Summer 2005

Gender Differences in Student Learning: A Review of the Literature from the Neuroscience and Psychology Perspectives

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ABSTRACT

GENDER DIFFERENCES IN STUDENT LEARNING:

A REVIEW OF THE LITERATURE FROM THE

NEUROSCIENCE AND PSYCHOLOGY

PERSPECTIVES

by

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May 2005

Literature from the fields of psychology and neuroscience were examined to establish what scientifically based information was available regarding gender differences. Myths of the past, psychological and neuroscientific perspectives, gender specific differences for students with genetic and metabolic-based exceptionalities, gender specific changes in behavior through maturation, and the educational implications for gender differences were included. The results indicated that children show developmental differences in expression of emotion, metacognition, and cognition, and the developmental differences are influenced by gender. The implications for educational practices are that curriculum, instruction, and assessment can be aligned to meet the unique need of both male and female students.

ACKNOWLEDGEMENTS

In appreciation for their contribution to this academic endeavor I would like to extend my thanks to my committee, Dr. Prigge, Dr. Curran, and Dr. Schmitz. Without the patience, advice, and encouragement of Dr. Prigge this project would have been far more difficult to complete, therefore a special thank you is extended to her.

I would also like to extend my thanks to my entire family, who has been kind and patient when I whined and complained. The special encouragement from both Melissa and Bryan, my two wonderfully talented children, has been instrumental in keeping me motivated throughout this process.

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CHAPTER I

BACKGROUND OF THE STUDY

Introduction

The literature gathered provided dissenting theories from the perspective of those in the fields of neuroscience and psychology. One thing is quite apparent: theories are changing with further research. The suggestions for the causes of gender differences have changed dramatically within the last 10 years, and will probably change significantly again in the next 10 years. This is most likely due to society's changing views regarding gender roles, the reduction of stereotyping, and advances in noninvasive brain research. The goal of this body of work was to compare and contrast the literature in the fields of psychology and neuroscience to find commonality and differences pertaining to gender differences in learning. It seems that the most logical and realistic approach may come from the realization that both social constraints of our time and biological brain development play a role in gender differences.

Once the applicable literature is gathered and compared, a practical application for teachers would be appropriate. The practical application of knowledge regarding gender differences could be used to develop curriculum and assessment that perhaps does not entirely eliminate gender bias, but could ultimately contribute to leveling the playing field for boys and girls alike. At times, instruction and assessment may favor learning styles and development of boys, whereas other times it

may favor girls. Balanced curriculum and assessment weighing the attributes and innate learning characteristics of each gender will assist teachers in addressing the educational needs of both.

Some students require different specialized instruction and support than that offered in typical educational experiences. Children with exceptionalities often have unique needs that accompany their disability. Therefore, it is also necessary to examine the gender typical relationship of sample disabilities in regard to learning and development along with how these disabilities manifest themselves in girls versus boys. Researchers have investigated genetic- and metabolic-caused disabilities due to the unique characteristics of the genders. Obrzut and Hynd (1991) found that children with disabilities exhibited problems that can be accentuated by their disability, but often also exhibit strengths and weaknesses that remain gender typical. Other researchers have noted that neurological and psychological differences of genetically or metabolically based exceptionalities are not typical and, therefore, needed to be addressed individually because of a student's unique individual needs (Swanson, Harris, & Graham, 2003).

Whether the teacher is educating the typically developing child or a child with special educational needs, a better awareness of prevailing cultural myths, psychological differences, and neurological differences between the sexes can be enlightening. It would make sense that an enlightened teacher would also be an aware teacher who is able to

provide an appropriate education for all students by utilizing relevant strategies.

Statement of the Problem

The focus of this analysis of current literature regarding gender differences is to couple instruction and assessment strategies for general education and special education classrooms with the prevailing literature on developmental gender differences. In turn, this information may assist teachers in creating a more gender-friendly environment for students. Many researchers have looked into the differences in brain development of girls and boys (e.g., Byrnes, 2001; Demetriou, 2000; Luders et al., 2003). Researchers have also examined environmental factors and gender differences (e.g., Demetriou; Gurian, 2001). Many times the results of such studies have produced conflicting opinions. Therefore, it seems most expedient that the data on gender differences should encompass the work from the fields of both neuroscience and psychology. To reduce it to one or the other would only provide half the picture. Whether the origins of gender differences are environmental, genetic, or hormonal, the literature seems to indicate that development of boys and girls can vary as they grow. It would have value for educators to understand the differences in the genders in order to address their changing educational needs in the most effective way.

Purpose of the Study

The purpose of this study was to compile a selected sampling of the current literature regarding gender differences to ascertain what the frequently seen differences are, the changes that develop with maturation, and their neurological and psychological origin. Through specification of gender-based differences, best practices may be used to address the needs of each group in terms of instruction, curriculum, and assessment for the optimal benefit of both boys and girls.

Significance of the Study

The awareness of developmental differences of boys and girls, whether it be nature or nurture, can be useful within the classroom. When gender bias could potentially deny a child an appropriate education, it has value to delineate best practices, as revealed in the literature, to bring gender differences to the forefront to improve the design of instruction, curriculum, and assessment. Significant differences in learning styles can often be seen in the classroom for both typically developing students and those with exceptionalities, and with the appropriate curriculum, instruction, and assessment, students of both genders will have increased opportunities to reach their potential.

Limitations of the Study

Over the years gender stereotypes have changed significantly (Huebner & Betts, 2002). In history, the role of males was that of hunters, which later developed into primary breadwinners. On the other hand,

female roles were that of gatherers and later homemakers exclusively (Huebner & Betts). As time passed, the roles of each gender became less rigidly defined. The literature base on gender differences has evolved and changed and will most likely continue to do so as neuroscientific methods advance and psychological perspectives change.

This review of the literature is a compilation of selected published work within the last 10 years, and therefore not all perspectives are represented in the findings used to develop this thesis.

Definition of Terms

Adrenal Androgens: Male hormones produced in the adrenal glands (Phelps, 1998).

Attention-Deficit Hyperactivity Disorder: "Disability (probably biological in origin) characterized by inattention and/or hyperactivity and impulsive behavior" (McDevitt & Ormrod, 2002, p. G-1).

Choreoathetosis: Involuntary rapid jerky movements (Phelps).

Cognition: "The various mental activities in which a person engages" (McDevitt & Ormrod, 2002, p. G-1).

Comorbidity: "Existing simultaneously with and usually independently or another medical condition" (Mish, 2004, p. 252).

Dimorphic: "Occurring in two distinct forms" (Mish, 2004, p. 351).

Dyslexia: "Inability to master basic reading skills in a developmentally typical time frame" (McDevitt & Ormrod, 2002, p. G-2).

Dysrhythmic: Extraordinary difficulty acquiring rhythmic motion (McDevitt & Ormrod, 2002).

Endogenous Hormones: Hormones produced within the body having an effect on another part of the body (Fitch & Denenberg, 1998).

Electrophysiological: "The electrical phenomena associated with a physiological process (as the function of a body or bodily part)" (Mish, 2004, p. 402).

Etiology: The study of the cause or causes of a particular developmental condition (Owen-Blakemore, 1998).

Executive Function: The areas of the brain that focuses on the dissemination of information, focusing and switching attention, and activating representations from long-term memory (Swanson et al., 2003).

Language Lateralization: The degree to which the left or the right hemisphere of the brain is simulated to process language, where one side is used more than the other (Burkett, 2001).

Learning Disability: "Significant deficit in one or more cognitive processes, to the point where special educational services are required" (McDevitt & Ormrod, 2002, p. G-3).

Lexical Skills: The ability to use words one knows in a particular language (McDevitt & Ormrod, 2002).

Metabolic: "Of, relating to, or based on metabolism" (Mish, 2004, p. 779).

Metabolism: "The sum of the processes in the buildup and destruction of protoplasm; *specif* : the chemical changes in living cells by which energy is provided for vital processes and activities and new material is assimilated" (Mish, 2004, p. 779).

Metacognition: "Knowledge and beliefs about one's own cognitive processes, as well as efforts to regulate those cognitive processes to maximize learning and memory" (McDevitt & Ormrod, 2002, p. G-4).

Neural Constructivism: "Features of the brain are constructed from the dynamic interaction between neural growth mechanisms and environmentally derived neural activity" (Demetriou, 2000, p. 781).

Neuropsychological: The integration of psychological observations on behavior and neurological examination of the brain and nervous system (Rucklidge & Tannock, 2002).

Neuroscience: "The science concerned with the workings of the nervous system" (Byrnes, 2001, p. 191).

Nonverbal Learning Disorder: A learning disorder that is not primarily language based including: "1) problems with spatial organization, 2) problems with paying attention to visual detail, 3) procedural errors in mathematics, 4) failure to shift psychological set (i.e., when two or more operations of one kind [e.g., addition] are followed by an operation of another kind [e.g., subtraction]), 5) graphomotor weaknesses, 6) poor factual memory, and 7) poor judgment and reasoning" (Mather & Goldstein, 2001, p. 32).

Quantitative Skills: Mathematical ability (Campbell & Storo, 1995).

Perseveration: "Continuation of something (as repetition of a word) usually to an exceptional degree or beyond a desired point" (Mish, 2004, p. 924).

Phonological Awareness: "Ability to hear the distinct sounds within words (McDevitt & Ormrod, 2002, p. G-4).

Psychotropic: Having an effect on the mind, such medications like Ritalin (Byrnes, 2001).

Reductionism: "1. The attempt to explain all biological processes by the same explanations (as by physical laws) that biologist and physicists use to interpret inanimate matter. 2. A procedure or theory that reduces complex data or phenomena to simple terms; oversimplification" (Mish, 2004, p. 1044).

Semantic Clustering: The grouping of meanings of words and word combinations (McDevitt & Ormrod, 2002).

CHAPTER II

REVIEW OF LITERATURE

Introduction

The focus of the review of the literature was an analysis of gender differences in learning from the perspectives of the fields of neuroscience and psychology, with an emphasis on growth and development of school age children. A closer examination of behavior changes of adolescent girls, behavior and gender differences of students with disabilities, and instructional strategies most effective for girls opposed to boys was included as well. When reviewing the literature it was necessary to consider social changes over the last decade along with scientific advancements made in neurological research. The literature was organized to address: myths, the view from the perspective of psychology, psychological effects of gender differences in the classroom, observed changes in behavior of girls and boys during their adolescence, the view from the neuroscientist perspective, technology used for research advancements, anatomy of the brain, development of the brain and learning, gender specific hormones, genetic and metabolic based disabilities, behavioral gender differences, and the significance of gender differences regarding instructional strategies.

Myths

The Office of Education Research and Improvement, with contributions from the U.S. Department of Education, published the

Findings of Campbell and Storo (1995) regarding long-standing myths and stereotypes on gender differences in education. These authors suggested that assumptions that boys performed better in mathematics or athletics just because they were boys were misleading. Additionally, they reported that sex was not a good predictor of academic skills. For example, the relationship between birth and death has a perfect 1 to 1 relationship, in that if you are born it is certain that you will die. On the other hand, gender was not found to be a good predictor for quantitative skills, verbal skills, or aggression (Campbell & Storo).

As Campbell and Storo (1995) have shown in Figure 1 the relationship between high school grade point averages (GPA) and College GPAs.

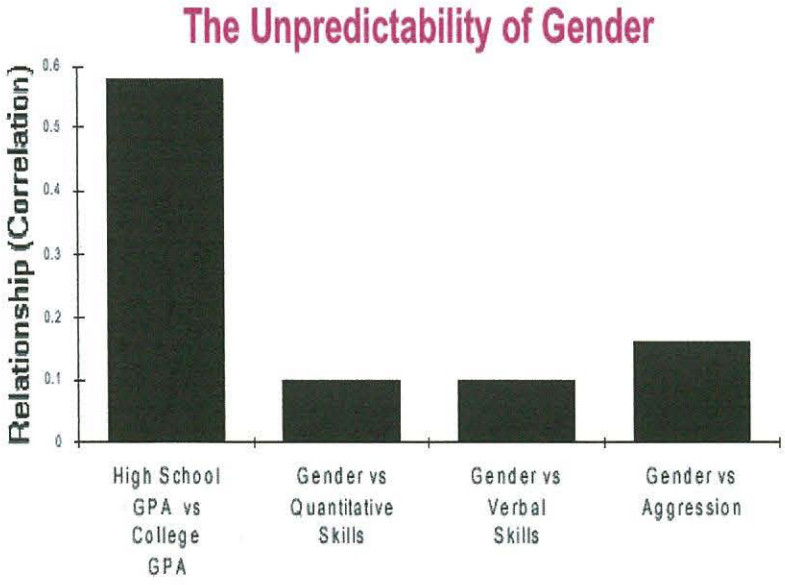

Figure 1. The unpredictability of gender.

A six-tenths of a percent, within the parameters of a 0 to 1 relationship, would be considered relatively high, therefore there would be a strong correlation between high school and college GPAs. To the contrary, the comparison of quantitative skills, verbal skills, or aggression versus gender were low enough to be insignificant when considering whether a student performed well in these areas or not (Campbell & Storo, 1995). According to Campbell and Storo, distinction would need to be made between the following myths and realities:

1. Myth: "Real" girls don't do math.

   Results: High school girls think of math as a "male thing" and equally talented girls were less likely to enter math-related careers.

2. Myth: There is a biological basis, math genes, for gender differences in mathematics.

   Results: Parents and educators lower their expectations for girls in math and science.

3. Myth: Girls learn better from female teachers and role models must always be of the same sex as the student.

   Results: Female teachers may feel that just being a woman is enough to encourage girls to do well and male teachers may feel that it is impossible to reach girls students, so neither teacher tries to educate girls to the same level as boys.

The myths regarding the expected level of achievement between boys and girls lacked validity in the Campbell and Storo (1995) study. Boys and girls seemed to have the potential to achieve academically to the same degree; however, that did not seem to indicate that there were no differences regarding societal expectations or differences in brain development. With the information available, knowledge of gender differences should help educators address inequities based on gender bias, society's attitude toward girls and boys expected behavior, differences in learning styles, and differences in brain development (Byrnes, 2001; Campbell & Storo; Rogers, 2001). In the case of nature versus nurture, or psychologists versus neuroscientists' views, the question may be raised as to which came first and what impact did each have on each other? The answer to this question interweaves psychology and neuroscience. The first perspective investigated was the view of the psychologists, then the perspective of neuroscientists. There were overlapping views and issues that both sciences addressed.

Psychological View of Gender Differences

Psychologists have observed that children show developmental differences in expression of emotion, metacognition, and cognition, and to some degree, their developments were influenced by their group membership, namely gender (Byrnes, 2001). Further, it has also been observed that male and female infants tended to have similar temperaments, and any gender differences were subtle and situation-

dependent (Eisenberg, Martin, & Fabes, as cited in McDevitt & Ormrod, 2002). At the age of 2, consistent gender differences began to appear. Girls responded more negatively to their failures, and report feeling of sadness, fear, or guilt beginning in the early elementary grades. Boys, on the other hand, showed more anger and tended to hide their true feeling, even from themselves (Sadker & Sadker, as cited in McDevitt & Ormrod). Biological maturation through puberty could have been the source of some gender differences in emotions, for instance, aggression and rebellion in boys and moodiness and depression in girls (Muchanan, Eccles, & Becker; Susman, as cited in McDevitt & Ormrod). Other theories have suggested that differences in socialization caused more significant gender differences in emotional responses. For example, parents were more likely to discourage overt anger in daughters than in sons. Parents were also likely to discourage the expression of emotions in their sons, and to encourage the expression of feeling in their daughters (Eisenberg, as cited in McDevitt & Ormrod). At school, teachers may prefer the passive, compliant nature that girls are more likely to exhibit, which could put boys at a disadvantage (Pollack, as cited in McDevitt & Ormrod). The reverse was also reported, in that, boys got more attention due to their overt behaviors and girls were forgotten (Gurian & Ballew, 2003).

Researchers and theorists noted that boys and girls negotiate different developmental avenues as they mature. Cosse (as cited in Huebner & Betts, 2002) suggested that girls placed a strong emphasis on

relationships with others, whereas boys focused more on autonomy and development of skills. Additional support of other researchers concluded that women tended to emphasize care and concern for interpersonal relationships, empathy, and understanding of emotional needs, whereas men tend to focus more on individuality, rationality, separation, impersonality, fairness, and rules (Chodorow, Gilligan, Gilligan & Attanucci, Stimpson, Neff, & Jensen, as cited in Huebner & Betts). This research produced some evidence that, during adolescence, pressure to behave in more stereotypically male or female ways did actually increase (Crouter, Manke, & McHale, Huston & Alvarez, as cited in Huebner & Betts), which resulted in a disparateness between academic achievement of boys and girls. This made adolescent years a salient time to examine gender differences.

Researchers also noted the discrepancies in factors related to academic achievement between boys and girls. Several concluded that girls had been socialized to believe that achievement for them was due to hard work and not innate ability; boys, on the other hand, attributed their successes to intelligence (Huebner & Betts, 2002). Girls had a greater fear of success than boys, and girls may have intentionally gotten lower grades than boys in school, because being intelligent was not considered feminine (Sadker & Sadker, as cited in Huebner & Betts). Even though there were no documented differences in ability, girls were less likely than boys to pursue and remain in advanced courses in math and science

(Stampt & Stanley, as cited in Huebner & Betts). It appeared that this did not happen suddenly or by a freak of nature, and was attributed to socialization that began at birth. It began with the messages given by primary caregivers, which in most cases were the parents. From the moment a child was born, that child was assigned a role of male or female and treated as such. Consciously or unconsciously, most all cultures taught female and male children different things and in different ways based solely on the gender of the child (Campbell & Storo, 1995).

A study done by Owen-Blakemore (1998) sought to replicate and check the validity of previous studies regarding the influence of parental attitudes on preschool children. Preschool children aged 3 to 5 were observed during interaction with infants. The researchers examined the correlational connection between gender roles in childhood and gender-linked social behaviors of adults. Prior published studies suggested that boys' interest in babies was diminished between the ages of 3 and 5, whereas for girls the interest in babies was amplified between the ages of 3 and 5 (Berman, as cited in Owen-Blakemore). If the findings were replicated, the period between 3 and 5 years of age could be studied intensively to investigate the etiology of the different developmental trajectories of boy and girls. According to Owen-Blakemore, from the perspective of the social learning theory, children learned through observation which behaviors were suitable for males and females. Boys with infant siblings saw their mother interact and take care of the babies

and the father take a minor role in raising the baby. Consequently, they observed that caring for a baby was not a typical male role; therefore they did not engage in interaction with the baby (Owen-Blakemore).

The results of the Owen-Blakemore (1998) study indicated that the impact of the children's age on the gender differences was minimal. The differences in behavior toward infants could be observed in the children 3 years of ages as well as 5 years of age, with only a slight observable increase of dissimilar behaviors with age progression. The significance of the study with regard to gender differences focused on the adult influences placed on children. Boys with traditional parents showed less interest in babies and the girls more interest in nurturing of babies, but the gender differences tended not to be seen in children of more egalitarian parents. This showed that children learn gender-typical patterns, such as differential interest in babies, from adults (Owen-Blakemore). Support for this pattern of behavior was found in Fagot, Leinbach, and O'Boyle (as cited in Owen-Blakemore) as well. The findings indicated that more traditional mothers had children who learned gender labels at an earlier age. While it was not observed that parents treated boys and girls differently, it was observed that parental attitudes did influence children's gender role development. Because interest in and interaction with infants had a strong connection to the gender differentiated patterns found among adults, the effect could be recorded without too much difficulty (Owen-Blakemore); whereas, studies of gender preferences regarding toys or

play were not observed. Children in the study would interact with the toys or play, without the benefit of seeing adults playing with those same toys. Therefore the children were not guided by what they saw; only their interests. Without adult interference children were not likely to pick gender specific toys (Owen-Blakemore).

The authors concluded that the findings of the child interaction with infant study had significance in that it was one way in which children learn gender roles. As a result, children came to school with preconceived idea of their roles as male or female (Gurian & Ballew, 2003). If children could have interpreted even subtle attitudes of their parents, they could have interpreted other social values as well. Cultural traditions, children's literature, and the media could have also been domains that perpetuate traditional conservative social values (Russell, 2001).

Much of the literature reviewed dwelled on the stigma placed on girls in today's world, and the self-image that shaped the personality and achievements of girls. Olive Schreiner wrote of experiences as a young girl in *The Story of an African Farm* (1883), "The world tells us what we are to be, and shapes us by the ends it sets before us. To men, it says Work!.... To us, it says Seem!.... The less a woman has in her head the lighter she is for climbing" (as cited in Pipher, 1994, p. 22). This statement came out of the last century, but the message was still be found as an underlying belief of people of both sexes in America in the twentieth century. Pipher alleged:

> Girls have long been trained to be feminine at considerable cost to their humanity. They have long been evaluated on the basis of appearance and caught in myriad double binds: achieve, but not too much; be polite, but be yourself; be feminine and adult; be aware of our cultural heritage, but don't comment on the sexism. Another way to describe this femininity training is to call it false self-training. Girls are trained to be less than who they really are. (p. 44)

In many cases the messages received by girls were unconcealed, such as the messages from parents, teachers, and peers. These messages could have included, but were not limited to (Pipher):

1. Teachers chose male oriented classroom activities.
2. Boys were depicted as clever, brave, creative, and resourceful.
3. Girls were depicted as kind, dependent and docile.
4. Boys were praised for academics and intellectual work.
5. Girls were praised for clothing, behaving properly and obeying rules.
6. Boys were criticized for behavior.
7. Girls are criticized for intellectual inadequacy.
8. Failure of boys was attributed to external factors and success to ability. Boys thought the problem was hard and stuck with it.

9. Failure of girls was attributed to lack of ability and success attributed to hard work and luck. Girls thought they were stupid and gave up.
10. Girls' difficultly with math may have been due to lack of confidence, trust in one's own judgment, and ability to tolerate frustration without becoming overwhelmed. Girls who have had an initial lack of success in math got anxious and were prone to self-doubt at the next opportunity to perform well in math.

Many more gender biases and messages were more concealed (Pipher; Russell, 2001):

1. Only one-seventh of textbook illustrations were of girls.
2. There were three times as many boy-centered stories as girl-centered stories.
3. Gender-biased language in literature perpetuated gender bias with the use of:
    a. masculine pronoun "he" to refer to all.
    b. chairman, mailman, policeman, businessman indicate historical dominance of males.
4. Gender roles within literature depict:
    a. Men as breadwinner, leaders, defenders and in the role of doctors, airline pilots, school principals, and corporate executives.

b. woman as nurturers, caregivers, supporters and in the role of nurse, flight attendant, teacher, and secretary.

Psychological Effects Within the Classroom

To avoid gender bias within classroom literature, it may be valuable to consider that gender bias in books did not create the problem, but may have reinforced it through subtle messages that naturally intuitive children internalize. One recommendation noted in the literature was to take opportunities to discuss bias in older books, so that awareness may develop. Russell (2001) suggested that when evaluating children's literature, educators should look for inclusive language and avoid:

1. Gender specific words, such as "he" only.
2. Books that stereotyped roles according to gender.
3. Books that stereotyped behavior and personality traits regardless of whether it was feminine or masculine.

Eliminating gender bias in the classroom and society at large may benefit both girls and boys equally.

The media also bear extensive responsibility for gender bias through subliminal messages within professional journals; with only pictures of men in prominent roles, or blatant sexism in teen magazine advertisements and TV programming (Burkett, 2001). Starting in the late twentieth century media had quickly become an integral part of all classrooms, regardless of the grade level. Computers have been used in a variety of capacities, where students were being evaluated on a computer-

generated products. The American Association of University Women reported that girls did not enjoy the game culture or the narrow focus of computer science and, as a result, did not achieve technological fluency (McGrath, 2004). As an elective educational option, girls most often choose computer application classes. Boys often choose the more advanced software design classes (McGrath). Appreciating the language of computers has remained a male domain, and in a like manner, language in general may be a factor for inequality as well (Burkett).

Was there gender bias when web-based discussion was the format used as an educational tool? One would think that web-based discussion would have created gender equity, but it was found that it was not automatically true. Bonebright, Thompson and Leger (as cited in Burkett, 2001) studied gender stereotypes regarding "vocal expression" and "found that females were better at perceiving fear, sadness, and happiness," which supported "the conclusion that women were more sensitive to nonverbal cues." Men were only able to perceive anger more often than women. Within the electronic media gender identification was still often possible. Herring (1994, as cited in Burkett) theorized that the male domination of the use of electronic media was not due to men having more computer skills, but that men preferred the computer discussion forum, whereas women did not. After analysis of the listserver message content use in the study, men were found to be more adversarial with more "sarcasm" and "put-downs", "lengthy and/or frequent postings", and

"self-promotion." Herring, I1994, 12 cited in Burkett). The women's message content displayed supportive language with "appreciation, thanks, and other community-building expressions." Herring interpreted the stereotype of women as lack of confidence, and the stereotype of men, in light of "the socio-cultural screen," as expected to be "knowledgeable, rational, and dispassionate" (p. 105, as cited in Burkett). It was considered that the computer was a male domain (Burkett).

The date, 1994, of Herring's findings has significance. More than 10 years have passed and the computer may no longer be considered a male domain with the change in social norms. However, more current literature (Herring, 2000) found that nothing has changed with the increased use of computer communication. Even with the anonymity of distant communiqués and not using gender specific names, computer-mediated communication (CMC) were still not gender neutral. Gender was often visible on the Internet based on the writer's style in text alone (Herring). Linguistic features of CMC users provided clues to the gender of the writer. Males were more likely to write "longer messages", "begin and close discussions, and assert opinions stronger and as facts, use crude language," and generally "manifest an adversarial orientation" in mixed gender CMC. On the other hand, females tended to have "shorter messages", "qualify and justify" their thought, "apologize", and "express support of others" (Herring). The differences could be easily seen even without identifying names or clues within the e-mail address of the user.

However, when nicknames, third person pronouns to describe their actions, and message contents were analyzed, differences in "discourse style" were evident. In a study of user "action verbs" in social chat rooms, Cherny (as cited in Herring) discovered that males "used more violent verbs", especially when communicating with other males, and females used mostly neutral and affectionate verbs. Herring came to the conclusion "that gender differences in online communication tended to disfavor women." In discussion groups with both male and female participants, it was generally found that "females posted fewer messages", were likely to give up and not post a second response if the first message was not responded to. Even when females did persist, they received fewer responses from both males and females; moreover they "did not usually control the topic or terms of the discussion." Within the mixed discussion groups an inherent tension seemed to exist between "feminine values of social harmony" and the masculine values of aggression. Because of the "contentiousness of male massages", females were discouraged from participation; in contrast males perceived female politeness a waste of time (Herring).

Since writing styles have developed based on culturally learned gender specific differences, the use of CMC in the classrooms in middle school and high school may serve to exclude girls from participating to the extent that boys do. It may be naïve to think the learned behavior patterns from off-line social interaction would not transcend into what was thought

to be a gender neutral communication forum of computers. The use of computer communication networks does not appear to guarantee a gender-free equal opportunity anymore than other forms of communication. Herring's (2000) findings have practical application for women and girls' participation in CMC in that the "conventional gender styles interact" with the Internet forum to create an "online climate" that had been "less hospitable to females than males." Herring's interpretation was supported by Kruat et al. (1996) (as cited in Herring), with a 2-year study of free access to unlimited Internet found that "female adolescents' use declined" significantly after "several weeks compared to adolescent boys", who used the Internet far more. When females logged on to the Internet, they had more private exchanges through email, whereas males controlled the more public domain for public discussion and chat rooms (Hoffman et al., as cited in Herring). This allowed the male voice to be heard by more and, therefore, this voice dominated the public CMC network. Further research in the twenty-first century may produce very different findings. Will the messages written by men still be aggressive and will the messages written by women still be community-building expressions? This requires further investigation.

Burkett's (2001) research on gender bias, when using web-based discussion as an educational tool, concluded that web-based discussion would not create gender equity. The implications for education were that even in the use of the computer as a communication tool, gender

differences were present. An "assessment of online communication could not be a one-size-fits-all" method. It was recommended that an effort must be made to recognize the "differences in communication styles while evaluating student's work" (Burkett). As long as psychological gender differences existed, whether learned or innate, efforts need to be made to recognize the differences and not allow gender bias to favor one over the other in assessment of student knowledge or achievement.

Observed Changes in Adolescent Girls

Society's expectation of girls creates a profound change in girl's behavior that begins in early adolescence. Longitudinal studies of the behavior and attitude changes in girls through adolescence can offer insight into these changes (Rogers, 2001).

In the past, actions of parents and educators had perpetuated old ideals that ultimately undercut the education of girls. It is worthwhile to examine the research concerning girls' development, and link the findings to the research, considering the connections between adolescent girl development and the adult communities that sometimes undermined them. Brown and Gilligan (as cited in Dorney, 1995) chronicled the losses that girls experienced as they move through adolescence. One hundred girls were interviewed over a 5-year period. The interviews conducted by Brown and Gilligan revealed the following:

1. Girls between the ages of 7 and 11 trusted what they knew from experience, which enabled them to be outspoken and bring their knowledge into both personal and public relationships.
2. Girls who were 10 to 13 years of age had begun to show signs of losing voice. This was exhibited through a reluctance to speak about their thoughts and feeling in relationships, loss of a sense of authority about their experience and knowledge, and deferment of knowledge and experience to others. Authentic thoughts and feelings could not be expressed for fear of the relationship collapsing.
3. By late adolescence girls avoided conflicts that would ensue from the authentic expression of thoughts and feelings.
4. The danger was that these young women would not be able to sustain their hidden or subjugated voice and knowledge that they were protectively concealing. Furthermore, if they were able to hide their voice, not only would their voice be lost, but be absent from the public arena as well. As a result, the traditional/conventional voices would continue to dominate both personal and public relationships.

A shift in teaching practices and relationships might occur when women teachers become aware of cultural pressure and resist it. As an end result, there would be a fundamental change in the nature of the women's relationship to authority, a deeper understanding of themselves,

a movement toward bringing this knowledge into the public world of school, and a movement toward community (Dorney, 1995). Dorney recommended that:

> Women educators have the power to be the handmaids of the traditions that have silenced and denied the knowledge of women and girls and that have caused us to dissociate from our knowledge and ultimately from our bodies and voices. Women educators can also find a way, to admit that as resisters, we maintain an outlaw status in those cultural and educational traditions that seeks to deny and suppress our knowledge, which at the same time urging us "not to mind it". (p. 71)

The psychological perspective embraced gender differences as learned from cultural pressure to behave certain ways based on gender. It could be concluded that with the recognition of cultural pressures educators have a responsibility to resist cultural barriers established by society to improve the lives and performance of girls.

Observed Changes in Adolescent Boys

The focus over the last 20 years has been on the changes needed to improve academic performance of girls, but a shift to recognizing the changing needs of boys has come to the forefront (Weaver-Hightower, 2003). Recent statistical data have shown that depression, drug use, suicide, teen sex, academic failure, and violence have risen among adolescent boys in the last couple of decades (Sommers, 2000). The data

have also shown that boys were falling behind girls in their level of engagement in school, with the number of suspensions, expulsions, dropout rates, special education placements, and diagnosis of attention deficit disorders disproportionately high for boys (Gurian & Ballew, 2003; Sommers). Gurian (2001) contented that the "nature" of boys was behind the issues confronting boys, and due to different brain structures of the genders, each had different educational needs. In his opinion, boys' needs were not being met in many schools.

One of the more observable characteristics of many adolescent boys, which were not observed in most girls, is aggression of various forms. Boys use aggression to define and promote their position in society (Gurian & Ballew, 2003). The aggressive activities that boys engage in include rough physical touch, competitive games, aggressive talk, and nonverbal gestures. An understanding of the needed value of aggression in boys has brought to the forefront a focus on the nurturing of aggressive behaviors. Boys traditionally have used bumping and pushing one another to build strength, focus, attentiveness, and their social hierarchy. The social strata and the position each boy held in the strata is important to boys, more so than girls. Physical size, verbal skills, personality, and abilities are the more prominent characteristics that establish placement in the social strata (pecking order). Those boys who find themselves on the bottom of the pecking order are often considered fragile learners (Gurian & Ballew). The aggressive strategies practiced by

boys may serve them well as adults by promoting greater hierarchical success in the workplace, but could also create problems in relationships with less aggressive men and women (Gurian & Ballew). The interpretation of the aggressive behaviors such as healthy aggressive play and competition in boys by adults as fighting could result in premature disciplinary actions. In contrast, disciplinary inaction could ultimately lead to bullying and harassment of others. Hormonal changes during puberty have often exacerbated the problem of aggression, which may lead to fist fighting, and other volatile behaviors (Strauch, 2003). An extension of aggressive behaviors included increased thrill seeking risky behaviors during adolescence (Strauch), which result in unsafe situations causing physical and emotional harm. Gurian and Ballew wrote that measures to counteract the inappropriate destructive tendencies with appropriate aggressive behaviors are needed, such as:

1. Healthy aggressive play, such as fantasy play, and shadow karate kicks.
2. Discussing aggression whereby boys could understand where the aggression comes from and how to make interaction more productive.
3. Healthy competition in a learning environment.

Teaching techniques on conflict and anger management have proven to be advantageous in assisting adolescent boys in identifying their feelings and channeling those feelings into positive coping behaviors (Gurian &

Ballew). Aggression is a distinctive characteristic of boys that showed a sizable prominence in boys over that of girls.

Neuroscientist View of Gender Differences

The field of neuroscience has been growing as technology improves. It has been argued that learning more about the brain has little to no bearing on educators, but these are misleading assumptions. There are good reasons to argue that neuroscientific evidence ought to be considered relevant, because it has corroborated or refuted recent thinking regarding cognition and learning, and it has generated findings that were not anticipated by psychological theories (Byrnes, 2001). As the research in neuroscience is still in its infancy and technologies are changing, there have been active debates among scientists that brought more disagreement and questions than answers. To better understand the neurological perspective, a better understanding of the tools used to gather data is necessary in this literature review.

Technologies Used for Non-Invasive Brain Imaging

Modern medical non-invasive devices used to study the brain growth and activity include electroencephalograph (EEG), computerized axial tomography scan (CAT), positron emission tommography scan (PET), magnetic resonance imaging (MRI), and magnetoencephalography (MEG). These technologies allow scientists the opportunity to understand what areas of the brain are activated in normally accruing situations (Public Broadcasting Systme [PBS], 2001).

The first technology is the EEG. This technology allows researchers to "follow electrical impulses across" only "the surface of the brain" (PBS, 2001). The electrical impulses are measured within split seconds of time, which could show the different states of the mind while a person is "awake, asleep, and anaesthetized." The most valuable use of the EEG is to "show how long it takes the brain to process various stimuli." This more primitive early technology has a major drawback, in that it does not show researchers the structures and anatomy of the brain or really tell which specific region of the brain has what function (PBS).

To gather the data, electrodes are attached to the subject's scalp. These electrodes picked up electrical signals produced by the brain and sends the signal to a galvanometer, which measures the small electric pulses, as shown in Figure 2, that information, in turn, is sent to pens, which record it on graph paper.

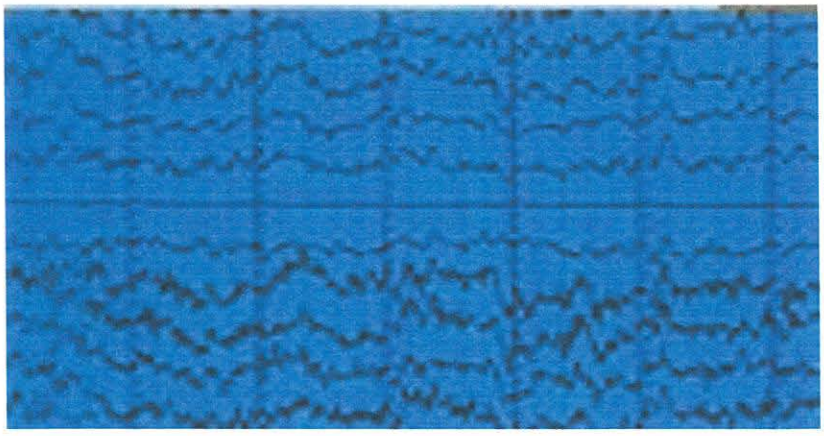

Figure 2. EEG electrical impulses recorded on graph paper. Source: (PBS, 2001).

The second technology is the CAT scan. This technology can scan the brain to "detect brain damage and highlight local changes in the cerebral blood flow" as the "subject performed a task" (PBS, 2001). The change in blood flow indicates changes in brain activity.

To accomplish this, the brain is scanned in "a process that combines many two-dimensional x-ray images to generate cross-sections" of the brain as shown in Figure 3. To create this three-dimensional image, the subject is positioned in a "donut-shaped x-ray machine" that "moves around the person and takes numerous x-rays." A computer combined the two-dimensional x-ray into a three-dimensional image (PBS, 2001).

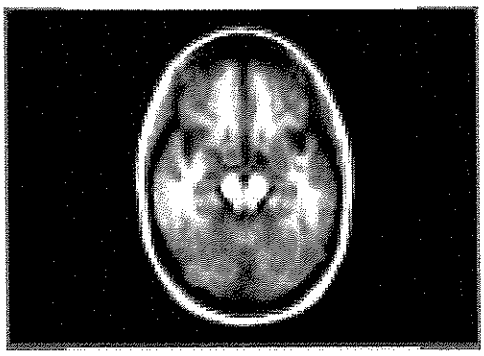

Figure 3. High-resolution magnetic resonance image of normal brain with CAT scan. Source: PBS (2001).

The third technology is the PET scan. This technology allows researchers to observe blood flow or metabolism in any part of the brain (PBS, 2001). Radioactive glucose is injected into the subject, and the absorption of the radioactive glucose is observed through the PET scan. Since "brain cells use glucose as a fuel", the theory is that brain cells

which are activated use more glucose as fuel, and, therefore, the concentration of radioactivity appears in the areas of the brain that are in use.

A computer applies color-coding to the levels of activity. In Figure 4, red represents high activity, yellow moderate activity, and green lower activity. Unlike the EEG, researchers can observe structures deep in the brain; consequently the PET scan is one of the more "popular scanning techniques in current neuroscience research" (PBS, 2001).

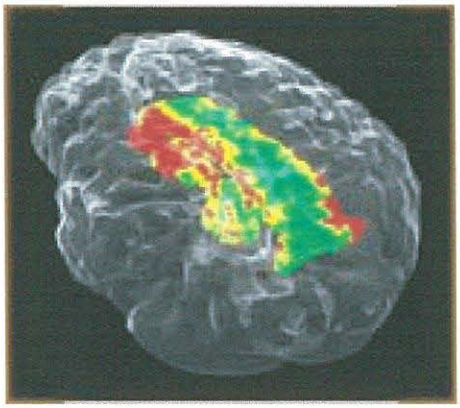

Figure 4. MRI image of gray outer surface of the brain and PET image of the inner cingulate gyrus (colored structure) that is part of the brain's emotional system. Photograph by Monte S. Buchsbaum, M.D. (PBS, 2001).

The fourth technology is the MRI. This scanner uses a magnetic field running down a long tube that the subject is placed in, which realigns the subject's hydrogen atoms (PBS, n.d.). Normally the body's atoms spin at random, but the powerful magnet attracts the protons of the atoms so

that all atoms spin on the same axis. Once the atoms are facing either up or down, most of the protons cancel each other out, but there are a few that do not. The MRI machine sends radio pulses to the area of the body in question to be scanned. The radio pulse make the uncancelled atoms spin at a frequency and direction depending on the type of tissue. The MRI machine intercepts signals from energy given off by atoms returning to their natural state, as shown in Figure 5. The computer then creates an image of the tissue. With the use of a MRI machine researchers can pinpoint the area of the brain they wish to view using gradient magnets. These images have great clarity, and unlike the PET, do not use radioactive tracers (PBS, n.d.).

Figure 5. Image from an MRI. Source: PBS (2001).

The final technology is the Magnetoencephalography (MEG). The MEG is considered to be on the forefront of new technology. This newest technology measures the very faint magnetic fields that emanate from the head as a result of brain activity (PBS, 2001). As of 2001, there were only

a few of these machines in use due to the high cost and size of the machine, since the technology costs many millions of dollars and machine weighs about 16,000 pounds (PBS). The size and design is shown in Figure 6. But cost and weight not withstanding, this brain scan method provides the most accurate resolution of the timing of nerve cell activity (PBS). More extensive use of the MEG for brain research may change the current wisdom regarding the dimorphic aspect of male and female brains (PBS).

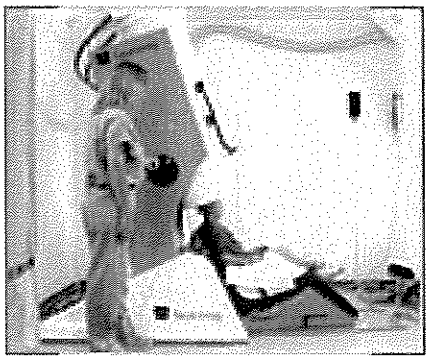

Figure 6. MEG machine at the University of Utah. Source: PBS (2001).

With the advancement of technologies and the sensitivity of the instruments used to measure electrical impulses from the brain, the resulting data have changed. Old ideas developed with the use of the EEG have either been confirmed as accurate or dispelled due to inaccuracy (PBS, n.d.). The noninvasive technologies have helped in pinpointing brain activity in awake and working brains. This work in progress is cited as a helpful tool in furthering research on the differences, or lack of differences, in male and female brain development (PBS).

There are limitations to the current brain studies conducted because of changing technology and the availability of the newest technology such as MEG. Byrnes (2001) suggested caution in interpreting the findings of neuroscientific tests that indicate exact locations of brain activities when performing task. These inappropriate inferences about the correlation between structures of the brain and the related function may be incorrect. It is suggested that more than one testing method needs to be used to corroborate or refute the results, and the future holds even more promise for new technologies (e.g., functional magnetic resonance imaging, transcranial magnetic stimulation). The excitement generated seems to prompt many to accept the findings without regard to the limitation of the methods. It should be recognized that as technologies improve some of the conventional wisdom about location of functions of the brain might be discredited as methods in neuroscience mature and more is learned about the meaning of physiological signals (Byrnes). The information reflected in the review of the literature is based on current conventional wisdom.

Anatomy of the Human Brain

To better understand and interpret the research on the brain it is necessary to know the basic anatomy of the brain. The anatomies of both male and female brains remain the same; therefore each of the following diagrams represents the human brain, which is not gender specific.

The diagram in Figure 7 shows the anatomy of the human brain. The image on the left represents the external portions of the brain, viewed from the side, showing the major lobes and the brain stem structures. The image on the right is also a side view, but illustrates the limbic system located internally.

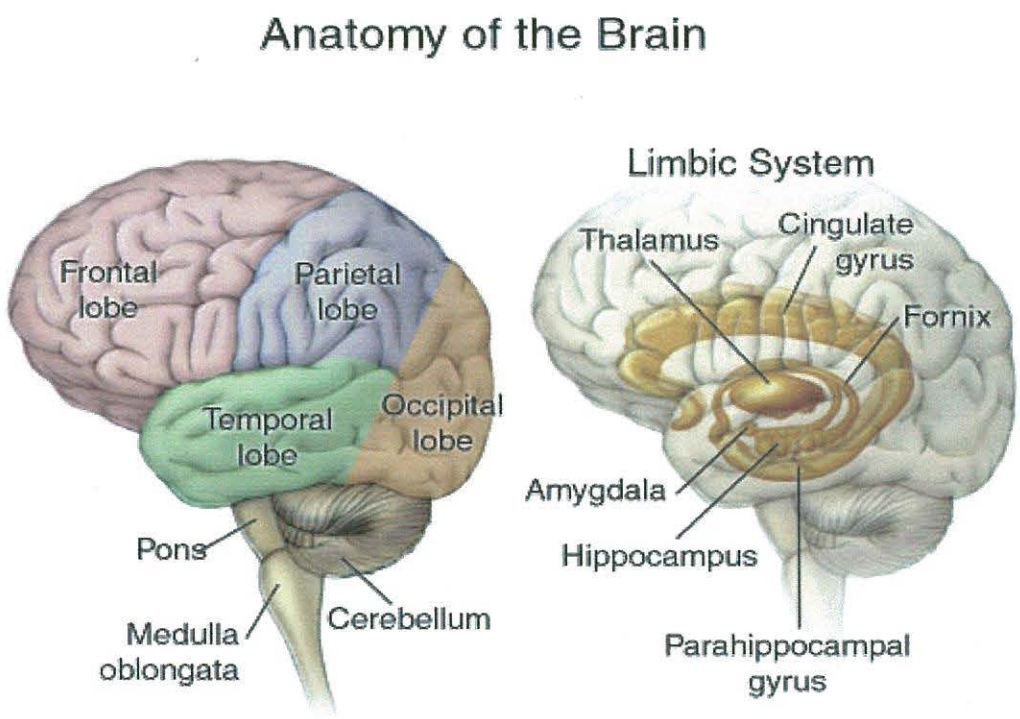

Figure 7. Anatomy of the brain. Source: American Health Assistance Foundation (n.d.)

The different lobes of the brain have been associated with certain functions (*Brain Structures and Their Functions*, n.d.). The frontal lobe has been associated with parts of speech, movement, emotions, problem-

solving and reasoning. The parietal lobe has been associated with orientation, recognition, movement, and perception to stimuli. The occipital lobe has been found to be necessary for visual processing, and the temporal lobe used for perception and recognition of auditory stimuli, memory, and speech. The lobe governing movement is the cerebellum (*Brain Structures and Their Functions*). The interior part of the brain houses the limbic system, which may have more significance regarding gender differences.

To perhaps oversimplify the function of the limbic system is to say that the interconnected structures of the limbic system mediate emotion, learning, and memory. The important connecting pathways between structures in the limbic system are provided by the parahippocampal gyrus, whereas the connecting pathways between just the hippocampus and other parts of the limbic system are provided by the fornix. In conjunction with the temporal lobe, the hippocampus plays a significant role in the creation of long-term memories. The cingulate gyrus processes "conscious emotional experiences", unlike the amygdala, which "processes 'reflexive' emotions like fear and anxiety." The pathways connecting the limbic system with the external lobes are incorporated into the thalamus, which appears to be a "major relay station between the senses and the cortex" (American Health Assistance Foundation, n.d.).

The structures of the brain remain consistent whether it is male or female. Lobes of each gender have the same function and processes in

the same way. There are differences in size. At birth, most boys' brains are larger than girls' brains. On average, the "brain of boys is between 12% to 20% larger than that of girls." This correlated with the circumference of boy's heads, which on average is 2% larger than girls. But if the brain size is compared to body weight, there is almost no difference between the two genders (Neuroscience for Kids, n.d.).

When comparing adolescents and adults, brain of males tended to be 11% to 12% larger than females, with the head circumference remaining at 2% larger in males (Neuroscience for Kids, n.d.). Figure 8 shows the size differences in male and female brains. For some individuals, the brain size offers proof that males are superior to females, because larger brains are more intelligent brains. This, of course, has been proven to be false. That is not to say that there are not observable behavioral differences between males and females. Over the past few years, studies have tried to find differences between the right and left cerebral hemispheres to suggest that there are differences between male and female brains. However, few of these experiments have found meaningful differences between men and women, with one exception. Recent claims by researchers have been made that the corpus callosum is bigger and more developed in women than in men (Neuroscience for Kids, n.d.). These claims are vigorously debated in the research community.

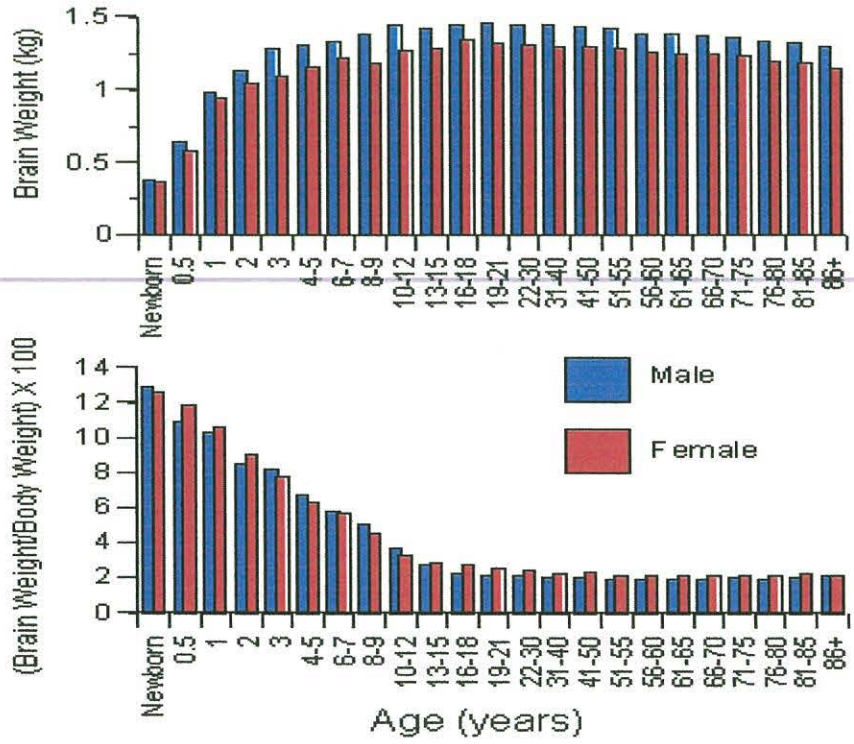

Figure 8. Changes in brain weights during the span of human life: relation of brain weights to body heights and weights. Source: Dekaban & Sadowsky as cited in Neuroscience for Kids (n.d.)

The significance of the corpus callosum will be debated further in the discussion of the effect of brain development on the learning process of boys and girls.

Development of the Brain With Regard to Learning

"How do minds emerge from developing brains?" The idea of "neural constructivism" is that the "representational features of the cortex are built from the dynamic interaction between neural growth mechanisms and environmentally derived neural activity" (Quartz & Sejnowski 1997, as cited in Demetriou, 2000). This is contrary to neurobiological evidence,

which suggested that growth resulted in a "flexible type of learning, constructive learning." According to "recent neurobiological evidence, the developing cerebral cortex is largely free of domain-specific structure", meaning no one specific region constructs a concept of thought, but it is the interconnection of more than one regions of the brain. The functional properties of the cortex are built by the nature of problem confronting it. This learning strategy undermines the assumptions of classical learnability theory, that learning is "deduced from a fixed computational architecture" (Quartz & Sejnowski, as cited in Demetriou). Therefore, "human cortical development is more extensive and prolonged than generally supposed, which suggests that the cortex could maximize the capacity of environmental structure to shape its structure and function through constructive learning" (Quartz & Sejnowski, as cited in Demetrious). How does this figure into gender differences?

Gender differences, based on the biological structure of the brain, may have contributed to male/female differences independent of societal influences. DeCourten-Myers (1999), Cowell, et al. (1994); Allen, Hines, Shryne and Gorski (1998); Hofman and Swaab (1991); and Kencht, Deppe, Drager and Bobe, (2000) (as cited in Burkett, 2001) have all conducted and published research on the dimorphic characteristics of the male and female brain, with emphasis on the hypothalamus and corpus callosum. The diagram in Figure 9 shows the location of the corpus callosum, and Figure 10 provides a cross section view of the same mid-

region of the brain. The corpus callosum has been the focus of attention for "studies attempting to show functional differences in language abilities between men and women." The corpus callosum is the region that lies "mid-brain and is the major pathway for connections between the left and right hemispheres of the cerebral cortex."

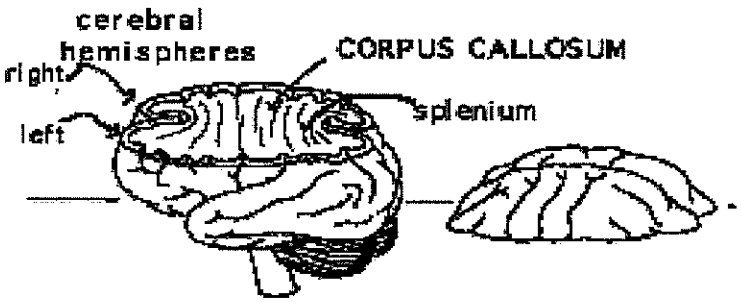

Figure 9. Location of the corpus callosum. Source: Pietsch (2004)

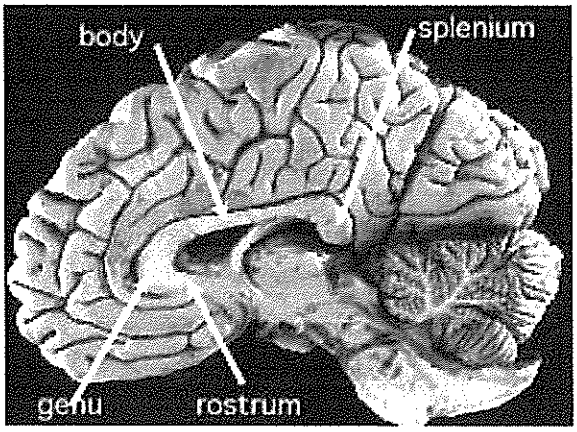

Figure 10. Lobes of the midbrain. Source: Pietsch (2004)

It has been "proposed that this relatively larger region" in female brains "is responsible for the multiplicity of connections," which gives females greater language and communication abilities. Two other regions of the corpus callosum have shown to be sexually dimorphic: the splenium and the isthmus, which are larger in females than males, and as an important side note, are larger in males and females who are right-handed as well (Burkett, 2001). Hines 1992 (as cited in Burkett, 2001) used inversion recovery MRI technology on 28 normal healthy females, while participants completed tests of visio spatial ability, verbal fluency, and language lateralization. Four midsaggital surface areas of the corpus callosum were measured and analyzed using multivariate statistics: splenium, isthmus, midregion, and genu. "Analysis of the data supported the hypotheses" that the splenial area showed positively for verbal fluency, while the other three were not significant (Burkett). There are two distinct possibilities for the relationship between verbal fluency and the posterior cortical regions. "The first is that the verbal fluency" contributed "to the size of the region and the second is that the size of the region" contributed "to the greater verbal fluency" (Burkett), which resembled the chicken or the egg scenario, in that, it is unclear as to which came first.

Similar studies have hypothesized that language functions are represented in both hemispheres in females, while they are more highly lateralized in males. Shaywitz (as cited in Burkett, 2001) concluded that during rhyme tasks, "brain activity in males lateralized in the left inferior

gyrus region," while female brains activated both "the right and left inferior frontal gyrus." The drawback of the study was its questionable validity due to the relatively small sample of right-handed men and women within the study. Later Frost, Binder, Springer, and Hammeke (as cited in Burkett) had very different findings with a larger sample of participants. Results showed that there were "no differences in lateralization between genders." Knecht, Deppe, Drager, and Bobe (as cited in Burkett) also concluded that "lateralization was equivalent for both male and female participants." The differing results of the studies provided evidence that neuroscience was still new and changing with the advancement of technologies. It also showed that definitive conclusions cannot be made regarding the gender differences as it was related to the limbic system.

How the size and symmetry of the regions of the brain are measured also has been debated as to whether it is an absolute or relative measurement (Fitch & Denenberg, 1998). The statistical norm is that male brains are larger and weighed more than female brains, but the larger size does not translate into higher IQs. If the larger relative size of the corpus callosum means that the corpus callosum is compared to the overall size of the brain, and it means that it has more connections between hemispheres then it would translate into higher IQs. Then it would stand to reason that larger brains are better brains. This has not been the case. If the neuroimages showing brain size were divided into the overall IQ of the individual, an IQ per unit of brain tissue could be

obtained; the logical result would be that female brains are far superior to male brains (Fitch & Denenberg). This would be an erroneous assumption. Fitch and Deneberg's results indicated there was no statistical difference between male and female brains. The issues of right or left-handedness also muddle the results. Left-handed and non-consistent right-handed males also had larger isthmus portions of the callosum in proportion to the rest of the brain (Fitch & Denenberg). Once again the data proved to be inconclusive.

With the passage of 5 years, further research has come to light that supports earlier studies that sexually dimorphic processes in the brain might influence the relationships between cerebral asymmetries and callosal connectivity (Wisniewski; Zaidel, Aboitiz, & Clarke, as cited in Luders et al., 2003). Brain mapping was conducted through the use of MRI cross-sectional scans in several different steps. The measurement focused on the asymmetry measures of the anterior portion of normal female and male brains. It may have been too speculative to relate the results in detail to the interpretations of gender-specific brain organization with regard to the findings of different correlations between sulcal and callosal measures in males and females, but it had been documented that male brains may be more lateralized in function or may be more asymmetric than female brains (Luders et al.). Furthermore, on average, females possessed better verbal abilities opposed to males, having better spatial and mathematical abilities. Sex dependent relationships with

respect to specific regions of the brain, namely the corpus callosum, which borders on the anterior language regions, may have reflected differences in the requirements for interhemispheric communication between males and females. But to muddle the results again, the issue of handedness needs to be taken into consideration. Results showed that the dimorphic organization in the brain of left and right-handers influenced regionally specific relationships between the asymmetry and callosal connectivity (Luders et al.).

Gender Specific Hormones and the Brain

Exposure to endogenous hormones, namely testicular hormones and ovarian hormones, early in life define male and female neuroanatomy and behaviors (Fitch & Deneberg, 1998). The differences in neuroanatomy are not so much genetic as formed by the introduction of gender specific hormones. Therefore, the interference is that introduction to gender specific hormones could alter the size of the corpus callosum. Data collected using rats found that hormone manipulation at an early age affected the size of the corpus callosum (Fitch & Deneberg). Whether this information could be generalized to humans is debatable, but it does add another variable. If endogenous hormones are not typical during early childhood development, brain structure would not be typical as well. This may also play a role in the inability to stereotype gender specific characteristics.

Samples of opposing views have been given to illustrate the diversity of views in the field of neuroscience and to show that views change as time progressed. Until more sophisticated, non-invasive techniques are readily available and less expensive, a definitive answer will remain elusive.

"The gender-based differences apparent in language ability are theorized" to be "microscopic and biochemical differences." "Significant gender differences in the biological structures of the brain at the molecular levels involve neuronal density, connectivity, and synaptic biochemical reactivity," which are "genetically based and hormonal." Burkett (2001) suggested that given current technology, "accurate studies of functional differences" in the brain would continue to be difficult. Non-invasive studies of larger groups with greater ethnic diversity would be needed before the findings made so far could be generalized (Burkett).

Genetic and Metabolic-Based Disabilities

Among the vast number of genetically caused disabilities in children, several display differently in females and in males. The effects and severity of the disabilities could be behavioral, physical, and/or gender specific. Phelps (1998) suggested that it was important to continue research in neuroscience and learning disabilities for two important interrelated reasons. First, if learning disabilities were believed to have a neurological involvement, it is important to provide evidence of the disordered structure, as well as evidence of disordered metabolic and

electrophysiological systems. Second, it is equally important to document the precise neurological basis of learning disabilities for insight into the etiology (Phelps). The assumption that the etiology for males and female is the same may be misleading. Phelps found that some disabilities were related to the X chromosome, some were metabolic, yet others had causes that were undetermined the literature was written. The following is a sample of gender differences of children with exceptionalities.

Disabilities associated with the X chromosome:

1. Scientists determined that fragile X syndrome is caused by an inherited abnormal repetition of a normally occurring genetic sequence on one end of an X chromosome (Klaiman & Phelps, 1998). This abnormality inhibits the gene from forming its intended protein production. The results are cognitive, affective, physical, and behavioral abnormalities due to the lack of production of the protein associated with the affected genes. Fragile X syndrome exhibits differently in females than in males. Because the mutation is on the X-chromosome, girls had some protection in that they had two X chromosomes. When one chromosome is lacking, the other could produce the necessary proteins. Boys did not have that protection since their chromosome structure is XY, not XX; therefore boys are unable to compensate for the defective gene. Not all boys with the fragile X gene are affected; 20% of boys show no signs at all

(Klaiman & Phelps). Prevalence studies indicates that approximately 1 in 2,000 girls could be affected, whereas 1 in 1,350 boys could be affected. Fragile X syndrome is the third leading cause of mental retardation in Western cultures, surpassed only by fetal alcohol syndrome and Down's syndrome.

a. The neuropsychological outcomes for boys are mental retardation and deficits in attention, short-term memory, visual-spatial reasoning, receptive and expressive language, and math competencies. These deficits are manifested because of abnormalities in the cerebellum, hippocampus, and superior temporal gyrus, which are areas of the brain that are responsible for motor coordination and balance, along with attention, memory, learning, and auditory processing (Klaiman & Phelps).

b. Typical behavioral, social, and emotional function of boys with fragile X syndrome consist of hyperactivity and attention deficits, stubbornness and defiance, physical aggression, anxiety, motor and vocal tics, and autistic-like behaviors. The autistic-like behaviors include tactile defensiveness, social withdrawal, poor eye contact, perseveration (doing something beyond the desired point), and self-injury. Although there appear to be an overlap between fragile X

syndrome and autism, there were distinctions that separate the two. For the most part, boys with fragile X syndrome are affectionate and interested in relating socially. Evidence also show that cheerful, affectionate, and engaging boys often react poorly in social situations due to social anxiety, hypersensitivity to environmental stimuli, and low frustration tolerance, which result in the misperception of social approaches as threats (Klaiman & Phelps).

c. Girls with fragile X syndrome have been shown to be a very heterogeneous group in regard to neuropsychological functioning. When the affected gene is inherited from the father there is very little impact, but genes inherited from the mother have a greater impact on overall intellectual function. Three quarters of girls expressing the fragile X chromosome, not just carriers, have cognitive impairments ranging from learning disabilities to mental retardation. They might also show signs of short-term memory deficits, inattentiveness, and impulsivity, as well as difficulties with math computations (Klaiman & Phelps).

d. Reaction to social situations, behavioral, and emotional function of girls are similar to boys, with the exception of autistic-like behaviors. The behaviors are more moderate in girls than in boys. Withdrawn behaviors are more often

interpreted as being shy. Shyness was also reported in 60% of carrier girls with normal IQs. Depression and low self-esteem are more frequently reported in girls than boys (Klaiman & Phelps).

e. With consistency it has been shown that "males and females with fragile X syndrome follow different developmental trajectories of cognitive decline" (Eliez et al.). This seems to show differences in the "cortical grey matter development." Grey matter was named as such because it looks gray to the naked eye, and refers to the areas of the brain that is mainly composed of the heads of nerve cells. The IQs of males with fragile X syndrome "decline more rapidly during childhood;" whereas female IQs seem to remain stable" throughout childhood. The suggestion was that males had a lag in the decline of grey matter during childhood with "decreased pruning of synapses." As a result, they had an excessive "number and lengths of dendrites," which resemble immature spinal dendrites typical of early development of the brain (Wieler & Greenough 1999, as cited in Eliez, Blasey, Freund, Hastie, & Reiss, 2001). Through neuroscientific research, Weiler and Greenough suggested that an FMR1 protein might have been necessary for normal synaptic pruning; therefore the lack of the protein

led to "excessive synaptice and dendritic density;" this in turn, led "to increased volume and decreased plasticity of grey matter in males" with fragile X syndrome (Eliez et al.)

2. Mucopolysaccharidosis type II (Hunter syndrome) is a rare sex-linked disorder, almost exclusively affecting boys, because the affected gene is located on the X chromosome (Brown & Trivette, 1998). The recessive gene does not affect carrier girls "unless there has been an inactivation of the normal X chromosome" (p. 443). The prognosis for affected children is not good because of several skeletal deformities, which lead to becoming bedridden by age 10 and most often death by 12 years of age (p. 444). Learning and developmental skills plateau between ages 2 and 6, after which, there is a regression of cognitive skills (Brown & Trivette, 1998, p. 444).
3. "Lesch-Nyham disease is a rare condition caused by a defective gene on the X chromosome" (p. 386). It was once thought that the condition was exclusively inherited in males, but later (Yukawn et al.) discovered that it could appear in females as a result of a mutated gene on the X chromosome. The abnormal genome causes below-average cognitive functioning, spastic cerebral palsy, choreoathetosis" (rapid jerky involuntary movements), and most importantly self-mutilation (p. 386).

Because of the self-mutilation most of these children are not in mainstream education (Little & Rodemaker, 1998).

4. Lowe syndrome is an X-linked recessive disorder primarily exhibited in males. Since it only affects approximately 1 in 200,000 live births, it is a very rare disorder. Lowe syndrome affects organ systems such as "ocular (eye), neurologic, and renal" systems (p.405). When the abnormality is in the central nervous system, as many as 50% of the children also have seizures. When the children, most of them boys, enter the school system they qualify for special education services under the classification of mental retardation or health impairments (Lopata, 1998).
5. Klinefelter syndrome affects only boys. It is the result of two or more X chromosomes where there should be only one. It is estimated that 1 in 500 to 1 in 1,000 male births have the XXY or XXXY chromosome pattern. Often boys born with Klinefelter syndrome "did not develop any observable signs or symptoms" (p. 359). Of those that did exhibit signs and symptoms, the physical attributes are "above-average height, breast enlargement, lack of facial and body hair, and a tendency to be overweight" (p. 359). When treated, the lack of sexual maturity was overcome with testosterone injections during puberty, but boys who are not receiving injections are subjected to peer

ridicule into adulthood. It was once thought the males with the XXY genotype are more prone to "psychiatric pathology, criminal behavior, and mental retardation", but subsequent studies had contradicted these generalizations (p. 360). However, many of the boys had deficits in language expression and cognition. Auditory processing and memory deficits, delayed speech development, "with difficulties in intonation and accent, sentence building, and word selection" made up much of the language deficit (p. 360). For the most part, school-age boys with Klinefelter syndrome are well behaved in class, although when faced with difficult academic tasks they withdraw. Teachers often overlooked these boys (Ginther & Fullwood, 1998a).

6. Unlike Klinefelter syndrome, Turner's syndrome only affects girls. The disorder is caused by the total or partial absence on one X chromosome; as a result, normal growth and maturation did not occur. Girls "with Turner's syndrome faces significant physical, social, medical, and academic challenges, especially as they approach adolescence (Ginther & Fullwood, 1998b, p. 692). The emotional challenge of not developing typical female bodies lead to "social isolation and low self-esteem" (p. 693), and some girls were even labeled as specific learning disabled because of the emotional effect of their poor self-image (Phelps,

1998). Caregivers needed to be concerned about bullying and harassment from peers in the teen years.

7. Rett syndrome is also associated with the X chromosome, but the etiology is not conclusive (Hutton). This is "a progressive developmental disorder affecting about 1 in 10,000 females" (Hutton, 1998, p. 550). Those with Rett syndrome lose purposeful hand skills and early language development "is severely diminished or lost" (p. 551). Language skills rarely developes beyond a single word. Many of the early behaviors closely resemble autism, which often leads to erroneous diagnoses. A true diagnosis is tentative until non-purposeful, hand-mouth movement starts to show at 2 to 5 years of age (Hutton, 1998). With the use of technology, communication with touch screens, punch keys, or flicking a switch take place with minimal effort in an inclusive educational environment (Hutton).

The disorders associated with the X chromosome discussed above are most often gender specific, but they are not exclusive to one gender or the other. The provided examples have shown that an X chromosome disorder can affect only males, as in Hunter syndrome and Klinefelter syndrome; primarily males, as in Lesch-Nyham disease and Lowe syndrome; or only more pronounced in males, as in fragile X syndrome; conversely, X-chromosome disorders can affect females exclusively, as in Turner's syndrome and Rett syndrome.

Examples of developmental, genetic, and metabolic disorders that affect one gender to a lesser or greater degree include autism, Tourette's syndrome, and callosal agenesis. Congenital adrenal hyperplasia presents a case for metabolic differences for both males and females based on hormones. The characteristics of each are as follows:

1. Autism is characterized as a severe impairment in "social interaction and communication" (p. 82). The degree to which the child is impaired varies from high functioning to profoundly impaired, and characteristics could overlap with other disorders such as mental retardation and language disorders. According to DSM-IV to be diagnosed with autism the "disorder requires symptoms to fit into three broad categories: (a) impairments in social interaction; (b) impairments in social communication; (c) restricted, repetitive, and stereotyped patterns of behaviors, interests, and activities" (p. 83) Autistic disorder is different from other types of pervasive developmental disorder by (1) "its predominant occurrence" in boys, (2) "delayed language development", (3) "no deterioration of function and early onset" (younger than 4 years of age), (4) "occasionally normal intellectual functioning" (p. 83). Early diagnosis of autism had been instrumental in the outcome for success. As autistic, children are at higher risk for behavioral and academic difficulties, early interventions for these children, predominately

boys, were best. Higher functioning children with autism performed well when included in the general education classroom as long as "early intervention and ongoing support" was provided (p. 86). More severely impaired children "require more specialized education" throughout their educational careers (Cole & Arndt, 1998, p. 86).

2. Like autism, Tourette's syndrome has been falsely associated with schizophrenia, and additionally like autism, Tourette's is predominantly a male disorder. It was estimated that 1 in 2,500 people in the United States had Tourette's syndrome, with a prevalence figure of 1 in 1,000 for boys (Harrington, 1998). Tourette's is characterized by tics that are sudden, repetitive, and uncontrollable" Harrington (p. 641). "These include, but are not limited to, eye blinking, facial grimaces, shoulder shrugging, and jerking of the head or hands" (p. 641). Associated with the disorder are "diagnoses of obsessive-compulsive disorder (OCD), attention deficit/hyperactivity disorder (ADHD), aggression, and sensory integration and learning problems" (Harrington, p. 643). When Tourette's and OCD were concurrently diagnosed, the child often insists on wearing certain colors or items to school, or worry incessantly about a light left on at home (Harrington). Additionally, children diagnosed with Tourette's and ADHD have added problems of

inattention, impulsivity, and acting out behaviors" (Harrington, p.643). Very recent research has shown that children with Tourette's syndrome and ADHD have slower processing speed when doing cognitive tasks (Swanson et al., 2003). As a consequence of Tourette's and other associated disorders, children often have learning problems (Kurlan, 1993, as cited in Harrington). This is unfortunate in that most children with Tourette's are of average intelligence, and yet one-third have been identified as learning disabled (Singer, Schuerholz & Danckla, 1995, as cited in Harrington).

3. Callosal agenesis is a disorder of the limbic system where the connective bridge of the corpus callosum was not formed (Cornett & Laurent). As discussed earlier, the corpus callosum is the bridge in the limbic system that connects and transfers information between the left and right hemispheres of the brain. It is interesting that researchers were recently debating the differences in size and development of the corpus callosum between males and females, and that callosal agenesis is unique to only females. This disorder results in "severe mental retardation" (Andermann & Andermann, 1994, as cited in Cornett & Laurent, 1998, p. 106). Because of the retardation it is assumed that normal functioning would be limited, but to the contrary, many individuals are able to "lead normal, productive

lives" (Cornett & Laurent, p. 107). The reading ability of girls with callosal agenesis falls within the average range for the IQ of a given age, yet at the same time, reading ability when attempting to read nonwords shows a marked deficit (Cornett & Laurent). This suggests that the development of the phonological aspects of reading is impaired despite normal lexical skills. Translating letter combinations into a sequence of sound must require communication between the right and left hemispheres of the brain (Temple et al., 1990, as cited in Cornett & Laurent).

4. Congential adrenal hyperplasia is a genetic disorder resulting from a recessive error on a non-sex-related chromosome (Boliek & Obrzut, 1998). The individuals afflicted produce high levels of adrenal androgens, which are "then converted into testosterone" (Boliek & Obrzut, p. 175). The high level of adrenal androgens caused female infants to take on masculine characteristics and male infants take on feminine characteristics. That, in itself, did not show gender differences, but the interesting thing was that studies have shown that when girls with the disorder reach school age, they are found to have "higher spatial abilities than their sisters", but had the same overall intelligence (Boliek & Obrzut, p. 175). In comparison, boys with the disorder had "lower spatial abilities" than normal

boys (Berenbaum; Hampson, Rovet, & Altmann, as cited in Boliek & Obrzut, 1998, p. 175).

All the examples of neurological and metabolic disorders previously discussed have educational implications, that require individualize interventions. One size does not fit all; although understanding of expected behaviors based on gender specific disorders can be insightful when educating boys and girls. There are other, less well-defined, disabilities that affect learning.

The exact causation for disabilities such as non-verbal learning disabilities, ADHD and dyslexia are not available as of yet. No particular chromosome or particular genes have been identified, but they are being researched extensively. The characteristics of ADHD and dyslexia are well documented, and the educational implications are clear. Yet the opinions on the effects of gender are changing. The disability characteristics are:

1. Nonverbal learning disorders (e.g., poor spatial organization, inattention to visual details, and poor visual imaging) (Mather & Goldstein, 2001), characterized by low performance IQ versus verbal IQ, awkward motor skills, dysrhythmic speech, poor calculation skills, marked constructional difficulties, poor social skills, but read reasonably well; these disorders were once thought to affect females more so than males (Johnson; Voeller; Weintraub & Mesulam, as cited in Obrzut & Hynd, 1991). In

more recent studies, the Learning Disabilities Research at the Kennedy Krieger Institute/Johns Hopkins School of Medicine dispelled earlier research. There had been a shift in understanding; nonverbal learning disorders alone did not occur often. Instead, individuals with nonverbal deficits usually had deficits in verbal domains and/or executive domains as well. This included fragile X syndrome, Tourette's syndrome, and ADHD, where the gender differences were varied. No data were given to support the earlier published data that females were more affected (Cutting & Denckla, 2003).

2. Dyslexia had an effect on both boys and girls when reading levels were significantly lower than typical children. It was once thought that, statistically, more boys showed symptoms of dyslexia than girls (Shin, 1998). According to Shaywitz and Shaywitz (as cited in Swanson et al.), there were indications of sex differences in functional organization of the brain for language. There was evidence of greater right-hemisphere involvement for females than for males, but current data shows that there are similar ratios of girls to boys who have symptoms of dyslexia (Shaywitz & Shaywitz, as cited in Swanson et al.). In many schools the ratio has been distorted, where male were over referred and girls under referred to special education. When looking at reading disabilities in general, no gender

difference in the number of children with reading difficulties was evident, but there was a predisposition to attention disorders in boys. This may be the cause of higher referrals into special education (Shin).

3. ADHD has been extensively researched in more recent years. The existing thought is that it had something to do with a deficit in cognitive domain of the executive function associated with the frontal lobe, resulting in metacognition difficulties (Swanson et al.). The data regarding the prevalence of ADHD in one gender more so than the other is changing, but there are differences in how the symptoms manifest themselves. Gender-related findings discovered that, despite an ADHD diagnosis, boys and girls performed differently. When reading ability was looked at, boys seem to use semantic clustering less often and recalled fewer words from the middle region of a list than girls. It was also found that girls outperformed boys in terms of overall recital, even if they had lower IQs (Swanson et al.). Under diagnosing of girls and over diagnosing of boys may have had less to do with neurobiology and more to do with behaviors that were more noticeable in boys. Therefore, the symptoms of ADHD needed to be considered in education from the psychological perspective as well as the medical perspective (Shin).

The value of understanding the differences in brain development of children with disabilities is to understand that genetically based disabilities can exhibit differently in males and in females. The noting of these differences may help in understanding and educating students with special needs. The neuroscientific justifications for gender difference overlap with psychological reasons for differences (Byrnes, 2001). It seems reasonable to believe that neurological differences might be the root cause for some differences in the typical psychological makeup of each, especially when considering disabilities. The interface between the two sciences requires understanding of each while still maintaining the separate existence and integrity of each. Reductionist philosophers argue that psychology can be reduced to a "lower level science" such as biology in finding causation of disabilities or gender differences (Byrnes p. 7).

Behavior and Gender Differences

It has been observed in the classroom, on the news, and in the general public that antisocial behaviors are, for the most part, displayed differently in girls than in boys. For example, the Council for Exceptional Children (CEC) (2003) reported in CEC Today Online that boys require more space to spread out and do their work, and they also required a variety of stimulations. The excessive movement exhibited in some boys has been interpreted as behavior problems, which causes academic troubles, and eventual referral to special education. Girls, on the other hand, are less obtrusive in other people's space and are generally quieter.

This recessive quality leads to a dismissal of their potential contribution and under referral to special education when needed (Gurian, 2001). Delinquency or antisocial behaviors have been observed in both adolescent girls and boys, but just like classroom behaviors psychologist have noted the differences in how those behaviors are exhibited. The following research was an effort to identify the differences in delinquency and the difficulties of those with ADHD.

When considering delinquency, differences were observed in girls and boys regarding the type of offenses. Boys typically were involved in "aggressive behavior, vandalism and theft, whereas girls" tended to have offenses such as" truancy and running away" (Chesney-Lind, 1999; Rhodes & Fisher, 1993, as cited in Huebner & Betts, 2002, p. 129). In 1994 Bergsmann (as cited in Huebner & Betts) published that boys were "traditionally reported" to have a higher rate of delinquent acts, but more recent statistics suggest that in later years "the number of girls involved in violent activities has increased at a faster rate than boys (16.5% versus 4.5%)" (p. 129). Huebner and Betts suggested that follow-up studies would be a valuable endeavor to see if the trend has continued.

Anderson, Holmes, and Ostresh (1999, as cited in Huebner & Betts, 2002) studied the differences between gender delinquency and the significance of attachment bonds. They found the "attachment to parents reduced the severity of adolescent boys' delinquency, whereas attachment to peers and school reduced the severity of adolescent girls'

delinquency" (p. 129). When studied in the context of gangs, it was found the girls reported "greater social isolation from friends and family than did boys in gangs. One interpretation for this finding could be that girls joined gangs, at least in part, to fulfill their need for relationship, whereas boys joined to fulfill their need for instrumental success" (Esbensen, Deschenes, & Winfree, 1999, as cited in Huebner & Betts, p. 129).

Other behavioral issues include bullying, self-control in conjunction with ADHD. The study completed by Unnever and Cornell (2003) investigated the influence of low self-control and ADHD on bullying and bully victimization in a sample of 1,300+ middle school students using a school survey. Analyses found that self-control had an important influence on bullying victimization, and that interaction with students based on gender and measures of physical size and strength were factors. The findings identified low self-control and ADHD as potential risk factors for bulling and victimization. This has implications for research on self-control in young adolescents, as well as how students react depending on whether they are male or female.

The extent to which students with ADHD are targeted for bullying had several variables. They may be vulnerable because of the correlation between ADHD and factors "other than poor self-control". Perhaps a student "whose ADHD is associated with poor social skills or lack of supportive peers is more likely to be victimized by a bully than a student without those same difficulties (Unnever & Cornell, p. 142). The

explanation may lie in the interaction between self-control and gender", in that different social values are placed on conformity versus aggressiveness in boys and girls. "Among boys, self-control is positively associated with being a victim, whereas among girls, the relationship between self-control and being bullied is negative (Unnever & Cornell, 2003, p. 142). The speculation can be made that "boys who" have high self-control can be at "risk for bullying victimization because they are not sufficiently assertive or aggressive in their behavior to discourage bullies from targeting them (p. 143). Conformity and passivity" in boys can be a "social liability". In contrast, self-control in girls is more consistent "with positive social qualities; therefore" those girls who lack self-control are more likely to be targeted for ridicule or "social ostracism" (Unnever & Cornell p. 143).

One aspect of bullying does not reflect any differences in behavior based on gender. According to Unnever and Cornell (2003), "when it comes to bullying, size matters" (p. 143). Students who are "taller and stronger than their peers are more likely to bully others" (p. 143). Weight, on the other hand, can be a characteristic of the bully or the victim. The student's weight can be associated with size for the bully, but obesity can also create the opportunity for ridicule (Unnever & Cornell).

The findings of Unnever and Cornell (2003) have implications for the classroom. Teaching students how to use effective strategies to deal with those who bully them depend on whether the students are girls or

boys. The CEC (Unnever & Cornell) reported that as of September 2003, between 500,000 and 1 million children under the age of 7 were prescribed psychotropic medications like Ritalin. Not surprisingly, most of those children were boys. Since 3% to 7% of the population have been diagnosed with ADHD and there were three times more boys than girls identified (Byrnes, 2001), chances are that the issue will need to be addressed in both the general education and special education setting.

Significance of Gender Differences Regarding Instructional Strategies

The research regarding the comorbidity of ADHD and reading ability, depending on gender, has potential impact on instructional strategies used to address the needs of developing readers diagnosed with ADHD. The neuropsychological profiles of adolescents with ADHD developed by Rucklidge and Tannock (2002) hypothesized that girls with ADHD would be less impaired in executive function (categorization, working memory, and fulfilling goals or instructions) based on the results of previous studies. The limitations of previous studies were that girls were not represented in significant numbers. Typically studies were predominantly male-centered, due to a greater preponderance of males in clinically referred samples. The advantage of current data is that there are an equal representation of females and males in the study. Preliminary studies of Rucklidge and Tannock have suggested that:

1. ADHD females may be less vulnerable to the executive deficits displayed in boys.

2. ADHD females had poorer language functioning and similar executive functioning as compared with ADHD males (Seidman, Beiderman, Faraone, Weber, & Ouellette, 1999, cited in Rucklidge & Tannock).
3. Previous results used data that yielded significant gender differences in processing speed and vocabulary on the Wechsler Intelligence Scale for Children–III with ADHD males showing slower processing speed and ADHD females showing lower vocabulary scores.

The results of the current study by Rucklidge and Tannock (2002) yielded very different results:

1. Groups were compared across gender lines on the naming and inhibitory tasks and no gender differences were found.
2. Even though it was found that ADHD boys showed overall slower reaction times, their analysis indicated that the slower ADHD responses came about because of a greater proportion of abnormally and not due to the generalized slowing of all responses.
3. No gender differences were found on the executive measures within the ADHD groups, indicating that the females were as impaired as males on their level of inhibition, response execution and naming speed.

4. Rucklidge and Tannock's findings of no gender differences in executive functioning were supported by other research, as well (e.g., Castellanow, Marvasti, Ducharme, Walter, Israel, Krain, Pavlovsky, & Hommer; Houghton, Douglas, West, & Whiting; Kuntsi, Oosterlann, & Stevenson, as cited in Rucklidge & Tannock). Prior results showed ADHD females less impaired on tests of executive function than ADHD males. Rucklidge and Tannock suggested that once the effect of a stimulant medications were removed, females were as impaired as the males.

The changing data and opinions of those conducting the research discussed above make developing instructional strategies based on gender differences ineffective. Given recent available information, the most effective strategies create learning environments that maximize student attention (Byrnes, 2001). Teachers need to use content that is interesting to students, hold moderately high standards of performance where students are held accountable to those standards, established routines to allow efficient progress toward goals, but periodically change routines to engage the orienting aspects of attention. Students should be active participants in the learning process to construct their own understanding (Byrnes).

Perhaps an open mind to changes in the research would be prudent. Other findings not related to ADHD, but behavioral and social

interactions have yielded more conclusive results. The information previously discussed regarding delinquency by Huebner and Betts (2002) also suggested intervention for both in school and after school setting showed positive results.

One interesting finding regarding gender differences concerning involvement in activities found that boys were more likely to show up somewhere without invitation and expect to participate (Huebner & Betts, 2002). This could be seen in pick-up sports games. Girls, on the other hand, felt that they needed to be invited. It was found that participation was greater when the girls were invited and a specific time was set (Huebner & Betts).

The implications for education is that for better participation on the part of girls in the classroom to take place, it is necessary to invite them into group activities and be specific about the role they will play and the duration of their involvement. If a blanket statement is made, "Everyone, just come and join in," girls are left out (Huebner & Betts, 2002).

Researchers have also examined the relationship between activity participation and delinquent behavior (Eccles & Barber, 1999; Mahoney & Stattin, 1998, as cited in Huebner & Betts, 2002). They suggested that all after-school activities were not created equal; that is, the type and context of the activity made a difference in adolescent outcomes (Blum, Beuhring, & Rinehart, 1999; Eccles & Barber, as cited in Huebner & Betts). The study by Eccles and Barber (as cited in Huebner & Betts) of the

extracurricular activities of 1,290 Caucasian adolescents, suggested that the protective function of participation in extracurricular activities depended, in part, on the type of extracurricular activities considered, as well as the gender of the adolescent. Results of the study found that youth involved in prosocial activities such as church and volunteer work were less likely to participate in risky behaviors than were their noninvolved peers. The study also revealed that whereas participation in team sports was related to higher GPAs, a greater chance of college attendance, and positive connections to school; it was also associated with an increased likelihood of alcohol use for boys. In the Mahoney and Stattin (as cited in Huebner & Betts) study of more than 700 14-year-olds and their parents, it was found that adolescent participation in highly structured leisure activities was inversely related to antisocial behavior. As well as, participation in minimally structured leisure activities was related to higher levels of antisocial behavior, especially for boys.

The above reported research findings can be generalized into the school setting, in that, good structure within the classroom would alleviate many problems with antisocial behavior. Since boys are more likely to exhibit problematic behaviors, structure may be most beneficial to them.

It appears as though both out of school attachment and involvement have the potential for a positive influence on academic achievement and against delinquency. The role of gender in determining the salience of these bonds for both deviant and positive outcome

remained unclear. The conclusions drawn from the Huebner and Betts, (2002) study were that:

1. Attachment was important to girls and revealed a preference in coping styles. The research suggested that girls tended to rely more on social networks for support than did boys. Boys, on the other hand, tended to use methods of distraction more than girls (Seiffge-Krenke, 2000, as cited in Huebner & Betts). It was believed that these differences were due more to socialization processes than to any innate differences in the need for relationships. Boss (as cited in Huebner & Betts) stated that gender role socialization that occurs in the US deprived each gender of effective coping resources, thus interfering with successful stress management.
2. Boys and girls who were involved in structured activities tend to perform better academically.
3. The implications of the study were that, regardless of gender, parents should not discount the importance of their adolescents' out-of-school time activity involvement.
    a. Parents should encourage their community to provide a variety of out-of-school time programming options, so their children can participate and develop the competencies they would need to become successful adults.

b. When activities were available parents should support the child involvement with other caring adults.

c. Young people needed a variety of role models in their lives, and parents should be proactive in surrounding their adolescents with other adults whom they respect.

4. Youth development professionals needed to be intentional about the relationships they foster with adolescents in the activities they offer.

   a. Girls needed to be invited and encouraged to participate in activities by a caring adult.

   b. Boys used conventional activities as a means of fostering positive relationships with adults and peers (Huebner & Betts).

Knowledge of the foundations of personal relationship of boys' versus girls can be used to encourage students at risk for antisocial behaviors to participate in out of school activities that will foster better prosocial behaviors.

Many gender differences observed in adolescence are not of a negative quality. They are simply differences. The few noted characteristics that differ between adolescent girls and boys include a myriad of subtleties. A prolific writer, educator, and family therapist, Michael Gurian (2001) researched and recorded many of these differences. Maturation played a role in the attributes of each gender, with

characteristics of boys and girls changing over the time frame of early adolescence through late adolescence. The characteristics evident in the fourth through sixth grade shown in Table 1 are different than the characteristic shown in Table 2 of students in the middle school grades and Table 3 of students in the high school grades.

These characteristics include, but are not limited to, the sample provided by Gurian (2003). The attributes of students in the fourth through sixth grades are samples of hormonal, social, and educational differences (Gurian).

Table 1

Gender Differences of Children in Grades 4-6

Male	Female
Hormones begin to increase at age 10	Affected by hormone changes earlier than boys
Predominantly focused on action, exploration, and things	Predominantly focused on relationships and communication
Preferred method of conflict resolution is aggression	Most likely will not use hitting to resolve conflict
Better map reading and deciphering directions skills	Better fine-motor skills
More likely to need remedial reading	Better at learning a foreign language and singing in tune
Can solve math problems without talking it out	Often needs to talk a math problem through
Better at chess	Better at learning a foreign language
Channel surfs when watching TV	Watches one TV program for longer periods

The second group, found in Table 2 (Gurian, 2003), consisted of students in middle school. These characteristics begin with hormonal changes due to maturation and have an effect on the confidence and potential achievement of boys and girls.

Table 2

Gender Differences of Children in Middle School

Male	Female
Testosterone increases	Estrogen increases
Testosterone helps to develop body at a ratio of 40% protein to 15% fat	Estrogen helps to develop body at a ratio of 23% protein to 25% fat
Testosterone is an aggression-inducing chemical	Estrogen generates increased activity in the brain
Amount of male hormones is related to success on traditional male tasks	Amount of female hormones is related to success on traditional female tasks
Talkativeness in class often is to gain attention	Quietness in class shows confidence
Poor achieving boys are 50% more likely to be retained in current grade	Poor achieving girls are 50% less likely to be retained in current grade
More likely to be victims of physical abuse	More likely to be victims of sexual abuse

As the students continue to mature, the differences become greater with social aspect playing a larger role. Not only are the students more focused on their future, but they are also more concerned with appearance and comparing themselves to their peers. This comparison often leads to a social hierarchy that dominates the school environment. Table 3 gives a larger sampling of differences between boys and girls in high school (Gurian, 2003).

Table 3

Gender Differences of Children in High School

Male	Female
More often concentrate on career considerations	More often concentrate on intimate personal relationships
Focus on strength and masculinity to have sexual attractiveness	Focus on slender appearance to have sexual attractiveness
Accepted socially when athletic and shows physical strength	Accepted socially based on beauty and peer relations
Social hierarchy among male peers tends to be stable	Social hierarchy among female peers tends to be fluid
Pursues power	Pursues a comfortable environment
IQ scores increase dramatically between 14 and 16	IQ scores drop off during middle school but rise in high school
Bullies are still popular among male peers	Bullies are unpopular among female peers
Jocks are more sexually active	Jocks are less sexually active
Graduated at a lower rate than girls	Graduated at a high rate than boys
Less likely than girls to suffer from clinical depression	Up to 50% of girls reported one episode of clinical depression during high school

Developmental gender differences cannot be viewed as positive or negative, but only as different. Consequently, the educational approaches to teaching adolescents differ to address unique educational needs of the

student, whether they be male or female. The nature of those educational approaches is discussed in chapter IV.

Conclusion

New research into the differences between the male and female brain has value, especially if knowing the baseline differences in normal female and male brains are used for therapeutic and educational reasons. Instead, most of the recent research is to simply gain new knowledge. According to Rogers (2001):

> There is nothing wrong with this in itself, but perceived biological difference is usually used to divide one group of people from another. All too often one group describes itself as "biologically" superior to another to justify holding power or most of the resources in a society. Biological difference is rarely seen as being value free. (p. 12)

Historically, the beliefs in gender differences have been used to show superiority of males versus females. Newer research has dispelled these myths, but this is not to say that psychological and biological differences do not exist.

The distinction between learned and biological maturation might not stand up under scrutiny, since the separation of developmental psychology and developmental neurobiology is the basis for these two distinctions. Developing hypotheses regarding gender differences when only considering the psychological or neurobiological sciences'

perspective would be considered reductionism. Integration of the two is necessary. The debate over whether the biological development of the brain or the influences of environment are responsible for cognitive development will continue. It was the opinion of Quartz and Sejnowski (2000) that "there is an increasing dialogue between developmental psychologists and developmental neurobiologist, suggesting that the developmental sciences are transforming into an integrated approach that will reveal a far richer account of how cognitive life is constructed from the developing brain" (p. 791).

The ambiguity of the research justifies some skepticism of unsubstantiated research. Much of the discrepancies are based on the dates of publication, in the sense that the older the research is, the more likely it is to contain biases. Implementation of instructional strategies using outdated or uncorroborated information would be unwise. Therefore, analysis and careful consideration of new evidence pertaining to neuroscientific data and psychological analysis, which take into account societal changes, is an ongoing process. With careful consideration of the research, effective instructional strategies can be developed to meet the education needs of both boys and girls in general education, special education, and extracurricular school activities.

CHAPTER III

PROCEDURES OF THE STUDY

This study required a comparative examination of past potentially biased literature and current scientifically based literature on gender differences of children in the context of the learning environment. An effort was also made to gather information with opposing conclusions in an attempt to avoid a biased representation of the related literature. This qualitative approach (McMillan, 2004) was used to analyze research of the differences based on gender from a wide variety of sources.

A review of related literature was conducted as an in-depth study of valid current literature available in books, professional journals, periodicals, and websites. Resources published after 1995 was considered to be current, whereas literature prior to 1995 is considered historical. The historical perspective was often cited in current literature for comparative purposes. For the purpose of locating information from the library at a small regional institution, databases (e.g., Articles First, ERIC, and Pro Quest), and the Internet, key words used for these searches included a combination of the following terms: gender, girls/boys, or male/female in conjunction with cognitive skills, education, assessment, curricula, classroom instruction, behavior, intelligence, learning, learning disabilities, memory, neuroscience, psychology, and brain development. The above was not considered a comprehensive list

of terms, but when used in a variety of combinations was projected to net the most effective results.

The research fell into three overlapping domains, psychology, neuroscience, and education with both qualitative and quantitative studies represented. Those in the field of neuroscience relied on autopsy, MRI, and other brain imaging technology to study developing brains of boys and girls, psychologists used observations in the natural environment as well as laboratory situations, and as a result of both, educators used the research evidence to develop best practices for creating a inclusive educational setting that addressed the needs of both boys and girls.

The information gathered from the research was organized into topical areas which included:

1. Historical thought on the characteristics and capabilities of each gender.
2. Psychologists' perspective.
3. Neuroscientists' perspective.
4. Intertwining of the two perspectives.
5. Educational implications.
6. Gender differences affecting students with exceptionalities.
7. Educational implications for students with exceptionalities.

The general topic areas were selected after results from preliminary readings seemed to indicate that the thoughts provided from a historical perspective differed from the psychologists' perspective, which also

differed from the neuroscientists' perspective. To get an inclusive view of gender differences, all three perspectives needed to be included. Incorporating both the psychological and neuroscientific views also helped to apply the information to education.

From this study, classroom practices are recommended that are designed to encompass student educational and social needs with the support of current research. Careful consideration is made to eliminate old cultural biases and to reflect realistic research based generalizations regarding the difference between the genders.

CHAPTER IV

RESULTS OF THE STUDY

The literature reviewed reflects a change in attitudes, which may be a result of a continuing change in perceptions regarding the talents and abilities of both boys and girls. It would seem that the perpetration of the myths of the past could only work to limit the potential of both sexes (Campbell & Storo, 1995). It is interesting to note that teaching has traditionally been a gendered career, and up until the mid-nineteenth century, the gender had been male (Sadker & Sadker, 2003). When females began to enter the teaching profession, they were considered gender trespassers because of their ambitions. At the time, ambition was considered a masculine domain. As the tables turned and women began to dominate the profession, new concerns arose, which were fears that female teachers would feminize the boys in their charge. Toward the beginning of the twentieth century, attitudes regarding men in the teaching profession became negative. Conventional wisdom was that effeminate men were gay and gay men were drawn toward teaching; therefore all men in the teaching profession were looked at skeptically (Sadker & Sadker). Hopefully, societal stereotypes have evolved to the point where the gender straightjacket has loosened, and educators can turn their attentions to providing equal opportunities to both boys and girls; recognizing both sexes do not learn in the same fashion.

Impact on Education

Title IX of the Education Amendments Act set into law in 1972 prohibited sex discrimination in education. Before Title IX, classes such as home economics were only for girls and shop was only for boys. Breaking the gender wall has been an ongoing process (Sadker & Sadker, 2003). Gender stereotyping has decreased over the past couple decades. This is, in part, due to enlightened teachers who have changed the way they teach, and have challenged the sex-role stereotypes of men as doctors and women as nurses, men as managers and women as secretaries, men as construction workers, and women as homemakers, and so forth. Glass walls still remain that keep men from entering traditionally female roles and women from entering traditional male roles (Sadker & Sadker). Progress has been made toward equality, but more focus needs to be made on becoming aware of gender specific learning styles to address the needs of both girls and boys in the classroom.

Instructional Environment and Strategies

Within the educational environment individuals within homogeneous groups of students have different learning styles; these learning styles could be typical for genders, but not always. Recognition of this brings an awareness of stereotyping, which involves absolute statements applied to all members of a group while ignoring individuality. Generalizations, on the other hand, offer information about groups to teach more effectively (Sadker & Sadker, 2003). Through knowledge

regarding gender differences teachers might help to ensure that they demonstrate sensitivity resulting in equalization of educational opportunities for both girls and boys. Some considerations include:

1. Classroom environment.
2. Classroom strategies designed to address student-learning styles.
3. Equal instructional attention.
4. Model behaviors that reflect sensitivity.
5. Typical pedagogical cycle of structure, question, respond, and react.

One size does not fit all. The ultimate goal of education should be to have students become self-directed, productive problem solvers, and thinkers regardless of gender (Gregory & Chapman, 2002). Classroom environment could contribute or detract from the ultimate goal. The learning community should:

1. Be conducive to emotional well-being (Gregory & Chapman).
2. Engage all regardless of learning styles and assessment preferences (Gregory & Chapman).
3. Envelop a feeling of safety (Gregory & Chapman).
4. Accommodate the needs of different kinds of learners, with the recognition that different children show aptitude or giftedness for different things; whether it be linguistics, logical-mathematical,

spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, or naturalistic (Armstrong, 2000).

In the broadest sense, the above can be generalized to genders, in that with a few exceptions males and females will show a preference with regards to acceptable classroom environments based on gender (Gregory & Chapman).

Second, strategies varied to attend to differences in knowledge acquisition equalize the opportunities to excel of both boys and girls. Some of the things to consider are:

1. Planning instruction with an awareness of how new information and skills are acquired by different students (Armstrong, 2000).
2. Using single sex and mixed gender cooperative learning groups. In cooperative groups the dynamics of the group could dictate the appropriateness of the group. There are times when members of the mixed gender group complement each other and aid in a fostering better understanding of the strengths that each member brings to the group. But, there are times when single sex groups allow for greater comfort for one gender because of a sense of inferiority and the natural tendency to withdraw when faced with concerns of those of the opposite sex witnessing the failures (Gurian, 2001).
3. Using adjustable assessments that are able to assess student learning in more than one way (Armstrong; Gurian).

4. Tracking amount of time given by the teacher to each gender during instructional time (Caplan, Crawford, Hyde, & Richardson, 1997).

Third, a physically and emotionally safe atmosphere is conducive for all learners to perform to their utmost capacity; therefore, the climate fostered by the teacher plays an important part in the learning process. To build a community of learners, respect for the individuality of the members is an important component. Students will not feel safe when bullying and sexual harassment are tolerated (Unnever & Cornell, 2003). The aggressive nature of boys can foster healthy competition, but if aggression leads to bullying behaviors, it is time for teachers to intervene. Students who exhibit learning disabilities can also become easy targets for aggressive students' ridicule (Unnever & Cornell). In contrast, those with learning disabilities may also be the aggressors. In either case, whether male or female, aggressors or victims, modeling respectful behaviors will lead to an environment conducive to learning, one where everyone has a voice (Gregory & Chapman, 2002). A teacher is charged with the responsibility of creating the appropriate classroom climate, and any time a teacher can create a risk-free supportive environment where students can feel safe and where they can thrive, it needs to be implemented (Gregory & Chapman).

Finally, the pedagogical cycle could be skewed in that questioning is the key to guiding learning. When the academic interaction is allowed

to take the typical course, boys will ask more questions, will call out answers without being called on, and their answers will be accepted more readily (Sadker & Sadker, 2003). According to Sadker and Sadker, teacher expectations play a role and are frequently cited as one of the reasons male students receive more questions and more active teacher attention than female students. The key would be to institute a protocol for student participation in the process of questioning and responding (Sadker & Sadker). The structure established by developing predictable protocol would also improve academic performance of both girls and boys (Huebner & Betts, 2002). When the teacher controls student responses to questions by having the students wait for recognition before responding, the opportunity to invite girls to participate becomes available. Huebner and Betts concluded that to establish gender equality regarding participation, girls often needed to be invited to participate before they will volunteer answers and boys will act without invitation to participate.

A key factor is for teachers to know the learners in their charge. Armstrong (2000) suggested that standardized tests are only a partial measurement of ability, and not a good measure of learning styles. Presenting the concept of multiple intelligences and then assessing each student's learning style as it relates to multiple intelligences can be done through assessment inventories (Armstrong). The realistic appraisal of student performance in the many kinds of tasks, activities, and experiences associated with each of the intelligences may be effective.

The results of this type of assessment indicate whether students are linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, or naturalistic (Armstrong), and those results may also show a trend where results may be aligned based on gender. Charting the results can then be used to differentiate instruction to address the variety of student intelligences (Armstrong). The concept of multiple intelligences is not the only way to consider learning styles; individual students can also show other preferences in learning styles such as being auditory, visual, tactile, kinesthetic, or tactile/kinesthetic learners (Gregory & Chapman, 2002). To know if individual students are imaginative or analytical learners is also important, since these learners may be gender specific in learning preferences (Gregory & Chapman). Specially designed curriculum, instruction, and assessments that address the different learning styles can give students the opportunity to showcase their talents in ways that are natural, which reduces the chance that curriculum, instruction, or assessment are gender biased.

Assessment

The current legislative need for accountability has resulted in standardized tests given at several grade levels. Standardized tests are also required of students wishing to gain admittance into higher education. Both have the potential to be flawed. Test bias remains a constant problem as race, culture, and gender issues compromise the tests, since one size does not fit all (Sadker & Sadker, 2003). High stakes testing

determines whether a student gets a high school diploma, college admission, and scholarship awards, yet in 1990 a lawsuit in New York determined that high stakes tests discriminate against girls (Sadker & Sadker). It would be improbable to think that all the discriminator issues have been totally resolved today. One addition to standardized tests that equalizes the opportunity for success is the addition of an essay format to tests. In general, the essay format favors girls; whereas the multiple-choice format favors boys (Gurian & Ballew, 2003). Boys use quick deductive reasoning to single out information rather than think out the larger range of possibilities, as girls do. Many boys are more prone to risk taking activities, therefore answer questions under pressure and even guess without difficulty (Gurian & Ballew). Even though standardized tests have favored males, with an approximate 7-point advantage in verbal areas and 35 points in mathematical areas, males earn 70% of the Ds and Fs and only 40% of the As in school (Gurian & Ballew). This would suggest that standardized tests could be an artificial measure in an artificial setting far removed from the real world (Armstrong, 2000). There are more authentic assessment measures available.

Authentic assessments cover a wide assortment of instruments, methods, and measures. Armstrong (2000) has suggested that observation gives the best picture of student achievement giving the students an opportunity to demonstrate evidence of competence in a wide range of topics taught in school. The observations are made in real-life

context. According to Armstrong, assessments can take many forms, which include but are not limited to:

1. Anecdotal records where the teacher records accomplishments, interactions, and relevant information on each student.
2. Portfolios of student work samples.
3. Audio or videotape of individual students at work or of group dynamics.
4. Photographs snapped to preserve moments or projects created by students.
5. Student journals used as an ongoing record of their experiences.
6. Student-kept charts on their academic progress.
7. Sociograms to keep a visual record of student interactions with others, whether they are positive, negative, or neutral.
8. Informal use of standardized tests where the rules are not stringent and the opportunity to experience the standardized test format is given.
9. Student interviews that give the student the opportunity to voice their thoughts and concerns.
10. Criterion-referenced assessments that are not norm referenced but are assessing the individual abilities on a specific set of skills.

11. Checklists used as information, criterion-referenced assessments to check off demonstrated competencies during daily tasks.
12. Classroom maps to document daily patterns of movement, activity, and interactions of students.
13. Recording activities and accomplishments on a calendar.
14. Projects with an accompanying rubric to measure the student's ability to apply what he or she has learned.

The theory of multiple intelligences suggests that varied assessments, such as the assessment listed above, can provide the most accurate picture of student achievement. Skills demonstrated via paper and pencil tests that are balanced with performance based assessments help to level the playing field for both boys and girls. Assessments designed to address the multiple intelligences include (Armstrong, 2000):

1. Linguistic demonstrations where students use their own words orally or in open-ended written format.
2. Logical-mathematical demonstrations through scientific principles, laws, theorems, or mathematically.
3. Spatial demonstrations through drawings, diagrams, or charts.
4. Bodily-kinesthetic demonstrations where understanding of a principle can be acted out or demonstrated through motion.
5. Musical demonstration where principles are demonstrated through song, instrumental representation, or sounds.

6. Interpersonal demonstrations relating a concept to one's own life experiences.
7. Intrapersonal demonstration describing a concept through someone else's eyes.
8. Naturalist demonstration of the recognition that the natural world can be integrated into a topic

Variety in assessment addresses differences for heterogeneous groups not only of the gifted, learning disabled, and racially diverse, but also differences between genders.

Role of Gender and Mathematics

Meta-analysis of gender differences with regard to mathematical performance conducted by Hyde, Fennema, and Lamon (1995 as cited in Caplan et al., 1997) was based on 100 studies that provided a sample of over 3 million people. The results suggested that the long held belief in male superiority in mathematics was incorrect and the differences in mathematical cognition were statistically insignificant. Yet boys still seem to hold an advantage in math in school; therefore, the advantage may be in the way that mathematics is traditionally taught. The mathematical success of boys may have had an unseen benefactor; boys ages 12 to 13 in Grade 7 may have had as much as 36 more hours of mathematics instruction than girls (Caplan et al.). The reasons may not be easily seen, but boys demand more attention by nature and teachers may expect less from girls, discounting their desire for assistance. To reduce the gender-

based disparity, varied techniques are needed to encourage learning (Gurian & Ballew, 2003):

1. Cooperative learning groups which take the pressure off individuals when they are answering for the group and not just themselves. Less confident girls paired with other girls will feel more inclined to participate and pairing strong girl math students with boys who will allow her a voice allows girls to fully participate.
2. Call-on ratio needs to be equalized so that not only are the outgoing boys allowed to answer, but others as well.
3. Showcase work to show equality in mathematical achievement.
4. Use a variety of approaches. Combining clear, complete, repeated instructions with visuals and hands-on activities becomes a multisensory approach that is engaging for both genders.

According to the U.S. Department of Education, boys are starting to lose the advantage in mathematics (Gurian & Ballew, 2003). This most likely can be credited to increased sensitivity to different learning styles and addressing those differences in classrooms.

Role of Gender and Language Arts

Traditional thought regarding gender differences in the subject of language arts favored the girls, but meta-analysis of verbal ability in large longitudinal studies conducted by Hedges and Nowell (1994 as cited in

Caplan et al., 1997) found no statistical difference between genders. Here again, the learning modality may create differences. Techniques to encourage learning should include (Gurian & Ballew, 2003):

1. Scholarly discourse where students are encouraged to talk and listen to each other, not just the teacher.
2. Seminar formats where everyone participates, nobody needs to raise their hand, those who are shy are included, silence is allowed, and compulsive verbal responses are curbed.
3. Connecting language arts to other experiential processes to make a connection that addresses different interests.
4. Movement that helps to release pent-up energy, stimulates the bored, and regains the tuned-out brains.
5. Graphic organizers to organize content and personal expression.
6. Note-taking innovations taught through modeling so girls who want to write every detail and boys who have shoddy notes can learn to find an effective middle ground.
7. Buddy note taking that holds the note taker responsible for helping others; thereby motivating him or her to take better notes.
8. Multisensory learning through visual aids, auditory lectures, discussion, and the kinesthetic act of taking notes.
9. Finally, topical projects by gender.

The use of language is not exclusive to one gender or the other (Gurian & Ballew, 2003). On average, males may produce fewer words and frequently work in silence and girls produce more words. Boys may use jargon and coded language found in sports for example; whereas girls conceptualize thoughts in everyday language with concrete details (Gurian & Ballew). Gender preferences may be different but not necessarily unequal.

Role of Gender and Language Acquisition

A study done by Baker and MacIntyre (2000) investigated the gender issues regarding communication and learning a second language. Many of the observations made can be applicable to communication of a first language and applied to how the genders communicate effectively but in different ways. It is fairly common knowledge that immersion in a language will help to speed the process of learning that language. Students immersed in a language show more willingness to communicate, have a higher competence, communicate more frequently, and have less anxiety (Baker & MacIntyre). But it is not as straightforward as we might think.

From the standpoint of teaching, it is important to note that knowing what makes one student a better communicator than another could lend to an understanding of how to present curriculum. The understanding of differences could help teachers develop an appropriate environment that would promote learning regardless of the diversity. Immersion in the

desired communication has its advantages. According to Baker and MacIntyre (2000), the constant interaction increases:

1. Perceived competence.
2. Actual mastering of language.
3. Willingness to communicate.
4. Frequency of communication opportunities.
5. Improved attitude toward the language.
6. Sense of satisfaction.
7. The likelihood of exploring further in their language acquisition.
8. And the reduction of anxiety when communicating.

In addition, there were variables that contributed to the success of immersion and nonimmersion second language learners (Baker & MacIntyre, 2000). Individual personality also figured into the equation. The conventional thought has been that females were generally more linguistically inclined, whereas males were more spatial. This would seem to indicate that females would excel in language immersion learning situations to a greater degree than males. This has been proven to be untrue. Based on the data from Baker and MacIntyre's research, the conclusion was drawn that female nonimmersion students did better than female immersion students. On the contrary, male nonimmersion students did poorly compared to male immersion students. This would dispel the notion that females were more socially oriented than males (Baker & MacIntyre). The only area that there was a significant difference

in performance was between nonimmersion males and females, being that female students were able to be more successful in that environment. Another variable was perceived competency. Speaking can be a very anxiety-provoking form of communication. Nonimmersion students may have just as much knowledge and ability as those in immersion classes, but because the immersion students have had the opportunity to practice speaking, they were more willing to risk speaking out a mistake than those whose perception was that they have less ability.

As Herring (2000) and Burkett (2001) indicated in their research, the aggressive nature of male communication may aid males in an immersion setting, whereas females prefer the less intimidating nonimersion language classroom environment. This could be generalized to all communication skills. Anxiety and the perceived inability to communicate, whether it is true or not, can inhibit one's abilities to converse effectively.

The Role of Gender and Students With Exceptionalities

Currently three times as many boys are diagnosed with learning disabilities than girls, and ten times as many boys are diagnosed with behavior disabilities than girls (Gurian & Ballew, 2003). Guiran and Ballew (2003) recommended some teaching techniques to encourage learning for students with exceptionalities that include:

1. Bonding with students at risk and those difficult to get close to. This bond with one teacher can serve as an intermediary in

improving relationships with other teachers. Often boys with learning disabilities for one reason or another do not have males bonds and could benefit from a bonding relationship with a male mentor.

2. Structure and order to establish predictable routines and boundaries provides students an opportunity for academic success and some students with the added bonus of social success.
3. Consistent guidelines and discipline that are set and enforced in a fair manner.
4. Lack of pressure or blame.
5. Safe spaces where students feel secure.
6. Personal bulletin boards or a way to showcase positive attributes of special needs students. Since these same students may be prone to drawing negative attention to themselves, which is better to them than no attention at all. This way they can take ownership in something that shows their abilities in a more positive light.
7. Classes within classes to build confidence and take learning risks while still among their peers without learning disabilities.
8. Separate-sex learning to remove distractions and create bonding between those with like disabilities and interests.

9. Character education integrated into subject areas to reduce behavior issues and help students fit within the social norms.

Many students identified as learning disabled or behaviorally disabled have similar attributes as girls and boys in the general education setting (Unnever & Cornell, 2003). The recognition that one size does not fit all and gender can play a role in the aptitudes and interests of students will help in designing special education instruction and classroom environments conducive to optimal learning.

Maturity Gap

During the teenage years the maturity gap is quite noticeable, with girls maturing physically and emotionally more rapidly than boys. Gurian (2001) suggested that there is a pronounced brain-based gap between males and females, where female hormonal maturation starts earlier and causes girls to gravitate toward long-term emotional attachments but in contrast the male hormonal immaturity causes boys to gravitate toward short-term experimental attachments. These opposing motivations conflict within the confines of the school. If not addressed, they can lead to sexual harassment, different motivations for becoming sexually active, and the interpretation of boy immature behaviors as defective behaviors subject to disciplinary actions (Gurian & Ballew, 2003). This can be a profoundly disruptive attribute of classroom life in middle school and high school. Appreciating the fact that not all students mature at the same rate and

respecting those differences is a necessity in any secondary school setting.

Summary

Addressing the needs of a diverse population within the classroom addresses the needs of boys and girls to an equal degree. Since much of literature has either been conflicting, has shown no statistical difference in cognition between genders, or has shown generalized differences in behaviors and attributes of each gender; the environment within the educational setting has to accommodate all students. For students to attain their optimal level of success, teachers must be aware that differences do exist and it is their obligation to instruct and assess in several different formats; as a result this will assure that all students have a fair and appropriate education. Educators must remember that the myths of the past do not apply to the realities of today.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Beliefs regarding the differences between males and females, their attributes or inabilities based on gender, have developed over time with little to no unbiased research behind them. Myths have been passed from one generation to another. The current literature obtained has attempted to remove the bias in an effort to understand gender differences or lack of differences from the viewpoints of psychology and neuroscience, and to see where the two sciences agree or disagree. Current literature does agree on one thing: myths that concern achievement potential for boys and girls lack validity.

Through focused research psychologists have determined that gender bias could be found intertwined throughout our society, including schools. It was found that parents and other influencing adults taught gender roles from birth, and as a consequence, the gender role learned could serve to limit the boys' or girls' potential as they grew, because of the expectation to adhere to societal gender norms. Gender bias can be found in the gender specific expectations that parents had for their children, exhibited through media such as television and magazines, children's literature, textbooks, classrooms, instructional designs, assessments, and communication tools such as computers.

The acquired attributes of boys and girls change as those children matured. These attributes had a huge effect on the dynamics of the classroom, in that they became a barrier to individual hopes and dreams of those students who did not wish to fit within the parameters developed from our cultural beliefs about gender roles. With that said, there are still generalizations that could be made about the typical behavior of males and females; how they addressed conflict, relationships, aggression, and learning has been found to be divergent. This information is worth consideration because it was ever present in the classroom.

Neuroscientists have taken a different road in researching gender differences. The work being conducted in neuroscience could corroborate or refute current thinking regarding cognition and learning of males and females, and will continue to change further as technology evolves. Older technologies such as EEG, CAT scan, PET scan, and MRI have been useful in the study of brain development, but will become less useful as technologies such as MEG, which measures the very faint magnetic fields that emanate from the head as a result of brain activity, improve and become more available to researchers. As the technologies improve, a better picture of the brain's anatomy and the correlating functions of the anatomy of the brain will become clearer. The differences between male and female brains will also become clearer. At present, the role of the corpus callosum, located within the limbic system, in connection to developmental and learning differences between males and females is

debated. Further study will need to be made to obtain a definitive answer. Neuroscientists are challenged with the task of researching gender differences based on the biological structure of the brain independent of societal influences. The brain is not the only biological possibility to consider; gender specific hormones and genetic coding of female and male DNA have an influence as well.

Gender specific disabilities are often genetically based or showed gender specific characteristics even though scientists have not made the genetic connection yet. The value in understanding the differences in brain development of children with disabilities was to understand that genetically based disabilities could exhibit differently in males and in females. The gender specific genetic exceptionalities included fragile X syndrome, Down's syndrome, mycolpholysaccharidosis Type II, Lesch-Nyham disease, Lowe syndrome, Klinefelter's sysdrome, Turner's syndrome, and Rett syndrome. Gender specific metabolic disorders include autism, Tourette's syndrome, caollosal agenesis, congential Adrenal Hyperplasia, and ADHD. The implications for education, in general, are that an understanding of possible expected behaviors based on gender specific disorders could be constructive when teaching students with exceptionalities.

Behaviors that are deemed antisocial or destructive also exhibited themselves differently in boys and girls. Antisocial behaviors are identified more often in boys than girls, but more over, the behaviors are acted out

differently in boys who had been diagnosed with emotional behavioral disorders, versus girls with the same diagnosis. This included a discussion on bullying and victimization. Instructional strategies could be implemented to more effectively address individual student needs based on their behaviors, learning difficulties, and social difficulties.

Most gender differences observed in children are not negative qualities, only different qualities. The observed differences are divided into developmental milestones; elementary grades, middle school, and high school age ranges. The observations are comparative, where each characteristic is neither negative nor positive, only different.

Given the information presented by psychologists and neuroscientists, instructional strategies could be implemented to meet the needs of boys and girls as they proceeded through the educational process. Boys and girls learn mathematics and language arts in different ways, acquire language differently, mature at different rates; therefore teachers ought to present educational material in a multitude of different forms to address the diverse needs of the students in their care. The optimal commitment of teachers should be to insure educational equality while removing the glass wall that serves to limit the potential of young people. This can be effectively achieved by developing instructional environments, instructional strategies, authentic assessments, equalized instructional time, and overcoming the cultural biases present today, because one size does not fit all.

Conclusions

Myths perpetrated from the past have a deep-seeded presence in cultural beliefs of today regarding the characteristics of females and males. What children can or cannot accomplish in school has been based on inaccurate and unfounded information, and because of this, students have been denied educational opportunities based on gender. The current literature in the fields of psychology and neuroscience has dispelled many of the myths. Although perceptions are changing, unfounded beliefs remain in the minds of teachers, parents, and students. When evaluating the validity of the literature a great deal of effort was made to consider the source and question whether the author had an agenda to prove the superiority of girls compared to boys or the opposite. Such literature was discarded in favor of objective and unbiased works.

Psychologists have observed that all children show developmental differences in expression of emotion, metacognition, and cognition, and these developmental differences are influenced by their gender. Often the influencing factors are based on adult interaction beginning at birth and learned gender roles. When the learned gender roles serve to limit the potential of one group in favor of the other, the learned behaviors could be considered bias. Gender bias can be found in children's literature and texts, teacher expectations, media, and instructional design. Therefore, opportunities to participate in knowledge expanding experiences as boys and girls grow are limited based on gender.

The psychological perspective embraced gender differences as learned from cultural pressure to behave in certain ways based on gender. Neuroscientists have been seeking evidence found in brain structure, genetics, and metabolic structures of males and females to explain differences. Developing hypotheses regarding gender differences when only considering either the psychological or neurobiological sciences perspective would be considered reductionism. Integration of the two is necessary. Educators have the responsibility to be aware of the latest valid research to help them resist cultural barriers that serve to limit student potential with the recognition that gender bias should not exist and that the educators themselves may be the perpetrators of the bias. Educators also need to be aware that the distinction between learned and biological maturation might not stand up under scrutiny, since the separation of developmental psychology and developmental neurobiology was the basis for these two distinctions.

The ambiguity of the research justifies some skepticism of unsubstantiated research, in that the older the research is, the more likely it is to contain biases. Implementation of instructional strategies using outdated or uncorroborated information should be considered imprudent. Therefore, analysis and careful consideration of new evidence pertaining to neuroscientific data and psychological analysis, which take into account societal changes, would be an ongoing process. With careful consideration of the research, effective instructional strategies could be

developed to meet the education needs of both boys and girls in an educational setting. The recommendations of the literature written by educational experts seems to agree that providing an array of different strategies to teach and assess a diverse group of learners will work toward limiting potential barriers to individual success. Addressing the needs of a diverse population within the classroom will address the needs of boys and girls to an equal degree. Since much of the literature has either been conflicting, shown no statistical difference in cognition between genders, or has shown generalized differences in behaviors and attributes of each gender, the environment within the educational setting has to accommodate all student differences. For students to attain their optimal level of success, teachers must be aware that differences do exist and it is their obligation to instruct and assess in several different formats to assure that all students have a fair and appropriate education. Remember, the myths of the past do not apply to the realities of today.

Recommendations

The research concerning gender differences as they affect the education of boys and girls is not conclusive at this writing. More psychological research needs to be conducted on larger groups and cultures (other than our own) in order to report more conclusive findings. The research conducted by neuroscientists is limited by technology and is still in its infancy, but growing quickly. Consequently, some disclaimers need to be included. Current information seems credible and appears to

be valid enough to act on with some confidence; however, it could transform with time. For example, a possible variable influencing validity of current literature may be future cultural changes where unfounded bias that limited the potential of girls in math and science, or the bias that created the over representation of boys in special education will be eliminated. When judging literature validity, the reader must be vigilant in identifying and suspect of those writings that have hidden agendas focused on proving gender superiority.

As more research on gender difference emerges in years to come, the beliefs people hold today may have to change again and again; but one thing is certain, better understanding of the contributions boys are capable of making to society and the contribution girls are capable of making to society is equally important. The recommendations for educators are to be conscious of their influence on the cultural evolution of our society, and that the teacher's contribution could be detrimental if gender bias is integrated in his or her personal beliefs and resulting instruction. Those beliefs will serve to limit the potential success of both boys and girls. It would be wise to step back and critically observe the classroom environment, instruction, and assessment each teacher employs to see if gender bias is present. But before teachers can effectively make changes, they must educate themselves on instructional, environmental, and assessment best practices that can assist them in

addressing the diverse educational needs of all students regardless of gender.

Generalizations made regarding learning styles, maturation, and behaviors of boys versus girls are not absolute. Often generalizations are made to show the likelihood of a girl or boy fitting a certain profile, and the same is true of students with exceptionalities whose disabilities are unique to one gender. These are only generalizations and should not be considered to be absolute. To do so would be considered stereotyping, because there will always be exceptions to the rule. Students will often show group identity, but should be treated as individuals.

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