Chapter 10: Differentiating for Girls and Boys

The trouble with conventional wisdom is that, more often than not, it is just that -- *conventional*. In other words, it is generally accepted without much critical examination, which on reflection, may be counter to just about everything we know about the pursuit of wisdom.

We believe that the education of boys and girls over the last century has been a victim of conventional wisdom.

Take, for example two children -- a girl and a boy -- born sixty years apart with their childhoods spanning the twentieth century: Myrna and David.

Myrna was born in the 1920s, the only child of a successful middle class family in Britain. Myrna's father was a dentist and her mother a housewife. The family was seen as a pillar of middle class respectability. Myrna was a bright, imaginative and sensitive child with considerable musical talents, who loved stories. But at school she was definitely an average student, frightened of the nuns who ran the Roman Catholic school she attended. While she enjoyed the opportunity to socialize with her friends, none of the school subjects really captured her interest. When Myrna turned sixteen, her parents presented her with a choice. She could go to university and follow in her father's footsteps as a dentist or she could go to secretarial school. The choice divided the family. While her father was keen to have

Myrna enter university, her mother felt strongly secretarial training was more appropriate for a girl and would better suit *her* perception of Myrna's cognitive abilities. "Myrna's just not the academic type," her mother would say to anyone within earshot, including Myrna herself. Myrna's mother may also have been concerned about the perceived difficulty that well-educated young women had in finding husbands. Perhaps predictably, Myrna chose to enter secretarial school.

David was born in the mid 1980's to a successful middle class family living in the suburbs of Baltimore. His father was a financial analyst and his mother was an elementary school teacher. As products of the 1960's and 70's, Mom and Dad were very conscious of traditional gender stereotypes. In college Mom had been active in a feminist organization and Dad shared her sympathies regarding the historical subjugation of women. They were determined to raise David in such a way as to avoid what they perceived as the parenting errors of the past. The new born baby's room was painted yellow instead of blue. His toys included stuffed animals. Toys that replicated weapons or were associated with violence of any form were strictly banned from the household. David entered the Hobby Horse Play School at the age of three and had two happy years there. The trouble began in kindergarten.

David struggled with the alphabet and was confounded by phonemic awareness. He had great difficulty retaining "sight words." By October of his kindergarten year, David told his mother that his teacher was "mean" and that he didn't want to go to school. Mom visited the class to observe the interaction and could see nothing wrong with what the teacher was doing. She began to worry about David. In November, the teacher called in both parents to communicate her concern about David's impulsivity, lack of concentration, and aggressive behavior towards the other children. The teacher supported her concerns by showing evidence of David's

lack of academic progress and sharing with his parents a series of drawings that David had made illustrating scenes of violence (a train crashing into a building, a spaceship attacking the school, and a dinosaur munching an airplane). David's down-hill spiral continued into first and second grade. By third grade he was referred for full psycho-educational testing and in the middle of grade five David started taking Ritalin. Middle School saw David constantly in disciplinary trouble for his impulsivity. He was suspended for skipping classes, for vandalism and stealing. The prognosis for David's high school career was not good.

It so happened that both Myrna and David emerged into adulthood successfully – albeit with little help from their formal schooling. Although she had nothing more than a tenth grade education, Myrna rose to be the director of a mental health clinic at a major American East Coast hospital. In her fifties, Myrna was touring the US making speeches at medical conferences on specialized therapies for the treatment of phobias. By any standard, she had emerged as a successful, self-educated career woman. David left high school during his tenth grade year and went into the job market – working first in a carpet factory and then on a fishing boat in Alaska. By his nineteenth birthday David had recognized his need for more education. He took the GED high school equivalency examination and entered a community college. Two years later he transferred to the state university. Today, David has two masters' degrees and is teaching high school social studies in New Mexico.

Some of the difficulties that both Myrna and David encountered in school can be traced to conventional wisdom about the education of girls and boys.

For most of the 20th century educators have operated on faulty and sometimes very misguided assumptions regarding how gender affects learning. For the first half

of the century, most teachers accepted that there were gender specific learning characteristics of boys and girls. Boys tended to be louder, more aggressive, more impulsive and more competitive than girls. Accordingly, schools offered boys different (and often many more) sporting opportunities than they did girls. On average, girls were able to concentrate on a given seat task longer than the more restless, more disruptive boys. In high school, however, boys tended to outperform girls in the areas of math and science and greatly out-numbered girls in terms of university admissions. For the years leading up to the feminist movement of the 1960's and 70's, teacher perceptions of how boys and girls learned differently were based on actual classroom observations *and* preconceived gender roles. It was *natural* for young boys to play with trucks and blocks and soldiers; just as it was *natural* for girls to play with dolls and stuffed animals. It was *natural* for boys to out perform girls on university entrance standardized testing. Girls were, after all, destined to be mothers, housekeepers, nurses or secretaries. Boys, on the other hand, had competitive corporate careers in front of them.

By the mid 1980's the pendulum of conventional wisdom, at least in the United States and Western Europe, had swung in the opposite direction. Traditional gender roles had come under fierce attack from the feminist movement. The historical subjugation of girls and women had become a widely accepted political reality and sexual chauvinism associated with bigotry and ignorance was widely scorned. In essence, the new conventional wisdom told us that traditional gender stereotypes had served as societal straight jackets for both girls and boys – but to the considerable detriment of girls. Historically, girls and young women had been the educational victims of a self-fulfilling prophecy. Myrna's lack of educational self-confidence had led her to choose a career as a secretary as opposed to a dentist.

The conventional wisdom that emerged from the 1980's would have us believe that while boys and girls start life with the same cognitive raw material, the traditional manner in which we raise and educate our children serves to transmit gender stereotypes from one generation to the next and perpetuate the subjugation of women.

This was a politically attractive notion since attitudes and perceptions, while difficult to alter, are considerably easier to change than physiology. The generally accepted idea was that by cleansing the upbringing and education of children of repressive gender stereotypes, we would nurture boys who would be more empathetic and sensitive and girls who would be more assertive and ultimately more self-fulfilled. Accordingly, we set about pruning our classroom libraries for sexually chauvinistic literature and encouraged boys to engage in imaginative and empathetic role play. Single sex home economics and woodworking classes disappeared. We offered girls more competitive sports options.

In our efforts to avoid the errors and injustices of the past, we engaged in the business of trying to create "gender neutral classrooms". In these classrooms, teachers ignored gender specific learning differences in girls and boys either because they were unaware of them or out of an attempt to be egalitarian. Nurture eclipsed nature.

However, recent research strongly suggests that as a profession we need to review and revise our perceptions and attitudes towards gender differences in learning. When we ignore the natural learning proclivities that boys and girls bring to the classroom, both genders suffer. There is increasing evidence that boys like David and girls like Myrna would learn more effectively in classrooms that included "gender-friendly" learning activities.

Some writers (Sax, 2005; Gurian, 2001) go so far as to suggest that because the "gender neutral classroom" does not take into account the real physiological differences in girls and boys brains, it inadvertently perpetuates the hurtful and pernicious stereotypes that it was designed to eradicate. There is also considerable evidence that the supposedly gender neutral classroom is particular damaging to the learning of boys. In the United States we have witnessed a dramatic drop over the past two decades in the academic performance of boys (Conlin, 2003; Newkirk, 2003). The so-called "new gender gap" has also been documented in the United Kingdom, Australia, New Zealand and Canada. According to a US Department of Education study (2000) the average 11th grade boy is now writing on the same level as the average 8th grade girl. The population of high school dropouts is predominantly male and the number of girls entering university in the US is now greater than boys. In fact, the National Center for Educational Studies predicts that by the year 2011, 60% of all earned degrees in the US will go to women.

Research over the last two decades in the medical profession, neuroscience, psychology and evolutionary biology strongly suggests that boys and girls do not start life with the same cognitive raw material. Researchers have identified more than a hundred structural differences in the brains of girls and boys (King & Gurian, 2006). These differences coupled with what we now know about chemical and hormonal differences in the male and female brains make it imperative that gender feature prominently in our efforts to differentiate instruction in order to maximize learning.

We are not suggesting that there isn't significant learning over-lap between girls and boys. Of course, there is. And often what works for boys also works well for girls and vice versa. Most importantly, we are not suggesting that there is a

difference in what girls and boys can do, but rather in how they may most efficiently learn how to do it.

> *The differences between* what *girls and boys can do are not large. But the differences in* how *they do it can be very large indeed. For example…you can teach the same math course in different ways. You can make math appealing to girls by teaching it one way, or you can make it appealing to boys by teaching it another way. Girls and boys can both learn math equally well if you understand the gender differences* (Sax, 2005, p.33).

This was a message that the teachers at Douglass Elementary School in Boulder, Colorado took to heart. The results of the 2005 Colorado State Assessment Program revealed a significant literacy gap in the 470 student school. Boys, who represented at least 50% of the total school population (and 75% of the special education population) underscored the girls by average of 13 points in Grades 3-5. It became clear to the teaching staff at Douglass that the gender literacy gap had serious implications for the school and, of course, for the future of its students. The teachers placed this gender gap on the proverbial front burner and sought out recent research that actually supported much of their intuition about how boys and girls learn differently. They implemented deliberately "boy-friendly" teaching strategies in the classroom and within one year Douglass was able to close the gender gap (the boys experienced a 24.4 percentage point gain in reading and writing). At the same time, the girls' performance in reading and writing also improved significantly (King and Gurian, 2006).

The research suggests that it is time for gender learning differences to feature prominently in our differentiation of classroom instruction. What then are some of these biologically based gender differences that influence learning in the classroom?

The answers will surprise very few veteran teachers or observers of children. There are differences in the ways that male and female brains are organized. There are differences in verbal and spatial capacities as well as in the optical, neural and auditory systems of girls and boys. These differences have profound implications for the classroom.

Male and Female brains are organized differently

Studies in the 1970's and 80's showed that the male brain is much more asymmetrical than the female brain. In other words, the brains of men are more regionally specialized -- more compartmentalized than the brains of women. In men, the left hemisphere of the brain is clearly specialized for receiving and generating language. In the female brain such asymmetry is much less noticeable. For example, men who have a stroke involving the left hemisphere suffer a drop in verbal IQ of about 20% (from 111.5 to 88.7). On the other hand, men who suffer a stroke centered in the right hemisphere see virtually no drop at all in verbal IQ. The message seems to be clear. If a man's left hemisphere is damaged, the language function will be damaged; while damage to the right hemisphere does not appear to affect language.

The female brain is significantly less compartmentalized. Women who suffer a stroke affecting the left hemisphere see drop in verbal IQ, on average of 9%. Women who suffer a stroke affecting the right hemisphere see a similar drop of about 11%. Women, unlike men, use both hemispheres of their brains for language (McGlone, in Sax, 2005).

Recent research seems to suggest that the female brain has, on average, a thicker corpus callosum than the male brain (Dubb et al.; 2003, Shin et al. 2005). Some claim it is up to 20% thicker in females (Gurian, 2001). The corpus callosum is the connecting bundle of tissue between the left and right hemispheres of the brain.

The speculation is that this thicker corpus callusum permits greater cross hemispheric communication in the female brain. *Newsweek*[1] recently speculated that this might account for "female intuition" and that women tend to be better at multi-tasking than men. While this is still in the realm of reasoned scientific speculation, there is no question that as teachers, we often see that boys are more single-task oriented and have greater difficulties with transitions between activities or subjects than girls do.

There is also speculation that the male tendency to lateralize its activity, that is to compartmentalize activities into discrete areas of the brain, may be linked to the preponderance of learning disabilities found in boys as opposed to girls. This may be particularly true for attention deficit disorders. In other words, if there is a dysfunction in a highly specialized region of the male brain, it is probably more debilitating in terms of learning and much more noticeable to teachers and parents than a dysfunction in the more integrated regions of the female brain. In addition, females also produce less of the neurotransmitter serotonin than do males and so are less inclined to hyperactivity disorders (Gurian, 2001).

Recent research is suggesting that differences in how male and female brains function is *not* solely the result of hormonal influences. In the 1990's studies out of Harvard University suggested that differences in how male and female brains functioned and how they organized themselves was primarily the result of hormonal differences, leading to the belief that since prepubescent children don't manufacture sex hormones in large quantities, the sex differences in the brains of young children must be small and virtually insignificant. We are now questioning whether, indeed, sex differences in the brains of males and females are the result of sex hormones. In 2004, a team of fourteen neuroscientists from the University of California, the

[1] http://www.msnbc.msn.com/id/9120157/site/newsweek/, accessed 18/5/07.

University of Michigan and Stanford University published their findings demonstrating a significantly different expression of proteins derived from the X and Y chromosomes in the male and female brains (Sax, 2005). These scientists examined brain tissue from thirty different individuals and in each case they were able to identify the gender of the donor. While hormones may certainly play an important role in how males and females learn differently, it is now clear that the actual brain tissue of girls and boys are genetically programmed to be different.

Another important distinction in the brains of boys and girls is that their respective development is *sequentially different.* Any veteran teacher will have noticed that girls tend to mature cognitively (in areas that we tend to value highly in schools) earlier than boys. However, this is something of an oversimplification. Researchers at Virginia Tech studied the brain activity in 508 normal children (224 girls and 284 girls) ranging in age between two months to sixteen years. Their results demonstrate that various regions of the brain develop in a different sequence in girls as compared with boys. Sax writes that these "researchers found that while the areas of the brain involved in language and fine motor skills mature about six years earlier in girls than in boys, the areas of the brain involved in targeting and spatial memory mature about four years earlier in boys than in girls. These researchers concluded that the areas of the brain involved in language, in spatial memory, in motor co-ordination, and in getting along with other people develop in 'different order, time and rate' in girls compared with boys (p. 93)."

Implications for the classroom

The significance of these findings for teachers is threefold. First, it clearly demonstrates that, in general, developmentally appropriate learning challenges may

be somewhat different for boys and girls. This does not mean a two tier structure for academic standards. But, it could mean that boys and girls may need to follow different pathways to achieve the same standards.

Secondly, and no less importantly, the gender specific sequential nature of brain development strongly suggests that the sex differences in the brains of children are more influential to learning than sex differences the mature brains of adulthood.

Thirdly, because a girl's prefrontal cortex is generally more active than a boy's at an earlier age, girls tend to be less impulsive than boys and are usually better able to sit still and focus on a literacy task (reading or writing) than boys are.

Teachers can also increase the use of experiential and kinesthetic learning activities. Both boys and girls need physical movement – boys perhaps even more than girls. Activities that require movement actually help boys to focus and concentrate.

Verbal/Spatial Differences in the Brains of Girls and Boys

Generally, male brains have more cortical areas that are specialized to spatial-mechanical functioning than female brains do. This may account for boys tending to prefer toys that move in space (balls or trucks) or sports that rely on spatial orientation. This may also provide for the proclivity that males show in spatial abilities in areas such as mechanical design, navigation, geometry, measuring, geography, and map reading. It may also have a connection to the statistically higher proportion of boys who select and succeed at higher level math and science courses.

Girls' brains, on the other hand, generally have a greater cortical emphasis on verbal and emotional processing (Blum, 1997). Girls tend to develop elaborative language earlier than boys. They tend to use a broader vocabulary than boys do and

they tend to think more verbally than boys. This has very significant implications for classrooms which tend to be language dominated.

The superior verbal ability of girls has been linked to emphasis that they placed upon the use of language in fostering and maintaining relationships. Sax (2005) describes friendships between girls as *face-to-face* in that these relationships focus on being together, talking together, developing a vocabulary for the emotions and engaging in a degree of self-disclosure. Sharing personal secrets is a measure of the girl-to-girl bonding that takes places in friendship groups. Girl friendships tend to be more intimate and personal and more reliant on conversation and oral language (Tannen, 2005). This emphasis that girls place on language development and use may be connected to the fact that girls outperform boys in reading and writing throughout elementary and middle schools.

Boy friendships, on the other hand, can be described as *shoulder-to-shoulder* (Sax, 2005) in that boys tend to socialize not around conversation but around a group activity – for example, a sport or a video game. Boys tend not to use language as a means of bonding friendships. Extended conversation among boys is not common and, as a general rule, boys do not tend to value emotional self-disclosure.

Researchers at Harvard using MRI brain imaging techniques have revealed some startling data about how males and females process emotions differently (Killgore, Oki & Yurgelum, 2001, in Sax 2005). Children from the age of seven to seventeen were exposed to negative or unpleasant visual images in order to ascertain which part of the brain was activated. In young children, the negative emotional activity was localized in the amygdala – a phylogenetically primitive portion of the brain that hasn't changed much through evolution. Thus it is not surprising that when

we ask a six or seven year old about the source of his or her emotional reaction (e.g. "why are you looking so sad?") we are often greeted by a confused silence. The source of this confusion is that there are very few direct connections between the processing of the emotional reaction (in the amygdala) and the language generative portions of the brain (the cerebral cortex).

In adolescence we see a shift in the area of the brain associated with the processing of negative emotions. We see the processing of negative emotion moving from the primitive amygdala up into the cerebral cortex – that area of the brain which is associated with our higher order thinking such as language production, critical thinking and reasoning.

The startling revelation of this research is that this shift takes places *only in girls*. The processing of negative emotions in adolescent boys remains in the amygdala. In terms of our evolutionary past, this may have made sense in terms of survival. The amygdala is the seat of the male "fight or fight" response and twenty thousand years ago the processing of negative emotion could easily have been caused by the appearance of a saber-toothed tiger. However, it may put boys at a considerable disadvantage when a high school English teacher asks the class to write their emotional reactions to novel or short story.

Implications for the Classrooms

Perhaps the most significant implication for the classroom is simply the awareness of the teacher that girls and boys bring to their learning different proclivities in the verbal and spatial arenas. In the service of gender friendly-instruction, we can increase our use of visual and spatial representations. These can

include tools such as graphic organizers, illustrations, manipulatives, and the skilful use of technology.

We can also vary our use of production style preferences. In other words we can provide students some choice in how they demonstrate their learning (e.g. by writing, drawing, building or performing). In addition, employing nonverbal planning tools (such as story boards, etc.) are often very useful as introductions to activities that are predominantly verbal (writing activities). These non-verbal planning activities can be particularly valuable for boys.

In terms of the differences in how boys and girls process emotion, it is probably important for teachers to recognize that girls and boys are looking for different types of relationships with their teachers. Gurian (2001) explores this in some depth and suggests that the gender-specific needs for student/teacher bonding can be an important determinant of teacher behavior in the classroom.

Gender differences in our optical and neural systems

We are now aware that the anatomy of the human eye is different in males and females and this has an important influence on how we perceive the world around us. In both girls and boys, the retina of the eye translates light into neurological signals. The retina contains the photoreceptors, the so-called “rods” and “cones”. Rods are sensitive to black and white; cones are sensitive to color. The rods and cones transmit their neurological signals to the ganglion cells. There are two types of ganglion cells, usually referred to as M cells (magnocellular – very big) and P cells (parvocellular – very small). The M cells, principally detectors of motion, are wired primarily to rods and receive very few neurological signals from the cones. They are distributed throughout the retina so that we can track moving objects anywhere in our field of

vision. P cells, on the other hand, are wired to cones and transmit extensive information about color and texture.

Microscopic examinations of the human eye over the last few years have revealed that the male retina is significantly thicker than the female retina. This is because large M cells predominate in the male retina while the female retina is richer in the small P cells. This means that boys are much more sensitive to motion and movement and girls more discriminating in terms of color and texture. This makes evolutionary sense when we consider that for the past several hundred thousand years males were the primary hunters and females had responsibility for identifying and gathering edible plants, fruits and roots.

Implications for the Classroom

These visual differences in girls and boys are borne out in the study of the art work of young children (Kawecki, 1994) Girls tend to draw pictures of people, pets, or colorful objects such as flowers, employing ten or more colors. Boys, on the other hand, tend to draw an action situation (e.g. a car crash, a rocket –taking off, a spaceship attacking earth) using a much narrower range of colors (gray, black. silver and blue). The difference in the distribution and density of M cells and P cells may have contributed to the stereotype that "art is for girls," and underscore the comparative ease with which girls are able to include visual details in their narrative and expository writing. Thus the importance of specificity in the construction of assessment rubrics (e.g., in an art rubric we might specify: "uses 4 or more colors" or in a writing rubric: "uses adjectives and adverbs to describe color, texture and motion").

Perhaps most significantly, girls and women have been shown to be able to "read" facial expressions better than their male counterparts (Hall, 1985; McClure,

2000). Given what we now know about the importance of non-verbal communication and how reliant we are (even unconsciously) on our intuition (Gladwell, 2005), the ability to interpret facial expressions represents a crucial dimension in any relationship building exercise, from parenting to teaching, from supervising a business associate to leading a work team.

Gender Differences in Hearing

In addition to seeing things differently, girls and boys actually hear differently. Extensive research on newborn girls and boys (Sax, 2005) has shown clearly that the average girl baby had an acoustic brain response about 80% greater than the response of the average boy baby. The researchers used sound in the range of 1,500 Hz because hearing in that range is essential for the understanding of human speech. Other studies have confirmed that girls' hearing is significantly more sensitive than boys'. In addition, this gender difference in hearing sensitivity appears to grow larger as the children grow older. This may have some significant implications for teachers in classrooms.

Implications for the Classroom

This gender difference in hearing may account for the perception of many teachers that boys tend to be "louder" than girls and are more inclined to shout. It may also be responsible for some of the difficulties boys may have when faced with a soft spoken female teacher. In addition, the greater hearing sensitivity of girls may contribute to the perception of the teenage girl that her adult male teacher has "yelled" at her, when the teacher believes he has used his normal conversational volume. There is also much room for mis-perception of non-verbal cues such as tone of voice. The greater hearing sensitivity of girls (and female teachers) also results in much greater auditory distractibility in girls than in boys. The British psychologist Colin Elliot

(1971) demonstrated that eleven year old girls are distracted by noise levels ten times softer than noise levels that boys find distracting. Obviously, this is also true for the female teacher in a classroom with exuberant, foot-tapping, pencil-drumming boys!

Neural Rest State Differences

Each day the brains of girls and boys going into what the neurologists call "neural rest states". However, according to recent evidence from Single Photon Emission Computed Tomography (SPECT) these neural rest states are very different in girls and boys (Gurian & Stevens, 2005). As teachers, the neural rest states of boys are fairly easy to recognize. We see boys day dreaming, staring off into space, zoning out, drifting off or, on occasion actually slipping off to sleep in class. Some boys will fight against these neural rest states by becoming fidgety, by flicking paperclips across the room or by poking their neighbor with a pencil. For a few boys, these distracting and disruptive behaviors *may* indicate an attentional problem or hyperactivity. However, for many boys these self-stimulating activities may simply be an attempt to stay alert in a classroom that is not suited to their learning needs.

When boys enter a neural rest state, some areas of brain functioning actually shut down (King & Gurian, 2006). Boys lose the ability to focus and concentrate. Learning and academic performance suffers accordingly.

While girls also enter neural rest states, these are very different for girls than they are for boys. When girls get bored, more of their brain functioning remains active. Even in an under-stimulating classroom, girls are more likely to be able to concentrate and focus on the material at hand. They are more likely to listen carefully and be able to take notes. Researcher Ruben Gur at the University of Pennsylvania using magnetic resonance imaging (MRI) and other brain imaging technology (in Gurian & Henley, 2001) has shown that the female brain *at rest* is as active as the

activated male brain. It would appear that there is more going on in the female brain. This does not suggest that the female brain is in some way better or more effective than the male brain. Ruben Gur is not saying the female brain "is necessarily superior, but he is showing that the female brain is using its resources, doing it quickly, and often, and in more places in the brain. The female brain…has a true learning advantage (p.29)."

Implications for the classroom

One of the pressing issues in gender differences in learning is the overwhelming proportion of boys as compared to girls who are diagnosed as Attention Deficit Disorder (ADD) or Attention Deficit Hyperactive Disorder (ADHD). In some boys there may be a biological basis for this. In others, however, we may be seeing poor attention and correspondingly disruptive behavior in classrooms because of a mismatch between the learning needs of boys and the learning organization of classrooms. This problem is brought to the forefront by the dramatic increase in the use of drugs such as Ritalin and Concerta. In our experience there is no question that some children benefit greatly from such medication. Without it, they would probably not be able to remain in school and could well be destined for incarceration in a juvenile detention center. However, we oppose the use of medication as an alternative for effective classroom management or for classrooms that are under-stimulating. Leonard Sax (2005) calls this "the medicalization of misbehavior." He writes "in a bizarre turn of events, it's become politically incorrect to spank your child, but it's okay to drug him (p.197)."

We also have a hunch that learning disabilities in girls may be under-diagnosed because girls are better able to mask them. Girls may be better at appearing to play the "school game". Because girls are better able to pay attention in

class even when they are bored or completely uncomprehending of what is going on, it may be that teachers fail to recognize learning problems in girls as often as they do in boys.

Gender differences in competitiveness and natural aggression

The topic of competition in schools and in classrooms has been much debated both in educational journals and in faculty lounges around the world. We have witnessed the polar extremes. On the one hand, school X routinely posts student examination results together with student ranking on a public notice board. On the other hand, school Y has a teaching faculty so adamantly opposed to any form of competition that it voted to remove debate and forensics from the extra-curricular activities offerings.

The chemical oxytocin is present in the brains of both girls and boys, but in significantly greater quantities in girls' brains. Oxytocin has been called the "bonding" chemical and has been associated with the evolutionary instinct in girls and women under stress to "tend and befriend" (Taylor, 2002), as opposed to the male evolutionary instinct to "fight or flight". With less ocytocin in the male neural system, boys tend towards more risk taking behavior, greater impulsivity and more aggression.

We have all witnessed gender different reactions to high risk taking. The boys will often appear excited, energized and stimulated by the "thrill" of the experience. The girls, on the other hand, are often not only *not* excited but can be repulsed by the same situation that boys find so thrilling. Many studies over the last two decades have illustrated dramatic sex differences in bio-behavioral responses to stress. While the male in stressful situations is more influenced by the sympathetic nervous system which releases the thrill-producing chemical adrenaline, the female in stressful

situations is more influenced by the parasympathetic nervous system which releases acetylcholine, which causes an unpleasant, nauseated feeling.

For a variety of neural and hormonal reasons, boys are generally more aggressive and competitive than girls. There are always exceptions, but on the whole the generalization remains true. This is not only the case in humans, but also in primates. Ironically, if young male primates are deprived of the opportunity to exhibit aggression in their play with other young males, they grow up *more* violent as adults, not less. They were deprived of the opportunity of learning how to bond with other males in a playful, aggressive way. There is evidence that this may also be true for human children (Sax, 2005). When we deprive boys of an opportunity to learn how to manage their aggressive drive constructively in childhood, there is a greater likelihood that the same aggressive drive will emerge in adulthood in unhealthy and anti-social forms.

Conclusion

While there is significant overlap in the learning of girls and boys, specific structural differences in their brains suggest implications for the classroom. Probably the most important one for the improved learning of girls and boys is simply an awareness on the part of teachers that there are very real physiological and hormonal differences in the brains of girls and boys that have significant effects on their learning in the classroom.

Putting aside our feelings about political correctness, we can allow for gender-specific student choice. In other words, we can allow a small group of girls to select a topic to write about or a project that appeals to them. Similarly, we can permit a group of boys to design a “boy friendly” project.

We can include in our flexible grouping strategies, gender groups. These can be short term work groups or longer term project teams. We would suggest that gender groups be *one* type of grouping among a variety that teachers employ. In the classroom setting, we believe it is important for students to get a clear message that they are expected to work with every student in the classroom. We believe that this can support respectful work relationships. In a coeducational setting, this expectation would obviously include students of a different gender.

We suspect that gender plays a significant role in how students come to perceive schools and the role of formal learning in their lives. Girls and boys do learn differently. They have different styles, learning needs, talents and gender-specific interests. When we are aware of these differences and incorporate them into our lesson planning, we optimalize learning for all.