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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

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CASE STUDIES

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INTERSECTIONAL DESIGN

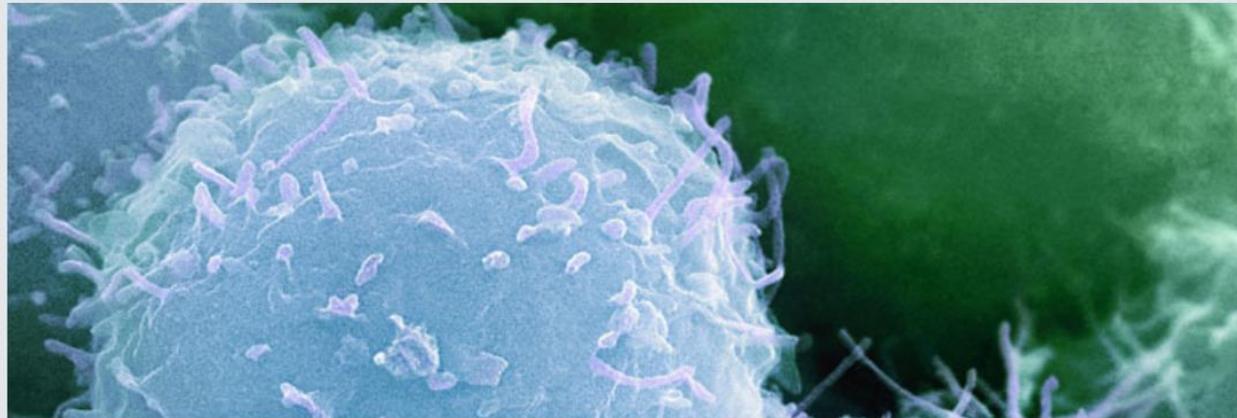
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SCIENCE

Sex and Gender Methods for Research

[Gendered Innovations](#)



SCIENCE

HEALTH & MEDICINE

ENGINEERING

ENVIRONMENT

FEATURED CASE STUDIES



**Marine Science:
Analyzing Sex**



**Chronic Pain:
Analyzing How Sex
and Gender Interact**



**Facial Recognition:
Analyzing Gender and
Intersectionality in
Machine Learning**

Why Gendered Innovations?

Gendered Innovations employs methods of sex, gender, and intersectional analysis to create new knowledge.

Gendered Innovations...

- ▶ How can we harness the creative power of sex, gender, and intersectional analysis for discovery?

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THREE FIXES

1. FIX THE NUMBERS

2. FIX THE INSTITUTIONS

3. FIX THE KNOWLEDGE



FIX THE KNOWLEDGE

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.

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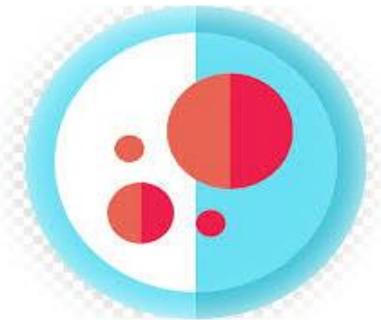
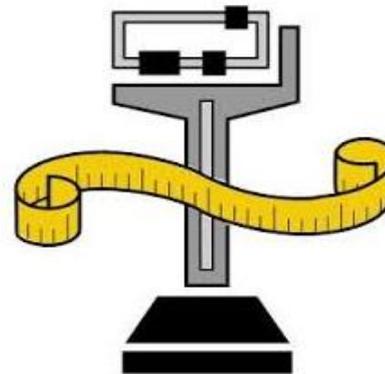
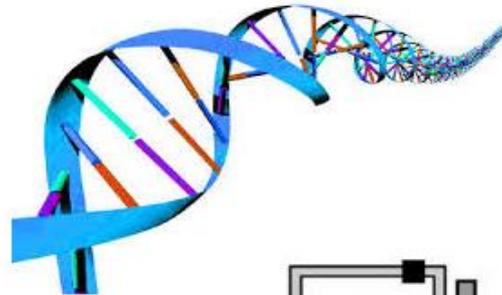
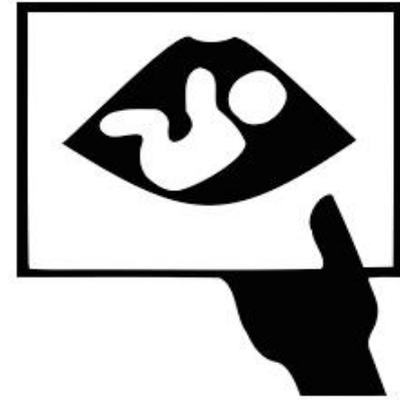
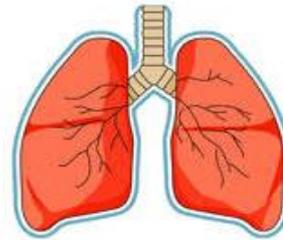
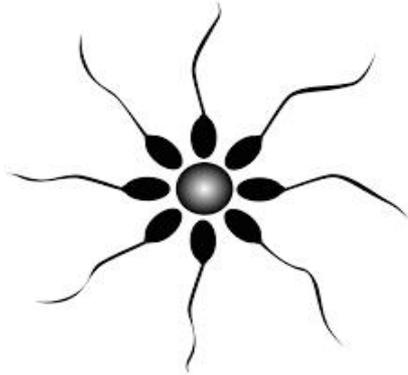
European Commission: Horizon Europe—2020

- ▶ Applicants are **required** to integrate sex and/or gender analysis into the design of research—or to justify that it is **not** relevant.

GENDERED INNOVATIONS 2: How Inclusive Analysis Contributes to Research and Innovation



Sex: Biological characteristics



Gender: Socio-cultural attitudes and behaviors



Figures for US. The Williams Institute, 2016;
GALLUP Poll, 2020.

	Percentage	Population
Female	51%	163 mill.
Male	49%	157 mill.
Intersex	0.06-1.7%	190,000- 5.5 mill.
Transgender	0.6%	~1.9 mill.
Gender-fluid	≥ 3%	9.8 mill.

Goal of Gendered Innovations

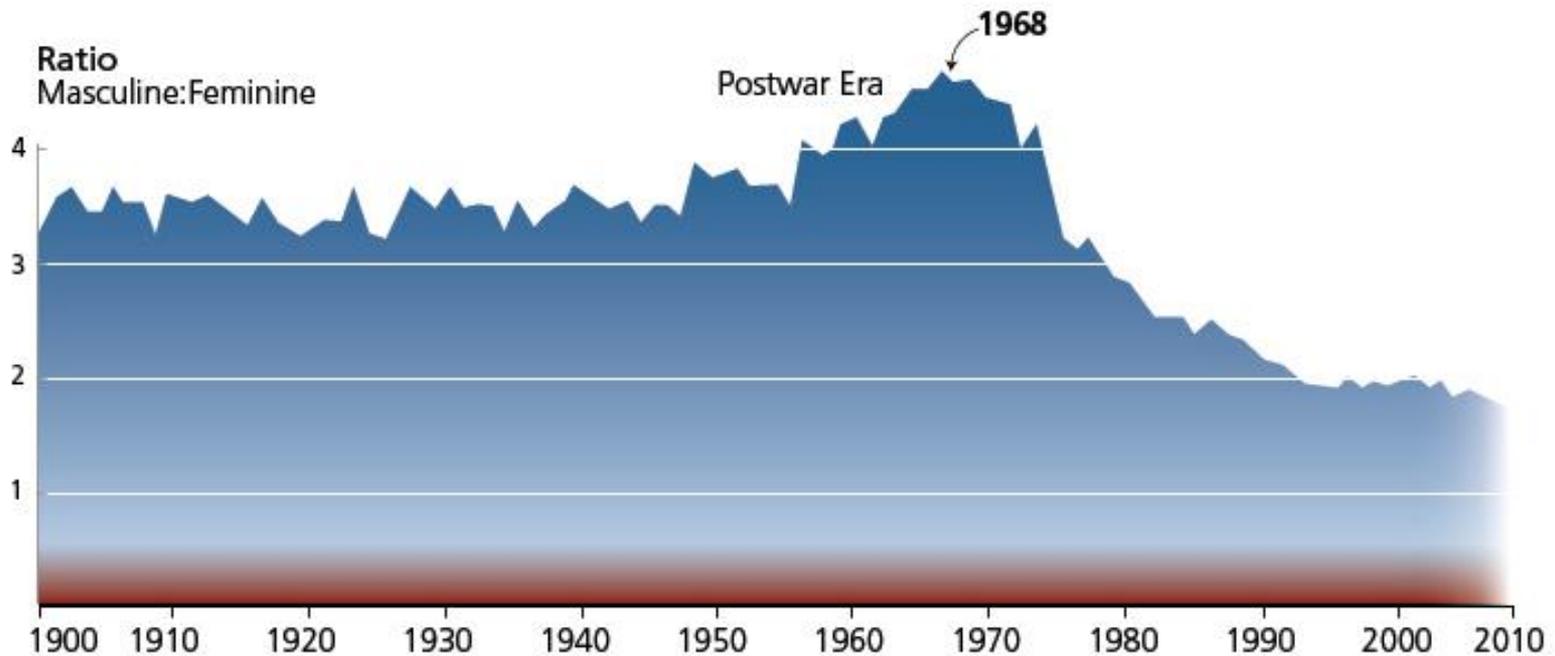
- ▶ Add value to research by ensuring excellence in science and technology.
 - ▶ Add value to society by making research more responsive to social needs.
 - ▶ Add value to business by developing new ideas, patents, and technology.
- 

Machine Translation—has a male default in English!

Original Spanish Text	Automated Translations	
	Google Translate	Systran
<p>El País 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>

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.

Search

- ▶ Men are 5 times more likely than women to be offered ads for high-paying executive jobs.

Datta, Amit, Michael Carl Tschantz, and Anupam Datta. "Automated experiments on ad privacy settings." *Proceedings on Privacy Enhancing Technologies* 2015.1 (2015): 92-112.



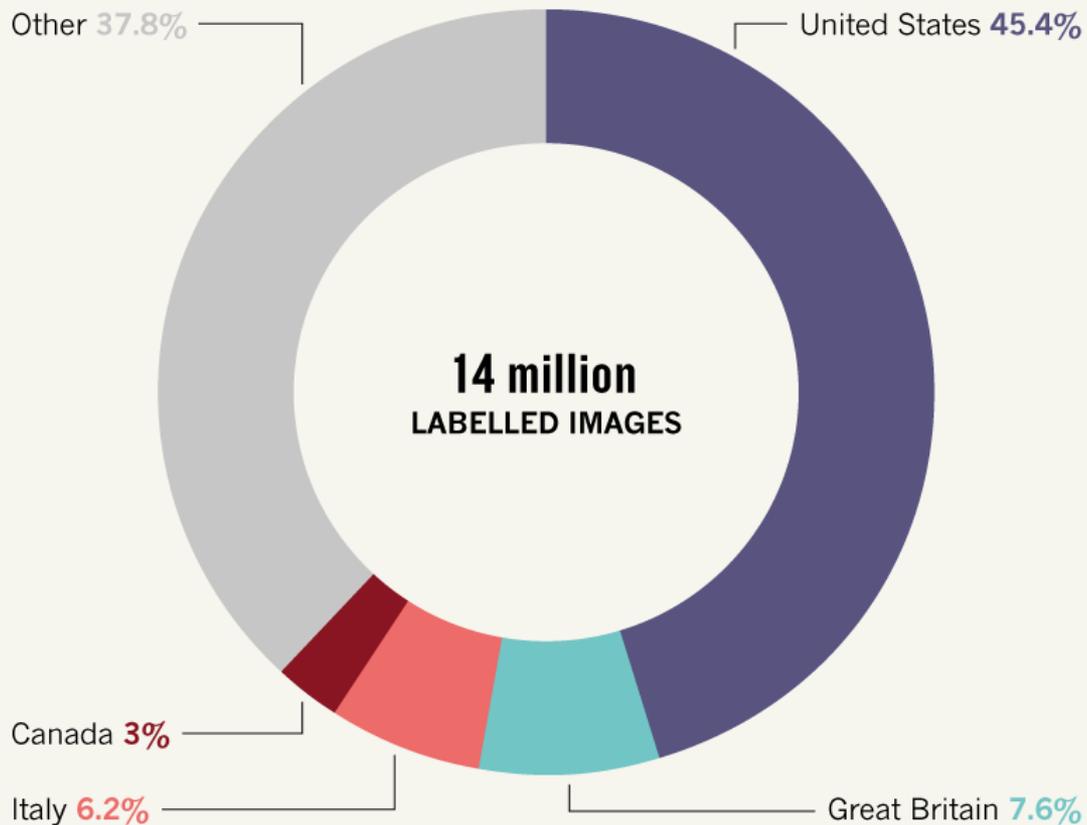
Computer Vision: “The Bride Problem”

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

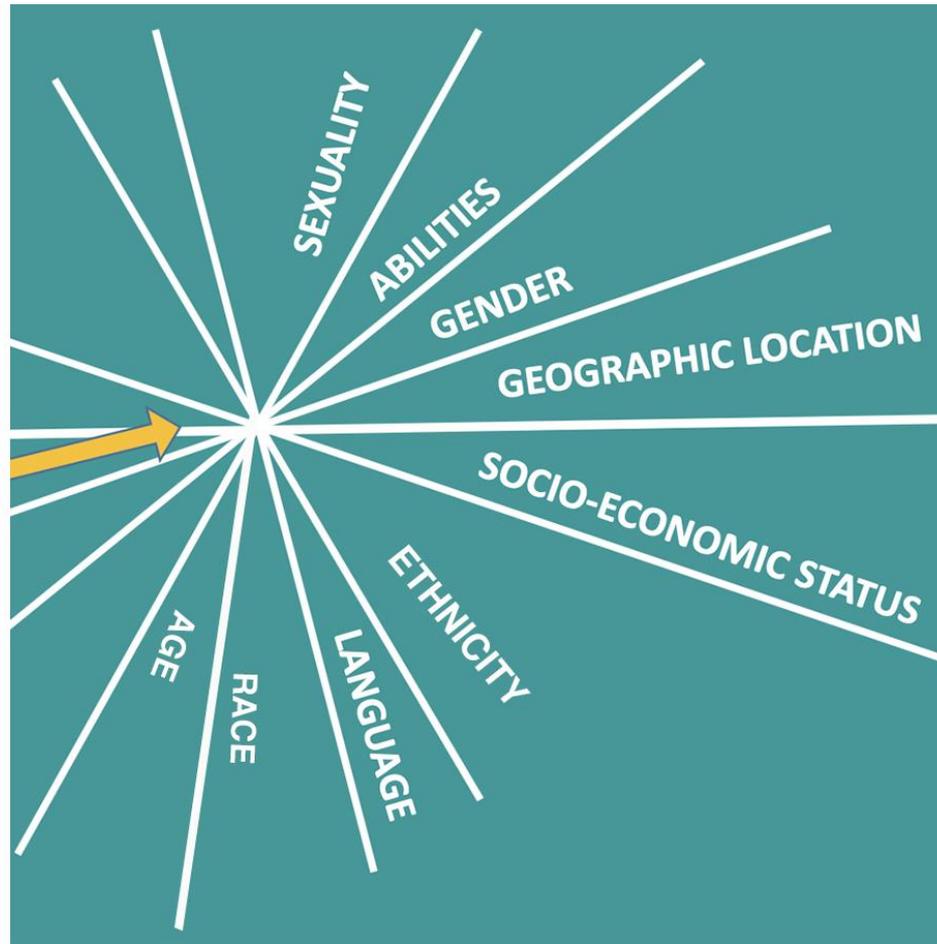
ImageNet

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.



Intersectionality



Facial Recognition

- Cannot see black women's faces!



Facial Recognition: Intersectional Analysis

- ▶ **Gender analysis:** systems performed better on men's faces than on women's faces
- ▶ **Race analysis:** systems performed better on lighter-skin than darker-skin.
- ▶ **Intersectional analysis:** system performed worst for black women. Error rates were 35% for darker-skinned women, 12% for darker-skinned men, 7% for lighter-skinned women and less than 1% for lighter-skinned men.

Buolamwini, J., & Gebru, T. (2018). Gender Shades: Intersectional accuracy disparities in commercial gender classification. In *Conference on fairness, accountability and transparency*, 77-91.

Facial Recognition

- **Sexuality analysis:** systems cannot “recognize” transgender faces, especially during transition periods.
- **Gender analysis:** facial cosmetics reduce the accuracy facial recognition by up to 76.21%!



Solutions Summarized!

- ▶ GI Website. [Machine Learning: Analyzing Gender](#)
 - ▶ Zou, J. & Schiebinger, L. AI can be sexist and racist — it's time to make it fair. *Nature*. July 2018.
 - ▶ Tannenbaum, C., Ellis, R. P., Eyssel, F., Zou, J., & Schiebinger, L. Sex and gender analysis improves science and engineering. *Nature*, 575 (2019), 137–146.
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Pulse Oximeters

- ▶ First patented in Japan in 1972 by Takuo Aoyagi

Pulse Oximeters

- ▶ Pulse oximeters don't accurately report oxygen saturation levels in patients with darker skin.

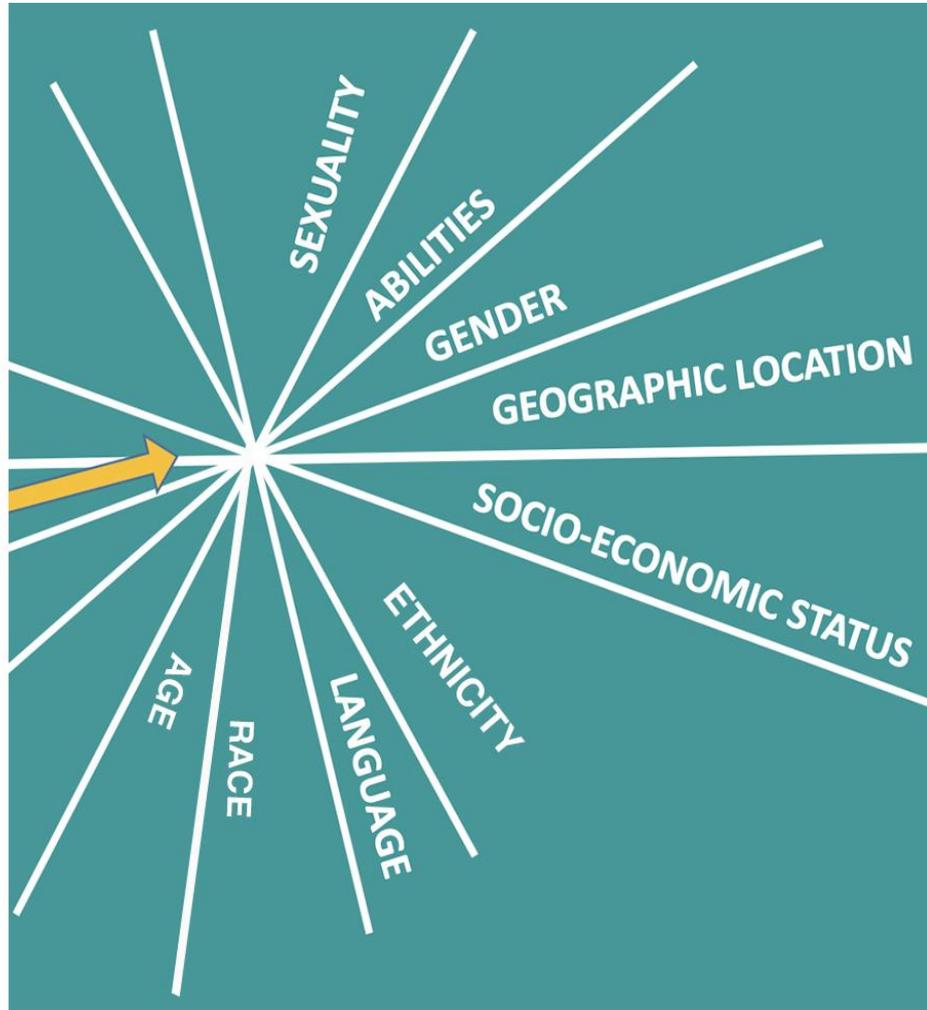
Feiner, J. R. et al. (2007). Dark skin decreases the accuracy of pulse oximeters at low oxygen saturation: The effects of oximeter probe type and gender. *Anesthesia & Analgesia*, 105(6), S18–S23

Pulse Oximeters

- ▶ Analysis of over 47,000 readings found that oximeters misread blood gases 12 % of the time in patients with darker skin compared to 4 % of the time in patients with lighter skin.

Sjoding, M. W., Dickson, R. P., Iwashyna, T. J., Gay, S. E., & Valley, T. S. (2020). Racial bias in pulse oximetry measurement. *New England Journal of Medicine*, 383(25), 2477–2478.

What about sex? In an intersectional analysis required?



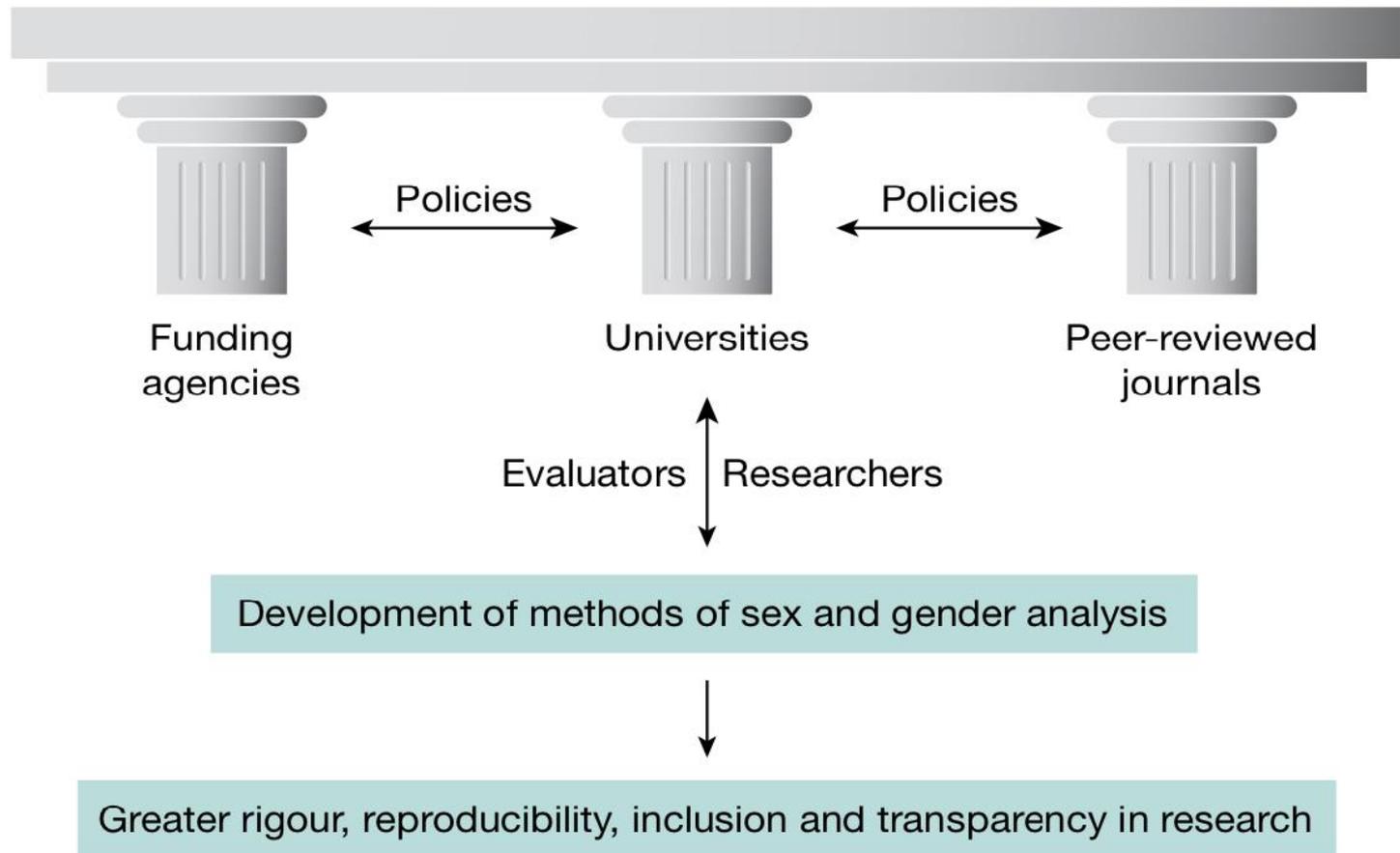
Do Skin Tone and Sex Intersect?

- ▶ Findings suggest slight differences by sex.
- ▶ If we analyze how skin tone intersects with sex, we see that women with darker skin are the most at risk.

Consumer Wearables: Digital Biomarkers

- ▶ Apple Watch, Fitbit, or other wearables collect a wealth of health-related information, including oxygen levels, sleep heart rate, arrhythmia, etc. The problem with devices that use infrared, red, or green light signaling is that these signals interact with skin pigmentation, and accuracy may vary with skin tone. This means basic data collection can be flawed.
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Integrate S&G Analysis across the Science Infrastructure



Join the Gendered Innovations listserv

- ▶ On the Gendered Innovations website, sign up at “Contact Us.”