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SCHOOL OF  
HUMANITIES AND SCIENCES



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Health & Medicine, Engineering, and  
Environment**

# Gendered Innovations

in Science,  
Health & Medicine,  
Engineering, and  
Environment

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What is **Gendered Innovations**?

SEX & GENDER ANALYSIS

Methods

Terms

Checklists

CASE STUDIES

Science

Health & Medicine

Engineering

Environment

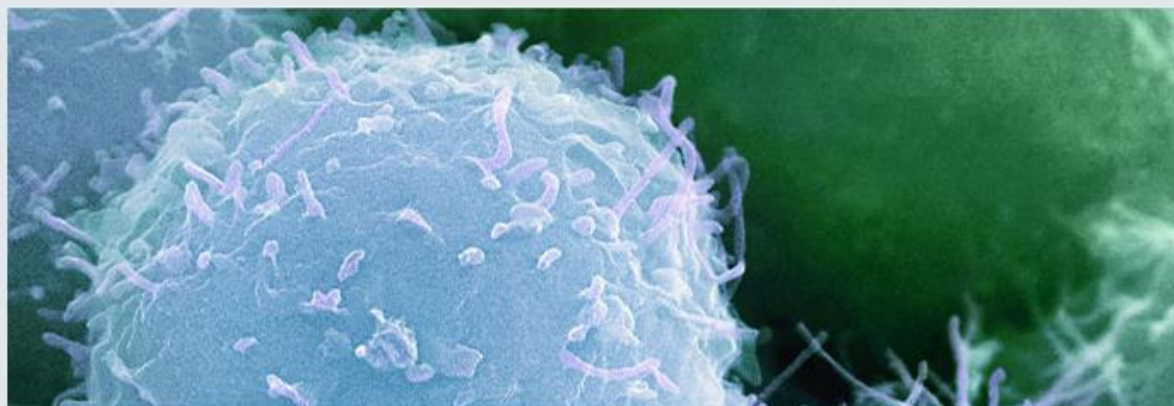
POLICY

INSTITUTIONAL  
TRANSFORMATION

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How to cite website



SCIENCE

Sex and Gender Methods for Research

Gendered Innovations



SCIENCE

HEALTH & MEDICINE

ENGINEERING

ENVIRONMENT

FEATURED CASE STUDIES



Stem Cells: Analyzing  
Sex



Osteoporosis  
Research in Men:  
Breaking the Gender  
Paradigm



HIV Microbicides:  
Formulating Research  
Questions & Analyzing  
Academic Disciplines

Why Gendered Innovations?

“Gendered Innovations”  
employs methods of  
sex and gender  
analysis to create  
new knowledge.

# Gendered Innovations...

- ▶ Can we harness the creative power of sex & gender analysis for discovery?

# Why might this be relevant to the GSR?

- ▶ On the Gendered Innovations website, please see our compilation of funding agencies policies supporting the integration of sex and gender analysis into research:  
<http://genderedinnovations.stanford.edu/sex-and-gender-analysis-policies-major-granting-agencies.html>
- ▶ Of particular interest is the European Commission, which introduced such policies in 2014.

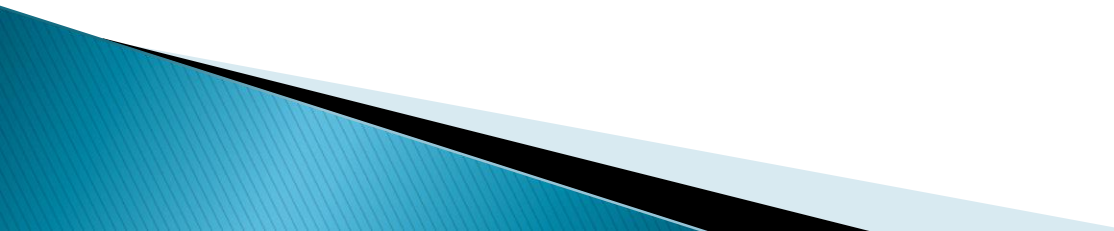
# First a bit of background...

- ▶ Governments, universities, and increasingly corporations have taken three strategic approaches to equality, diversity, and inclusion over the past several decades:

# THREE FIXES

1. FIX THE NUMBERS OF WOMEN
2. FIX THE INSTITUTIONS
3. FIX THE KNOWLEDGE

# The three fixes:

- ▶ 1. "Fix the Numbers of Women" is about participation. It's about gender equality, diversity, and inclusion in research careers. It's about recruiting more women and underrepresented minorities to science and engineering careers.
  - ▶ 2. "Fix the Institutions" is about institutional transformation, i.e., transforming research organizations so that women's, men's, and gender-diverse individual's careers can flourish.
  - ▶ 3. "Fix the Knowledge" is about the gender dimension in research or "gendered innovations." Gendered innovations stimulates excellence in science and technology by integrating sex and gender analysis into research. This is the newest area, and the most important for the future of science, engineering, and innovation.
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# Doing Research Wrong Costs Lives and Money

- Between 1997 and 2000, 10 drugs were withdrawn from the U.S. market because of life-threatening health effects—8 of those showed greater severity in women.

United States General Accounting Office. (2001). *Drug Safety: Most Drugs withdrawn in Recent Years had Greater Health Risks for Women*. Washington, DC: Government Publishing Office.



# Doing Research Right Saves Lives and Money

## WHI Hormone Therapy Trials

- Each \$1 spent returned \$140 to US taxpayers in health care savings
- Health Improvements
  - \* 76,000 fewer cases of cardiovascular disease
  - \* 126,000 fewer breast cancer cases
  - \* 145,000 more quality-adjusted life years
  - \* However: 263,000 more osteoporotic fractures

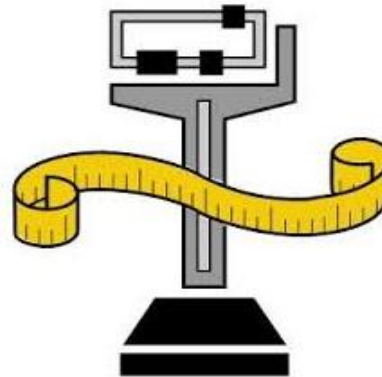
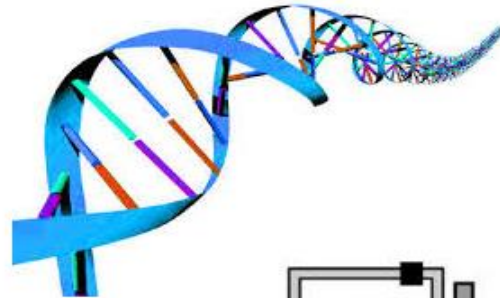
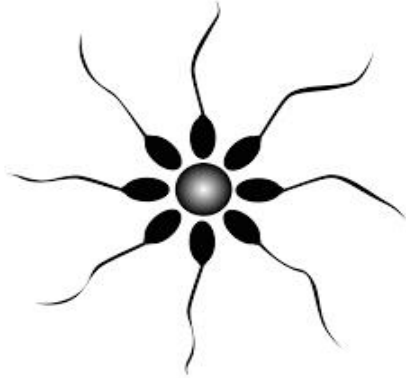
Joshua A. Roth et al., *Annals of Internal Medicine* (2014) 60, 9:594-602.

# Gendered Innovations

- 1) develop State-of-the-Art Methods of sex and gender analysis
- 2) provide Case Studies to illustrate how gender analysis leads to discovery and innovation.

<http://genderedinnovations.stanford.edu/index.html>. Updates coming November 2019.

# Sex: Biological characteristics

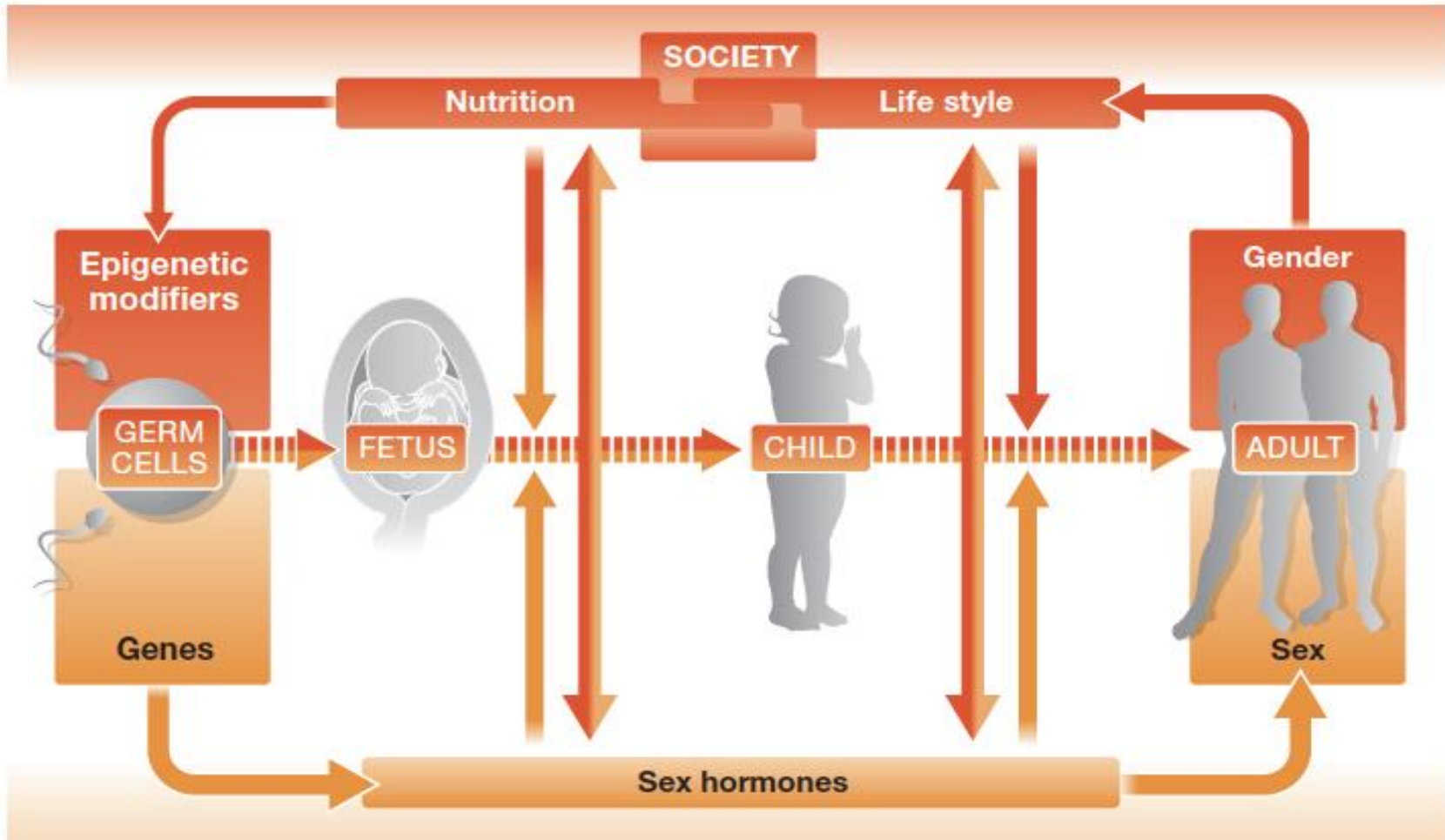


# Gender: Socio-cultural attitudes and behaviors

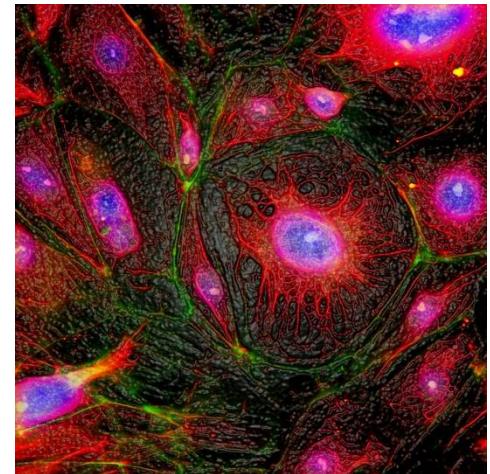
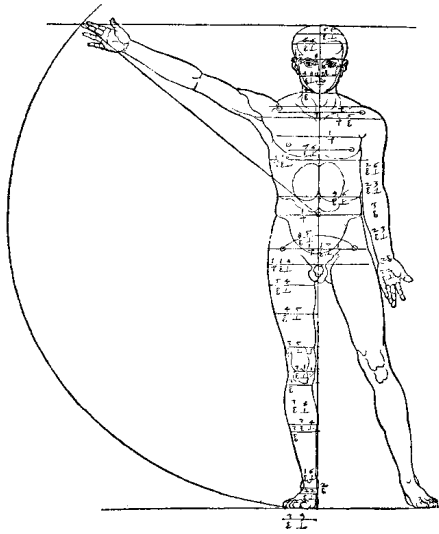


# Sex and Gender Interact

Regitz-Zagrosek, V. (2012). Sex and Gender Differences in Health. *EMBO Reports*, 13 (7): 596-603.

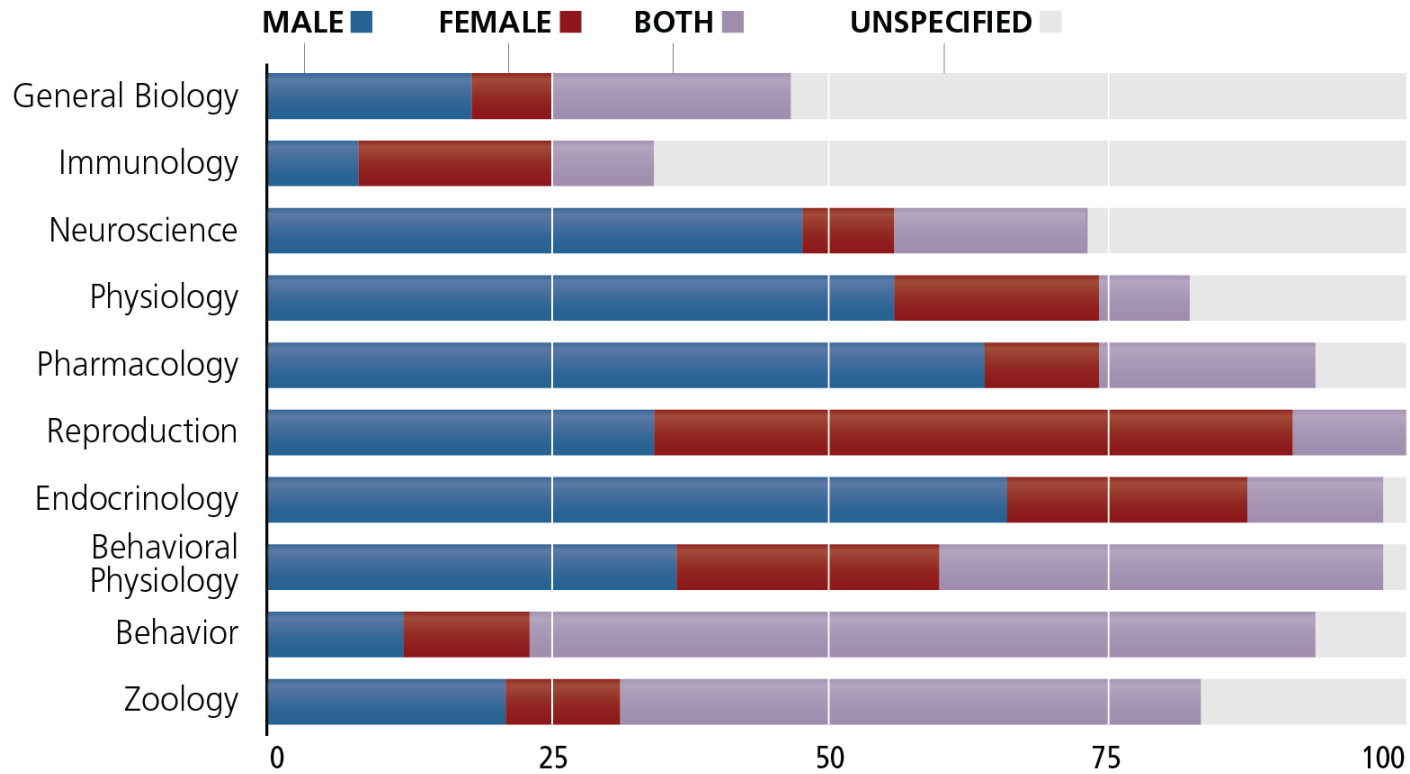


# Most research is done in males



# Proportion of Research Studies Using Male and/or Female Animals

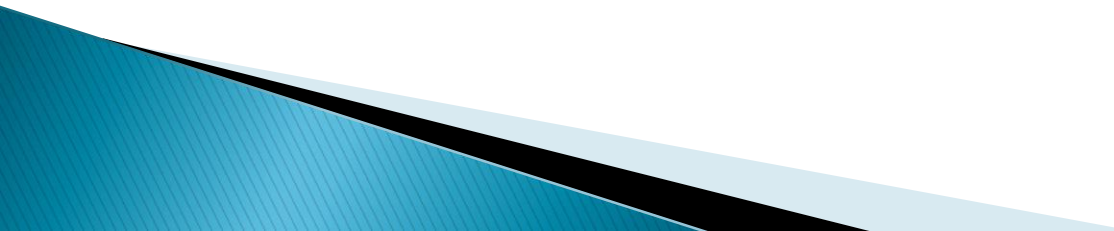
From published journal articles within specified biomedical subfield, 2009



Adapted from:

Beery, A., & Zucker, I. (2011). Sex Bias in Neuroscience and Biomedical Research. *Neuroscience and Biobehavioral Reviews*, 35 (3), 565-572.

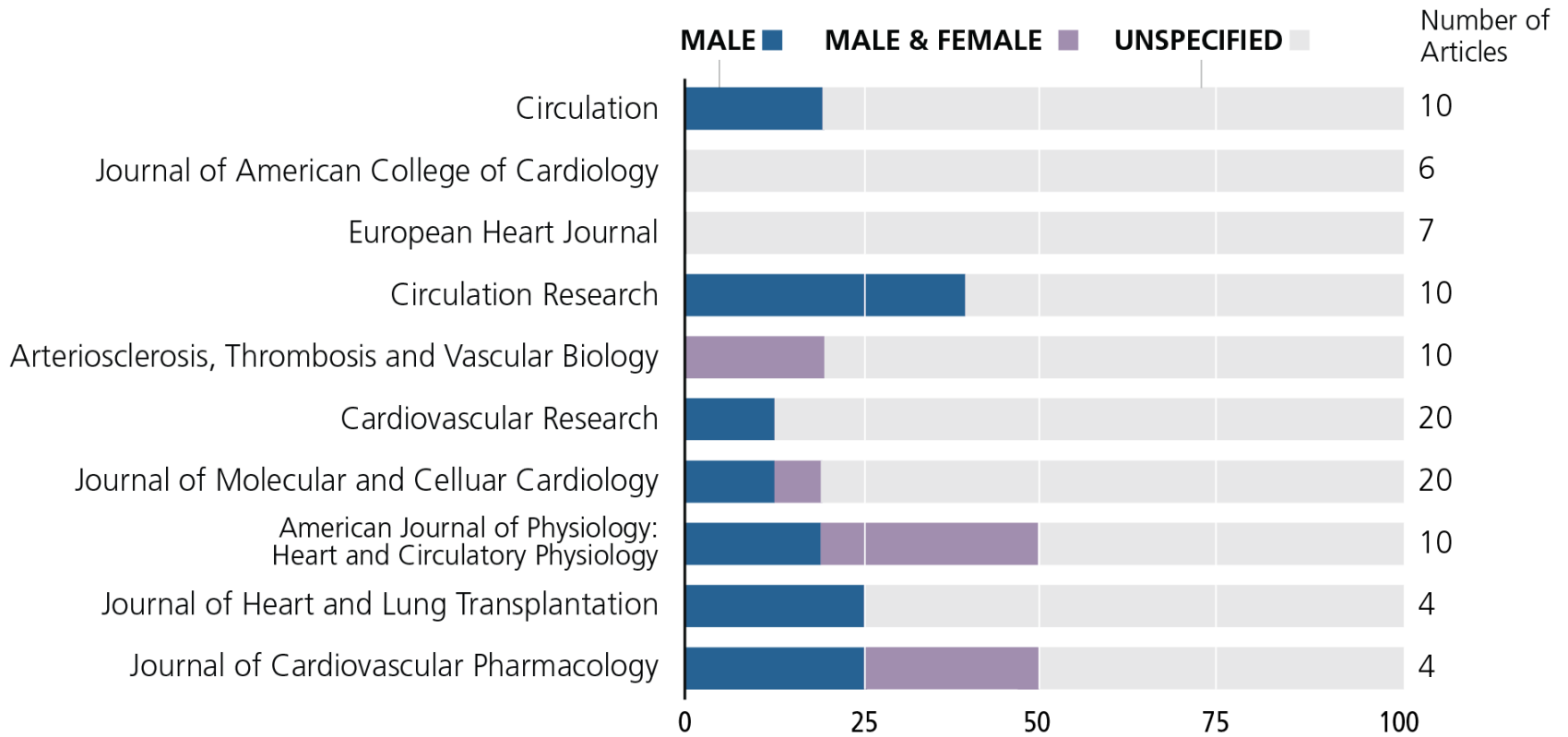
▶ This study was done in 2011 by some of our colleagues at Berkeley. It shows the sex of the animals used in research. The blue indicates that males are used more than females in all areas, except reproduction. But what I'm interested in is the gray area where the sex of the animal was not recorded. This is research money wasted. You might as well throw it out the window!





# Percent of Articles Reporting Sex of Cells Used in Experiments

From published journal articles, 2009

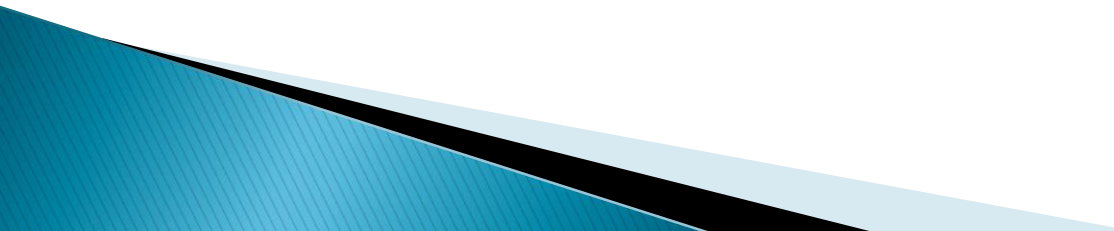


Adapted from:

Taylor, K., Vallejo-Giraldo, C., Schaible, N., Zakeri, R., & Miller, V. (2011). Reporting of Sex as a Variable in Cardiovascular Studies using Cultured Cells. *Biology of Sex Differences*, 2 (11), 1-7.

- ▶ A similar study was done at Mayo Clinic on cells and Tissues. And look at the gray area! The sex of the cell is almost never reported. Again, this is research money wasted.

# The Gender Dimension in Research enhances...

- ▶ Excellence—sex, gender, and/or diversity analysis may be necessary, additional variables
  - ▶ Innovation & Discovery
  - ▶ Social Equality
  - ▶ Profitability (corporations)
- 

# Examples given

- ▶ Why it's important to include both sexes in stem cell research:

[http://genderedinnovations.stanford.edu/case-studies/stem\\_cells.html#tabs-2](http://genderedinnovations.stanford.edu/case-studies/stem_cells.html#tabs-2)

- ▶ Google translate defaults to the masculine pronoun:

<http://genderedinnovations.stanford.edu/case-studies/nlp.html#tabs-2>



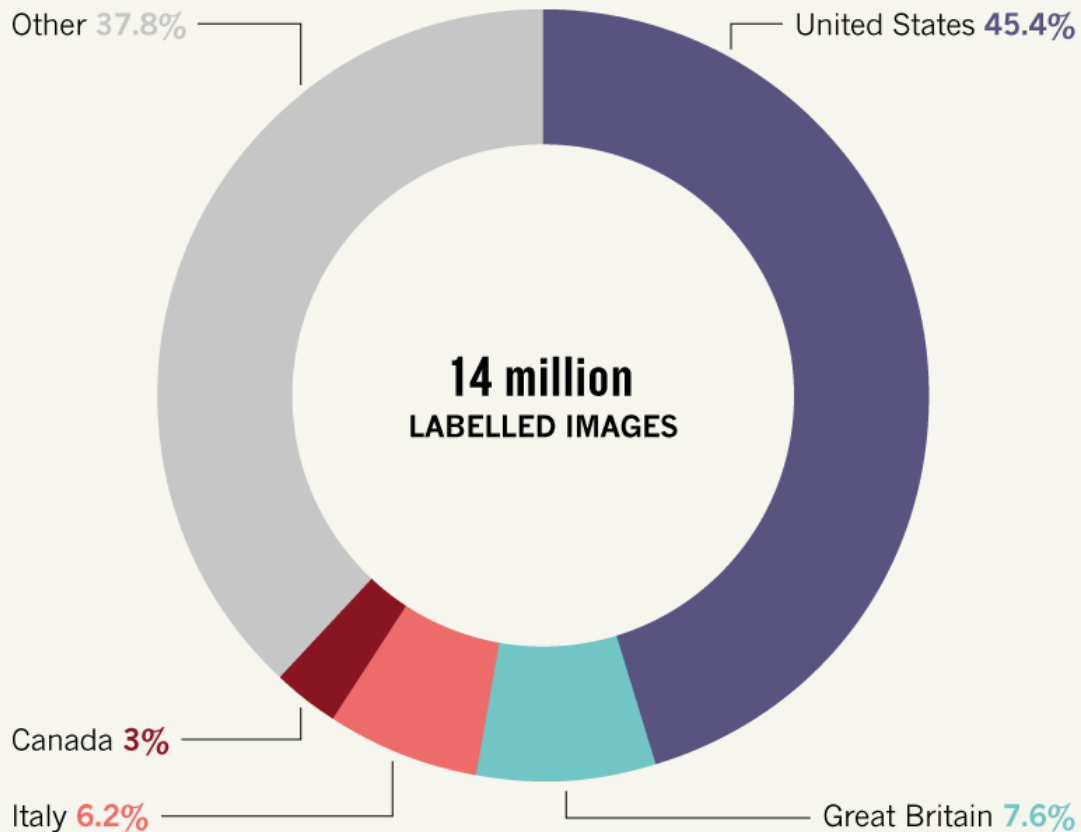
## “The Bride Problem”

Zou, J. & Schiebinger, L. AI can be sexist and racist — it's time to make it fair. *Nature*. July 2018, 324-326.

# ImageNet

## IMAGE POWER

Deep neural networks for image classification are often trained on ImageNet. The data set comprises more than 14 million labelled images, but most come from just a few nations.



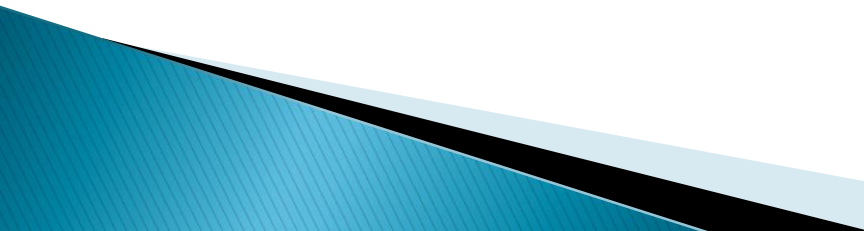
# Convolutional Neural Networks

Recent applications of deep learning have been **successful diagnosing skin cancer.**

Esteva, A., Kuprel, B., Novoa, R. A., Ko, J., Swetter, S. M., Blau, H. M., & Thrun, S. (2017). Dermatologist-level classification of skin cancer with deep neural networks. *Nature*, 542(7639), 115.

But the dataset of 129,450 images is dominated by European Americans and contains few images from people with darker skin. The performance of the classifier across different populations is unknown.

# Solutions! Stanford Gendered Innovations Workshop on Machine Learning, 2018

- ▶ Identifying where in machine learning bias resides input (data), output (predictive models), or algorithms.
  - ▶ Mapping solutions.
  - ▶ Discussing who should be involved in the decision making to fix these problems: Computer scientists? Ethics teams? Government oversight committees? An FDA of AI?
- 



# Solutions!

- ▶ **Datasheets for Datasets:** Gebru, T. et al. Preprint at <https://arxiv.org/abs/1803.09010> (2018).
- ▶ **Dataset Nutrition Labels:** Holland, S., Hosny, A., Newman, S., Joseph, J. & Chmielinski, K. Preprint at <https://arxiv.org/abs/1805.03677> (2018).

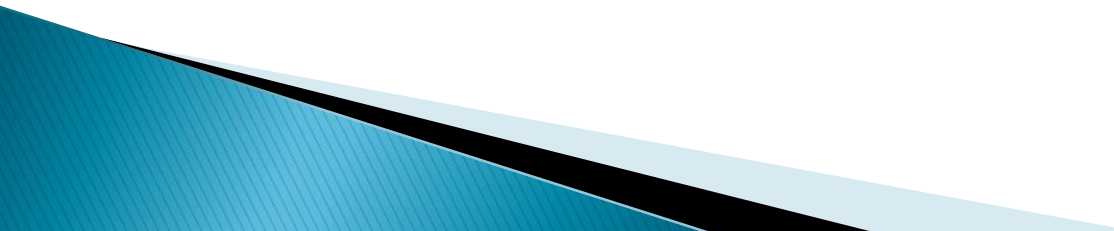
# Solutions! Gendered Innovations

Zou, J. & Schiebinger, L. AI can be sexist and racist — it's time to make it fair. *Nature*. July 2018.

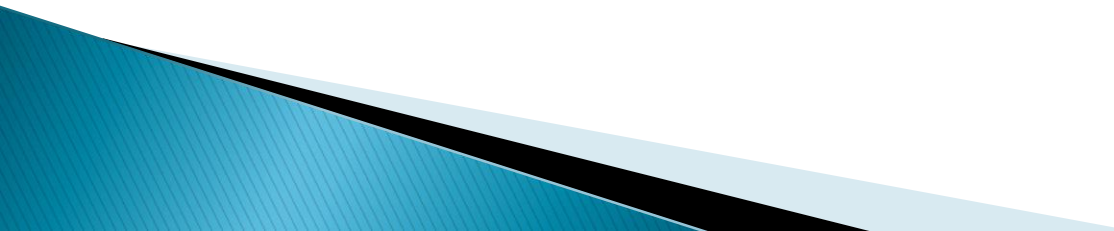
Case Study: [Machine Learning: Analyzing Gender](#)



# Stanford Gendered Innovations projects: Workshop on Gender and Robotics, 2018

- ▶ Gendering robots: Why do people feel the need to attribute gender to robots? Is gender domain specific (a woman's voice ideal for dating advice vs a man's voice for math tutoring)? What genders a robot? Appearance, voice, mannerisms, movement, demeanor?
  - ▶ How do we design socially-responsible robots?
- 

# The challenge for designers is:

- ▶ 1) to understand how gender becomes embodied in robots
  - ▶ 2) to design robots that promote social equality
- 

# What genders a robot?

## Pepper

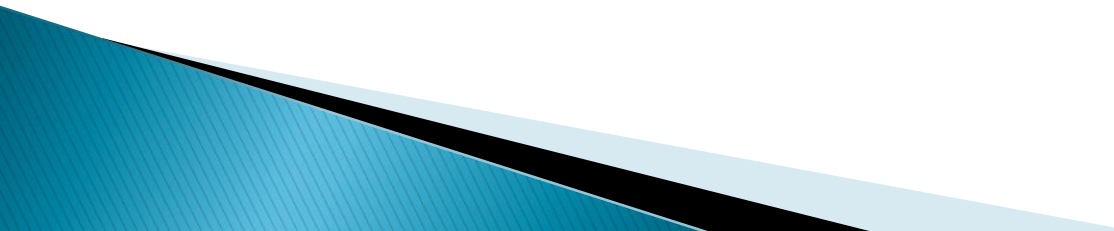


- Color
- Voice
- Name
- Anatomy
- Personality (or “character”)

<http://genderedinnovations.stanford.edu/case-studies/genderingsocialrobots.html#tabs-2>

# Further examples given:

- ▶ The importance of analyzing both sex and gender in designing assistive technology:  
<http://genderedinnovations.stanford.edu/case-studies/robots.html#tabs-2>
- ▶ Water infrastructure in sub-Saharan Africa—the importance of integrating gender analysis into civil engineering:  
<http://genderedinnovations.stanford.edu/case-studies/water.html#tabs-2>

- ▶ There is much work to be done! Researchers need to develop sophisticated methods of sex and gender analysis. Funding agencies and peer-reviewed journals need to put in place policies that encourage sophisticated sex and gender analysis. Universities need to incorporate these methods into their curricula. Corporations need to integrate these insights into product design.
  - ▶ But eyes have been opened—and we cannot return to a world that ignores gender. Innovation is what makes the world tick. As I hope I've begun to show, gendered innovations spark creativity by offering new perspectives, posing new questions, and opening new areas to research. Can we afford to ignore such opportunities?
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# Join the Gendered Innovations listserv (for updates from Londa Schiebinger on research in this field)

- ▶ Sign up on the Gendered Innovations website,  
at “Contact us”:  
<https://mailman.stanford.edu/mailman/listinfo/genderedinnovations>
- ▶ Follow us on Twitter: @GenderInnovate