

Comparing Overexcitability Levels between STEM Talented Students and Generally Gifted

Students Using the OEQII

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Abstract

Gifted individuals have been shown to have higher developmental potential, making them more likely to exhibit overexcitabilities (OEs) classified as psychomotor, sensual, intellectual, imaginal, or emotional. The OE levels between IMSA males and females and between IMSA students interested in STEM and Ohio generally gifted students were examined using the Overexcitability Questionnaire-two. Data from 70 IMSA sophomores were analyzed using descriptive statistics, ANOVA, and Bonferroni Correction method. Results showed that IMSA females had significantly higher sensual and emotional levels than males. Both IMSA males and females exhibited significantly lower imaginal OE levels than the Ohio students. This study will hopefully spark awareness of overexcitabilities in gifted populations, allow students to understand their feelings and behaviors, and provide possible explanations for low imagination in STEM populations.

Keywords: overexcitabilities, OEQII, gifted, STEM

Biography

Taylor Imburgia belongs to the Class of 2013 at the Illinois Mathematics and Science Academy (IMSA). “The mission of IMSA, the world’s leading teaching and learning laboratory for imagination and inquiry, is to ignite and nurture creative, ethical scientific minds that advance the human condition.” Taylor conducted this investigation through IMSA’s Student Inquiry and Research Program with recently retired Clinical School Counselor, Deborah McGrath, and IMSA Coordinator of Research and Evaluation, Christopher Kolar. Taylor presented this investigation at the 10th International Dabrowski Congress in Denver, CO and IMSA’s annual conference, IMSAloquim.

Introduction

Dabrowski's Theory of Positive Disintegration

An increasing number of studies have begun to utilize Dabrowski's Theory of Positive Disintegration (Dabrowski, 1964) to explain personality growth and overall characteristics of gifted and talented individuals (Lind, 2000; Mendaglio, 2002; Daniels & Piechowski, 2009). According to the Theory of Positive Disintegration (TPD), inner growth occurs following a sequence of psychological despair and disruption, or disintegration (Mendaglio, 2002), which disrupts primitive instincts in one's psyche and prompts one to realize not only flaws in one's character but also one's responsibility to better one's behavior (Dabrowski, 1964; Dabrowski, 1967; Daniels & Piechowski, 2009). After this period of negative emotion experienced during disintegration, people with great developmental potential no longer govern themselves through instinct but through intelligence, approaching an elaborate, idealized version of themselves (Dabrowski, 1964; Dabrowski, 1967; Daniels & Piechowski, 2009). As a result of this growth, individuals broaden their objectivity and are able to form deeper relationships with others through removal of instinctual perplexity (Dabrowski, 1967). Additionally, TPD postulates that gifted individuals have greater developmental potential which can lead to a higher level of development than the average population. Dabrowski believed this elevated developmental potential could be seen in individuals through three distinct characteristics: immense talent and intelligence, OEs, and self-improving emotional potential (Daniels & Piechowski, 2009).

While not all gifted individuals experience OEs, research has shown that these characteristics are found more often in the gifted population than in the average population (Lind, 2000; Yakmaci-Guzel & Akarsu, 2006). Dabrowski defines OEs as above-average reactions to stimuli; people with OEs experience intense, lengthy reactions to lower amounts of

stimuli than people without OEs would need to undergo a similar reaction (Daniels & Piechowski, 2009). These characteristics are classified under 5 categories: psychomotor, sensual, intellectual, imaginal, and emotional. The psychomotor OE involves a heightened response of the neuromuscular system which results in an affinity for constant movement and exercise. The sensual OE concerns intense pleasure or disgust that one experiences in response to expressions of the 5 senses. The intellectual OE prompts an interest in collecting information, making connections, and analyzing discoveries to find answers to their questions about the world around them. The imaginal OE sparks an affinity for vivid dreams, figurative language, invention, and fantasy. Lastly, the emotional OE involves a high capacity for meaningful relationships and deep emotions (Dabrowski, 1964; Lind, 2000; Daniels & Piechowski, 2009). Overall, these OEs cause individuals to have intense reactions to daily-life events (Larsen, Diener, & Emmons, 1986), which incline them to experience life more deeply but also to have more persistent crises than their average peers (Lind, 2000).

Measuring OEs using the Overexcitability Questionnaire II

The *Overexcitability Questionnaire II* (OEQII) was created by Falk, Lind, Miller, Piechowski and Silverman (1999) to measure the OE levels of individuals that could comprehend an 8th grade reading level. The questionnaire includes 50 items, 10 for each OE, in which participants rate how much each statement describes their current state using a Likert scale. Because this instrument takes roughly 10 minutes to administer and 10 minutes to score, several studies have used this questionnaire instead of the lengthier OEQ to investigate OE levels in both gifted and non-gifted populations (Tieso, 2007; Piirto, Montgomery, & May, 2008; Siu, 2010; Wirthwein & Rost, 2011).

For example, Wirthwein and Rost (2011) used the OEQII to examine differences in OE levels between gifted (high general intelligence) and average adults as well as between high-achieving (identified using GPA) and average adults. Findings showed significantly higher intellectual levels for gifted adults and high-achieving adults than for average adults as well as significantly higher sensual levels for high-achieving adults than for average adults. Similarly, Siu (2010) used the OEQII to investigate the differences in OE levels between gifted and non-gifted children as well as between the genders. Results indicated that mean scores for both males and females were always higher in gifted children than in non-gifted children. When looking at just the gifted population, the intellectual levels were highest while the imaginal levels were lowest. Lastly, gifted and non-gifted females both had higher emotional levels than males with gifted females also having higher sensual levels as well. In addition to comparing people of the same age, some studies like the one conducted by Tieso (2007) compared OE levels between gifted children and their parents. Results from this study showed higher OE emotional and sensual levels for females and discussed reasons for why differences occurred between ages for the imaginal OE; for example, the investigation suggested that as adults take on greater responsibilities they lose their childish wonder and vivid imaginations. Furthermore, a study completed by Piirto, Montgomery, and May (2008) examined OE differences between gifted students from the United States (Ohio) and Korea. Findings showed that male and female Koreans had fewer differences between emotional and sensual OEs than Americans did.

Characteristics of STEM students

As secondary and university educations have started to focus on science, technology, engineering, and mathematics (STEM) more than in the past, researchers have begun to identify

specific characteristics of students studying these fields. Gallant (2010) described STEM students as logical, technologically-savvy, problem solvers who utilize the creativity and inquisitiveness emphasized in their education to solve real-world issues. Additionally, she described them as more studious, more stable in their career choices than students in other fields, and more concerned with impacting their field than with personal goals. With these characteristics in mind, studies such as those conducted by Chen and Weko (2009) and Kokkelenberg and Sinha (2010) have looked into who completes undergraduate and graduate degrees in STEM fields and how demographics affect these statistics. Namely, greater percentages of men and Asian/Pacific Islander students enroll in STEM programs (Chen & Weko, 2009).

Background information on STEM school utilized in study

The Illinois Mathematics and Science Academy (IMSA), located in Aurora Illinois, is a public, three-year residential high school for students who are academically talented in mathematics and /or science. Students apply in their freshman year and are chosen based on test scores and grades as well as other accomplishments such as extracurricular projects or performances. About 10-15% of the sophomore class enters IMSA from the eighth grade. Since its establishment in 1985, the internationally recognized institution has worked towards creating leaders who work to improve society. Approximately 650 students from urban, suburban, and rural areas across the states are enrolled at the institution in grades 10 through 12. The school's staff is comprised of Presidential Award winners, National Board of Professional Teaching Standards (NBPTS) certified teachers, authors, and fellowship recipients, who all

possess advanced degrees in their respective fields of study (“Illinois Mathematics and Science Academy,” 2010).

Rather than emphasizing competition, the academy stresses the importance of collaboration between peers, as different perspectives aid in problem solving. In relation to this desire for diversity of thought, the school also focuses on creating cultural diversity on campus (population comprised of considerable groups of Asian, Caucasian, African American, and Hispanic students). In regards to academic philosophy, instructors focus on teaching students how to piece together information in order to understand advanced topics and to draw sophisticated connections between several disciplines. In other words, the staff wishes to teach the student body how to learn rather than just how to retain information for assessments. Since 1989, the school has offered a unique opportunity for professional research and independent study: students conduct original investigations at leading universities, work with established members of the fields of study, and share their work in a professional manner. Throughout their academic experience at the institution, students are encouraged to push the boundaries of their current knowledge and of human knowledge in general in order to find new ways to advance the world (“Illinois Mathematics and Science Academy,” 2010).

IMSA is a residential high school; therefore, all attendees are required to live on campus. This residential setting prompts students to develop independence along with self-discipline and to take responsibility for their actions. In a diverse environment, they learn to accept the opinions of others and become emotionally with their classmates as they adjust to life away from home (“Illinois Mathematics and Science Academy,” 2010).

Present Study

The present study measured OE levels of sophomore students at IMSA using the OEQII and looked for significant differences between genders. IMSA data was also compared to previously published data from generally gifted students enrolled in Ohio public schools (Piirto et al., 2008).

Materials and Methods

Students were randomly selected to participate in this investigation through their Sophomore Navigation groups. (Sophomore Navigation is a program for all sophomores consisting of approximately 14 students and 1-2 facilitators. Students meet on various Wednesdays throughout the school year to discuss the academic, social, and emotional experiences of their current life at IMSA) (“Illinois Mathematics and Science Academy,” 2010). Six Navigation leaders were approached and asked if they were willing to volunteer a 10-minute portion of one of their small group sessions so that their students could complete the OEQII. The questionnaire was administered to the groups on either November 2, 2011 or February 8, 2012 by either their Navigation leader or one of the authors. Seventy participants willingly agreed to complete the questionnaire. All students were read the same consent statement thanking them for their participation and giving them specifics regarding confidentiality and how to complete the questionnaire. Before completing the questionnaire, students were notified that their responses would be used in this investigation and were told that they may skip any item they felt uncomfortable answering. They were also made aware that the school counselors were educated about the study and could talk with them if necessary. Students were instructed to indicate their age and gender on their paper but not to disclose their name in order to keep their responses confidential.

Questionnaires were collected promptly after completion, and responses were entered into an Excel document on the day they were administered. All entries in the document were double-checked with the paper questionnaires to ensure valid data. After all responses had been recorded, questionnaires were stored in a secure location. Using MINITAB Release 14: Statistical Software and the OEQII Scoring Procedure, scores for each OE were calculated on a scale of 1 to 5 for each student (One student left a psychomotor question blank, so that person did not receive a psychomotor score. Therefore, 70 scores were found for every OE except psychomotor, which had 69 scores instead). Using MINITAB, descriptive statistics were first conducted on the entire data set and separately for each gender to calculate mean, standard error of mean, standard deviation, minimum, and maximum. In order to see if the differences between genders were significant, a One-Way ANOVA was conducted on each OE separately to determine a p-value. The Bonferroni Correction method was used to account for error across the five different areas. P-values that were less than the Bonferroni error were considered significant. The Bonferroni Correction method was applied to the three p-values which were less than 0.05, starting first with the smallest p-value and then continued on the next p-value until the Bonferroni error was smaller than the p-value, indicating an insignificant p-value. The remaining p-values, which were greater than 0.05, were considered to be insignificant as well.

Data were then compared to the results from the Ohio study conducted by Piitro et al. (2008) by gender. The mean values found using the gender-specific descriptive statistics in these studies were subtracted from the mean values found in my study to determine the difference between them. Significance of these results was estimated by looking at the differences of mean scores for my data between genders and seeing how large the difference needed to be in order to produce a significant p-value.

Results

Data analysis for IMSA data

Descriptive statistics were conducted on the entire sample in order to compare the means, standard deviations, minimums, and maximums of each OE. Results, presented in Table 1, show that the means ranged from 3.7200 to 2.8629 in the following descending order: intellectual, emotional, sensual, psychomotor, and imaginal. Descriptive statistics were also conducted separately on the male and female sample populations.

One-Way ANOVA tests, the Bonferroni Correction method were then conducted for each OE to determine whether the differences in means were significant between genders. These calculations are displayed in Table 2. Through these analyses, females were seen to have significantly higher sensual and emotional OE levels than males. Figures 1 and 2 visually display the significant difference between the genders for the sensual and emotional OEs respectively.

Comparison to other studies

The means found in the gender-specific descriptive statistics were then compared to the means found for the Ohio gifted students from the study conducted by Piirto, et al. (2008). As seen in Table 2, the smallest difference in IMSA means that resulted in a significance difference between the genders was 0.587 (subtract emotional male mean value from emotional female mean value). Therefore, a difference of greater than 0.587 was estimated to be significant. A comparison of mean values between the 36 IMSA males and 88 Ohio gifted males is presented in Table 3. This comparison indicates that IMSA males have significantly lower imaginal and sensual OE levels but significantly higher intellectual OE levels than the Ohio gifted males. A similar comparison of the mean values between the 34 IMSA females and the 139 Ohio gifted

females is presented in Table 4. This comparison suggests that IMSA females also have significantly lower imaginal OE levels but significantly higher emotional OE levels.

Discussion

The OE levels measured in the entire IMSA sample matched a similar trend found by Siu (2010) in her study of non-gifted and gifted Hong Kong students. She also found that the gifted population had highest OE levels for the intellectual OE and lowest OE levels for the imaginal OE (Siu, 2010). IMSA students may have highest intellectual OE levels because they voluntarily enroll in a gifted educational setting. Students enrolled in gifted or talented programs are often asked to exhibit characteristics of the intellectual OE, such as collecting data, drawing conclusions, and finding answers to real-world questions. As IMSA students choose to apply to a school known for its challenging curriculum for talented students, it seems reasonable that students who willingly choose to attend this type of school would enjoy or excel at the intellectual OE characteristics found in most gifted educational programs. On the other hand, the low imaginal levels may be related to the questionnaire statements themselves. Upon examining the OEQII (Falk et al., 1999), three statements seem to appeal more to younger children than the other seven statements:

- 4) My pretend world is very real to me.
- 20) Sometimes I pretend I am someone else.
- 33) I believe that dolls, stuffed animals, or the characters in books are alive and have feelings.

As seen in Table 5, if the means for these three statements were not included in the overall imaginal mean for IMSA students, the psychomotor mean would actually be smaller than

the imaginal one—3.0565 (psychomotor) v. 3.0797 (new imaginal). Removing these three statements in future drafts of the questionnaire may more accurately measure imaginal OE levels in adolescents.

The similarity in data between samples from two different countries indicates that characteristics of gifted students may remain constant, despite cultural differences. To further investigate this claim, a larger sample size for IMSA data should be used to see if this trend remains true for the majority of the IMSA population, not only a small portion. It may also be valuable to note the ethnicities of the IMSA students completing the surveys. As IMSA had a 36% Asian population in 2007 (“Illinois Mathematics and Science Academy,” 2010), which has risen since then, it may be interesting to see if ethnicity alters the trend or if the trend remains true regardless of ancestry.

IMSA females’ significantly higher sensual and emotional OE levels support the conclusions found in previously conducted studies (Tieso, 2007; Siu, 2010). While the present study only surveyed gifted students, Siu (2010) utilized both non-gifted and gifted students from Hong Kong. Because both gifted and non-gifted females had higher emotional OE levels, one could suggest that females have higher OE levels in all populations, regardless of intelligence. Siu (2010) also showed higher female sensual levels for gifted females but not for non-gifted females, indicating that sensual levels may vary with intelligence. To further test this claim, students from non-gifted classes from public schools near IMSA could be administered the questionnaire to see if the same conclusion found in the Chinese study holds true in Illinois. Tieso (2007) also found higher emotional and sensual levels in gifted students and their parents. These results indicate that the emotional and sensual OE may be independent of age. To test this

hypothesis, IMSA teachers and other faculty members could be tested to see if a similar conclusion is found when comparing all female data to all male data.

The low levels of imaginal OE amongst both the male and female population may relate to the fact that IMSA students live in residential facilities while the Ohio students (Piirto et al., 2008) live in their home environment. As IMSA students no longer have their parents to rely on, they learn to live independently and through the process become more mature. Tieso (2007) found that imagination decreases as people approach adulthood and age. It seems plausible to assert that this extra stage of maturation that IMSA students experience could account for their lower imaginal levels.

IMSA students' interest in STEM could also result in lower imaginal levels. As STEM students are known for their sense of logic and ability to problem solve, they may have lost some imagination as they became more logical. In addition, most IMSA students are mainly focused on mathematics and/or science, which involve logical abilities rather than strictly creative ones (although STEM education programs often work to promote creativity) (Gallant, 2010). Because students at public high schools do not necessarily need to be interested in these areas to be considered gifted, Ohio students may have more interests in the humanities or the arts, which deal more with elements of the imagination such as figurative language and imagery.

IMSA males and females were also different than the other gifted sample in unique ways. IMSA males may have higher intellectual levels because characteristics of STEM students overlap with those of intellectually overexcitable individuals. For example, skills like problem solving and making connections between education and real-world situations are attributed to both groups (Dabrowski, 1964; Lind, 2000; Daniels & Piechowski, 2009; Galland, 2010). To see if having an interest in STEM education makes a difference in intellectual overexcitability, it

would be interesting to sample a group of public high school students and have the students indicate their educational interests to see if a relationship exists between a person's desired area of study and intellectual overexcitability. IMSA females may also have higher emotional levels because of the emotional maturity that they experience during their adjustment to living away from home. As females are already thought to be more emotionally excitable than males, it seems probable that IMSA females are more likely to experience a stronger emotional reaction to moving away from home. As IMSA students live together in one place, the sharing of feelings between friends is common. Therefore, IMSA females may have come in contact more with their emotions as they transitioned to living at the residential academy during their sophomore year and found new people to share them with. Because most Ohio students do not transition from living at home to living independently during high school, they may not confront a similar event that prompts this growing awareness with their emotions, resulting in a higher emotional OE level. To test this hypothesis, IMSA applicants still living at home could be sampled before they lived at IMSA and after they transitioned to living there to see if a change in emotional OE occurred.

Conclusion

IMSA sophomores were seen to have highest intellectual levels but lowest imaginal levels according to the mean levels calculated using descriptive statistical analysis. As seen in previous studies (Siu, 2010; Tieso, 2007; Piirto, et al. 2008), OE levels varied between genders for the IMSA population. ANOVA statistical analyses indicated that females were significantly more emotional and sensual than the males. In addition to finding differences between IMSA students themselves, significant differences were found between IMSA students and the Ohio

students from the study by Piirto et al. (2008). Both IMSA males and females were seen to be significantly less imaginative than the other gifted students, which was determined through comparing mean levels of each group separately for each OE. By gender, IMSA males exhibited significantly higher intellectual OE levels but lower sensual levels than Ohio males. For females, the IMSA sample had significantly higher emotional OE levels.

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Appendix

Overexcitability	Mean	Standard Deviation	Minimum	Maximum
Intellectual	3.7200	0.6102	2.6000	4.9000
Emotional	3.4657	0.7510	1.5000	4.9000
Sensual	3.1629	0.8311	1.4000	5.0000
Psychomotor	3.0565	0.7873	1.2000	4.9000
Imaginational	2.8629	0.7791	1.4000	4.9000

Note: Overexcitabilities are organized in descending order with regards to the means. The psychomotor OE sample size is 69 instead of 70.

Table 2 OE levels gender comparison at IMSA				
Overexcitability	Individual Means	Difference in Means	Bonferroni Correction	Significant?
Sensual	2.764 3.585	0.821 F	0.000<0.01	Yes
Emotional	3.181 3.768	0.587 F	0.001<0.0125	Yes
Imaginational	2.669 3.068	0.399 F	0.032>0.0167	No
Intellectual	3.817 3.618	0.199 M	0.174>0.025	No
Psychomotor	2.994 3.121	0.127 F	0.509>0.05	No
<p>Note: The male means are listed first followed by the female means. The M or F in the difference column indicates which group had a higher mean. When p-values (left) were less than correction values, the gender difference was considered significant.</p>				

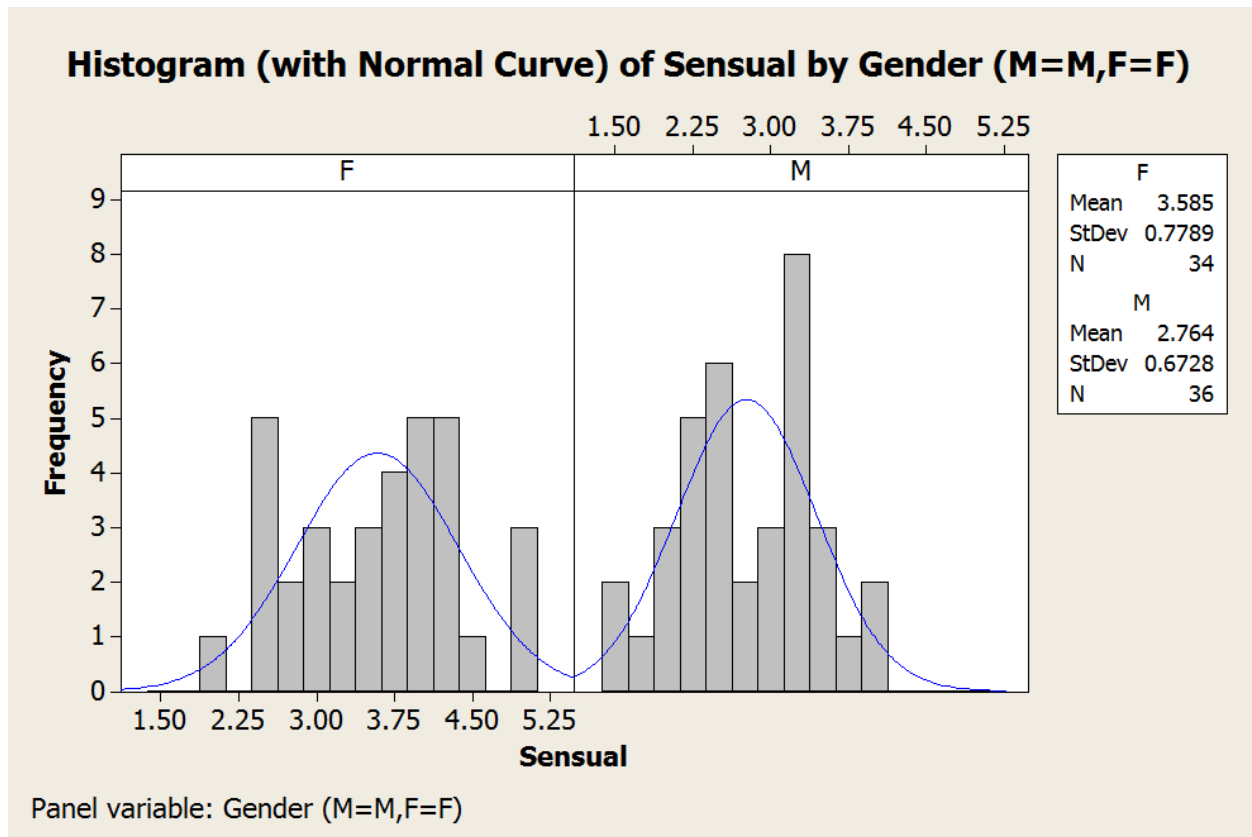


Figure 1. Histogram comparison of the sensual OE by gender (IMSA). A difference of 0.821 in means between females and males produced a significance difference in sensual OE levels. The peak of the curve represents the mean. While there are some taller male columns, the fact that there are multiple substantial sized columns near the 3.5-4.25 range resulted in a larger mean overall.

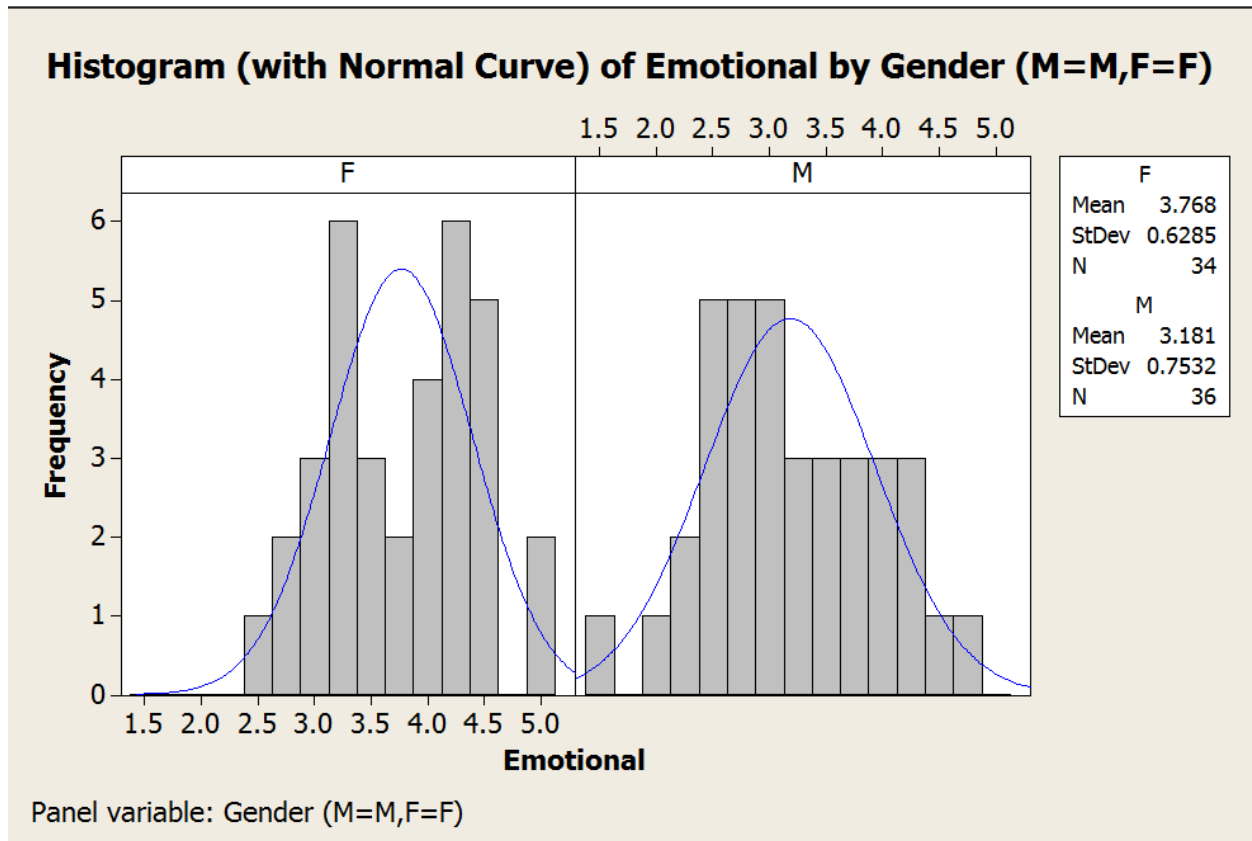


Figure 2. Histogram comparison of the emotional OE by gender (IMSA). A difference of 0.587 in means between females and males produced a significance difference in emotional OE levels. The peak of the curve represents the mean. High columns in the 3.25-4.5 range for the female histogram resulted in a mean near the average of the range 3.875. However, the male histogram has higher columns from 2.25-3, making the mean only slightly above 3.

Table 3 Male comparison of IMSA data (n=36) to Ohio data (n=88)			
Overexcitability	Individual Means	Difference in Means	Significant?
Imaginational	2.664 3.776	1.112 (O)	Yes
Sensual	2.764 3.649	0.885 (O)	Yes
Intellectual	3.817 3.147	0.67 (I)	Yes
Emotional	3.181 3.713	0.532 (O)	No
Psychomotor	2.994 3.025	0.031 (O)	No
Note: The IMSA means are listed first followed by the Ohio means. The O or I in the difference column indicate which group had a higher mean. Differences greater than 0.587 were considered to be significant.			

Table 4 Female comparison of IMSA data (n=34) to Ohio data (n=139)			
Overexcitability	Individual Means	Difference in Means	Significant?
Imaginational	3.068 3.940	0.872 (O)	Yes
Emotional	3.768 3.088	0.68 (I)	Yes
Intellectual	3.618 3.057	0.561 (I)	No
Sensual	3.585 3.317	0.268 (I)	No
Psychomotor	3.121 3.224	0.103 (O)	No
Note: The IMSA means are listed first followed by the Ohio means. The O or I in the difference column indicate which group had a higher mean. Differences greater than 0.587 were considered to be significant.			

Table 5 IMSA means for each imaginal OE statement									
#1	#4	#14	#20	#22	#24	#28	#33	#34	#47
3.629	2.500	3.486	2.371	2.843	2.823	3.143	2.200	2.729	2.886
Note: Statements #4, 20, and 33 have the three lowest means. Removing these three statements (which are more childish in nature) would increase the imaginal OE mean from 2.8629 to 3.0797.									