Why Gender Matters

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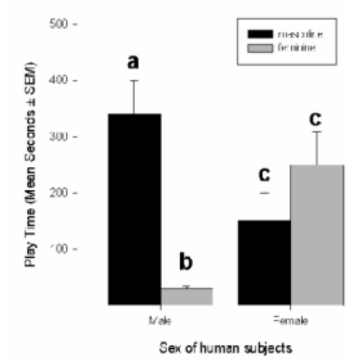
Leonard Sax MD PhD

www.leonardsax.com

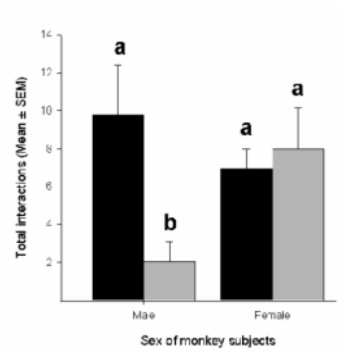
Please note: this handout is intended as a ***supplement to*** *the presentation, not as a* ***substitute for*** *the presentation. It is intended to assist those who attend my workshop, to spare them the distraction of taking excessive notes. These pages are NOT intended to be read separately from the presentation; they cannot "stand by themselves."*
If you would like to get a sense of the presentation but did not have the opportunity to attend, please read the revised second edition of **Why Gender Matters**. *You can reach me via email at* *mcrcad@verizon.net* *but also please send a copy to my personal email* leonardsax@gmail.com.

Sex differences in vision / hearing / smell

Sex differences in the visual system



Researchers have long known that young boys tend to prefer playing with a truck rather than a doll. The graph at right shows the typical findings when girls and boys are given a choice of playing with a "boy toy" such as a truck (black bar) or a "girl toy" such as a colorful plush doll (grey bar). Before 2002, most scholars agreed that boys' preference for trucks over dolls reflected the social construction of gender. Boys were taught that boys were supposed to prefer trucks over dolls; as a result, boys preferred to play with trucks rather than dolls.



Dr. Gerianne Alexander was the first to offer monkeys the same choice: playing with a dull grey truck or a colorful plush doll. Her findings have since been replicated by Kim Wallen and colleagues with a different species of monkey, and by Sonya Kahlenberg and Richard Wrangham in their observations of chimpanzees. The primate data are shown above.

It's difficult to invoke the social construction of gender to explain these findings in monkeys or in chimpanzees. One *can* reasonably invoke the social construction of gender to explain the difference across species. Why is the preference of the juvenile male to play with a truck rather than a doll greater in our species than among monkeys or chimpanzees? Answer: the social construction of gender among humans exaggerates the innate preference. The preference of the juvenile male primate to play with trucks rather than dolls must be innate, because this preference is conserved across species. This preference is more pronounced in our species because of the social construction of gender in human cultures; or as Dr. Melvin Konner puts it, "Culture *stretches* biology." But what explains the main effect? Why do juvenile primate males – whether they are human or monkey – prefer to play with a dull grey truck rather than with a colorful plush doll?

Dr. Gerianne Alexander was the first to document this finding in nonhuman primates, and also the first to propose a plausible explanation. To understand her explanation, you have to recall some basic facts about the visual system in primates.
Two visual systems:

- One visual system, the Parvocellular (P) system, is devoted to color, texture, detail
- The other visual system, the Magnocellular (M) system, is devoted to detecting speed, direction, and change in direction
- Why do juvenile males – whether human or monkey – prefer to play with a dull grey truck rather than with a colorful plush doll?
- Because the truck MOVES; it has wheels
- Katrin Amunts et al.: compared M system in human occipital cortex (hOc), in women and men; McGivern et al, moving objects on a screen

  ***Application**. Suppose you give a child a blank sheet of paper and a box of*

*crayons and ask the child to draw whatever they want. What do children draw? Studies using this paradigm have found that young **girls** tend to draw people, pets, flowers, and/or trees, facing the viewer, with lots of detail, eyes, hair, clothes, etc.* →

About 1 in 12 boys draw people, pets, and trees, just as girls do. These boys share a number of characteristics which distinguish them from other boys:

- These boys may be athletically talented, but if so, they tend to prefer tennis, track, or golf, rather than football or soccer
- These boys are more likely to suffer from allergies, asthma, and eczema
- These boys are more likely to be precocious, particularly with regard to language
- Sexual orientation is a separate parameter.

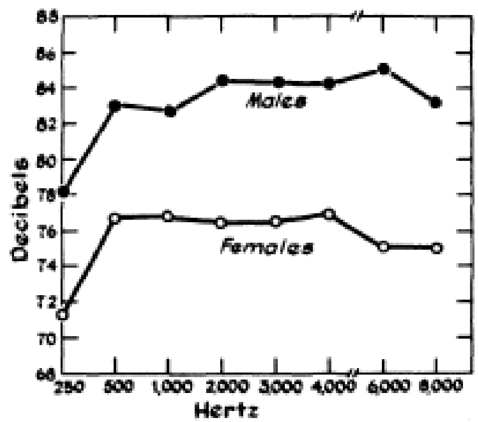
Most boy draw a dynamic scene of action, such as a rocket smashing into a planet, or soldiers shooting at each other. Faces, if visible, are often lacking features. ←

The key is to understand: **What is the picture the boy is trying to draw?** Then help him to draw it better.
Don't insist on "one right way." The result of this misguided approach is not that boys try to draw like girls. The result is that many boys decide that "drawing is for girls."
The lack of awareness of gender differences has the unintended consequence of reinforcing gender stereotypes. When more teachers understand these differences,

the result is that they are able to break down gender stereotypes, and boys like to draw. At least, that is the experience of Margrét Pála Ólafsdóttir in Iceland. Boys at all 17 of her schools love to draw.

> The big differences between girls and boys are not in what they *can* do but in what they *want* to do. See chapter 2 of my book *Boys Adrift,* and chapter 5 of my book *Girls on the Edge,* for much more on these points.

Sex differences in hearing



- L = Loudness (subjective)
- Φ = physical amplitude of the sound
- *n* = "loudness exponent"
- Stevens' Law: $L = k\,\Phi^{n}$
- *n* declines as a function of amplitude
- At any particular amplitude and frequency, ***n is higher for females than for males***
- Stevens' *n* is higher for the average girl compared with the average boy (e.g. D'Alessandro & Norwich, 2009); this difference is clearly established at 5 years of age
- As a result: You need to speak about 8 decibels more loudly for the **average** boy. But not for all boys!

Sex differences in olfactory sensation (smell)

Please see my article on this topic for the *New York Times,* August 30 2017, "Why stinky socks may bother women more than men," https://www.nytimes.com/2017/08/30/well/family/why-stinky-socks-may-bother-women-more-than-men.html. Be sure to read the comments!

Dr. Pamela Dalton and her colleagues exposed men and women to several smells. Not just once, but over and over again. Dr. Dalton and her coworkers found that with repeated exposure, the women's ability to detect the odor improved. How much did it improve? By a factor of 50%? Or maybe by 500% - a five-fold improvement? No, the *average* improvement for women was an improvement of 100,000-fold: the women were able to detect the odor at a concentration 1/100,000th of the concentration the women needed at the beginning of the study.

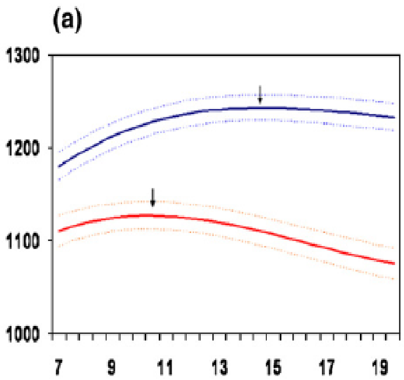
What about the men? Did they show a similar improvement – a 100,000-fold increase in sensitivity? No, they did not. OK, how about a thousand-fold improvement? Nope. How about just a hundred-fold improvement? Sorry. The men, on average, showed *no improvement at all* in their ability to detect the odor.[i]

Quick anatomy lesson: Smell receptors in the nose send their signals via the olfactory nerve to the olfactory bulb. The olfactory bulb is located on the bottom side of the brain. The olfactory bulb is the first stop for information about smell.

There are two kinds of cells in the brain: *neurons* are considered the most important, because they seem to play the most important role in sending information via electrical signals. But *glial* cells are essential too, because they provide structure and may also modulate information processing in the brain.[ii]

On all counts, women beat men. Women have more cells in the olfactory bulb: 16.2 million in the average woman, compared with 9.2 million in men. When you look just at the neurons in the olfactory bulb, the average woman has 6.9 million, compared with just 3.5 million in males. When you look at the glial cells, women again have more: 9.3 million in the average woman compared with 5.7 million in the average man. All these differences are highly statistically significant.[iii]

Sex differences in brain development. We now know that the various regions of the brain develop in a different sequence in boys compared with girls.



NIH study, (Lenroot et al., 2007, figure at left; Raznahan et al. 2010; comment in Sax 2010). Girls reach the inflection point (arrow) just before 11 years of age. Boys do not reach the inflection point (arrow) until about 15 years of age.

Sex differences in the brain are largest between young girls and young boys; sex differences between adult females and adult males are small. The same is true for many parameters relevant to education. For example: ***How long can you sit still, be quiet, and pay attention?*** We find no difference on that parameter comparing a 40-year-old woman with a 40-year-old man. But when we compare a 6-year-old girl with a 6-year-old boy, we find that the average 6-year-old boy can sit still, be quiet, and *pay attention* for only about half as long as the average 6-year-old girl. He may be sitting still and being quiet, but he is not paying attention. It's not unusual to find 6-year-old boys who absolutely have to stand and make buzzing noises in order to learn. It *is* unusual to find a 40-year-old man who absolutely has to stand and make buzzing noises in order to learn.

The androgen receptor (excerpt from *Why Gender Matters,* [2017] chapter 9)

Androgens are hormones, such as testosterone, which are found in much higher concentrations in men than in women. Male sex characteristics such as facial hair, a large Adam's apple, deeper voice, greater muscularity, and greater aggressiveness, have all been linked to androgens such as testosterone.

But how do androgens work? The answer begins with the androgen receptor. Androgens such as testosterone and dihydrotestosterone bind to the androgen receptor, which becomes activated. The activated androgen receptor then binds to certain genes and turns them on, resulting in masculinization.

That process begins in the womb. The male fetus produces testosterone, which masculinizes the male brain.[iv] The biggest sex differences in the expression of genes in the human brain occurs not in adulthood, nor in puberty, but in the prenatal period before the baby is even born.[v]

So far so good. Girls and boys are different. But some of the most startling discoveries of recent years have helped scientists to understand variations *among* girls and *among* boys better than before. Researchers now understand that the gene for the androgen receptor varies from one boy to the next. Every gene is made up of units called *codons:* each codon normally codes for one amino acid in the protein that gene is programmed to make. One end of the androgen receptor gene has a series of codons called CAG codons because the codons are a repeating string of cytosine (C), adenine (A), and guanine (G). These codons used to be called “nonsense” codons because they don’t directly code for amino acids. But nobody calls them “nonsense” codons anymore, because scientists now recognize that these CAG codons help determine how active the androgen receptor will be.

The number of CAG repeat codons in the androgen receptor gene varies from one person to the next, from a low of 8 repeats to a high of 31 repeats. Many research teams have now discovered that if you’re a boy and your androgen receptor gene has a low number of CAG repeats, then your androgen receptor is very active and you will tend to be more masculine. If you’re a boy and your androgen receptor gene has a high number of CAG repeats, then your androgen receptor is less active and you will tend to be less masculine.[vi] This new research helps to explain much of the noise in earlier research on testosterone levels. Two young men may have exactly the same testosterone level, yet one young man is very masculine – he plays football, he is aggressive, he is muscular – and the other young man hates football, he is timid, and he is not muscular. The same testosterone molecule may cause lots of activity via the androgen receptor in the first young man, and much less activity via the androgen receptor in the second young man.

In recent years, there has been substantial research linking variation in CAG repeats with behavioral outcomes such as aggressiveness, impulsiveness, and depression: and the research helps to broaden and deeper earlier research on testosterone levels and various behavioral outcomes. For example: what's the relationship between testosterone levels and depression in adult men? It turns out that the answer depends critically on the number of CAG repeats in the androgen receptor gene. If you're a man and you have a low number of CAG repeats – which means that you are likely a very masculine man – then your mood depends on testosterone. Among men with a low number of CAG repeats, depression was more than *five times* as common among men with low testosterone than among men with high testosterone. But among men with a high number of CAG repeats – men who will be, on average, less-masculine men – there was no difference in the frequency of depression between men with low testosterone levels compared with high testosterone levels.[vii]

Researchers have now documented many links between the number of CAG repeats in the androgen receptor, and outcomes related to behavior and personality. For example, young men with a low number of CAG repeats have been found to be more impulsive compared with young men with a high number of CAG repeats.[viii] And, several studies have suggested that men with a smaller number of CAG repeats are more likely to be aggressive and to engage in criminal violence, independent of their testosterone levels.[ix] Incidentally, this link between the number of

CAG repeats and aggressiveness may not be confined to humans. In dogs as well, a low number of CAG repeats has been associated with higher aggressiveness.[x]

For me, the take-home message of all this research on how the number of CAG repeats in the androgen receptor gene influences behavioral traits associated with masculinity is simple: the tendency for a boy to be a rough-and-tumble boy is hardwired to a significant extent. That also means that the tendency for another boy NOT to be a rough-and-tumble boy is also hardwired. Trying to get a timid boy who doesn't like to hit or be hit to sign up to play defensive tackle in football is not likely to be productive.

Paul Simon's song, "I am a rock": "*I have my books and my poetry to protect me*"

Lisa Selin Davis, "My daughter is not transgender. She's a tomboy" https://www.nytimes.com/2017/04/18/opinion/my-daughter-is-not-transgender-shes-a-tomboy.html.

Tomboy is about what you DO

Trans is about who you ARE – with some disclaimers, and limitations

Lisa Selin Davis, "Like tomboys and hate girlie girls? That's sexist" https://www.nytimes.com/2018/12/19/opinion/tomboys-girlie-girls-sexism.html

Sexual orientation / gender identity

Sexual orientation: who you go to bed WITH

Gender identity: who you go to bed AS

Left-handedness is a normal variation.

"Normal" and "abnormal" are medical terms (as used here)

"Good" "bad" "right" "wrong" are moral judgments

We are not making moral judgments.

Auditory sensitivity: Hypothesis:

Straight F > Lesbian F > Gay M > Straight M

Findings:

Straight F > Lesbian F > Straight M > Gay M

Gay men were "hypermasculine" relative to straight men. Dennis McFadden and Craig Champlin, "Comparison of auditory evoked potentials in heterosexual, homosexual, and bisexual males and females," *Journal of the Association for Research in Otolaryngology,* volume 1, pp. 89 – 99, 2000, full text online at https://liberalarts.utexas.edu/_files/fryca/DM.CAC.AEPs.Gays.pdf.

Fraternal birth order effect: if you are male, the more older male siblings you have born to the same mother, the more likely you are to be homosexual. See chapter 10 of *Why Gender Matters.* The primary sources include Ray Blanchard and colleagues, "The relation of birth order to sexual orientation in men and women," *Journal of Biosocial Science,* volume 30, pp. 511 – 519, 1998; and Ray Blanchard, "Fraternal birth order and the maternal immune hypothesis of male homosexuality," *Hormones and Behavior,* volume 40, pp. 105 – 114, 2001. See also Anthony Bogaert and Malvina Skorska, "Sexual orientation, fraternal birth order, and the maternal immune hypothesis," *Frontiers in Neuroendocrinology,* volume 32, pp. 247 -254, 2011.

MZ / DZ concordance: see chapter 10 of *Why Gender Matters* (2017). The primary sources include J. Michael Bailey and Richard Pillard, "A genetic study of male sexual orientation," *Archives of General Psychiatry,* volume 48, pp. 1089 – 1096, 1991.
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Lisa Diamond, “Was It a Phase? Young Women’s Relinquishment of Lesbian/Bisexual Identities over a 5-Year Period,” *Journal of Personality and Social Psychology*, volume 84, pp. 352–64, 2003. Also see: Lisa Diamond, “What Does Sexual Orientation Orient? A Biobehavioral Model Distinguishing Romantic Love and Sexual Desire,” *Psychological Review*, volume 110, pp. 173–192, 2003.

Transgender:

MtF early onset, usually homosexual.
MtF late onset, usually heterosexual.
FtM early onset, usually homosexual.
FtM later onset, varies.

MtF early onset exhibits FBO and is likely to show the CAG codon effect seen with gender-nonconforming males.

Professor J. Michael Bailey, University of Wisconsin Madison: “Only a small minority of gay men become transgender, but homosexual transsexuals are a type of gay man.” *The Man Who Would Be Queen,* p. 178.

Contact information:

Leonard Sax MD PhD
Montgomery Center for Research in Child & Adolescent Development (MCRCAD)
64 East Uwchlan Avenue, #259
Exton, Pennsylvania 19341
Telephone: 610 296 2821
Fax: 610 993 3139
e-mail: mcrcad@verizon.net and leonardsax@prodigy.net (use both)
www.leonardsax.com

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Notes on olfactory sensation

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[i] See Jeanmarie Diamond, Pamela Dalton, Nadine Doolittle, and Paul Breslin, "Gender-specific olfactory sensitization: hormonal and cognitive influences," *Chemical Senses,* volume 30 (supplement 1), pp. i224 – i225, 2005. See also Pamela Dalton, Nadine Doolittle, and Paul Breslin, "Gender-specific induction of enhanced sensitivity to odors," *Nature Neuroscience,* volume 5, pp. 199 – 200, 2002; and also Nassima Boulkroune and colleagues, "Repetitive olfactory exposure to the biologically significant steroid

androstadienone causes a hedonic shift and gender dimorphic changes in olfactory-evoked potentials," *Neuropsychopharmacology,* volume 32, pp. 1822 – 1829, 2007.

[ii] For an introduction to the emerging evidence on the importance of glial cells, see the review by Nicola Allen and Ben Barres, "Glia – more than just brain glue," *Nature,* volume 457, pp. 675 – 677, February 5 2009. See also Baljit Khakh and Michael Sofroniew, "Diversity of astrocyte functions and phenotypes in neural circuits," *Nature Neuroscience,* volume 18, pp. 942 – 952, 2015.

[iii] Ana Oliveira-Pinto and colleagues, "Sexual dimorphism in the human olfactory bulb: females have more neurons and glial cells than males," *PLOS One,* November 2014, online at http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0111733.

[iv] See for example Bonnie Auyeung and colleagues, "Prenatal and postnatal hormone effects on the human brain and cognition," *European Journal of Physiology,* volume 465, pp. 557 – 571, 2013.

[v] Hyu Jung Kang and colleagues, "Spatio-temporal transcriptome of the human brain," *Nature,* volume 478, pp. 483-489, 2011.

[vi] Anton Aluja and colleagues, "Interactions among impulsiveness, testosterone, sex hormone binding globulin and androgen receptor gene CAG repeat length," *Physiology & Behavior,* volume 147, pp. 91 – 96, 2015. See also Michael Zitzmann and Eberhard Nieschlag, "The CAG repeat polymorphism within the androgen receptor gene and maleness," *International Journal of Andrology,* volume 26, pp. 76 – 83, 2003.

[vii] Stuart Seidman and colleagues, "Testosterone level, androgen receptor polymorphism, and depressive symptoms in middle-aged men." *Biological Psychiatry,* volume 50, pp. 371 – 376, 2001.

[viii] Aluja, 2015 (cited above).

[ix] See for example Marina Butovskaya and colleagues, “Androgen receptor gene polymorphism, aggression, and reproduction in Tanzanian foragers and pastoralists,” *PLOS One,* August 20 2015, http://dx.doi.org/10.1371/journal.pone.0136208; and also Singh Rajender and colleagues, “Reduced CAG repeats length in androgen receptor gene is associated with violent criminal behavior,” *International Journal of Legal Medicine,* volume 122, pp. 367 – 372, 2008.

[x] Akitsugu Konno and colleagues, “Androgen receptor gene polymorphisms are associated with aggression in Japanese Akita Inu,” *Biology Letters,* volume 7, pp. 658 – 660, 2011, full text online at http://rsbl.royalsocietypublishing.org/content/roybiolett/7/5/658.full.pdf.