is meant to help close the achievement gap between disadvantaged and minority students and their peers. It is based on four basic principles: stronger accountability for results, increased flexibility and local control, expanded options for parents, and an emphasis on teaching methods that have been proven to work.

ACT (American College Testing Assessment) An all-multiple-choice test given five times a year at various locations. It is an examination designed to measure academic achievement in four major curriculum areas: English, mathematics, reading, and natural sciences. Materials covered on the four tests that make up the ACT Assessment correspond very closely to topics covered in typical high school classes. Many colleges and universities use ACT scores as part of the admissions process.

SAT II Subject Tests are required by some colleges for admission and/or placement in freshman-level courses. Each Subject Test measures one's knowledge of a specific subject and the ability to apply that knowledge. Students should check with each institution for its specific requirements. In general, students are required to take three Subject Tests (one writing, one mathematics, and one of their choices).

SPSS (Statistical Program for the Social Sciences) It is a comprehensive and flexible statistical analysis and data management system. SPSS can take data from almost any type of file and use it to create tabulated reports, charts, and plots of distribution and trends, descriptive statistics, and conduct complex statistical analyses.

Appendix B

MBTI Type vs. MCAS Math Performance Categorical Crosstabulation

			mperflev Categorical				
			F	NI	P	A	Total
MBTITYPE	ENFJ	Count	7	4	3	1	15
		% within MBTITYPE	46.7%	26.7%	20.0%	6.7%	100.0%
		% within mperflev Categorical	2.5%	2.0%	2.9%	1.8%	2.5%
	ENFP	Count	32	30	23	8	93
		% within MBTITYPE	34.4%	32.3%	24.7%	8.6%	100.0%
		% within mperflev Categorical	11.2%	10.7%	22.5%	14.3%	15.6%
	ENTJ	Count	10	5	3	2	20
		% within MBTITYPE	50.0%	25.0%	15.0%	10.0%	100.0%
		% within mperflev Categorical	3.5%	3.0%	2.9%	3.6%	3.4%
	ENTP	Count	27	12	14	9	62
		% within MBTITYPE	43.5%	19.4%	22.6%	14.5%	100.0%
		% within mperflev Categorical	9.5%	7.9%	13.7%	16.1%	10.4%
	ESFJ	Count	18	9	6	2	35
		% within MBTITYPE	51.4%	25.7%	17.1%	5.7%	100.0%
		% within mperflev Categorical	6.3%	5.9%	5.9%	3.6%	6.0%
	ESFP	Count	23	9	6	2	40
		% within MBTITYPE	57.5%	22.5%	15.0%	5.0%	100.0%
		% within mperflev Categorical	8.1%	5.9%	5.9%	3.6%	6.7%
	ESTJ	Count	27	13	5	2	48
		% within MBTITYPE	56.3%	27.1%	12.5%	4.2%	100.0%
		% within mperflev Categorical	9.5%	8.6%	5.9%	3.6%	8.1%
	ESTP	Count	44	19	9	2	73
		% within MBTITYPE	60.3%	24.7%	12.3%	2.7%	100.0%
		% within mperflev Categorical	15.4%	11.8%	8.8%	3.6%	12.3%
	INFJ	Count	3	3	4	2	12
		% within MBTITYPE	25.0%	25.0%	33.3%	16.7%	100.0%
		% within mperflev Categorical	1.1%	2.0%	3.9%	3.6%	2.0%
	INFP	Count	7	11	3	5	26
		% within MBTITYPE	26.9%	42.3%	11.5%	19.2%	100.0%
		% within mperflev Categorical	2.5%	7.2%	2.9%	8.9%	4.4%
	INTJ	Count	3		1	5	9
		% within MBTITYPE	33.3%		11.1%	55.6%	100.0%
		% within mperflev Categorical	1.1%		1.0%	8.9%	1.5%
	INTP	Count	17	7	5	5	34
		% within MBTITYPE	50.0%	20.6%	14.7%	14.7%	100.0%
		% within mperflev Categorical	6.0%	4.6%	4.9%	8.9%	5.7%
	ISFJ	Count	10	5	6	1	22
		% within MBTITYPE	45.5%	22.7%	27.3%	4.5%	100.0%
		% within mperflev Categorical	3.5%	3.3%	5.9%	1.8%	3.7%
	ISFP	Count	11	2	2	3	18
		% within MBTITYPE	61.1%	11.1%	11.1%	16.7%	100.0%
		% within mperflev Categorical	3.9%	1.3%	2.0%	5.4%	3.0%
	ISTJ	Count	20	12	7	5	44
		% within MBTITYPE	45.5%	27.3%	15.9%	11.4%	100.0%
		% within mperflev Categorical	7.0%	7.9%	6.9%	8.9%	7.4%
	ISTP	Count	26	12	4	2	44
		% within MBTITYPE	59.1%	27.3%	9.1%	4.5%	100.0%
		% within mperflev Categorical	9.1%	7.9%	3.9%	3.6%	7.4%
Total		Count	285	152	102	56	595
		% within MBTITYPE	47.9%	25.5%	17.1%	9.4%	100.0%
		% within mperflev Categorical	100.0%	100.0%	100.0%	100.0%	100.0%

MBTI Type vs. MCAS English Performance Categorical Crosstabulation

			eperfiev Catagorical				Total
			F	NI	P	A	
MBTITYPE	ENFJ	Count	4	6	3	2	15
		% within MBTITYPE	26.7%	40.0%	20.0%	13.3%	100.0%
		% within eperfiev Catagorical	1.9%	2.8%	2.1%	8.0%	2.5%
	ENFP	Count	14	27	26	6	93
		% within MBTITYPE	15.1%	29.0%	27.6%	6.5%	100.0%
		% within eperfiev Catagorical	7.1%	12.6%	18.6%	24.0%	15.7%
	ENTJ	Count	9	6	5		19
		% within MBTITYPE	47.4%	31.6%	26.3%		100.0%
		% within eperfiev Catagorical	3.8%	2.8%	3.5%		3.2%
	ENTP	Count	18	22	20	2	62
		% within MBTITYPE	29.0%	35.5%	32.3%	3.2%	100.0%
		% within eperfiev Catagorical	8.5%	10.3%	14.2%	8.0%	10.5%
	ESFJ	Count	14	13	6	2	35
		% within MBTITYPE	40.0%	37.1%	17.1%	5.7%	100.0%
		% within eperfiev Catagorical	6.6%	6.1%	4.3%	8.0%	5.9%
	ESFP	Count	10	11	8	2	40
		% within MBTITYPE	47.5%	27.5%	20.0%	5.0%	100.0%
		% within eperfiev Catagorical	9.0%	5.1%	5.7%	8.0%	6.8%
	ESTJ	Count	19	21	8	1	49
		% within MBTITYPE	37.5%	42.9%	16.7%	2.1%	100.0%
		% within eperfiev Catagorical	8.5%	9.8%	5.7%	4.0%	8.1%
	ESTP	Count	39	23	10	1	73
		% within MBTITYPE	53.4%	31.5%	13.7%	1.4%	100.0%
		% within eperfiev Catagorical	18.4%	10.7%	7.1%	4.0%	12.3%
	INFJ	Count	1	3	7	1	12
		% within MBTITYPE	8.3%	25.0%	58.3%	8.3%	100.0%
		% within eperfiev Catagorical	.5%	1.4%	5.0%	4.0%	2.0%
	INFP	Count	1	14	11		26
		% within MBTITYPE	3.8%	53.8%	42.3%		100.0%
		% within eperfiev Catagorical	.5%	6.5%	7.8%		4.4%
	INTJ	Count	1	2	4	2	9
		% within MBTITYPE	11.1%	22.2%	44.4%	22.2%	100.0%
		% within eperfiev Catagorical	.5%	.9%	2.8%	8.0%	1.5%
	INTP	Count	14	12	5	3	34
		% within MBTITYPE	41.2%	35.3%	14.7%	8.8%	100.0%
		% within eperfiev Catagorical	6.6%	5.6%	3.5%	12.0%	5.7%
	ISFJ	Count	6	11	4	1	22
		% within MBTITYPE	27.3%	50.0%	18.2%	4.5%	100.0%
		% within eperfiev Catagorical	2.8%	5.1%	2.8%	4.0%	3.7%
	ISFP	Count	0	4	3	1	17
		% within MBTITYPE	52.9%	23.5%	17.6%	5.9%	100.0%
		% within eperfiev Catagorical	4.2%	1.9%	2.1%	4.0%	2.9%
	ISTJ	Count	19	17	7	1	46
		% within MBTITYPE	42.2%	39.6%	15.6%	2.2%	100.0%
		% within eperfiev Catagorical	9.0%	7.9%	5.0%	4.0%	7.4%
	ISTP	Count	26	12	5		43
		% within MBTITYPE	60.5%	27.9%	11.6%		100.0%
		% within eperfiev Catagorical	12.3%	5.6%	3.5%		7.3%
Total		Count	212	214	141	25	592
		% within MBTITYPE	35.8%	36.1%	23.8%	4.2%	100.0%
		% within eperfiev Catagorical	100.0%	100.0%	100.0%	100.0%	100.0%

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