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The Science of Boy-Girl Learning Differences

A primary concern for nearly every teacher is the difference we each intuit in the males and females we teach. We all know that there is immense overlap between the genders, and that each child is an inherently sacrosanct individual not to be limited by a gender stereotype, but we also know that boys and girls learn differently right before our eyes.

—Michael Gurian

IN the past couple of decades one question has taken on more and more significance when we consider how ready an individual child might be for entering school: Is the child a boy or a girl? Exciting and ongoing research into the living brains of boys and girls is showing us that not only are boys and girls different at the organic level, but how they learn is different in many, many ways from the day they are born.

In the early days of the Gurian Institute's work with educators, we would ask the question, "How many of you took a course on how boys and girls learn differently during your teacher training in college?" Even in audiences of several hundred teachers, no hands would go up. When we ask that same question today, a few hands might go up. When questioned further, those who raise their hands generally report that they covered the topic of gender and learning briefly in an education class.

At the same time, when teachers take our course in how boys and girls learn differently they often ask, "Why isn't this taught in college? Why aren't schools of education teaching this?" Fortunately, more and more are every day. Many are catching up to the newest brain research in learning, development, and gender.

The book you are about to read is based on twenty years of in-school research and ten years of training teachers in the practical strategies that grow from teaching (and learning) that work. You'll meet many teachers in this book, and your toolbox will be increased manifold.

You'll also have a head start on the education course that will, we hope, be taught in every school of education in the future.

Boys and Girls Learn Differently!

This chapter will give you an overview of the latest information available on how boys and girls learn differently and how that difference can and should change the way you implement your curriculum to ensure that every child, male and female, will have the chance to succeed to his or her maximum potential. For many of you, this information will bring an "Aha!" that validates intuitions you've had for a long time. We hope it will confirm that you have been on the right path as you work with your students. We hope that, for many of you, this information will open the door to exciting new experiences as you implement what you learn.

Where and when does gender in the brain begin? Soon after conception, boys and girls are on diverging development paths. If a child receives an X chromosome from each parent, a female architectural plan goes into action. If a child received one X chromosome and one Y chromosome, a different plan is activated and a male system is designed. These plans result in not only different bodies, but different brains. Beginning at around six weeks, a male fetus triggers biological mechanisms toward the secretion of large amounts of testosterone in his fetal system. His genitals drop, producing the testosterone he needs. From that point until somewhere between five and six months of development, testosterone becomes the "chief engineer" of the developing male's body and brain, giving him the capacity for a higher muscle mass than a female, different iron and calcium ratios, and different brain "formatting." Developing female fetuses receive testosterone during the developmental period between six weeks and six months in utero, but not as much. They receive more estrogen-type hormones. This helps format their brains to be female. By six months in utero, boys and girls have been formatted with different brains.

Are these differences all that matter? Of course not. There are many similarities between girls and boys in utero and once they are born. There are also many differences among girls and among boys that indicate how powerfully individual personalities can trump gender in importance. Furthermore, the way a child is nurtured can affect how he manifests his maleness and she her femaleness.

Caveats aside, gender is a big deal—especially in learning. One can make the argument, if one wished to, that every boy could cry as much as every girl, or that every boy could talk about his feelings as much as every girl (it would be a tough argument, but social theories can make it); however, the brain research on gender difference is now so detailed, it is no longer possible to responsibly argue that boys and girls learn the same way.

What *Are* the Differences?

Although researchers are still discovering new areas of difference between the male and female brain, a number have already been identified that have implications for how boys and girls learn. Remember that we are generalizing based on relevant research. There will be exceptions to each generalization, as every child is an individual, and male and female brain difference ranges both between boys and girls and among boys and girls. Remember also that difference means only that—one is not better than the other. Both are equally capable of learning and succeeding, but they do so in ways that we must understand if we are to create an educational environment that meets the needs of both!

Structural Differences

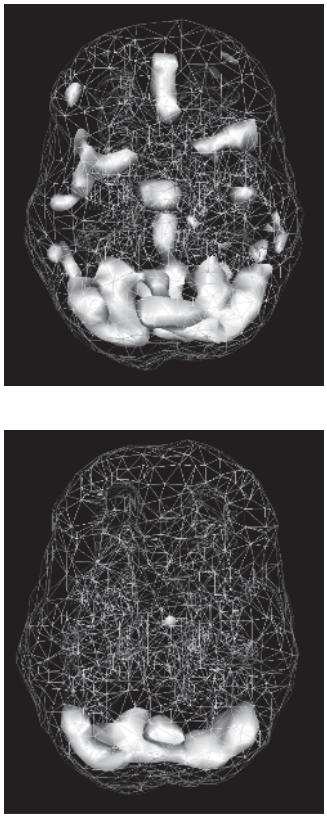
Using *magnetic resonance imaging* (MRI), *positron emission tomography* (PET) and *single photon emission computed tomography* (SPECT) technologies, scientists can look at the living brain and watch it work. The most advanced technologies let researchers watch actual blood flow in the brain, see where the brain is working, and by looking at male and female brains in this way, can see that boys and girls are working in different areas when completing the same tasks.

Over the past couple of decades, technology has helped researchers focus on some specific areas of structural difference between the male and female brain. Following are some of the most significant differences and their potential impact on your classroom.

Corpus Callosum—This dense bundle of nerves connects the two hemispheres of the brain. In females, this bundle of nerves tends to be denser and larger than in males, resulting in increased cross-talk between the left and right hemispheres. The anterior commisure, a tiny additional connection between the unconscious areas of the hemispheres attached to the end of the corpus callosum, is also larger in females.

> ***And this means***—girls are generally better at multitasking than boys, including watching and listening and making notes at the same time. It also may explain why girls tend to tune into their own and others' feelings and move emotional content more quickly into thought and verbal processes. Girls can tell you how they feel as they are feeling—boys often need time to process before they can explain feelings.

Brain Stem—This is the most primitive part of our brain. Our "fight or flight" responses come from the brain stem; when we're threatened or in crisis this area of our brain takes over, telling the body how to respond.



Amen Scans of the Female Brain (top) and Male Brain (bottom) at rest. The areas you see that look like bubbles are areas of activity—while at rest!

SPECT scans used by permission of Dr. Daniel Amen

With the male brain's greater amount of spinal fluid, messages tend to move more quickly from the brain to the body.

> ***And this means***—boys' brains tend to be poised for fight or flight and for a physical response when they feel threatened or emotionally charged. Boys in your class may slam a book, kick a chair, use an expletive, or engage in some other kind of physical display when challenged. This behavior may be the result of an emotionally charged incident when the boy is not given enough time to process the emotional content.

Limbic System—This system is a collection of structures located under the corpus callosum and just above the brain stem, most of which are duplicated in each hemisphere of the brain. Within the limbic system are several structures that play a key role in how boys and girls learn and perform differently. Parts of the limbic system that process emotion and sensorial memory are, in general, more active in girls than in boys, resulting in increased emotional memory for females. Additionally, females tend to be better able to read emotional cues in others.

- *Hippocampus.* A key player in converting information from working memory into long-term or permanent memory. This process is crucial for learning to have meaning and for retention. The hippocampus tends to be larger in females and the speed of neural transmissions is faster than in males, resulting in generally increased memory storage for the female brain.
- *Amygdala.* A small, almond-shaped structure connected to one end of the hippocampus that plays a very important role in the processing of emotions, especially fear and anger. The amygdala tends to be larger in males. Some researchers believe that the close proximity of the amygdala to the hippocampus suggests that emotional content is "tagged" onto many long-term memories. Consequently, recalling a memory can recall an emotion as well.

  And this means—boys often display increased aggressive or impulsive responses—they tend to be sent to the principal a lot more than girls! Girls attach more emotional and sensory detail to events and remember them longer. They can hold grudges a long time. Writing stories will tend, on average, to be easier for girls when words are the only medium of inspiration used to help set up the paper.

Cerebral Cortex—This part of the brain contains about ten thousand miles of neural connections in each cubic inch! As thick as about three of your hairs, this area is where the serious intellectual functions of the brain take place. Thinking, speaking, and recalling—all things that need to happen in

a classroom—are controlled in the cerebral cortex. The female brain tends to have more connections between neurons in the cerebral cortex. Blood flow in the brain is up to 20 percent greater in the female brain. Along with the increased neural connectivity between hemispheres, this adds more potential for information to move quickly between areas of the brain.

> ***And this means***—the increased speed of their neural connections may help girls process and respond to classroom information faster than boys, help them make transitions faster, help them multitask, and help them access needed verbal resources (reading, writing, complex speech early in life) better than the average boy as they engage in learning.

Cerebellum—This is the "doing center" of the brain. It is larger in the male. Coupled with about 15 percent more spinal fluid in the male neural system, messages between the brain and body can move more quickly (and with less impulse control) in the male body.

> ***And this means***—boys often learn better when their bodies are in motion. Sitting still can frustrate the male system, causing him to exhibit behavior that can appear disruptive or impulsive, and sometimes land him in the principal's office because he "can't sit still, can't stop touching things, is distracting his classmates" when he's really responding to his biological needs.

Processing Differences

Studying the images of the working brain, researchers find that not only are there structural differences between the brains of males and females, but there are also differences in how they use their brains. This has significance for teachers, as you develop strategies to implement your curriculum in ways that will allow all your students, both boys and girls, to perform at their best.

Here are just a few of the processing differences that have the most impact on learning.

Language Processing Areas—These areas are different in the male and female brain. Whereas males tend to have these areas centralized in the left hemisphere, females have multiple language processing areas in both hemispheres. As a result, females have more access to verbal resources than males, and therefore develop language earlier.

> ***And this means***—girls generally have significantly more access to verbal resources when they start school, and throughout life, than boys. On average, females use twice the number of words that males do (this includes writing and reading). It is easier for them to learn to read and write in kindergarten and first grade. Because literacy is the foundation

of learning, this early difference often results in gender gaps that show up early in elementary school and persist throughout middle and high school.

Spatial Processing Areas—These areas are also significantly different in the male and female brain. Testosterone, the primary architect of the male brain, is believed to create more and denser neural connections in the right hemisphere of the male brain, with the result that males have increased resources for spatial reasoning—mental manipulation of objects, gross motor skills, mathematical reasoning, abstract reasoning, and the like. With less testosterone at work during fetal development, females tend to have less right hemisphere area devoted to spatial resources. (A crucial note: although girls generally test out worse than boys in spatial manipulation tests, there is less of a gender gap in mathematical calculation. Girls are not worse at math, as has been the stereotype in the past).

And this means—boys tend to need more space in which to function while they are learning, need to move more during learning, and are generally more interested in and often better at spatial tasks than girls. This shows up more in science and technology classes (a crucial area for those of us teaching girls and working toward parity). Girls will often find it easier to sit still and be quiet at their desks while doing seat work, but they may not gravitate as quickly to computers. They may need extra encouragement for this.

Sensory Systems—Females tend to process more data across the senses. Girls generally see better (in certain kinds of light), hear better, have a better sense of smell, and take in more information tactilely.

And this means—girls will be likely to include more sensory detail in their writing and conversation. They will generally use more varied color in their artwork. Boys will often use less sensory descriptors in their writing, an area in which those of us working with boys must be quite vigilant. Boys may also have a more difficult time hearing certain ranges of sound, especially from their usual, self-selected seat in the back of the room!

Chemical Differences

Male and female bodies are chemical plants! Hormones, neurotransmitters, all variety of proteins, nutrients—on the molecular level there is chemistry happening in every one of our cells all the time. And there are differences in the male and female laboratories. There are differences in the types and amounts of hormones and neurotransmitters that affect how boys and girls

learn and interact. We've mentioned some of these. Let's now look more closely at them.

Testosterone—Testosterone is the male sex and aggression hormone, responsible for the architecture of the male system before birth, and for increased male aggression, competitiveness, self-assertion, and self-reliance throughout life. Male testosterone levels rise when males "win" and decline when males "lose." Female testosterone levels, always lower than males, remain basically constant and are not as subject to fluctuations brought about by winning or losing.

> ***And this means***—healthy competition in the classroom will help motivate boys. Research has shown that boys tend to score better on tests at times when testosterone levels are high, and levels rise during competition. Using games that provide all students a chance to succeed, even if they are competing against themselves and "beating themselves" at a task, can be very productive. And although girls' testosterone levels don't fluctuate as boys' do, research shows that they gain self-confidence from active, healthy competition.

Estrogen—Estrogen is not one hormone, but a group of hormones, identified as the female sex hormone. Estrogens are present in both males and females, but they are usually present at significantly higher levels in girls and women, and promote the development of female secondary sex characteristics. Researchers have found that estrogen levels may affect aggressive tendencies in females, and levels may be affected by seasonal variations, such as length of daylight hours. Additionally, girls with increased amounts of body fat may be subject to earlier onset of puberty, as the body believes it is more prepared for reproduction because of increased hormone levels.

> ***And this means***—for elementary girls who are overweight, puberty may be coming earlier and earlier, bringing with it increased levels of estrogen and the potential for more volatile mood swings and more aggressive behavior. When outward signs of puberty become noticeable, the brain changes that accompany puberty are also beginning. These changes can have a significant impact on behavior and performance for girls, beginning as early as third or fourth grade.

Serotonin—Serotonin is a neurotransmitter known as the "feel good" chemical. It affects mood, anxiety, and helps us to relax and cool off during times of conflict. Girls' levels of serotonin tend to be about 30 percent higher, making them less apt to rely on a fight response when in a conflict. Dr. Bruce Perry has studied neurotransmitters and found them to

be responsive to environmental stimuli and reports that "kindness can be physically calming," helping to increase serotonin levels. Once angered, boys have less access to serotonin to help them manage their anger.

> ***And this means***—boys will have less serotonin in their system to help them calm down and to de-escalate volatile situations. A calm, kind, supportive adult intervention will be more helpful than an adult who engages in a power struggle, escalating the boy's fight response.

Dopamine—Dopamine is a neurotransmitter that stimulates motivation and pleasure circuits in the brain of both boys and girls. Dopamine is critical to the way the brain controls our movements. Not enough dopamine? We can't move or control our movements well. Too much dopamine? Uncontrollable or subconscious movements (such as picking, tapping, repetitive moments, jerking, twitching) are observable. Dopamine also controls the flow of information between areas of the brain, especially memory, attention and problem-solving tasks.

> ***And this means***—once boys are "revved up" with dopamine, their lower levels of serotonin will make it harder for them to come down. Their increased stimulation may actually tend to stimulate them more, causing them to spiral more and more out of control. A balance must be found in the classroom to help students get a "dopamine rush" from learning, but in an environment that provides enough structure to manage enthusiasm.

Oxytocin—Oxytocin is often referred to as the "tend and befriend" hormone, and is related to social recognition and bonding. Researchers have shown that oxytocin is involved in the formation of trust between people, and females have significantly higher levels in their systems than males throughout life. Oxytocin promotes the development and maintenance of relationships and females are biologically driven to maintain relationships, even those that are sometimes best let go.

> ***And this means***—girls will be motivated by their chemical system to establish and maintain relationships with teachers and peers, and will behave in ways meant to meet that need, including pleasing the teacher. Boys are less chemically driven to establish and maintain these relationships prima facie, and may not see their behavior as having as much direct connection to their relationship with the teacher and their peers.

The Two Hemispheres

Hormones, processing, and structural elements exist throughout the brain, and especially in the two hemispheres. Quite interestingly—and this has

an impact on learning—the male and female brains "do" their hemispheres somewhat differently.

Left-hemisphere preference is more common in *girls.* The left brain

- Is connected to the right side of the body
- Processes information sequentially and analytically
- Generates spoken language
- Recognizes words and numbers, when the numbers are spoken as words
- Responds more sensually to external stimuli
- Constructs memories (including hyperbolic memories)
- Does arithmetic functions
- Seeks explanations for occurrence of events

Right-hemisphere preference is more common in *boys.* The right brain

- Is connected to the left side of the body
- Processes information abstractly and holistically
- Interprets language non-verbally
- Recognizes places, faces, objects, music
- Fantasizes abstractions (such as science fiction and video game scenarios)
- Is less detailed and more concrete in recall
- Does relational and mathematical functions
- Organizes occurrences into spatial patterns

Male and female brains function in both hemispheres, but the right- and left-hemisphere preference of boys and girls has important implications when we look at how our schools are designed. Most educators will admit that schools are designed to be more left-hemisphere friendly: they are structured environments with time periods and ringing bells, are organized based on facts and rules, rely primarily on verbal processing, limit access to free space and movement, and require lots of multitasking.

Because this left-hemisphere-friendly environment naturally favors left-hemisphere preferences, girls are going to find school, in general, more comfortable than will many boys. Not surprisingly, schools report that 80 to 90 percent of their discipline problems are created by boys. Boys are not only biochemically more prone to "make a fuss" than girls but also quite often chafing against an environment that doesn't fit their right-hemisphere preference as learners.

If you would like a more comprehensive overview of the differences between the male and female brain, you might want to read *Boys and Girls*

Learn Differently! and *The Wonder of Girls* (by Michael Gurian) and *The Minds of Boys* (by Michael Gurian and Kathy Stevens).

Looking at the Male-Female Brain Spectrum

Male and female brains are different, but it's important to remember that one male brain is also different from another male brain; the same is true of female brains. All of us, male and female, fall somewhere on the male-female brain spectrum, a continuum from "the most male" to "the most female." Some boys' brains are more like the average girl's, and some girls' brains are more like the average boy's. What do we mean by that?

Researchers have identified what Michael Gurian labels "bridge brains," brains that fall in the middle of that spectrum. These are brains that are wired for more male and female brain architecture overlap. Research conducted by the Amen Clinics (which have performed thirty-five thousand brain scans) in the United States, and research by Professor Simon Baron-Cohen at Cambridge in the United Kingdom has confirmed the wide spectrum of male and female brains, as well as the existence of males and females very much in the middle of that spectrum. According to Baron-Cohen's scans, for instance, approximately one in five women and one in seven men are believed to fall within the bridge-brain range. These bridge brains are most easily seen after puberty.

A female bridge brain might have a brain system inclined to process more like a male brain. Women who enjoy careers that are very competitive and highly spatial, and that require a higher degree of risk-tolerance—such as criminal law or engineering—might likely be bridge brains. A male bridge brain might be a man who enjoys a career requiring more verbal and emotional sensitivity and processing—such as a male kindergarten teacher.

Although bridge brains are not as easily identified in elementary school, it's important to be on the lookout for children who might think just a little differently from others of their gender. Providing a diverse array of ways to learn meets the needs of children who don't fit any generalization and validates that who they are is just great!

Gender Difference: A Path to Success

Understanding that boys' and girls' brains are wired differently is just the beginning. Focusing on how those differences impact the classroom is the next step. This workbook focuses on how you can you design strategies to meet the needs of boys and girls in your elementary classrooms.

The Gurian Institute Training Division has worked in more than a thousand schools throughout the United States and Canada, public and private, coed and single-sex. This work has been utilized in classrooms by over twenty-five thousand teachers in the United States, Canada, and Australia.

By helping teachers, administrators, parents, and others working with children to understand the differences in how boys and girls learn, and by providing (and gathering from wise teachers) strategies that work, schools are changing the way they do the business of education. They are succeeding in closing achievement gaps, helping at-risk students, helping students with learning disabilities, and creating classroom stability.

Schools and teachers who use the strategies suggested in this book have provided us with success data in these quantitative areas:

- Test scores
- Grades
- Discipline referrals

The strategies and best practices in this workbook have been field tested and provide a toolbox that can help you increase test scores and grades, and lower discipline referrals. We have gathered for you a number of Web sites, resources, and in-class projects and tools that you can begin to use today. Our recommendations work for both boys and girls—hindering neither. Many of these strategies and practices grow from research and from teachers' wisdom of practice that target boys or girls specifically, but we have not included (and never support) a practice that would be detrimental to either boys or girls.

This is one example of the success that can occur when teachers and schools understand how boys and girls learn differently, and when schools provide training and resources to help teachers implement effective strategies. Every teacher at Douglass knows that one strategic approach is not the only cause of statistical gains in test scores. Teachers can try many things, and many variables can affect improved learning. At the same time, Douglass teachers were happy to see rewards for their focus on how boys and girls learn differently. By visiting the Gurian Institute Web site (www.gurianinstitute.com) you can read more success stories and learn more about how teachers and schools are improving performance and helping kids excel.

Now we hope you'll enjoy the remaining chapters of this book, which show you how to implement strategies like those at Douglass in your own elementary classroom right now. We hope, too, that what you read here will resonate with your life experience as a teacher and make you say, perhaps a little more often than you did before, "I sure love teaching these kids."

Douglass Elementary: A Success Story

Kelley King, coauthor of this workbook, was principal of Douglass Elementary School in Boulder, Colorado when she met Michael Gurian and Kathy Stevens. Her school is a success story in applying strategies for teaching boys and girls specifically. Douglass has been featured in *Educational Leadership,* the *American School Board Journal,* in *Newsweek,* and even on the *Today Show.*

In August 2004, Douglass faculty studied their achievement data and noted a gap in achievement between boys and girls in writing. Having developed programming to address math and science gaps among girls, Douglass now noticed a significant gap for boys in reading and writing. The Douglass faculty, under the guidance of Kelley and the gender team, decided to establish a school improvement goal to close the gap through the implementation of instructional strategies shown to be effective in accommodating the brain differences of boys while meeting the needs of girls.

The teachers and principal studied the research in Michael Gurian's book, *Boys and Girls Learn Differently!* and an article by Michael Gurian and Kathy Stevens titled "With Boys and Girls in Mind," from *Educational Leadership.* The instructional strategies recommended by Michael and Kathy included the following:

- Increasing movement and kinesthetic learning opportunities
- Expanding the selection of reading materials to interest boys and girls specifically in classrooms
- Teaching and encouraging visual-spatial representations of thinking, especially during the planning stages of writing
- Creating a greater sense of purpose by offering expanded audiences for writing, thus helping shy students, among them many girls, to find voice, and helping many unmotivated boys to see the power of their work on an audience
- Creating a greater sense of relevancy across the curriculum through more student choice of topics in writing
- Increasing the participation of male role models in reading and writing in classrooms
- Offering some opportunities for single-sex activities within a classroom (such as all-boy and all-girl literature circles)
- Offering real-life simulations, such as reenactments and debates, to engage boys emotionally, and stimulate girls toward greater real-world learning

After the first year of implementation of these and other strategies, Douglass saw quantitative results in their writing achievement scores—especially for boys, but also for all sub-groups of students. For example, the overall gap between boys' and girls' performance in writing decreased from 13 percentage points to 5 percentage points, which was the target goal. This broke a cycle of girls outperforming boys by 13 to 16 percentage points over the prior three years. Not only did more boys reach proficiency, but more boys also reached the advanced levels or proficiency. Weighted index scores provide a clearer picture of student performance across all levels of proficiency. When examined as weighted index score gains and broken down by grade level, boys in third grade made a 7 point jump. Boys in fourth grade jumped from a weighted index score of 92 in third grade to 96 in fourth grade. An increase jump from 93 to 106—a full 13 points—was made by students in fifth grade.

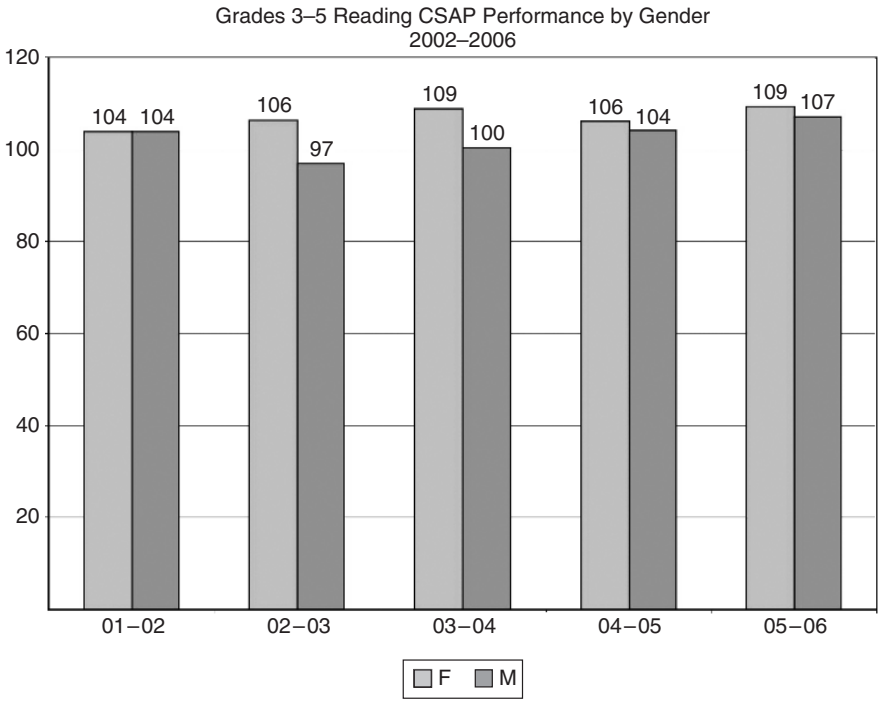
A parent on the Douglass Elementary School Improvement team put these numbers in perspective. She said, "My son started the year in tears about writing. You folks did all these things and the change was almost immediate. Now, at the end of the year, he loves writing." This mom's comments reveal not only the improvement in achievement, but also a crucial element of success that Douglass focused on: parent buy-in and involvement.

In June 2006, Douglass Elementary School completed its second year of implementing gender-friendly instructional strategies in all classrooms. In addition to ongoing professional reading, Douglass Elementary School and a number of other Boulder Valley schools hosted the Gurian Institute for a full day of teacher training. Whereas the gender gap had been reduced to 4 percentage points after year one of implementation, after year two, the gap was reduced to a statistically insignificant 3 percentage points. There now is, statistically, no achievement gap in reading between boys and girls at Douglass.

A further gain has occurred among special education students. Because three out of four special needs students at Douglass were boys, Kelley and her staff suspected that meeting the gender-specific needs of boys would have a great impact on the special education population. In fact, in the two years of implementation, Douglass special needs students made substantially greater and more rapid gains than the special needs students in the school district as a whole. Currently, Douglass special education students are scoring almost 50 weighted index score points above the district average for this subgroup of students.

Douglass is seeing similar positive benefits in the area of math. There is no gender gap in either math or science now. As with literacy, these gains have occurred not just among general student populations, but also among special education students. Their math scores increased by 31 percentage points, with

Douglass students out-performing district special education students by 75 percentage points.



In year three of implementation, Douglass teachers are becoming increasingly skilled in developing, using, and refining instructional tools in their classrooms that engage both boys and girls, and that honor, challenge, and build on the unique strengths that boys bring to the classroom setting.