



STANFORD

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SCHOOL OF  
HUMANITIES AND SCIENCES



**Londa Schiebinger**

**John L. Hinds Professor of History of  
Science**

**Director, EU/US Gendered Innovations  
in Science, 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

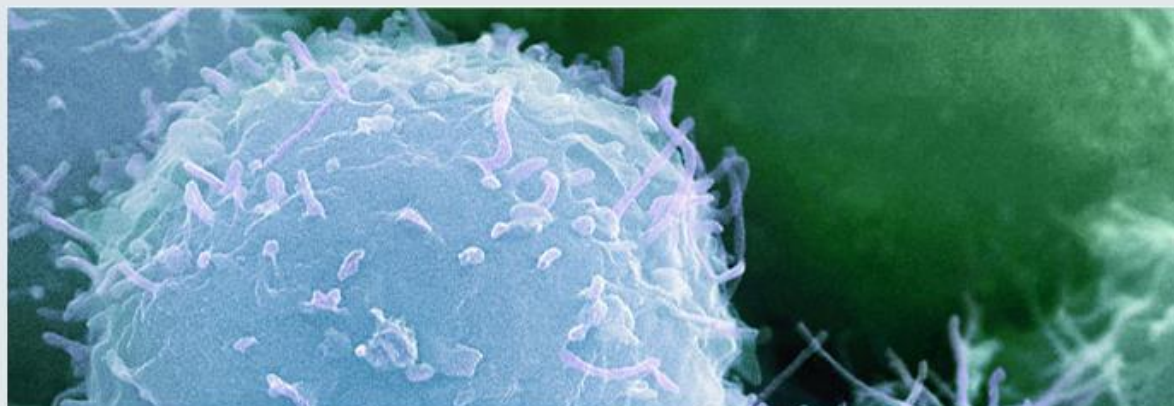
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TRANSFORMATION

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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...

- ▶ provide researchers with the **tools** to integrate sex and gender analysis into research.

# Gendered Innovations...

- ▶ How can we harness the creative power of gender analysis to discover new things?

# Business Case

## Sex and gender bias in research

- is expensive in terms of lives and costs.
- limits scientific creativity, excellence, and benefits to society.

# Business Case—Public Health

- *Science* (26.3.2010): Between 1997 and 2000, 10 drugs were withdrawn from the U.S. market because of life-threatening health effects—8 of those showed greater severity in women.

# Gendered Innovations



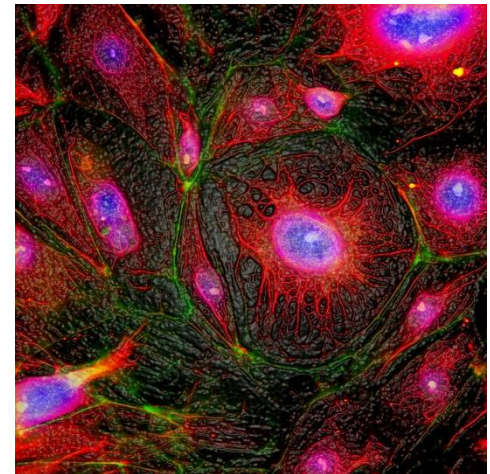
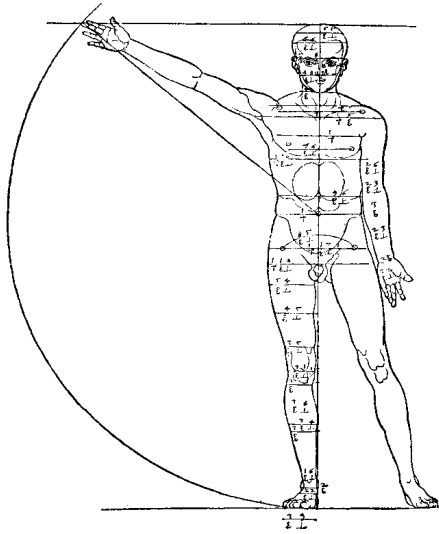
**1) develop state-of-the-art  
Methods of sex and gender  
analysis**

**2) provide Case Studies to  
illustrate how gender analysis  
leads to innovative science and  
technology**





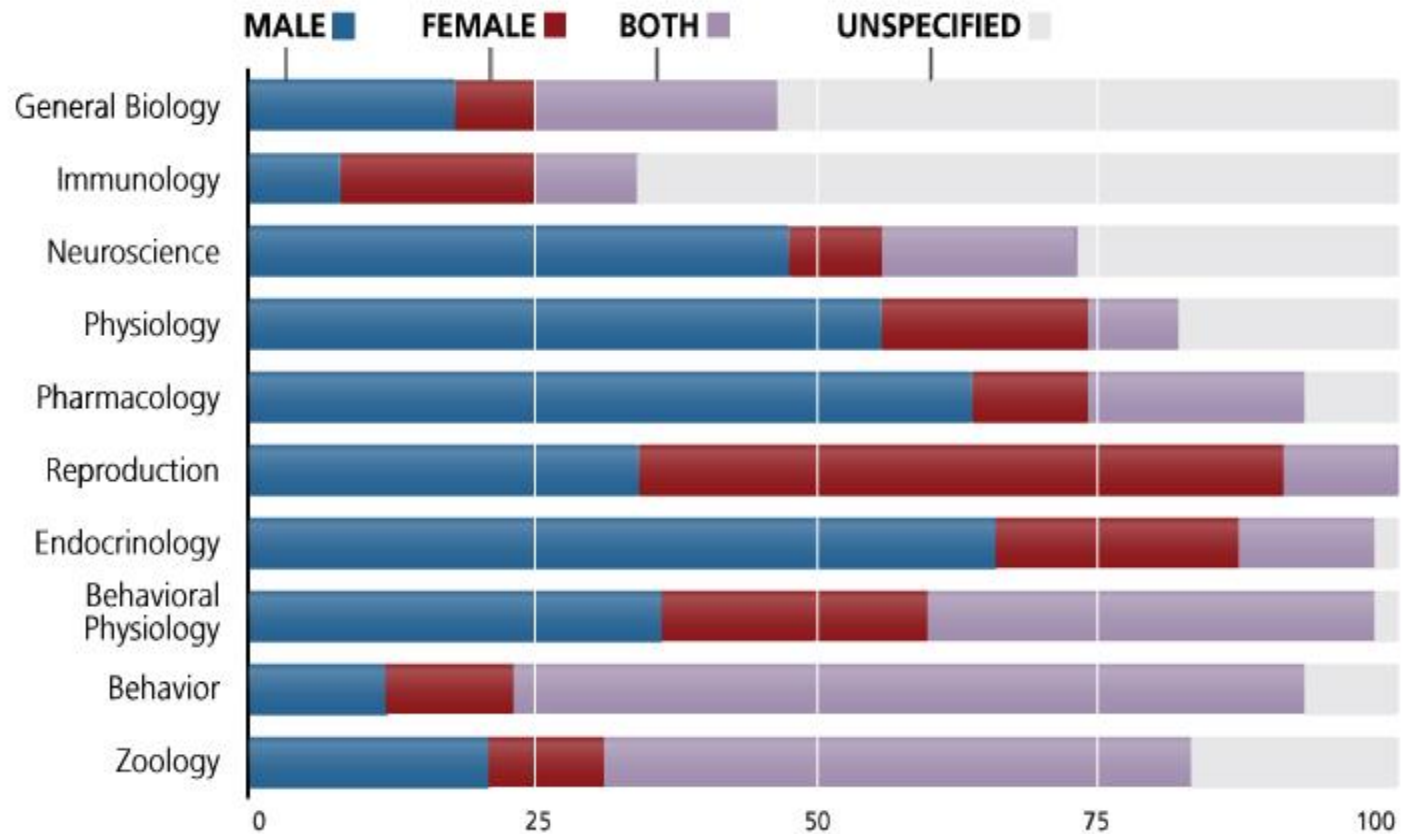
# Most research is done in males





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

From published journal articles within specified biomedical subfield, 2009

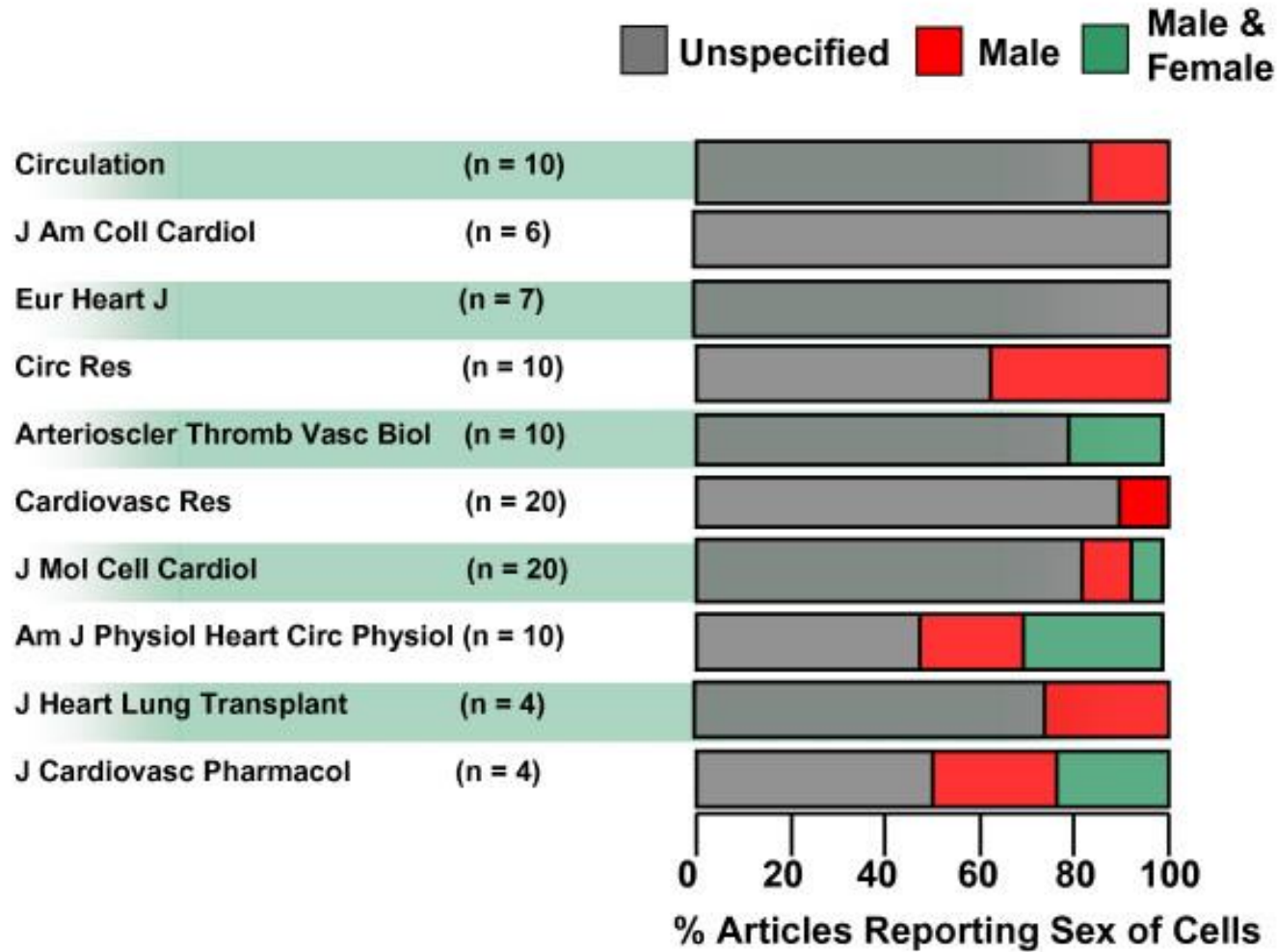


Adapted from Beery et al., 2011

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

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.

**Percentage of articles reporting sex of cells used in the experiments**



# Gendered Innovation

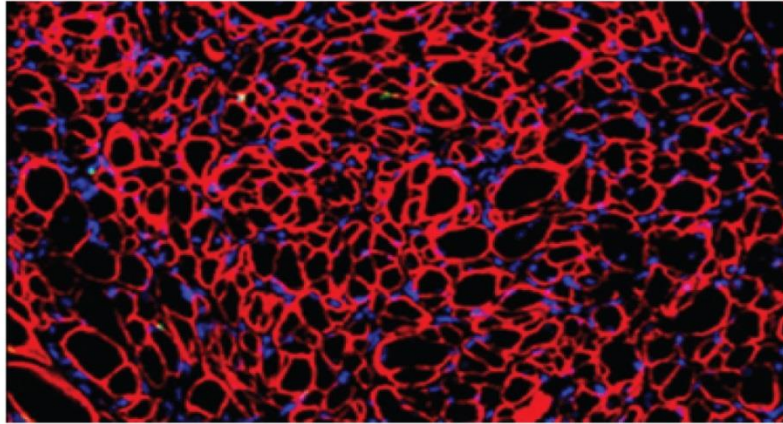
## Example 1

- ▶ Stem cells: Why sex matters

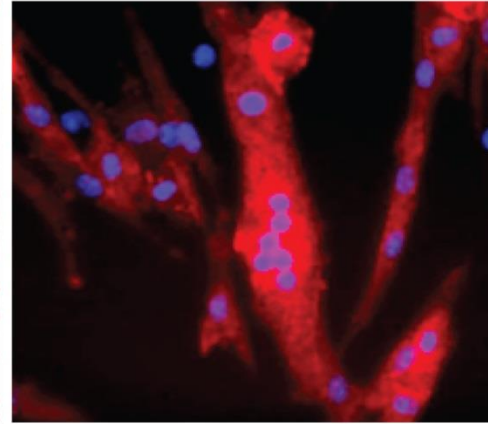
## Magnified Muscle Fiber Developed from XX and XY Stem Cells

After two weeks' development in *mdx* mice

### XX STEM CELLS

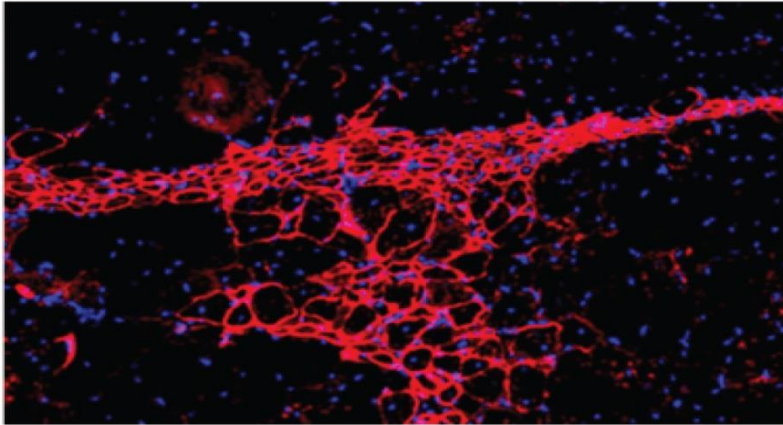


100 $\mu$ m Lower magnification

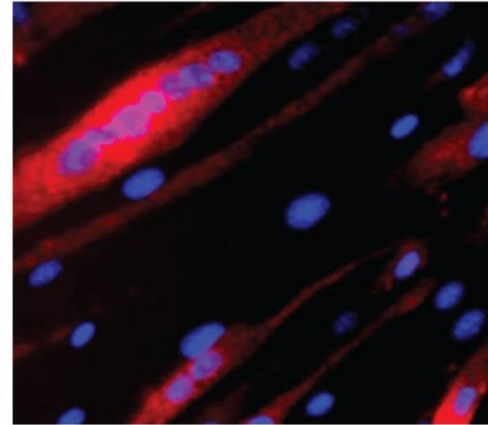


50 $\mu$ m Higher magnification

### XY STEM CELLS



100 $\mu$ m Lower magnification

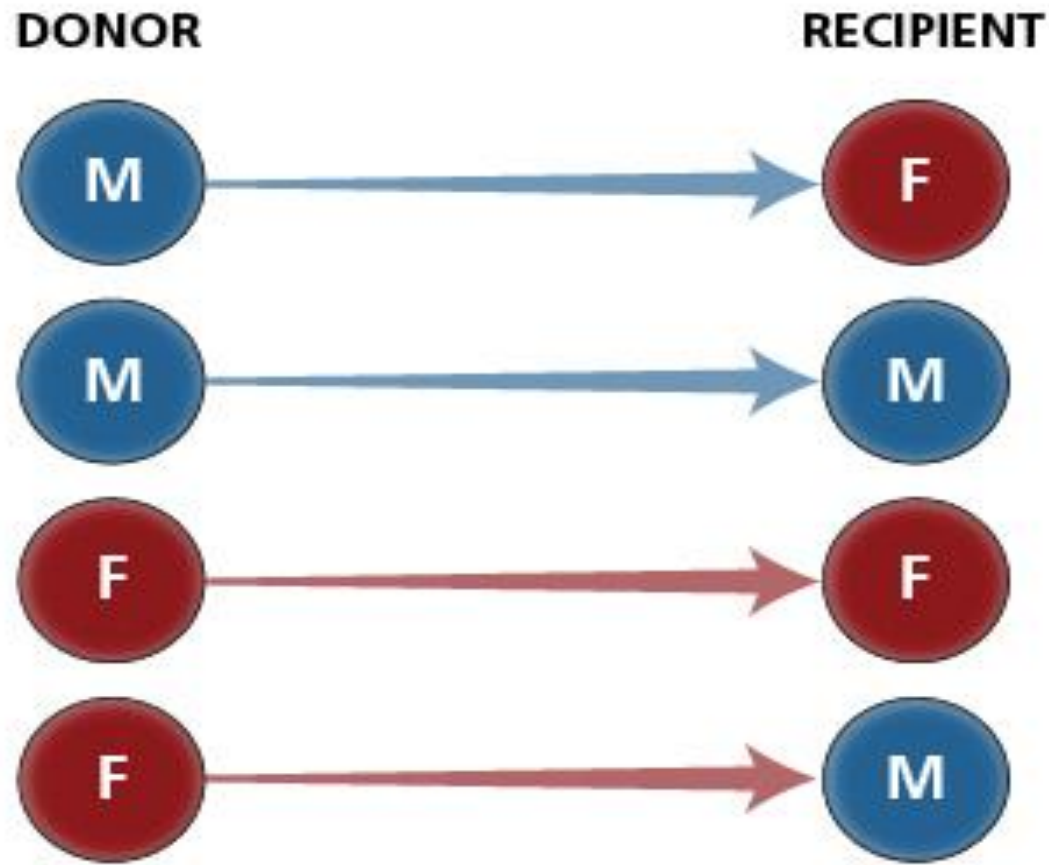


50 $\mu$ m Higher magnification

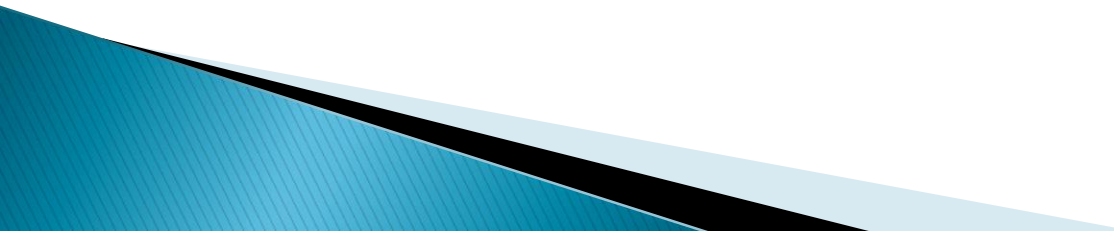
These micrographs show muscle fibers produced from XX and XY MDSCs and demonstrate that XX MDSCs induce "more efficient skeletal muscle generation" than their XY counterparts based on the number of dystrophin-positive muscle fibers produced for a given number of donor cells. Muscles were harvested after two weeks of development in *mdx* mice. Dystrophin-containing muscle fibers are stained red, indicating that they arose from transplanted stem-cells, as *mdx* mice lack a functional dystrophin gene and develop a syndrome similar to muscular dystrophy in humans. Nuclei are stained blue. Reproduced with permission from Deasy et al., 2007.

## Considering Sex in Stem Cell Therapy

All combinations of donor/recipient sex interaction should be tested before being ruled out



# Method: Analyzing Sex

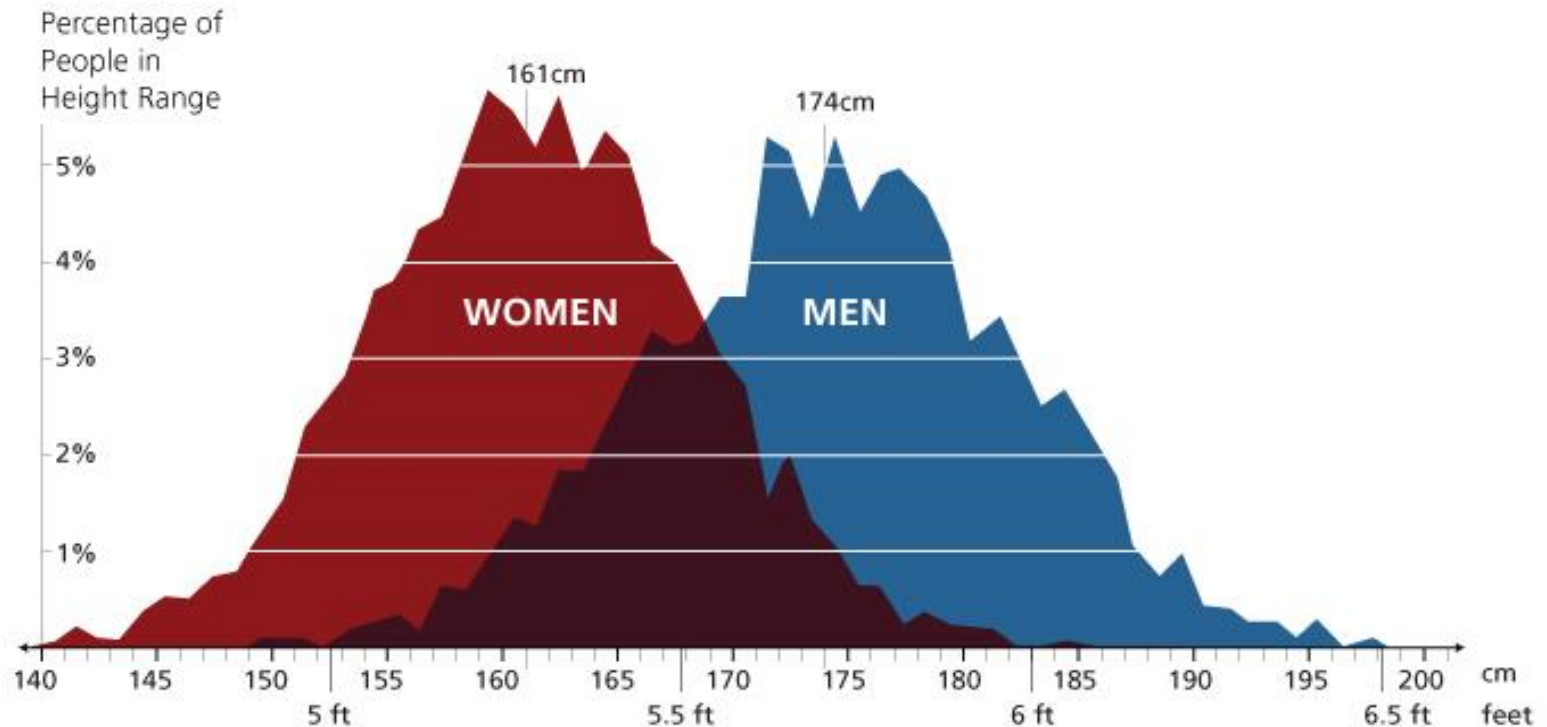
- ▶ 1) reporting the sex of research subjects
  - ▶ 2) recognizing differences *within* groups, and *overlap* between groups
  - ▶ 3) analyzing and reporting results by sex
  - ▶ 4) reporting null findings
- 



# *Between and Within* Group Differences

## Height of Adult Women and Men

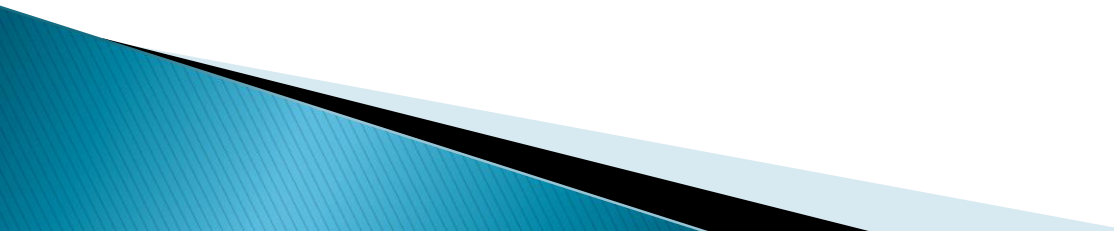
Within-group variation and between-group overlap are significant



Data from U.S. CDC, adults ages 18-86 in 2007

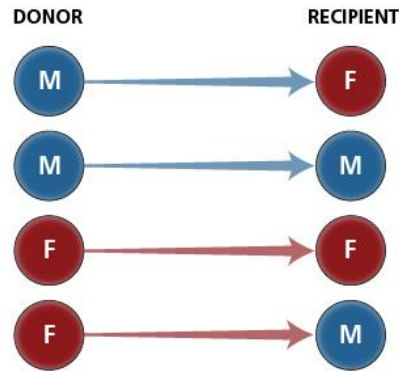


# Method: Analyzing Factors Intersecting with Sex

- ▶ collecting and reporting data on factors intersecting with sex, such as age, socioeconomic status, ethnicity, co-morbidities, reproductive status, etc.
- 

### Considering Sex in Stem Cell Therapy

All combinations of donor/recipient sex interaction should be tested before being ruled out



Consider sex in interaction with other factors:

1. Cell type
2. Disease
3. Other variables: hormonal, immunological, environmental

# Policy Recommendations

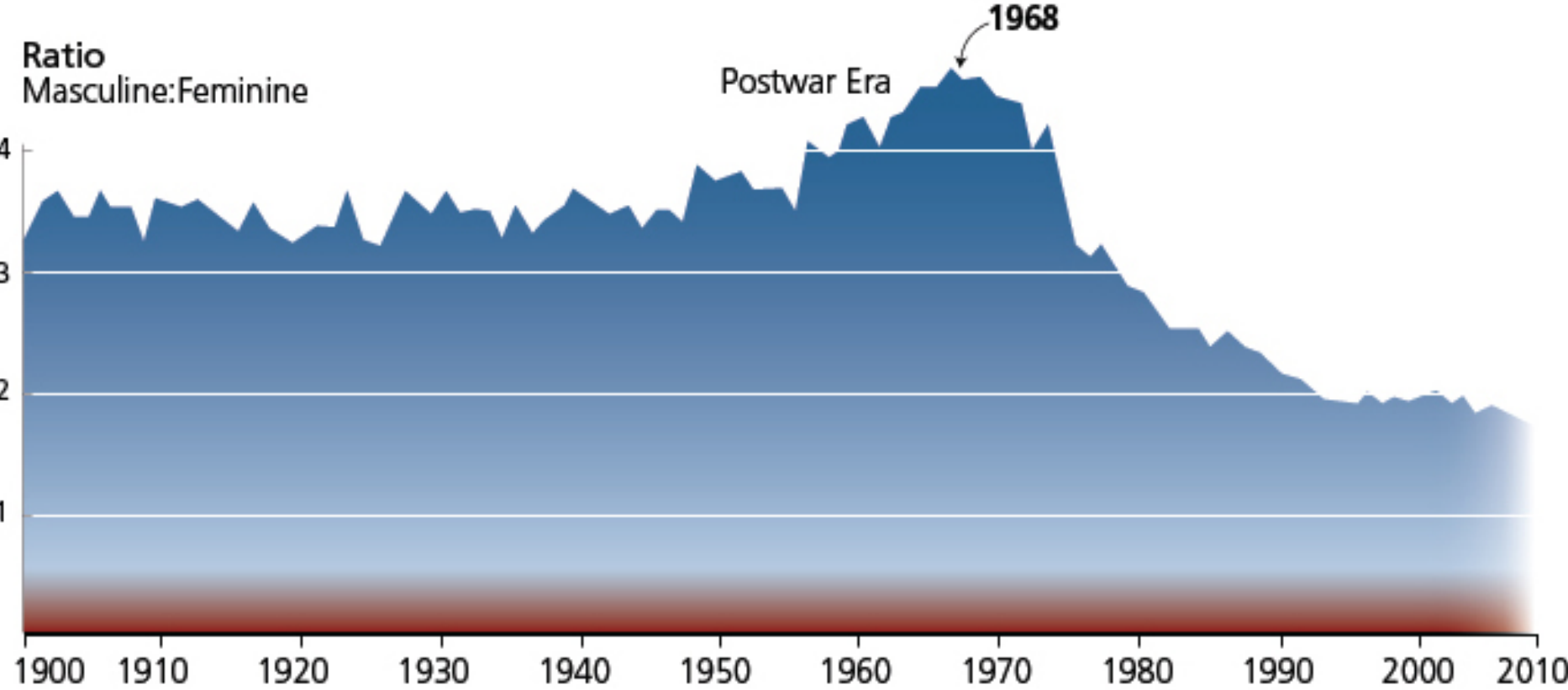
- For Granting Agencies
- For Editorial Boards of Peer-Reviewed Journals

Original Spanish Text	Automated Translations	
	Google Translate	Systran
<p><b>El País</b>  March 22, 2011  Desde que Londa Schiebinger llegó a la Universidad tuvo claro que era lo suyo. Primero como estudiante y después como profesora. "Decidí quedarme en la enseñanza porque se aprende cada día. Me encanta el conocimiento", dice. Se nota. Esta catedrática de Historia de la Ciencia de la Universidad de Stanford (EE UU) interroga curiosa sobre el pescado del menú del día: merluza. Su traducción al inglés -hake- no le dice nada. No hay problema, mejor probarla...</p>	<p>Since Londa Schiebinger came to the University was clear that was his thing. First as a student and later as a teacher. "I decided to stay in education because you learn every day. I love knowledge," he says. It shows. This professor of History of Science at Stanford University (USA) curious questions about fish from the daily menu: hake. Its translation into English-hake-not say anything. No problem, better try it...</p>	<p>Ever since Londa Schiebinger arrived at the University knew clearly that he was his. First like student and later like professor. "I decided to remain in education because every day is learned. The knowledge enchants to me", it says. Note. This university professor of History of the Science of the University of Stanford (the USA) interrogates peculiar on the fish of the meal of the day: hake. Its translation to the English - hake- does not say anything to him. There is no problem, better to prove it...problem, better to prove it...</p>

Two state-of-the-art systems commonly default to the masculine pronoun; Systran occasionally uses the neuter pronoun "it," as does Google Translate in other paragraphs.

# Ratio of Masculine to Feminine Pronouns in U.S. Books, 1900-2008

Changes parallel increases in women's labor force participation, education, age at first marriage, etc.

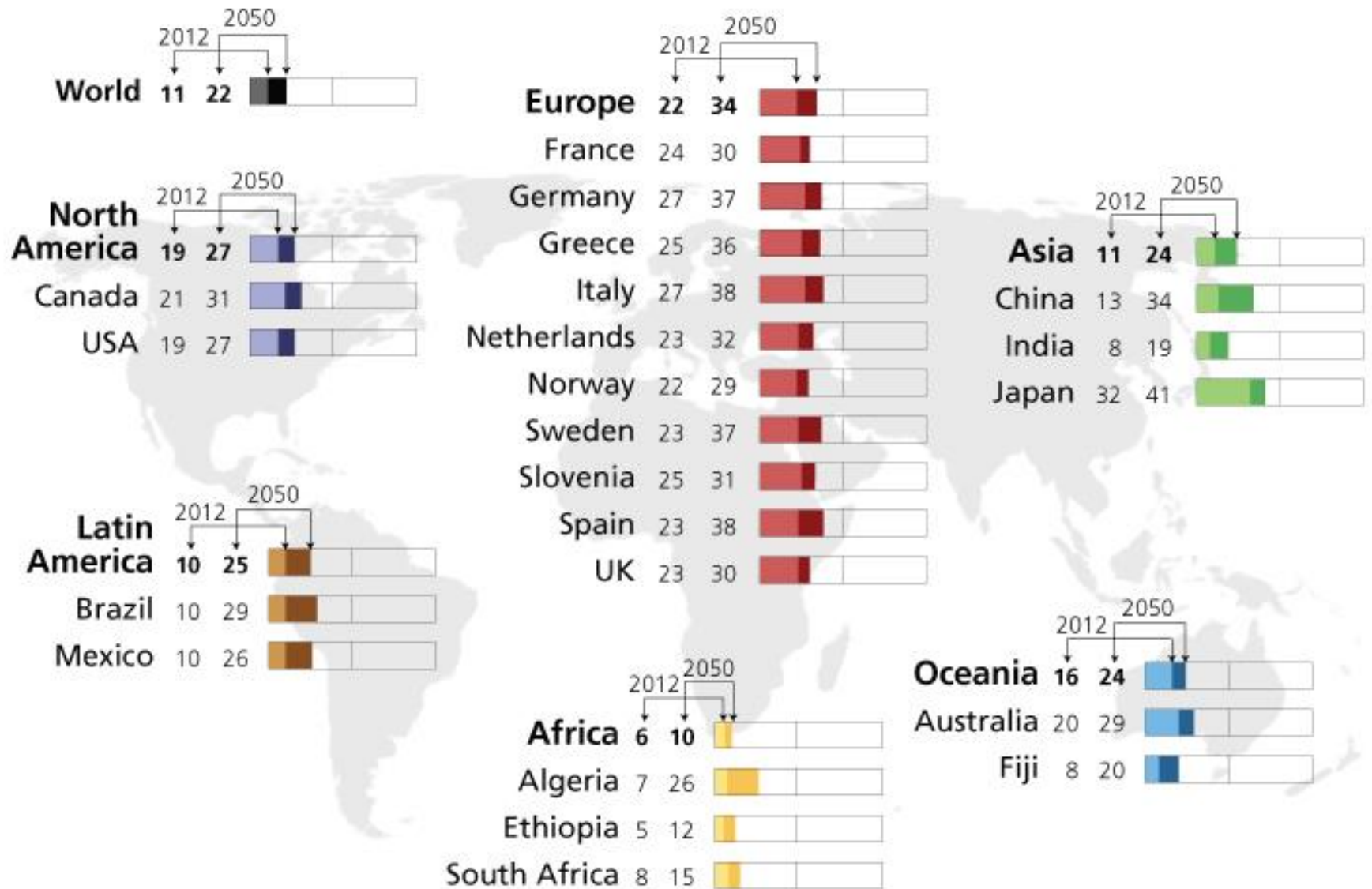


The ratio of masculine pronouns ("he," "him," "his," "himself") to feminine pronouns ("she," "her," "hers," "herself") peaked at over 4:1 in 1968. By 2000 the ratio dropped dramatically to 2:1 (Twenge et al., 2012).

Data from American English corpus of the Google Books database (~1.2 million books).  
reproduced from Twenge et al., 2012.

# Population Aged 60 or Over

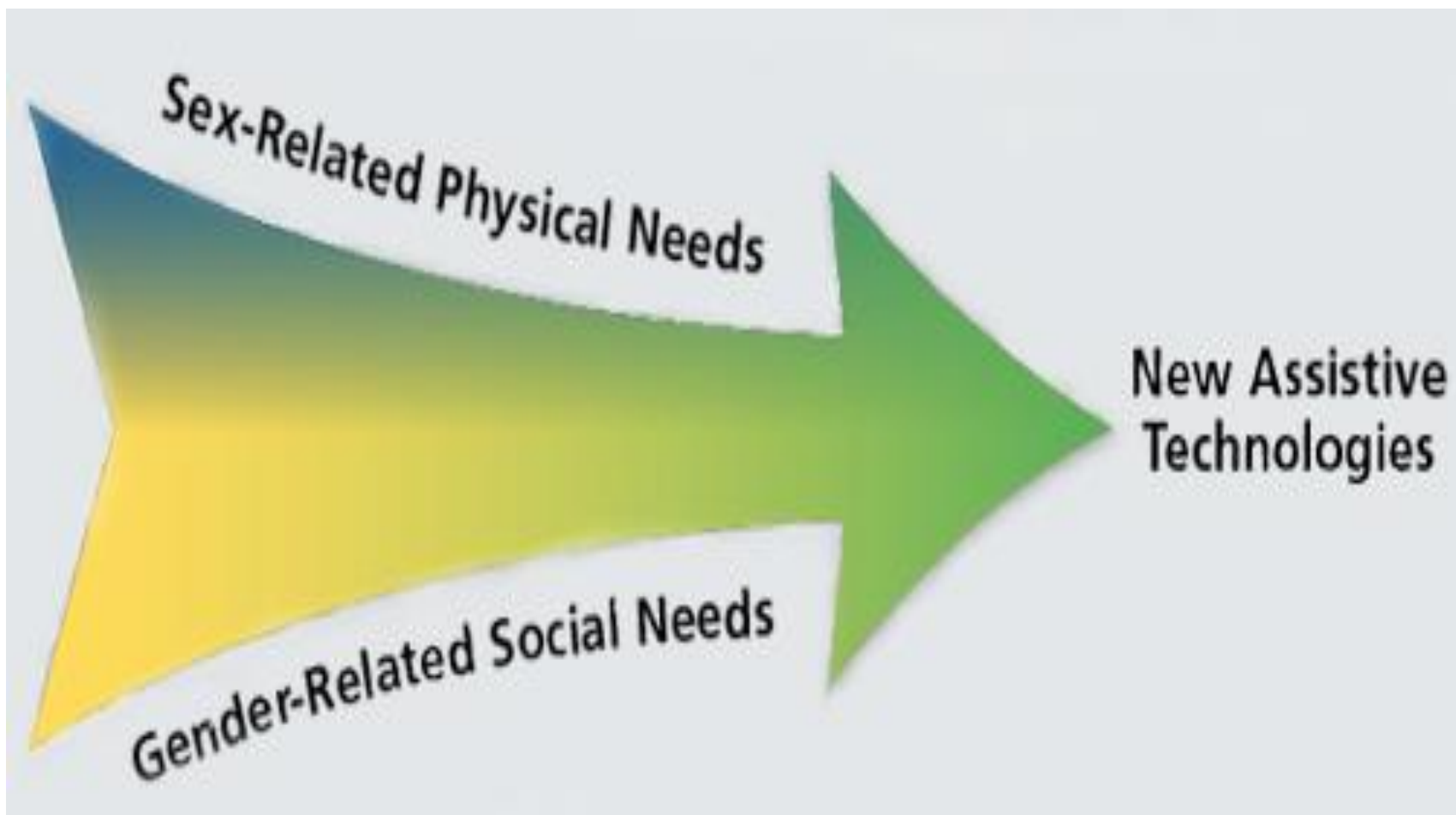
Percent 60 or over in 2012 and 2050 (projected)



**Sex-Related Physical Needs**

**Gender-Related Social Needs**

**New Assistive Technologies**





## Expressions of the CompanionAble Robot

Robot can adjust the appearance of its eyes depending on the scenario



"Shut down or perform safety critical tasks"



Normal conversation



Attempting to engage in mental exercises



Nighttime sleep state

*Adapted from CompanionAble, 2009*