

4-1-2011

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**Teaching Methods at Single Sex High
Schools: An analysis of the
implementation of biological differences
and learning styles**

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Fall 2010**

Introduction

For those who have a choice in their mode of high school education, choosing co-educational or a single sex high school may become one of the defining factors in school choice. What does each school offer? What may be the benefits and drawbacks?

Coeducational and single sex high schools both present a significant amount of pros and cons within such a debate. While significant research exists regarding achievement in both the curriculum and the hidden curriculum, this study is designed to focus on the teaching methods within the single sex high school. This research is designed to look first at the teacher, as teachers are all greatly influenced by their students. As such, this research will investigate if teaching styles and chosen methods used in single sex high schools relate to researched biological differences in the brain. That is, how closely do teaching methods at single sex high schools correlate with biological differences between each sex?

My sophomore year of high school my brother and I were each taking a philosophy class as part of our religion requirement at our respective single sex high schools. He came home and shared that their class discussion had centered around “mowing kittens.” Their teacher taught them to understand each philosopher by telling the students that on his way home from work he had found a box of kittens, taken them home, buried them up to their necks, and then mowed the lawn. The teacher then asked the boys to tell him how each philosopher would react to such an action. I, however, spent my class discussing each philosopher’s strengths and weaknesses. Our end goal was the same: to understand and characterize; apply and understand concepts. His,

however, was done through a method that never would have been accepted or received well as my all-girls institution.

It was during that time that I began to observe more and more the differences between our school settings. I learned physics through trial and error, with small group discussion; my brother learned physics by building and testing catapults in a class wide competition. This first hand-experience with differences in teaching methods caused me to wonder if such differences were based on the type of school we each attended. Would coeducational school students “mow kittens,” or make catapults, or work in small groups to discuss topics? Did my brother receive this different instruction on purpose? Was it at all related to sex?

This experience, coupled with courses such as Psychology of Gender Differences led me to create this research question and develop the hypothesis that teaching methods at single sex high schools would be different between the two sexes, and would be influenced by the literature and research on differences in the male and female brain.

Literature Review

Since the beginning of feminist research, significant analysis has been conducted regarding the existence of differences between the two sexes (Eagly, 1995; Halpern, 1997). Research has been cultivated within many different disciplines including psychology, neuroscience, sociology, and public policy. As with any type of research, much debate has surfaced in conjunction with this discipline concerning whether or not sex differences should be studied, what sex differences mean, and the role that such differences may or may not play in society (Anselmi & Law, 1998).

Many approaches have been taken by researchers in an attempt to fully understand sex differences within psychology and neuroscience. The two most prominent accounts for sex differences are biological and socio-cultural (Anselmi & Law, 1998). Biological accounts emphasize the importance of innate differences in abilities, brain structure/organization, and evolutionary theory. Opposing, socio-cultural accounts examine differences based on socialization, the prevalence of gender roles, and the importance of stereotypes (Anselmi & Law, 1998).

Within the biological understanding of sex differences, researchers emphasize prenatal exposure to specific hormones (Kimura, 1992; Baron-Cohen, 2003; Gurian & Stevens, 2005) directly influencing cognitive—specifically spatial—abilities. Measured levels of testosterone directly correlate to ability on visuo-spatial tasks of cognitive functioning (Gouchie & Kimura, 1991). Hormones similarly play a role in language ability, showing that women perform best on verbal tasks in the middle of their menstrual cycle (when estrogen is highest) and best on spatial tasks at the end of their cycle (when estrogen is lowest) (Kimura, 1992). Brain organization is another key to biological sex differences, especially the specialization of certain structures and the phenomenon of lateralization. Due to an increased corpus collosum (Baron-Cohen, 2003), women communicate more with both hemispheres simultaneously. This decrease in lateralization causes women to use both hemispheres for language tasks resulting in less space for visual tasks. This is opposite to the male phenomenon in which evidence shows that increased lateralization in men offers better specialization on spatial tasks (Baron-Cohen, 2003; Halpern, 1992; Gazzaniga, 1983). Finally, the evolutionary approach to biological differences contends that evolutionary adaptations such as the ability to throw a projectile

weapon in hunting is the root cause of male spatial superiority; whereas female foraging and gathering has led to a biological adaptation for superior spatial location (Baron-Cohen, 2003; Buss, 1995; Geary, 1995; Silverman & Eals, 1992; Eagly & Wood, 1999).

Socio-cultural accounts argue that formal and informal experiences serve to explain sex differences in cognition. Play, for example, greatly structures a child's cognitive abilities such that boys are more likely to play with blocks, which have a much more spatial component, than girls (Connor & Serbin, 1985; Halpern, 1992). Influences from teachers and society regarding gender roles are the most influential factors for cognitive success according to this model. Boys are more likely to be encouraged in math and science, conversely girls in English, and such a waxing and waning of self esteem about certain subjects becomes the root cause of cognitive success (Benbow & Stanley, 1982; Kimball, 1989; Anselmi & Law, 1998). Even when boys and girls take the same course, they may receive different instruction, reinforcement, or support for their efforts (Tyre, 2008; AAUW, 1999; Gurian & Stevens, 2005). Therefore, teachers and parents play a pivotal role in the socio-cultural perspective of sex differences. While socio-cultural influences are intriguing, this research concentrates on biological sex differences.

These theories have shown how two different scientific approaches can result in the same conjecture that sex differences do exist. The biological perspective, however, is much more aligned with the idea that boys and girls should be instructed differently. What is equally—if not more—important to study is the implementation of such understandings in the classroom (Halpern & LaMay, 2000). Due to the cognitive differences of each sex, and the importance of the school and teacher in the development of the child, a positive implementation for such sex difference understanding is a single

sex educational environment, which provides a separate but equal educational opportunity. For education to be most effective for its students, the instructor, institution, and system, should acknowledge differences in learning modality and capacity (Sax, Arms, Woodruff, Riggers, & Eagan, 2009; Reichert & Hawley, 2009). In order for classrooms to be gender-fair and for teaching to best serve all students, single-sex classrooms can best achieve this goal (Sax, et. al, 2009). Not only is the modality of instruction important, but environment and the hidden curriculum play an equally potent role.

The mode of instruction a student receives can be directly related to their most refined and specialized cognitive processes. Each sex has an innate and socially reinforced cognitive profile, and, as such, each sex should be instructed according to its neuro-scientific blue print for success. Biological differences in the male brain include decreased lateralization, smaller frontal lobe, less sensitized sensory receptors, and increased testosterone (Gurian & Stevens, 2005; Gurian, 2001; Tyre, 2008). Decreased lateralization in males shows increased use of the right hemisphere for problem solving, therefore increasing male's spatial relation abilities (Buss, 1995; Gurian & Stevens, 2005; Gurian, 2001; Tyre, 2008; Anselmi & Law, 1998; Baron-Cohen, 2003). Smaller frontal lobes increase male propensity for impulsiveness since the frontal lobe is specialized for executive function and reasoning (Carlson, 2005; Gurian & Stevens, 2005). The biological construction of the male sensory organs makes males less sensitive to sensory inputs such as light and sound (Tyre, 2008; Gurian & Stevens, 2005). Decreased sensitivity shows that boys are less responsive to dim light and soft noises. The male hormones, specifically testosterone, promote aggressive-active, and kinesthetic life

experience (Gurian & Stevens, 2005; Buss, 1995; Anselmi & Law, 1998). Kinesthetic life experience is similarly important for boys from an evolutionary approach. Until the initiation of formal schooling, boys learned by doing (Gurian & Stevens, 2005; Anselmi & Law, 1998). Boys learned how things worked by taking items apart and fixing them, they learned spatial relations from hunting and math from working the books in their father's store.

These biologically important differences in the male brain often lead to specific “symptoms of the boy brain” (i.e. factors that directly affect their classroom behavior). Due to their propensity for spatial relations, boys are likely to be bored by words (Gurian & Stevens, 2005). Long lectures, therefore, are more likely to decrease a boy's ability to learn—specifically if the lecture is conducted at a low volume. Since boys are less sensitive to light and noise, their senses are better activated for learning if they are “on edge” (Sax, 2006). That is to say, brighter light and louder voices initiate and hold a boy's attention for longer. The lack of lateralization, which initiates increase spatial ability in males, also decreases their ability to multi-task (Gurian & Stevens, 2005). Because the corpus collosum of males is less dense, this inhibits communication between the hemispheres and increases the difficulty of multi-tasking (Anselmi & Law, 1998; Baron-Cohen, 2003). The aggressive nature of boys (compared to their female counterparts) increases their need for competition in the classroom (Gurian & Stevens, 2005; Tyre, 2008; Buss, 1995; Eagly & Wood, 1995; Bailey, 1998).

Boys struggle more than girls to keep their attention for long periods of time (Anselmi & Law, 1998; Tyre, 2008) so short-term targets in the classroom with vibrant and fast interaction are much more advantageous (Kimball, 1998; Tyre, 2008). The need

for competition can best be fostered by teachers through public praise, structure with clearly set rules and punishments, and with reinforced high expectations (Tyre, 2008; Kimball, 1998). Spatial mechanical stimulation and kinesthetic learning, however, are the most important aspects to a boy's educational success (Tyre, 2008; Gurian & Stevens, 2005). Spatial stimulation can best be achieved through the use of diagrams, pictures, objects moving through space, and the use of visual media (Tyre, 2008; Gurian & Stevens, 2005). Kinesthetically, spatial manipulation can be encouraged through hands-on activities such as scientific experiments so that boys—as evolution encourages them—can learn by doing (Gurian, 2001; Buss, 1995). In other classroom settings acting, role-play and drama can be helpful to keep boys interested, attentive, and active in the classroom (Tyre, 2008).

Biological differences in the female brain often show a mirror image of the male brain. The female brain shows increased lateralization, denser temporal and occipital lobes, a better developed left hemisphere, a larger hippocampus, and increased female hormones, specifically estrogen (Gurian & Stevens, 2005; Gurian, 2001; Anselmi & Law, 1998; Halpern & LaMay, 2000; Johnson, Carothers, & Deary 2009). Increased lateralization and a more developed left hemisphere present females with better ability in language and on language tasks (Baron-Cohen, 2003). This phenomenon may explain female's difference in comparison to males on spatial reasoning tasks. Since females use both of their hemispheres equally, their superiority at language tasks implies they are using both hemispheres for language reasoning—which conversely impacts their spatial reasoning areas (Baron-Cohen, 2003; Buss, 1995; Eagly & Wood, 1999). These biological differences in the average female brain also increase multi-tasking ability

(Tyre, 2008; Gurian & Stevens, 2005). Increased communication between each hemisphere fosters increased ability to address multiple stimuli simultaneously (Tyre, 2008; Anselmi & Law, 1998; Halpern, 1992)

Hormones are also important factors in the female ability to perform spatial and verbal/language tasks. As estrogen increases, testosterone decreases and therefore estrogen supports verbal ability (Kimball, 1998). Lack of testosterone, conversely, decreases ability on spatial tasks (Anselmi & Law, 1998; Colom, Contreae, Arned, Leal & Santacreu, 2004). Denser temporal and occipital lobes in females directly relate to sensory-input sensitivity. Females are more sensitive to light and noise, and therefore need less of such stimulus for a response (Gurian & Stevens, 2005). The hippocampus, which serves in memory storage, is more refined in females (Gurian & Stevens, 2005; Baron-Cohen, 2003). On aptitude testing, females struggle since aptitude tests often assess abstract thought rather than regurgitation of memorized facts. Males perform better at abstract thinking, and females at memorization (Gurian & Stevens, 2005; AAUW, 1999; Kimball, 1998; Chipman, Marshall, & Scott, 1991). Girls are more deliberate in their decision-making, as biologically explained through their larger frontal lobes (Gurian, 2001; Anselmi & Law, 1998). This impacts their test taking and evaluation abilities; specifically on multiple choice testing where they cannot explain their thought processes through language (AAUW, 1999; Anselmi & Law, 1998; Halpern, 1998; Colom, et. al. 2004).

In the classroom setting, increased language abilities show that lecture or seminar style classes are more advantageous for girls (Gurian, 2001; AAUW, 1999; Kimball, 1998). The ability for girls to be attentive to multiple concepts simultaneously—

specifically in language—make them best suited for class discussions where opinions and ideas are offered freely (Gurian & Stevens, 2005; AAUW, 1999). Increased sensitivity to sensory information allows for the teacher to speak quieter and in a more friendly or endearing tone (Gurian & Stevens, 2005; Baron-Cohen, 2003; Halpern & LaMay, 2000). A girl-friendly classroom is one of less comparison and more collaboration, with a warmer and more ‘fair’ teacher (Kimball, 1998). While challenge is important, challenge should be rooted in high standards rather than competition amongst peers (Kimball, 1998).

Research regarding the benefits of single sex girls schools (Sax, et. al, 2009) focuses on extraneous characteristics that do not include teacher method. These measures include: attitude (towards self and others), achievement, attributions, and activities. Research on the benefits for boys, however, includes researching teaching methods and curriculum at all-boys institutions. The International Coalition of Boys Schools published a 2009 study analyzing teacher’s most effective lessons from both the student and the teacher perspective. Subjects in this study were asked to describe a successful lesson plan, and why it was successful. Trends for success parallel those supported by other research and include: active and project centered learning, role-playing, competition, responsibility, and immediacy (Reichert & Hawley, 2009).

Due to the biological differences in the male and female brain, significant research has established that the ability to learn through certain modalities is heightened for one sex versus the other. As seen in this research presentation, for one sex to have a more refined brain region, it must be compared to the other sex which is not as developed in the same area. For this reason, it appears impossible to teach a co-ed classroom in

which each sex is being instructed equally. While single sex schools appear to be more advantageous, it is equally important to determine the extent to which teachers at single sex institutions are actually implementing advantageous practices. That is, how often do teachers using strategies best suited to the sex of the students they teach (Kimball, 1998; AAUW, 1999; Reichert & Hawley, 2009), and do such teaching methods correlate with researched sex differences?

It must be clarified, however, that research recognizes the fluidity of sex and gender (Anselmi & Law, 1998). This research is rooted in the dichotomous relationship between male and female, yet recognizes that these assumptions are generalities. Colum, et. al., 2004) note that as estrogen increases, testosterone decreases, yet all human individuals have some level of both. Therefore the statement that testosterone increases visuo-spatial activity (Buss, 1995; Gurian & Stevens, 2005; Gurian, 2001; Tyre, 2008; Anselmi & Law, 1998; Baron-Cohen, 2003) can itself create a fluidity, as females have varying levels of testosterone and estrogen in their system. As Kimura (1992) found, these varying levels can alter an individual's ability at such tasks within the isolation of the menstrual cycle. While this research is rooted in the between groups differences that serve to create the dichotomy between male and female, it must be recognized that within groups variation does exist, These statements are generalities conveying a "male" and "female" yet there is significant variation within each of these categories.

Method

Participants

A survey of 42 questions was administered electronically to full-time instructors at one all-boy's and two all-girls boarding high schools. All three schools are located in

rural western Connecticut with an average enrollment of 300 students, with full time teaching faculty between 45 and 57. A total of 152 full time teachers received the survey, with 56 (35%) responding. Of those who responded to the survey, 28 came from the all boys school and 28 came from the all girls schools. Thirty-one respondents were male and 25 were female with an average of 6-10 years teaching experience. Teacher certification is not required in private institutions, and only 13 respondents possessed certification, although 34 respondents had received a master's degree or higher.

Procedure

Schools were contacted via email message and phone call to the headmaster/mistress to solicit the school's participation in the research study. Of the six schools contacted, three responded positively to the request. A survey was then administered electronically through an online survey program, which participants accessed through a link embedded in the email solicitation. Faculty members at each institution were given one month to complete the survey before the online site closed and information was collected.

Design

The survey contained demographic analysis questions as well as self-report inquiries regarding teaching methods. Instructors were asked about their knowledge of cognitive differences, their frequency of exposure to such information, and their mode of exposure. Additionally, teachers were asked to report how often (if at all) they utilized various tactics of instruction. A total of 17 factors were tested: volume of voice during instruction, use of visual aids, use of media, language and lecture, use of handouts and lesson reiteration, kinetic learning, experiential learning, use of guiding questions,

following strict outlines for class, collaboration, one-on-one instruction, peer instruction, use of multiple stimuli at once, peer grading and competition, use of formality, association with the 'real world,' and value of rote memorization. Each measure was scaled on a 1-5 point Likert Scale, 1 being often (almost daily), 3 being sometimes (a few times a month) and 5 being never. Open-ended comment spaces were allotted at the end of the survey for instructors to expand on their method techniques outside of the 17 concrete measures.

The first measure, volume of voice during instruction, was based off of literature regarding sense sensitivity (Tyre, 2008; Gurian & Stevens, 2005). This measure asked instructors how often they found themselves speaking at a volume louder than a conversational volume during instruction in order to "establish and maintain attention." A second question asked instructors how often they found themselves speaking at or below a conversational level in order to maintain comfort in the classroom.

The second measure, use of visual aids, asked teachers to rank how often they used visual aids such as graphs, diagrams, and writing on the chalkboard so students could also see what they were saying. This measure was designed to analyze instructor sensitivity to male visuo-spatial affinity (Buss, 1995; Gurian & Stevens, 2005; Gurian, 2001; Tyre, 2008; Anselmi & Law, 1998; Baron-Cohen, 2003). Measure three was structured to analyze teacher methods in media use such a television and computer games, a feature often cited as another source of spatial stimulation (Tyre, 2008; Gurian & Stevens, 2005).

The fourth and fifth measures were directed more toward literature about educating girls. The fourth measured how much of the course was language and verbal

comprehension based, and the fifth asked how often teachers implemented the use of handouts or outlines for the class as a way to display the lesson in a written form. Both measures were influenced by the research stating that females thrive in language tasks, most often seen through class discussions where thoughts and ideas are shared freely and reading comprehension (Gurian, 2001; AAUW, 1999; Kimball, 1998).

Measures 6 and 7 emphasized movement and activity, inquiring about kinetic learning where students are moving physically as they learn, and experiential learning where students role play or experience the lesson actively. These two measures were influenced by research regarding the boy propensity to learn by doing (Gurian, 2001; Buss, 1995; Tyre, 2008; Gurian & Stevens, 2005). The following measure was designed, similarly to measures 4 and 5, and based on the same research, in order to once again ask about language in the classroom. Measure 8 asked about the use of guiding questions to get the students talking but then allowing them to direct class (to Socratic method). Measure 9 asked teachers to what extent they follow a strict outline for class activities, simply designed to inquire about class structure in which both sexes thrive in informality—however a different form in each case (see pgs. 5, 7).

Measure 10 asked teachers about their use of collaboration and small group work in the classroom, based on the female emphasis on collaboration over competition (Kimball, 1998). The one on one instruction in Measure 11 asked teachers to analyze how often they used whatever format necessary to allot them the most individualized time with students, allowing for collaboration between the teacher and the student. The following measure increased the amount of collaboration being analyzed, and asked how often students were in charge of teaching class.

The female ability to multi-task (Tyre, 2008; Anselmi & Law, 1998; Halpern, 1992) and address multiple stimuli simultaneously were analyzed in Measure 13, which asked teachers how often they incorporated simultaneous use of multiple stimuli during lessons. Analysis of competition (Tyre, 2008; Kimball, 1998) was incorporated into Measure 14, and asked teachers how often the students grade each other or participate in a competition to see which individual or group is 'the best.' Measure 15, the informality measure, asked teachers how formal their classroom was, including how often students call them by a first name or a nickname, a measure pertaining to the boys necessity for a relaxed environment that maintains high expectation (Tyre, 2008; Kimball, 1998).

The final measures, 16 and 17, addressed relation to the real world and values of rote memorization. The real world measure asked to what extent teachers use associations with real life application to teach their students. The last measure (17) asked teachers how often their main form of analysis relies on rote memorization and repetition, a measure designed to understand the female struggle (in relation to boys) with multiple choice in which they cannot explain their thought process.

Analysis

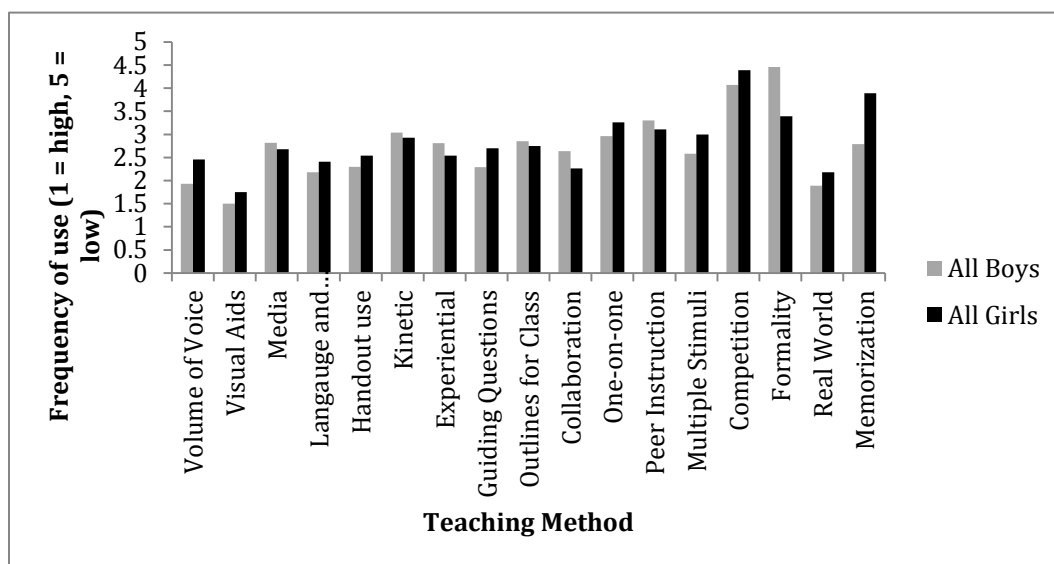
Responses were analyzed via *PASW Statistics 18* statistical analysis software using t-test comparisons of means. Each of the 17 teaching mode factors was analyzed against the sex of the students receiving the instruction. It was predicted that there would be a statistically significant difference between the teaching methods at each institution, taking into account the different learning styles of each sex based on cognitive differences.

Results

Of the 17 teaching method factors tested, two were found to be significant. The formality measure, of which teachers were asked the frequency of students calling them by a nickname or a first name was significant where $t(54) = 2.568$, $p = .013$. The memorization measure, relating the frequency to which students are asked to memorize, rehearse, and repeat information on exams was significant where $t(54) = -3.506$, $p = .001$. While these two correlations were significant, they were significant in the opposite direction expected. The formality measure was predicted to have more frequency in boy's schools, and the memorization measure was predicted to have more frequency in girl's schools; the result was the converse of each prediction. Volume of voice ($t(58) = -1.858$, $p = .06$) presented a trend toward significance in the direction predicted, but did not reach the assigned value of significance (.05).

The hypothesis, therefore, was refuted on two levels. A majority of the comparative measures were not found to be statistically significant, showing little to no difference in the teaching styles at each institution. Similarly, the significance that was found in the opposite direction predicted. It can be concluded that at these single sex high schools, teaching styles are not influenced by the sex of the learners.

Figure 1 shows the frequency means for each teaching method analyzed. The significance of the "formality" and "memorization" factors can be noted, as well as the lack of differential in all other measures.

Figure 1: *Frequency of Teaching Method*

Discussion

The hypothesis was not supported on any of the 17 measures taken, with 15 non-significant results and two significant results in opposition to the predicted correlation. Although the numbers were not statistically significant, trends in self-description match the correlation that was expected. Teachers at all boys' schools, however, assessed their teaching methods in ways that paralleled the research. Teachers described their style as dynamic, always changing, fast moving, unpredictable, active, and high energy, which matches previous research which recommends that boys be taught with vibrant and fast interaction (Kimball, 1998; Tyre, 2008). Reinforced high expectations with clearly set rules and punishments (Tyre, 2008; Kimball, 1998) are seen in teacher comments where class is "fun while maintaining respect," "unpredictable but the boys know what's expected of them," "friendly but authoritative," and "creative yet students know expectations." The need for competition (Gurian & Stevens, 2005; Eagly & Wood, 1995) as boys learn was also noted by many teachers in explaining a guidance and critique

approach in which they describe themselves guiding students to an answer, yet critiquing them slightly in order to draw more out of the student. Experience and learning by doing (Buss, 1995; Anselmi & Law, 1998) was frequently cited by teachers in describing their learning style, as was relation to life experience (specifically sports and other common interests). While the specific measures did not produce responses strong enough for significance to be found, teachers do appear—to an extent—to be embodying methods that relate to research in cognitive differences.

Also following the expected correlation, teachers at all girl's schools stated their methods paralleled those recommended by research. Superiority at language reasoning (Baron-Cohen, 2003; Buss, 1995; Eagly & Wood, 1999) is supported in teacher reports of using the Socratic method, which requires substantial language use and analysis. The advantage of seminar style classrooms for girls (Guardian, 2001; AAUW, 1999) is similarly supported in teacher comments on the importance of group discussion, and methods that are teacher guided but student centered. The importance of the teacher being friendly and endearing in tone, rather than demanding (Halpern & LaMay, 2000; Baron Cohen, 2003) is supported by teachers describing their methods as “gentle,” “patient,” “encouraging,” and “warm.” Kimball (1998) recognized that a girl-friendly classroom was one of more collaboration, as seen in teacher comments of working together with an emphasis on small group work. While teachers at the all-girls school did mention high energy and high expectation, such were mentioned more in relation to “sensitivity to each learning style and inspiration” rather than the competition seen in comments from teachers at all-boy's schools.

The disparity between the responses on closed versus open-ended questions is an interesting element of this research. While 60% of teacher comments from all-girl's schools mentioned small group and student-teacher discussion, the mean frequency reported for each of those measures was 2.70 and 2.26, equating to "frequently (once a week)" and "sometimes (once a month)," with only 2 responders responding that such tactics were used "often (daily)." Similar differentials in report and explanation were found from teachers at the all-boy's school. It is interesting when asked to quantify such teaching methods that teachers appear to underestimate each method's level of use but are willing to exaggerate a method's use in their comments.

The cause for such an opposing report from the statistical and qualitative analyses is recommended for further research. Possible explanations for such disparity are clarity of measures, sample size, and school demographic. The Reichert & Hawley (2009) study (2009) focused exclusively on open-ended qualitative questions of description of lessons. This study found research similar to that expressed in the comment sections presented: active learning with little Socratic question and answer, and a classroom that stresses an adrenaline rush of competition and dynamism. The attempt of this current study to ask quantifiable questions appears to have limited teacher willingness to accurately report methodologies.

The similarity between this study's qualitative results and the Reichert & Hawley's (2009) qualitative results show that there are specific methods which work in boy's classrooms, regardless of the insignificant quantitative results in this study. This difference may be explained when observed by Reichert & Hawley (2009) that instructor's who had a tendency to state their teaching method as having a "traditional"

nature, still presented an imaginative or non-traditional example when describing their practices. The Reichert & Hawley (2009) study, therefore also observed a disparity within self-reports on methodologies. The reinforcement of this finding in this subsequent research offers the recommendation that analyses of teaching methods lie outside self-reporting. As with this current study, it is unclear which mode of self-report is more accurate.

The small sample size of this research may have influenced the statistical significance of the data. With 56 respondents and only 28 from each sex school, the sample size is small enough that had responses been larger, values may have become significant or begun to approach significance. An additional factor approaching significance and providing support for this hypothesis was volume of voice ($t(58) = 1.858, p = .06$), which presented a trend in the direction predicted. However, the size of the study may not have impacted the results as drastically as anticipated. The Reichert & Hawley (2009) study of 18 schools in 6 countries had a much larger sample size, and predicts in its conclusion that the lesson plans and methods described by teachers working with boys have an inherently for-boys feel and pedagogy, giving them a decidedly male appeal. However, this is an assumption. Coupled with a lack of analysis of an all-girl education, while these methods may work with boys their success may be just as possible with girls, which is an assumption supported by these study results. Therefore, since the Reichert & Hawley (2009) study does not consider girls, sample size cannot be argued as a refutation of these results. These results considered teaching methods at girl's schools as well, while their study did not.

In each case of analysis (for both boys and girls schools) the only schools reviewed were boarding schools. Each school has an average tuition of \$45,000, with between 10% and 20% of the student body identifying as a student of color. Therefore, a majority of instruction was targeted towards students that do not experience roadblocks to their education such as race, ethnicity, or socio-economic status. Due to these school's exemptions from No Child Left Behind (2001) sanctioned standardized testing, it is difficult to compare these schools on achievement factors. Due to lack of achievement comparisons and little student risk, differences in education of boys and girls may be more dramatic in schools implementing the 2006 regulations from the US Department of Education that legalize single sex classrooms in public schools. Further research is recommended to determine if single sex schooling needs are correlated with socio-economic needs. That is to say, does the single sex environment more greatly benefit lower socio-economic status students?

Although 33 of the respondents had participated in seminars delineating the cognitive differences between the sexes, and 29 participated per the request of their institution, this knowledge appears to have not influenced teaching method. Teachers did, however, present a significant amount of familiarity and frequency of having read such information when published in common periodicals. Respondents mentioned that distribution of such findings in memo format was most effective. There was no significant difference between teaching method frequency and exposure to cognitive differences and/or the means of such exposure. Similarly, no trends were identified.

A correlation between the gender of the teacher can also not be created, as not all boy's school instructors were male, and not all girls school instructors were female. With

31 male respondents, and 25 female respondents, no significant correlation was made between teaching styles of males versus females at each respective institution.

A majority (73%) of respondents had previously taught at a school different than their current institution, and of those, 82% previously taught in a co-educational setting. Due to this high percentage of experience outside of single sex schooling, current teaching methods reported may have been influenced by previous experiences.

While the disparity between the closed and open ended results in the survey provide for an inability to fully conclude this research question, the possibility exists that cognitive differences are not as important as popular culture and researchers have believed. As aforementioned, success levels were not measured in this research. These researched schools, however, are continually producing successful students even though initial survey results show no significant differences between instructional styles. Such an assumption is, as previously stated, recommended for further analysis regarding teaching styles and success rates in single sex environments.

The single sex classroom has proven to be beneficial in many different areas (Sax, et. al, 2009; Reichert & Hawley, 2009). An abundance of research exists in the realm of single sex schooling, and significance in the differences between coeducational and single sex schoolings has been found to be important in many factors, including self-esteem. This factor, along with achievement, career goals, and attitude shows significant trends in the benefits of single sex schooling. Although teaching styles targeted toward the cognitive differences between the sexes, based on this research, does not seem to be a factor in single sex schooling, other factors such as those listed above may be the foundation of single sex school success. Therefore, cognitive differences may not be as

important in education as other factors such as race, socio-economic status, and type of classroom setting (co-ed/single-sex).

The quantitative data of this study showed little to no significance between the all-boys and all-girl's school, yet the qualitative results demonstrated a trend in the predicted direction. Due to these conflicting results, trends can be identified that support teaching methods conducive to cognitive differences in sex, yet no significant conclusions can be made about the significance of teaching method within the single sex education classroom.

Conclusion

This research was designed to investigate the correlation between teaching methods at single sex high schools and the biological differences in the brain between each sex. If boys learn better through activity, are teachers stressing such activity in the classroom? If girls learn better through collaboration, are teachers fostering small group discussion? The results of teacher's surveys at 3 single sex high schools found that there was no significant difference in teaching methods at all-boys and all-girls schools. This conclusion may be due to: high socio-economic status, the inaccuracy of self-report, sample size, and previous experience at co-educational institutions. Lack of significance, however, was not influenced by: familiarity with research on the subject, or gender of the teacher. Further research includes a comparison with lower socio-economic statuses to gauge significance. However, a possibility exists that teaching method and sex differences are not nearly as important as perceived. Similarly, single sex education may be succeeding not because of teaching methods but because of other factors of benefit.

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Acknowledgements:

I would like to thank everyone in the Fall 2010 Educational Studies Seminar. I would also like to thank David Reuman for his assistance in citing my paper. Similarly, Barbara Chapman and Rachael Barlow were also very helpful in research analysis. I would like to extend thanks to the three schools that allowed me to conduct research on their faculty. My advisors: Jack, Kathleen Elliot, and Dina Anselmi.

Appendix A: Sample Letter of School Solicitation

Dear Headmaster,

I am in my senior year at Trinity College (Hartford, CT) and have just begun the process of writing a thesis for my Educational Studies and Psychology double major. As my thesis project, I am looking to research the teaching styles used in the classrooms of single-sex high schools. This subject has been fascinating to me ever since my own experience at an all-girls school at home in Ohio. Significant research has been published on the different learning styles of boys and girls, and I am interested in analyzing whether and how such research is being implemented into practice. I have chosen Salisbury School as one of my subject schools due to your school's renowned ability to develop men through a traditionally rigorous and community-oriented education.

I have designed a survey with the purpose of determining teacher's practices by inquiring about daily lessons, classroom practices, and the classroom environment. In order to aide in my thesis research, I would like to ask for the Salisbury School's faculty to participate in my survey. The survey is an electronic questionnaire able to be distributed through email and designed to take no more than 5-10 minutes to complete.

Please let me know if you would be willing to have your faculty participate in my research. If you have any questions about my research, my methods, or the survey itself, please contact me at my school address, through email (sarah.keller@trincoll.edu), or by telephone (419-356-1023). You can also contact my professor and advisor for this project, Professor Katie Elliott (Kathleen.elliott@trincoll.edu; 860-297-5202). I look forward to hearing from you soon. Thank you very much!

Sincerely,

Sarah Keller

Appendix B:

Accessible at: <http://www.surveymonkey.com/s/9NBTBKQ>

- What is your age?
 - A. 22-30
 - B. 31-40
 - C. 41-50
 - D. 51-60
 - E. 61 and over
- Are you Male or Female?
 - A. Male
 - B. Female
- How long have you taught at this institution?
 - A. 1 year
 - B. 2-5 years
 - C. 6-10 years
 - D. 11-15 years
 - E. 16-25 years
 - F. 25 or more
- Which best describes the school at which you currently teach?
 - A. Co-ed
 - B. All Girls
 - C. All Boys
- Have you ever taught at another institution (s)?
 - A. Yes
 - B. No
- If yes, what best describes your previous institution?
 - A. Co-ed
 - B. All Girls
 - C. All Boys
- Are you teacher certified?
 - A. Yes
 - B. No
- What is your highest degree?
 - A. Bachelors
 - B. Masters
 - C. Doctorate/Advanced Degree
- In what discipline?

- What subject(s) do you teach?

- Have you ever participated in a seminar/instructional program specifically targeting learning practices in each gender?
 - A. Yes
 - B. No
- If so, which best describes your reason for participating:
 - A. Required and conducted on the school campus
 - B. Required and conducted off campus
 - C. Recommended by institution
 - D. Voluntary due to general interest/curiosity

- How many seminars have you participated in?
 - A. 1-2
 - B. 3-5
 - C. 6-10
 - D. More than 10
- Have you read articles or reports published on the different learning styles of students (boys and girls)?
 - A. Yes
 - B. No
- If so, with what level of frequency?
 - A. As soon as new publication is released
 - B. If the report is published in common periodicals (Ex: New York Times, Time Magazine)
 - C. Other _____
- Which statement best describes your DAILY classroom setting:
 - A. Small group discussion arrangement
 - B. Round table seminar discussion
 - C. Lecture-styleComments: _____
- Which statement best describes your classroom environment:
 - A. Dim lighting and slightly cooler
 - B. Dim lighting and room temperature or warm
 - C. Bright lighting and slightly cool
 - D. Bright lighting and room temperature or warmComments: _____
- Which statement best describes your DAILY mode of instruction:
 - A. Lecture style instruction
 - B. Lecture while leaving chances for class participation and tangential discussion
 - C. Class-wide and teacher facilitated group discussion
 - D. Class or student lead instruction/discussion
 - E. Small group discussion
 - F. Individualized exploration of specific subjectComments: _____
- How do you interact with students outside of the classroom?
 - A. I do not interact with students unless I have to
 - B. During my office hours
 - C. In the dining hall and when regulated by the administration
 - D. As a coach of an athletic team
 - E. As a dorm parent
 - F. Answers B-E all apply
- With which level of frequency do you see yourself use each of these teaching styles or methods:
Often (almost daily), frequently (at least once a week), Sometimes (a few times a month), rarely (once or twice a term), Never
 - A. Speaking slightly louder than a conversational voice to keep and to maintain attention
 - B. Speaking quietly or softer to increase students comfort in the classroom
 - C. Visual learning (writing on the chalkboard/whiteboard) so that students can also see what I am saying.

- D. Watching movies and other forms of media so that the lesson can be conceptualized visually
 - E. Language based learning emphasizing student's ability to listen and comprehend the lesson
 - F. Concrete lesson reiteration through handouts or outlines of the notes for class/lecture
 - G. Kinetic learning (students are moving physically as they learn the lesson or to better demonstrate the lesson)
 - H. Experience (students act out or role play, students solve problems on the board, etc)
 - I. Providing students with guiding questions to spur discussion and then letting them direct the class
 - J. Following strict outlines for the class, making sure all information is covered (usually done lecture style to avoid interruptions)
 - K. Short lessons and lots of individualized or small group work to accompany lessons
 - L. Any form of instruction that allows me to best give students one-on-one attention
 - M. Having students teach each other
 - N. Incorporation of as many sensory inputs as possible and appropriate through multiple stimulation (For example: writing on board while lecturing and drawing visual representations of the lesson)
 - O. I allow students to grade each other on their work (based on peer reviews of papers or class presentations) to allow for competitive classroom environments
 - P. Students address me by my first name or a nickname to further develop comfort and understanding
 - Q. I do everything I can to connect the lesson with the students lives and the 'real world'
 - R. I teach my students so that they can easily memorize the information and repeat it to me on a test.
- In your own words, how would you describe your teaching style?

 - Are there any specific teaching styles or methods required by your institution?
 - A. Yes
 - B. No
 - If yes, what are they?
