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The Myth of Pink and Blue Brains

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If educators hope to close gender gaps, they must abandon the notion of a male and female brain.

Gender differences are a hot topic. But much of the recent discussion about boys' and girls' learning has generated more heat than light. As a neuroscientist who has studied children's cognitive and emotional abilities and, in particular, analyzed gender differences in children's brains, I hope to help set the record straight on this incendiary subject.

Boys and girls differ in many ways—in physical activity level; self-control; and performance levels in reading, writing, and math. Above all, they differ in interests. But most of these differences are nowhere near as large as popular ideas about a "Mars-Venus" gulf imply, nor are they as "hardwired" as current discourse portrays. The truth is that neuroscientists have identified very few reliable differences between boys' and girls' brains. Boys' brains are about 10 percent larger than those of girls, and boys' brains finish growing a year or two later during puberty (Lenroot et al., 2007). But these global differences reflect physical maturation more than mental development.

Few other clear-cut differences between boys' and girls' neural structures, brain activity, or neurochemistry have thus far emerged, even for something as obviously different as self-regulation. Boys and girls, on average, differ in self-regulatory *behavior*, with girls showing better ability to sit still, pay attention, delay gratification, and organize a take-home folder, for instance. We know that self-regulatory abilities depend on the prefrontal cortex of the brain, but neuroscientists have thus far been unable to show that this area develops earlier or is more active in girls (Barry et al., 2004).

The same is true of gender differences in the adult brain. In spite of what you may have read, women do not have a larger corpus callosum,[1] process language in a more symmetrical fashion, or have higher circulating levels of serotonin compared with men. The latest high-resolution MRI studies reveal small differences in brain lateralization or "sidedness" (Liu, Stufflebeam, Sepulcre, Hedden, & Buckner, 2009) and functional connectivity (Biswal et al., 2010), on the order of three-tenths of a standard deviation, meaning there is more overlap between average males' and females' brains than differences between the average brain of each gender. These studies, based on thousands of subjects around the world, give us a better picture of the true size of neurologic sex differences than do the cherry-picked, single studies of a few dozen men and women that are often cited as proof of evolutionarily programmed gender differences.

Our actual ability differences are quite small. Although psychologists can measure statistically significant distinctions between large groups of men and women or boys and girls, there is much more overlap in the academic and even social-emotional abilities of the genders than there are differences (Hyde, 2005). To put it another way, the range of performance within each gender is wider than the difference between the average boy and girl.

Of course, teachers know this. Teachers recognize that girls *or* boys can be strong readers. On the playground, about one-third of girls are physically more active than the average boy. When it comes to academic achievement and even classroom behavior, gender is a very poor predictor of any individual student's performance.

So What's Behind Gender Gaps?

Society as a whole, however, cannot ignore the striking gender gaps in academic performance. Girls have out-performed boys in reading and boys have outscored girls in math (although by a smaller margin) on

the National Assessment of Educational Progress (NAEP) in every year assessed since 1971 (U.S. Department of Education, 2005). Similar gender gaps exist on the Program for International Student Assessment (PISA) (Else-Quest, Hyde, & Linn, 2010).

At first glance, this stability suggests there *is* something inherently different about boys' and girls' academic abilities. But a closer look reveals that the gaps vary considerably by age, ethnicity, and nationality. For example, among the countries participating in PISA, the reading gap is more than twice as large in some countries (Iceland, Norway, and Austria) as in others (Japan, Mexico, and Korea); for math, the gap ranges from a large male advantage in certain countries (Korea and Greece) to essentially no gap in other countries—or even reversed in girls' favor (Iceland and Thailand). What's more, a recent analysis of PISA data found that higher female performance in math correlates with higher levels of gender equity in individual nations.

This suggests that environmental factors are important in shaping gender gaps. The truth is that no mental ability—or ability difference—is "hardwired" into the brain. Abilities develop in a social-cultural context that includes each child's opportunities, relationships, sense of identity, and more. Biologists call such development *epigenetic*. Environmental factors—ranging from diet and chemical exposure to less tangible influences like parenting styles—are known to alter DNA structure, gene expression, and an organism's lifelong brain and behavioral function (Champagne & Curley, 2005). When it comes to gender gaps, boys and girls start out a little bit different, but these differences become rapidly magnified by a culture that sees them—and encourages them to see themselves—as fundamentally different creatures.

Three Little Differences—and How They Grow

Three small, early biases appear to be programmed by prenatal hormone exposure or sex-specific gene expression:

- Baby boys are modestly more physically active than girls (Campbell & Eaton, 1999).
- Toddler girls talk one month earlier, on average, than boys (Fenson et al., 1994).
- Boys appear more spatially aware (Quinn & Liben, 2008).

Such differences contribute to each gender's well-known toy preferences, which surface in the second year of life (Servin, Gohlin, & Berlin, 1999). Boys prefer more active playthings, like trucks and balls; girls choose more verbal-relational toys, especially dolls. In each of these cases, however, boy-girl differences are magnified through parental treatment. For example, parents encourage more physical risk-taking in sons than in daughters (Morrongiello & Dawber, 2000); mothers generally talk more to preschool-aged daughters than sons (Leaper, Anderson, & Sanders, 1998); and parents discourage "gender-inappropriate" play, especially in terms of boys showing too much interest in sister's Barbie collection (Lytton & Romney, 1991).

This is important, because children develop the skills they will bring into the classroom through such early play. Simply put, girls spend more time talking, drawing, and role-playing in relational ways, whereas boys spend more time moving, targeting, building, and role-playing as heroes. Each activity is beneficial, but because of the potency of early experience on children's brain wiring, the differences between typical "girl" and "boy" play have deep consequences for cognitive and emotional function.

For example, as boys and girls progress through childhood, clocking very different amounts of time throwing, catching, constructing, and playing high-speed driving and targeting games, their spatial skills grow increasingly disparate, with boys scoring higher in this area. The ability to visualize three-dimensional objects and their orientations, distances, and trajectories is important in higher math, science, and mechanical work—domains in which boys eventually pull ahead.

Alternatively, consider verbal skills. Thanks to their extra conversation with peers and parents, girls' small verbal advantage balloons by kindergarten into a significant gap in phonological awareness, the key

stepping stone for learning to read. By 3rd grade, 20 percent more girls than boys score in the proficient range as readers, according to NAEP data—a gap that grows to 38 percent by 8th grade (Lee, Grigg, & Donahue, 2007) and a startling 47 percent by the end of high school (Grigg, Donahue, & Dion, 2007).

The numbers are stark, but they reveal that the reason boys don't read and write as well as girls has little to do with innate brain wiring and everything to do with the reality that girls engage more than boys with words: talking, reading, journal writing, or endless text-messaging. Only 25 percent of teenage boys around the world cite reading as one of their favorite hobbies, compared with 45 percent of teenage girls (Organisation for Economic Cooperation and Development, 2010).

So if we want to tackle academic gaps between boys and girls, we need to start early, nurturing skills and attitudes that will better prepare both genders for the modern classroom. We also need to make sure that the classroom remains a place where students' potential is broadened, rather than narrowed through misguided beliefs. As always, the best way to do this is to focus on each child's unique combination of cognitive and emotional talents.

Navigating Gender Differences

In spite of claims—and intentions—to the contrary, few parents or teachers are truly gender neutral. The good news is that attempts at gender equity do make a difference. Students develop more stereotyped attitudes in classrooms that emphasize gender (such as by lining up boys and girls separately) and more egalitarian attitudes where it's deemphasized (Hilliard & Liben, in press).

So how should teachers pay attention to gender? Very carefully. As with all types of diversity, the challenge is to respect and honor differences without turning them into self-fulfilling prophecies. Just as we would never try to guess a student's math skill on the basis of skin or eye color, we must avoid prejudging any student's verbal, athletic, scientific, artistic, leadership, analytical, or social ability on the basis of chromosomes.

We must challenge gender stereotypes for *both* sexes. In mainstream U.S. culture, girls are rewarded for behaving like boys more than the other way around—which is great for girls' math and athletic skills, but not for boys' verbal and relational abilities. Boys hear that "girls can do anything" whereas the boys get boxed into smaller corners by their presumed limitations ("Boys are less verbal"); teachers' prohibitions ("No running"); and peers' narrow views of masculinity ("Art is gay"). Might this be why girls excel in many areas, while boys' success is shrinking to sports and a few select curricular zones?

Here are a few suggestions for reducing opportunity gaps between boys and girls:

Avoid stereotyping. I suspect most teachers try to do this, but I fear that the recent focus on boy-girl differences and claims of "hardwiring" have caused things to slip backwards. Some news reports about single-gender programs describe teachers guiding students into stereotyped activities, for instance, giving girls quiet spaces to "sit and discuss their feelings" while boys get extra opportunities for competition and physical play (Tyre, 2005). This approach is wrong: Both sexes need more physical exercise, and both need to be comfortable blending competition and cooperation.

Appreciate the range of intelligences. Beyond the three *R*s lie many zones of performance in which individual students may excel but which aren't typically recognized at school. Howard Gardner brought nontraditional kinds of intelligence and skill to teachers' attention years ago but with the new back-to-basics focus, some important domains—such as the arts and kinesthetic ability—have been forgotten. Broadening the range of abilities that we teach and affirm can help more students feel successful at school.

Strengthen spatial awareness. Spatial skills are arguably the most overlooked nontraditional abilities in the curriculum. Yet spatial cognition is important for understanding such areas as fractions, proportionality, calculus, geography, physics, and chemistry. Research supports the idea that practice in activities

requiring spatial awareness improves such skills (Newcombe, Mathason, & Terlecki, 2002), but most training in this domain happens outside school. Beginning in preschool, teachers should formally teach spatial and mechanical skills using puzzles, map reading, targeting sports, and building projects that get students thinking in 3D.

Engage boys with the word. Parents and educators alike need to do a better job with this, starting early with the verbal and literary immersion that builds vocabulary, phonologic skill, and a love of books. The simple equation, "Language in = Language out" should remind teachers of the importance of engaging boys in one-on-one dialogue, word play, stories, songs, and every kind of text. Once they begin formal reading instruction, boys benefit from a wide variety of reading material that appeals to their sense of humor and frequent interest in action, adventure, and nonfiction.

Writing ability shows an even larger gender gap, but in a world that produced Shakespeare and Stephen King, it's absurd to suggest that boys are constitutionally incapable of writing as well as girls. The solution is time on task. Beginning in preschool, teachers should emphasize "mark-making" to promote writing using vivid markers, crayons, charcoal, or paint on large surfaces like appliance boxes—or fun ones like portable slates. The goal is not formal printing, but symbolic expression and fine-motor practice. Although penmanship is important, divorce it from composition by allowing students to dictate or type their thoughts.

Recruit boys into nonathletic extracurricular activities. When did the school newspaper, yearbook, and student council become all-female clubs? Unfortunately, many of these activities have reached a tipping point; when the number of boys falls below 25 percent, it becomes—perplexingly—"unmasculine" to join the chorus or run for class president. Just as we'd be appalled to host a science club without girls, we should not accept boys' absence from a wider variety of campus activities.

Bring more men into the classroom. The number of male teachers in elementary school has declined precipitously since the 1980s. We need to increase the ranks of young men who enter teaching, and bring more fathers and adult males into preschool and elementary classrooms as role models for intellectual engagement.

Treat teacher bias seriously. There still are teachers who believe "girls are good at reading and boys are good at math." There still are teachers who cannot tolerate physical exuberance or coloring outside the lines. Considering the potent effect of teacher expectations on student performance, we must train teachers about potential bias and evaluate them with respect to it. Just as girls have benefited from efforts to root out antifemale bias, boys deserve protection from teachers who may—consciously or unconsciously—regard them as "toxic."

In the past 15 years, claims about hardwired differences between boys and girls have propagated virally, with no genuine neuroscientific justification. In reality, culture, attitudes, and practices influence boy-girl academic gaps far more than prenatal testosterone does. The sooner teachers open their eyes to such influences, the sooner we can bring out the best in every child.

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Endnote

[1] The corpus callosum is a white matter tract that provides most of the connections between left and right cerebral hemispheres. Some studies have reported that it's larger in the female brain; others have found it larger in the male brain, but a meta-analysis of 49 studies found no significant difference in corpus callosum size between the genders (Bishop & Whalsten, 1997).

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