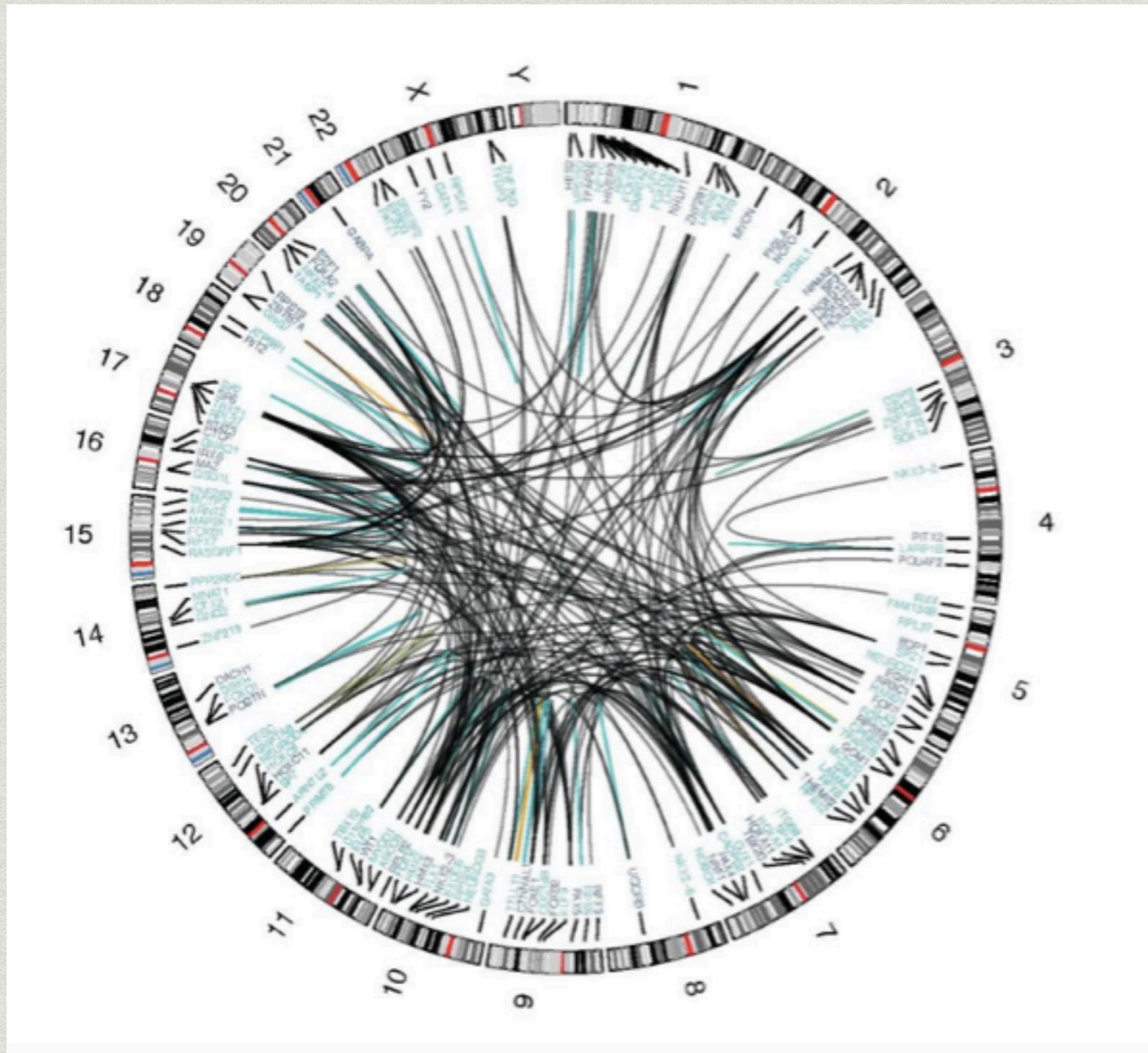


# Neurosexism

Sex-based differences in the brain



# Neurosexism

Sex-based differences in the brain

## **Neurosexism**

1. Stereotypes vs. new research
2. Statistics 101
3. Direction of new research
4. Explanations/Biology
5. Why is there a difference?
6. What's the future??

# Neurosexism

Sex-based differences in the brain

## 1. Stereotypes vs. new research

We are taught, that stereotypes about men and women are

- at best . . . humor in bad taste
- at worst . . . blatant ignorance.

And some of the most frowned-upon stereotypes target women unfairly (dumb blondes, fx).

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In fact, social psychologists and sociologists pooh-poohed the notion of *any* fundamental cognitive differences between male and female humans

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Girls and boys have no differences in brain function or math ability, according to researchers who used imaging to analyze the development of kids' brains

We see children's brains function similarly\* regardless of their gender; hopefully we can recalibrate expectations of what children can achieve in mathematics!

\*Note: similarly . . . not "the same way"

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But . . .  
a large amount of research shows there *are*  
differences between how men and women  
behave . . . five examples:

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Sex-based differences in the brain

1. Women are 30% more likely to having F-F collisions than men having M-M collisions\*

\* despite 60% of drivers are men

Men died at a rate of 2.5 deaths per 100 million miles traveled, vs. 1.7 deaths for women.

[Insurance Institute for Highway Safety.](#)



...but they told me to look both ways!

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2. Women are 5x as likely as men to squeeze the tube of toothpaste at the middle



... and no one knows why!

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3. Men are 100x as likely as women to *leave* the toilet seat up



... and no one knows why!

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4. Men are 10x as likely as women to keep their electronics organized



... and no one knows why!

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5. Women are 20x as likely as men to place the L and R shoe in opposite order in the closet



... and no one knows why!

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**Let's be serious . . .**

**FROM**

The neuroscience community has traditionally considered any observed sex-associated **differences in cognition and behavior** in humans to be due to the effects of **cultural** influences (boys/cars; girls/dolls).

**TO**

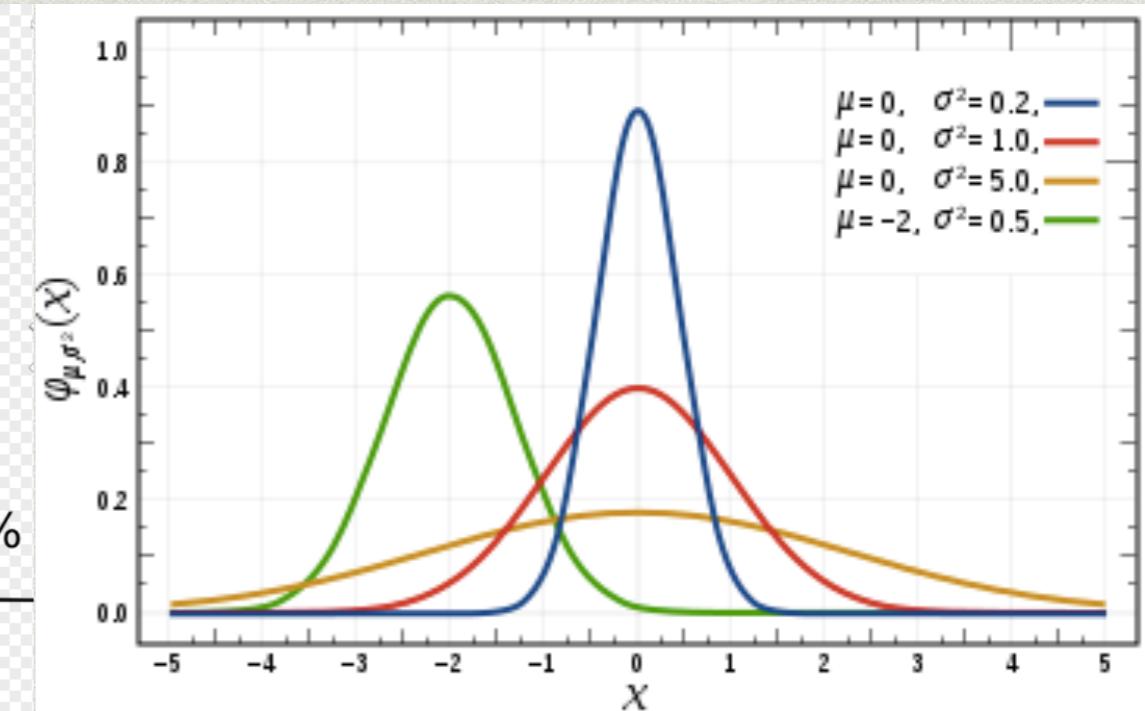
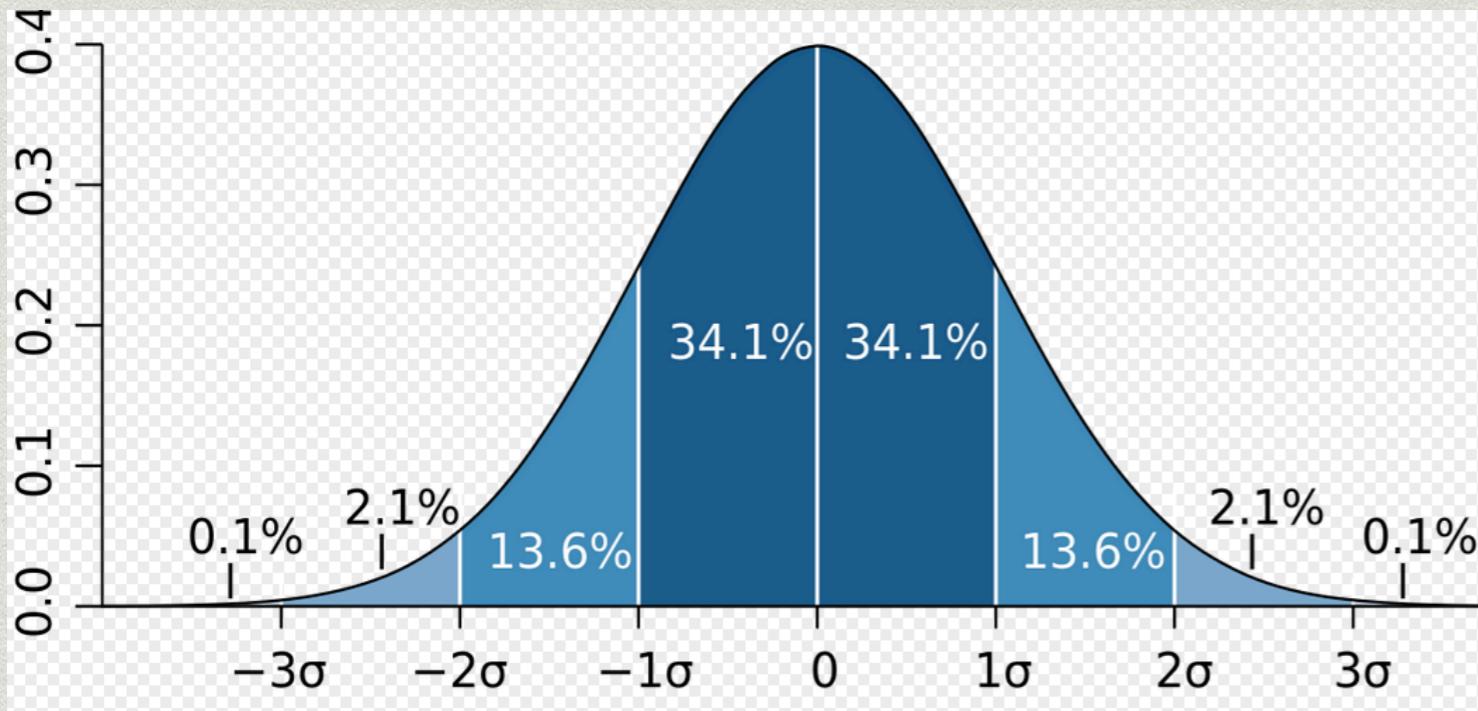
New technologies have generated a growing pile of evidence that there are ***inherent differences*** in how men's and women's brains are wired and ***how\**** they work.

\*Not “how *well*” they work, mind you.

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Sex-based differences in the brain

## 2. Statistics 101

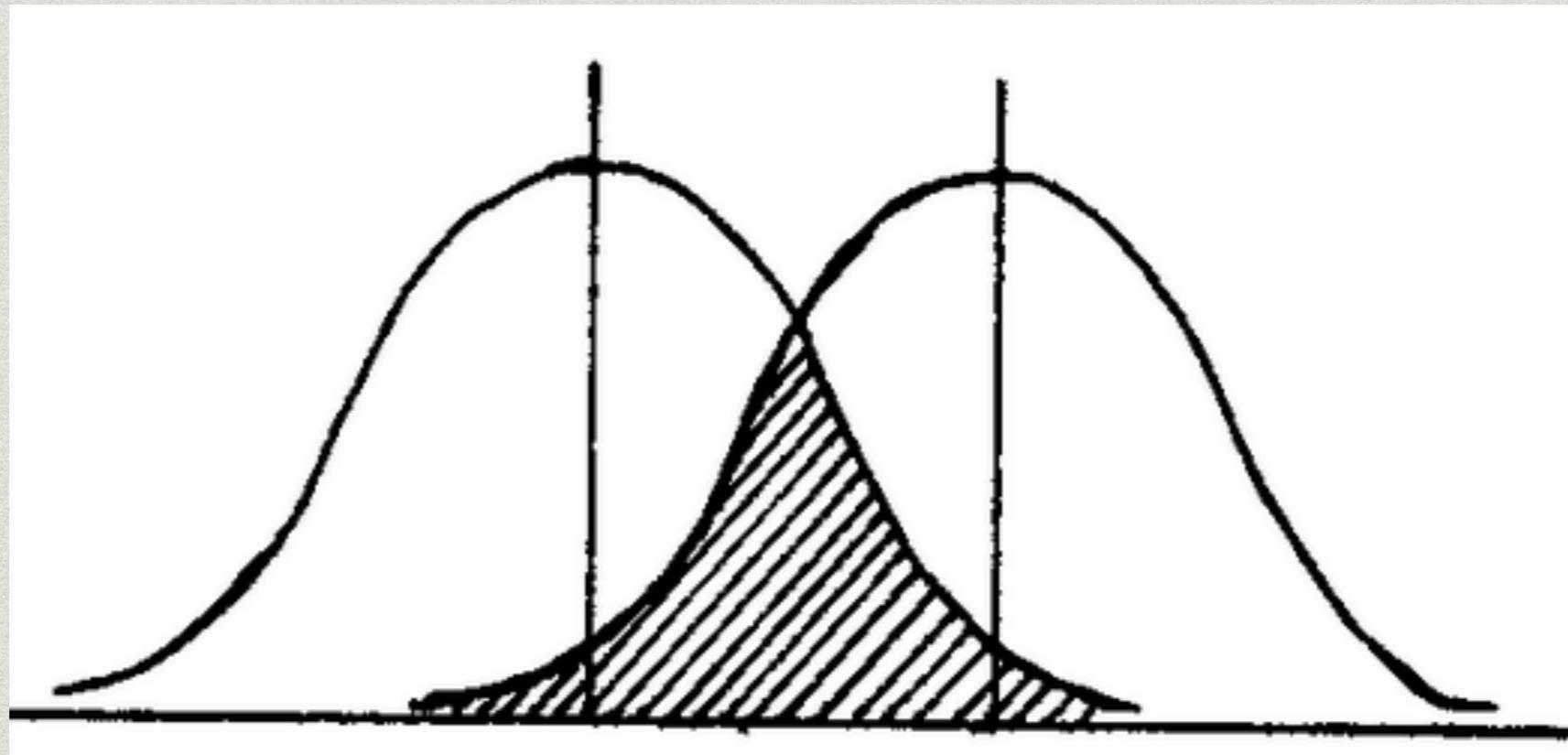


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Research note:

While *statistically significant*, the differences tend not to be *all that big*. They are most noticeable at the extremes of a bell curve, rather than in the middle, where most people cluster.



# Neurosexism

Sex-based differences in the brain

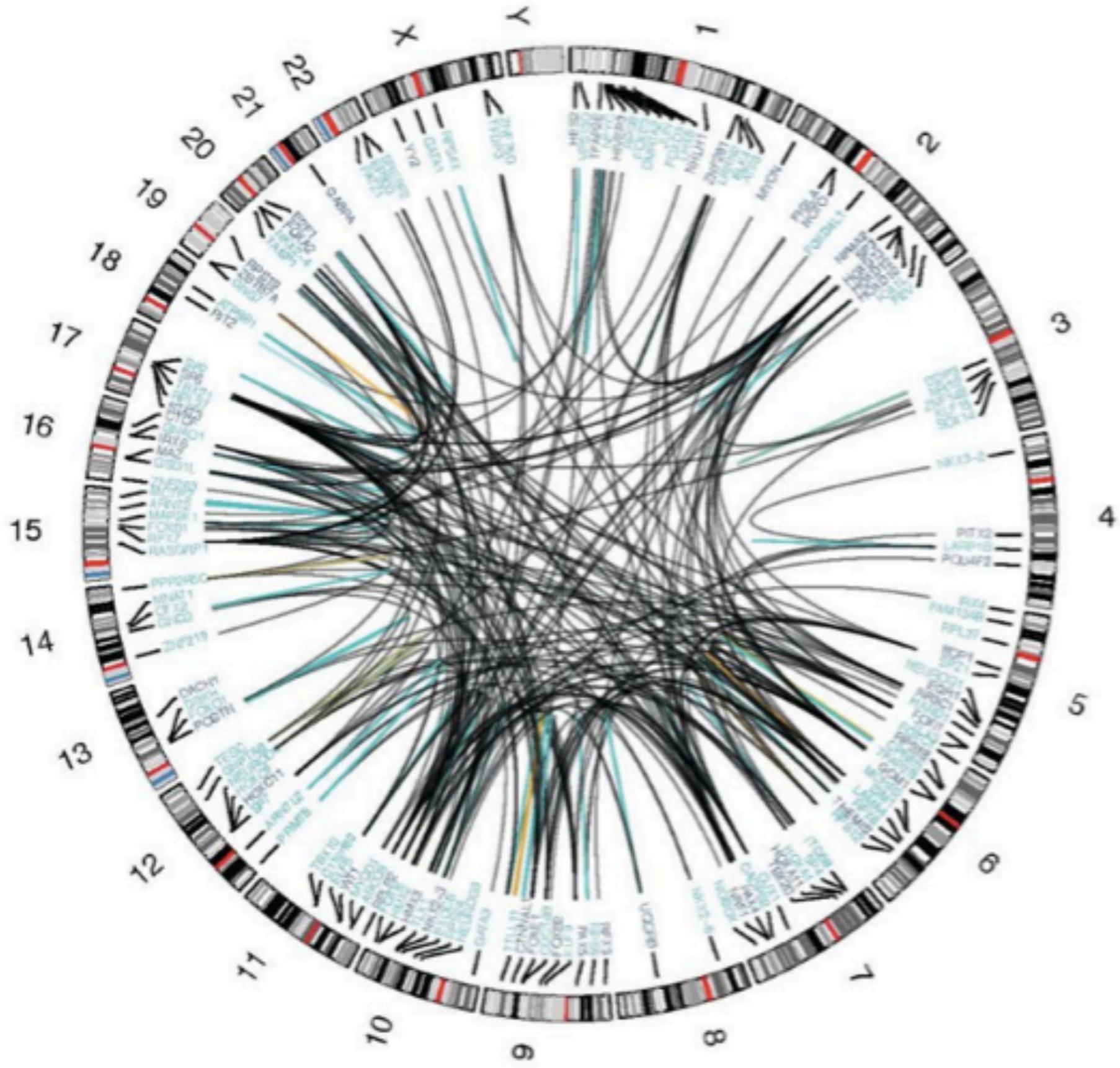
## **3. Direction of new research:**

. . . to learn about the activity of genes and/or underlying brain circuits tied to behaviors that differ between the sexes

Rationale: If these circuits differ between M and F, they are innate (developmentally hard-wired into the brain) rather than learned

Strategy:

- find/explore the neural circuits that regulate sex-associated behavioral differences in *mating, parenting, and aggression.*



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Sex-based differences in the brain

“At the time (Book, 1991), it seemed clear to me that any M/F differences in thinking abilities were due to *socialization practices, artifacts and mistakes in the research, and bias and prejudice...*

*After reviewing a huge number of journal articles, books, and book chapters ... I changed my mind.*”

## WHY?

“You could not ignore the fact that there was too much data pointing to the *biological basis of sex-based cognitive differences.*”

\* by **Diane Halpern**, Ph.D., past president of the American Psychological Association, a professor emerita of psychology at Claremont McKenna College

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Sex-based differences in the brain

Halpern reported from a study of 34 *rhesus monkeys*,

- males strongly preferred toys with wheels over plush toys,
- females found plush toys likable.

In a recent study, boys and girls 9 -17 months old showed marked differences in their preference for stereotypically male versus female toys (cars vs. dolls).

NOTE: Children that age show few if any signs of recognizing either their own or other children's sex, in other words: They don't know there's a difference

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Sex-based differences in the brain

**Studies of superior ability  
among adults, show**

	
All measures of verbal ability (excl. analogies)	Visuo-spatial skills
Reading comprehension	Rotation of 2D and 3D objects in space
Writing ability	Determining angles from horizon
Rely on landmarks	Estimating direction and distance traveled
Fine-motoric coordination	Tracking moving objects

# Neurosexism

Sex-based differences in the brain

**Studies of superior ability  
among adults, show**

	
Respond more readily to faces / Face orientated	Object orientated
Speak earlier	React earlier to induced perceptual discrepancies
Retrieving information long-term memory	Joggling items in working memory

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Sex-based differences in the brain

Other observations:

The long list of “unbalanced” M/F behavioral tendencies extends to cognitive and neuropsychiatric disorders!



Women are

- twice as likely as men to experience **clinical depression** in their lifetimes; likewise for post-traumatic stress disorder.



Men are

- twice as likely as women to become alcohol- or drug dependent
- 40% more likely to develop **schizophrenia**.
- about ten times as likely as women to be **dyslexic**
- 4-5 times more likely to have **autism** spectrum disorder

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Sex-based differences in the brain

Conclusion . . .

New technologies have generated a growing amount of evidence that the M and F brains are inherent **different** in how they *are wired* and how they *work!*

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Sex-based differences in the brain

## 4. Explanations

The big question is:

Are there underlying (subtle) *biological\** *differences* that explain the M/F imbalances in cognitive and behavioral differences?

\* *in the brain anatomy*

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Sex-based differences in the brain

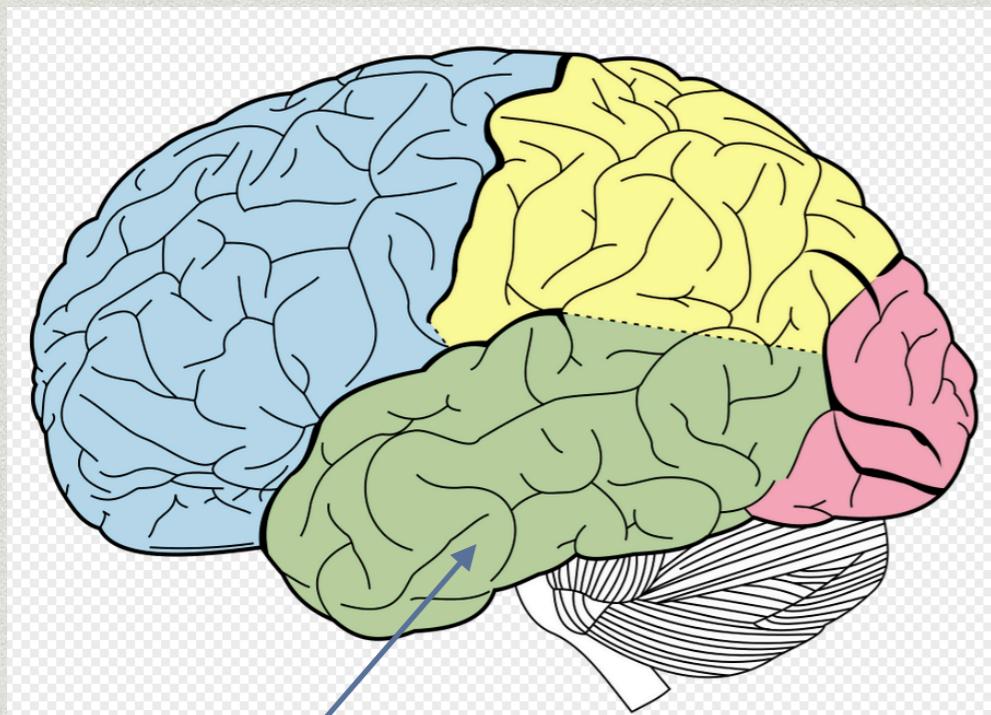
Yes, there is:

Neuroscience literature shows that “*the human brain is a sex-typed organ* with distinct anatomical differences in neural structures . . . resulting in accompanying physiological differences in function.”

(Dr. Cahill /UC-Irvine)

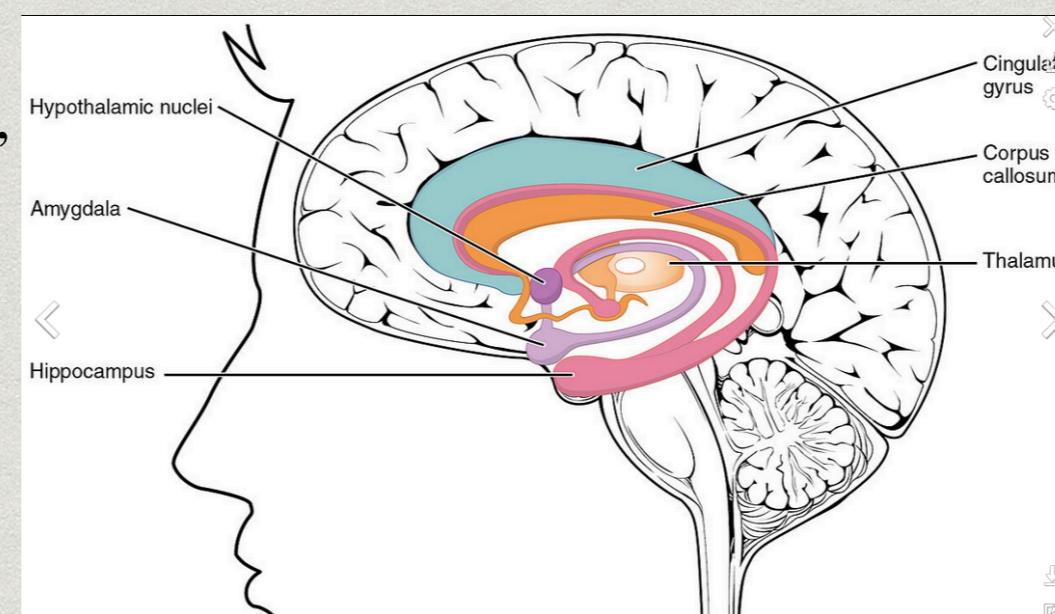
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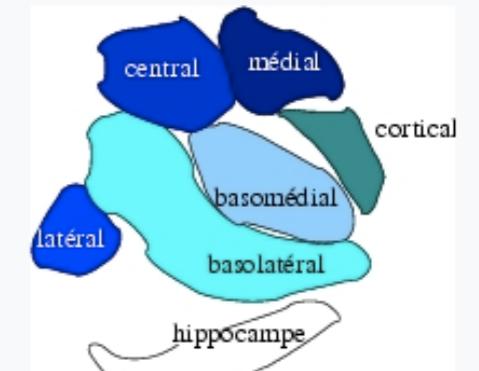


Temporal lobe [visual memory](#),  
[language comprehension](#),  
and emotion association

## Brain structure 101



Location of the amygdala in the human brain



Subdivisions of the amygdala

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Sex-based differences in the brain

Adjusted for total brain size,\* the differences are:

- a woman's hippocampus, critical to learning and memorization, is larger than a man's and works differently.
- a man's amygdala (associated with the experiencing of emotions and the recollection of such experiences), is bigger than a woman's.

\*Yes, if you wondered: men's *are* bigger

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Sex-based differences in the brain

On the issue of emotion, brain scans (Cahill, 2000) of M and F viewing highly *aversive films* (expected to trip off strong negative emotions and concomitant imprinting in the amygdala), showed:

Activity in the amygdala relates to the subjects' ability to recall the viewed clips, but in *women*, this relationship was observed *only in the left amygdala*. In men, it was *only in the right amygdala*. These results have since been confirmed.

**RESEARCH PROBLEM:** Women, it's known, retain stronger, more vivid memories of emotional events than men do. They recall emotional memories more quickly, and the ones they recall are richer and more intense. So, maybe the larger size of the M-amygdala is unimportant? Maybe F relate to the left amygdala better than M relate to the right one?

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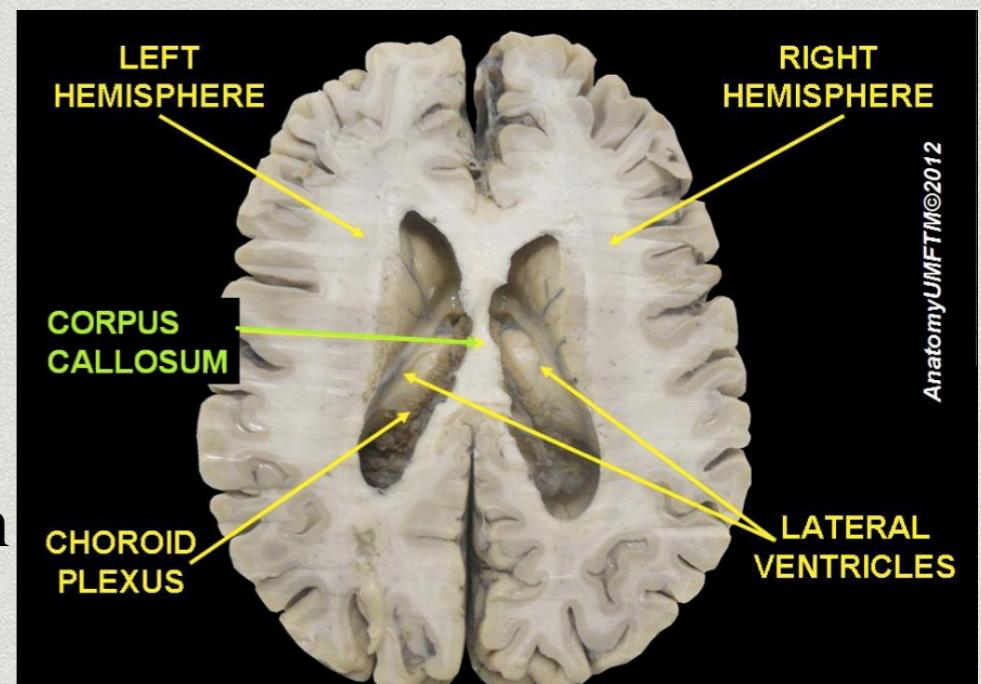
Sex-based differences in the brain

Other aspects of brain differences:

- Women's brains tend to be more bilaterally symmetrical than men's.

The two hemispheres of a woman's brain *talk to each other* more than a man's do.

- The corpus callosum\* is bigger in women than in men
- Women's brains has more strongly coordinated activity *between* hemispheres
- Men's brain activity is more tightly coordinated *within local* brain regions).



\*the white-matter cable that crosses and connects the hemispheres

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Sex-based differences in the brain

Many cognitive differences (*translating to behavioral differences*) appear quite early in life.

For example:

- (a) Sex differences in **spatial-visualization** ability can be observed in 2- and 3-month-old infants.
- (b) A 2017 image study of two groups of 98 M and 98 F at age 8-22 with *autism* spectrum disorder showed different *pattern of variation* in the cortex thickness between M and F.

But the great majority of Fs *with ASD* had cortical-thickness variations similar to those of typical M *with no-ASD*. . .

. . . explaining why explain why ASD is 4-5x more common among boys than girls ? ?

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Sex-based differences in the brain

## 5. Why\* are there differences?

SO . . . there *are* differences between F and M brains

The other big question is:

\*) Why? Meaning: *How* do they arise?

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Sex-based differences in the brain

**Answer:** The hormones

- women have estrogens and progesterone
- men have testosterone (and a few other androgens).

# Neurosexism

Sex-based differences in the brain

## Answer: The hormones

- women have estrogens and progesterone
- men have testosterone (and a few other androgens).

In utero, the female form is the “default condition,” but between week 14 - 20 into pregnancy, males are hit with a high dose of testosterone, permanently shaping body parts (sexual dimorphism of genital tubercle) and differentiating the brain.

Amygdala and hippocampus have high concentrations of receptors for sex hormone. Genetic defects disrupting testosterone’s influence on a developing male human’s cells induce a shift toward a *female body plan*.

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Sex-based differences in the brain

**Another big reason is**

Sex chromosomes (#23 pair\*) in each cell.

Genes on the Y chromosome are responsible for developments that cause bodies and brains to take on male characteristics.

Some other genes on the Y chromosome seems to be involved in brain physiology and cognition.

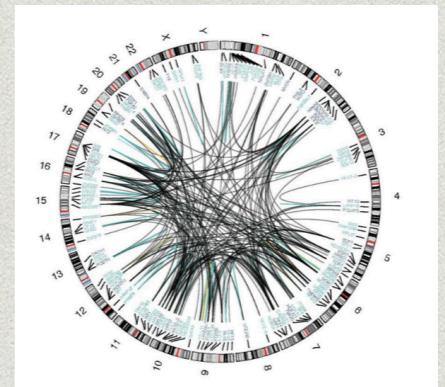
\* F gene 23: XX; M gene 23: XY

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Sex-based differences in the brain

## How do we know that?

Scientists can boost or suppress the activity of individual nerve cells — or even of single genes within those nerve cells. This done in conscious, active *animal's* brains.



For example: By suppressing one reproduction gene in female mice, it totally eliminated the normal instinct to

- defend their nests from intruders
  - retrieve pups who had wandered away
- . . . yet it had no observable effect on their sexual behavior.

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Sex-based differences in the brain

## **Research problem:**

Are animal models good for studying the significant differences in activity levels in the brains of male and female mice.?

Today's answer:

Almost all of these (animal) genes have human analogues.

# Neurosexism

Sex-based differences in the brain

## 6. What's the Future?

Bigger **imaging** studies and imaginative *animal research* will reveal much more about humanity's inherent *sex-associated cognitive differences*

### Research problem:

Are animal models good for studying the significant differences in activity levels in the brains of male and female mice.?

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Almost all of these (animal) genes have human analogues.

# Neurosexism

Sex-based differences in the brain

Back to the beginning . . .

The best answer to “*culture versus biology*” of the behavior of humans living in complex social environments, is:

**It's tough at best.**

Halpern: “The role of culture is not zero. The role of biology is not zero.”

**On top of that . . .**

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Sex-based differences in the brain

## **Personal philosophy:**

- \* The universe has gone through endless effort in creating each person as a unique individual - different from ANY other individual.
- \* Let's celebrate those differences!

# Neurosexism

Sex-based differences in the brain

