STANFORD

SCHOOL OF
HUMANITIES AND SCIENCES

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Gendered Innovations

in Science, Health & Medicine, Engineering, and Environment

What is **Gendered Innovations**?

SEX & GENDER ANALYSIS

- General Methods
- Specific Methods
- Terms
- Checklists

CASE STUDIES

- Science
- Health & Medicine
- Engineering
- Environment

INTERSECTIONAL DESIGN

POLICY RECOMMENDATIONS

VIDEOS

- Facebook
- How to cite website

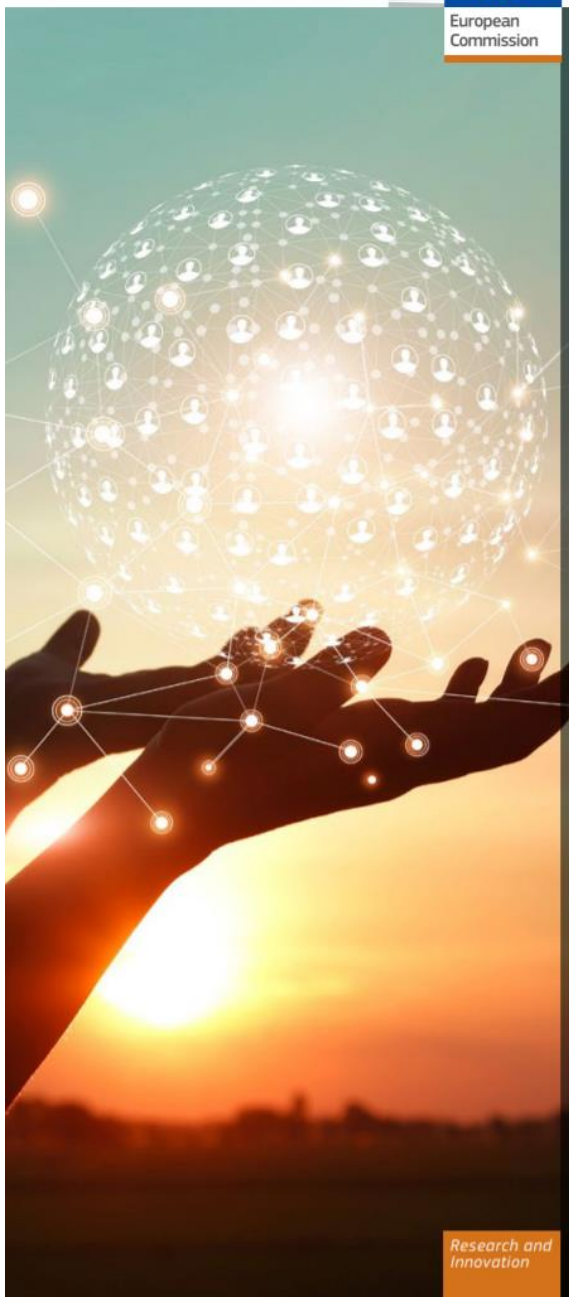
SCIENCE
HEALTH & MEDICINE
ENGINEERING
ENVIRONMENT

FEATURED CASE STUDIES

Why Gendered Innovations?

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

European Commission



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

Policy Review

Research and Innovation

NSF-Funded GI Workshop, August 2022, Stanford University

New Case Studies, coming Dec 2022

- Domestic Robots
- Sustainable Fashion—*Intersectional* E-LCA
- & S-LCA
- Computer Science Curriculum
- Space Travel

Gendered Innovations…

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

Computer Vision

ImageNet

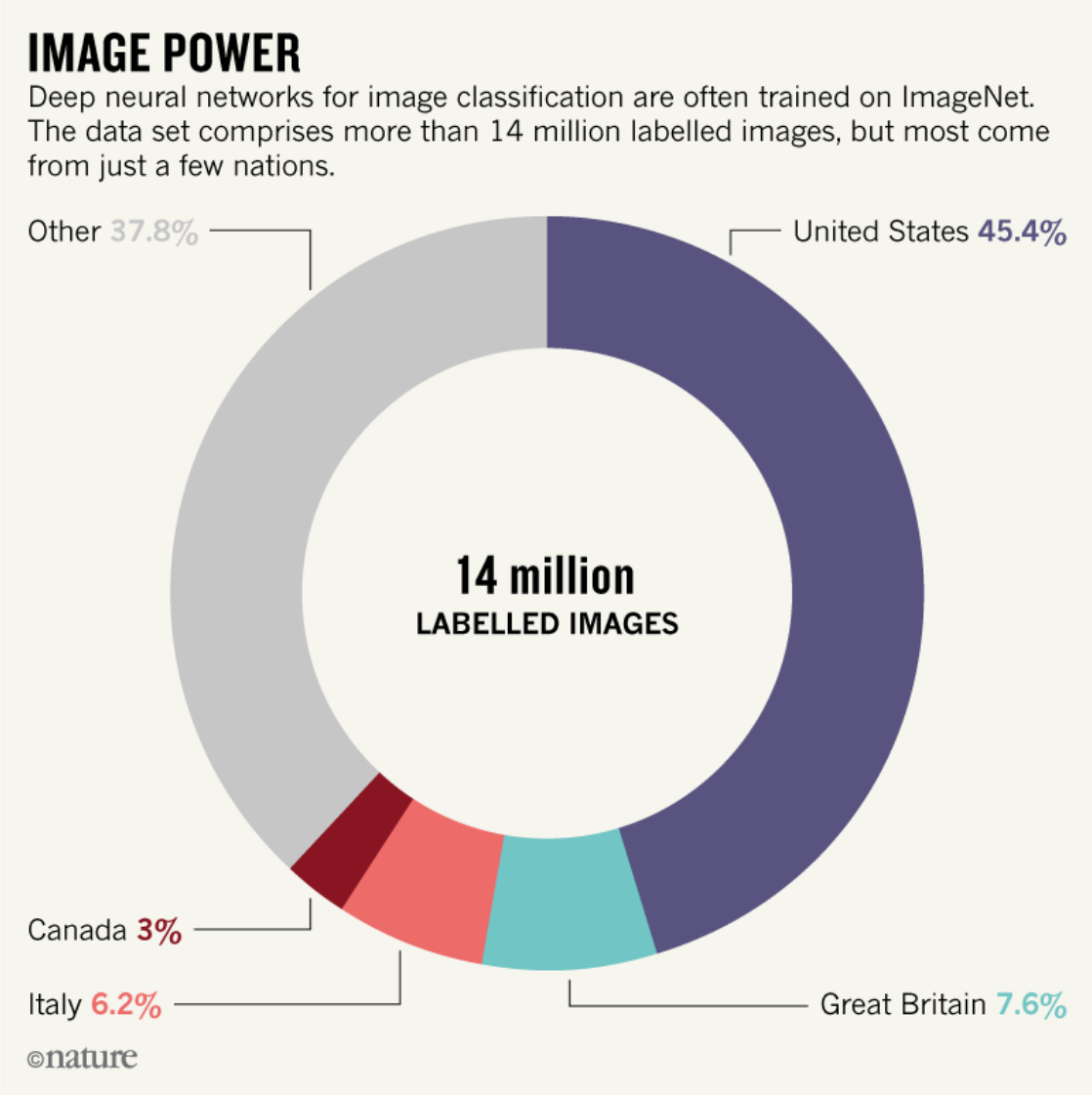
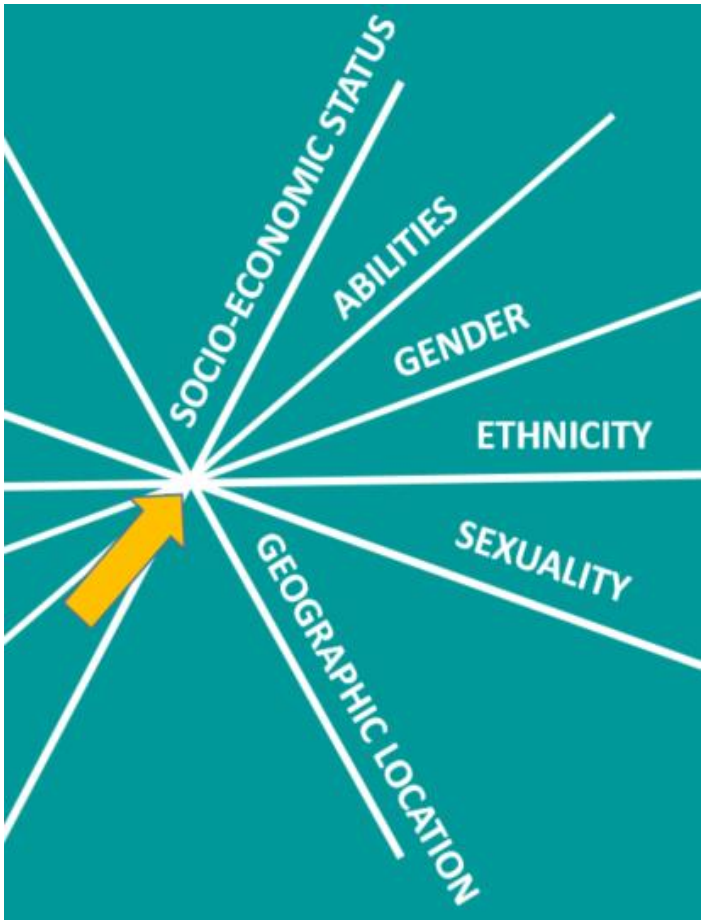


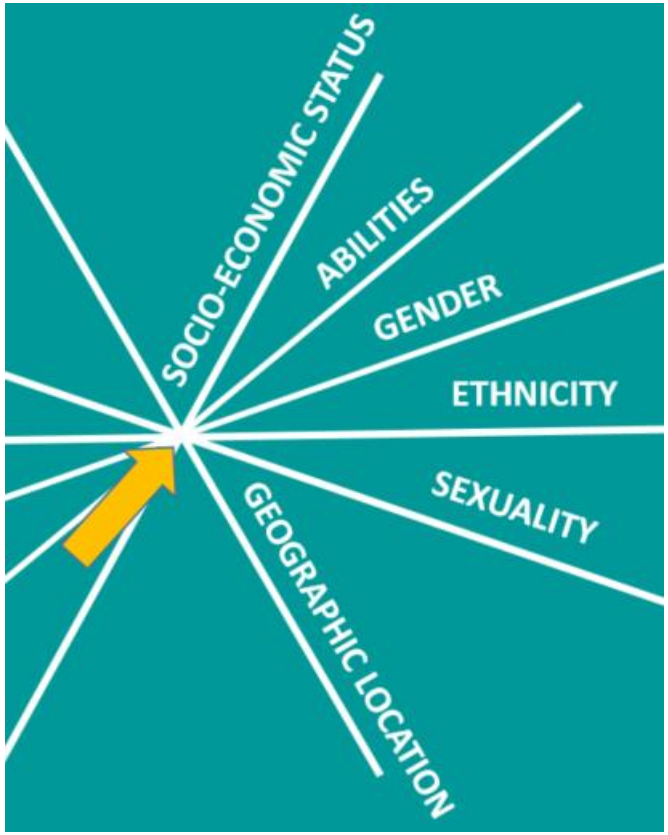
IMAGE POWER
Deep neural networks for image classification are often trained on ImageNet. The data set comprises more than 14 million labelled images, but most come from just a few nations.
Other 37.8%
United States 45.4%
14 million
LABELLED IMAGES
Canada 3%
Italy 6.2%
Great Britain 7.6%
©nature

Intersectionality



Intersectionality

…describes overlapping or intersecting forms of discrimination related to gender, sex, ethnicity, age, socioeconomic status, sexuality, geographic location, etc.



Facial Recognition: Intersectional Analysis

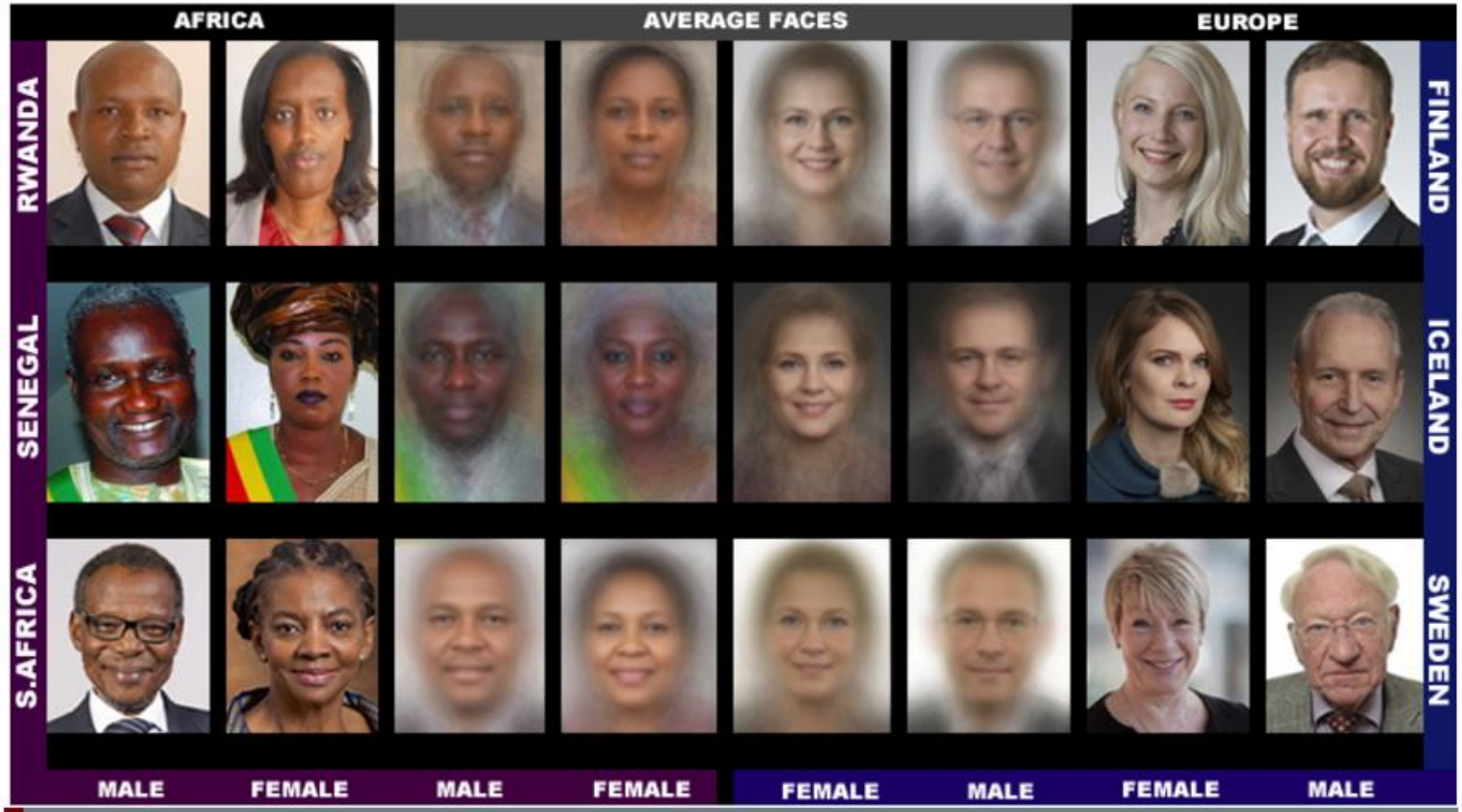
- **Gender analysis**: systems performed better on men's faces than on women's faces
- **Race analysis**: systems performed better on lighter-skin than darker-skin.
- **Intersectional analysis**: system performed worst for black women. Error rates were 35% for darker-skinned women, 12% for darker-skinned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

Sexuality analysis: Systems may not “recognize” transgender faces during transition periods.

Gender analysis: Use of makeup can reduce accuracy in facial recognition systems by 76%.

Intersectional Innovation

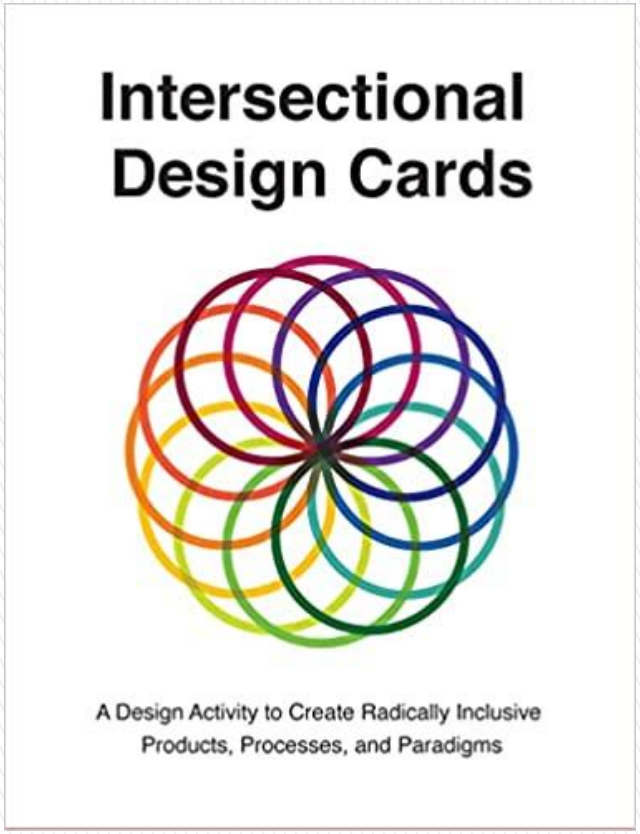


Example images and average faces from the new dataset, which includes women and men of darker and lighter skin drawn from Members of Parliament form six countries. Buolamwini & Gebru, 2018, with permission.

12 Intersecting Factors

- Age
- Disabilities
- Educational Background
- Ethnicity
- Family Configuration
- Gender
- Geographic Location
- Race
- Sex
- Sexuality
- Social and Economic Status (SES)
- Sustainability

- … There are many more!



Available online: https://intersectionaldesign.com/
Also available at Stanford University Press.

Apple's Intersections of Diverse Axes: To empower and delight everyone

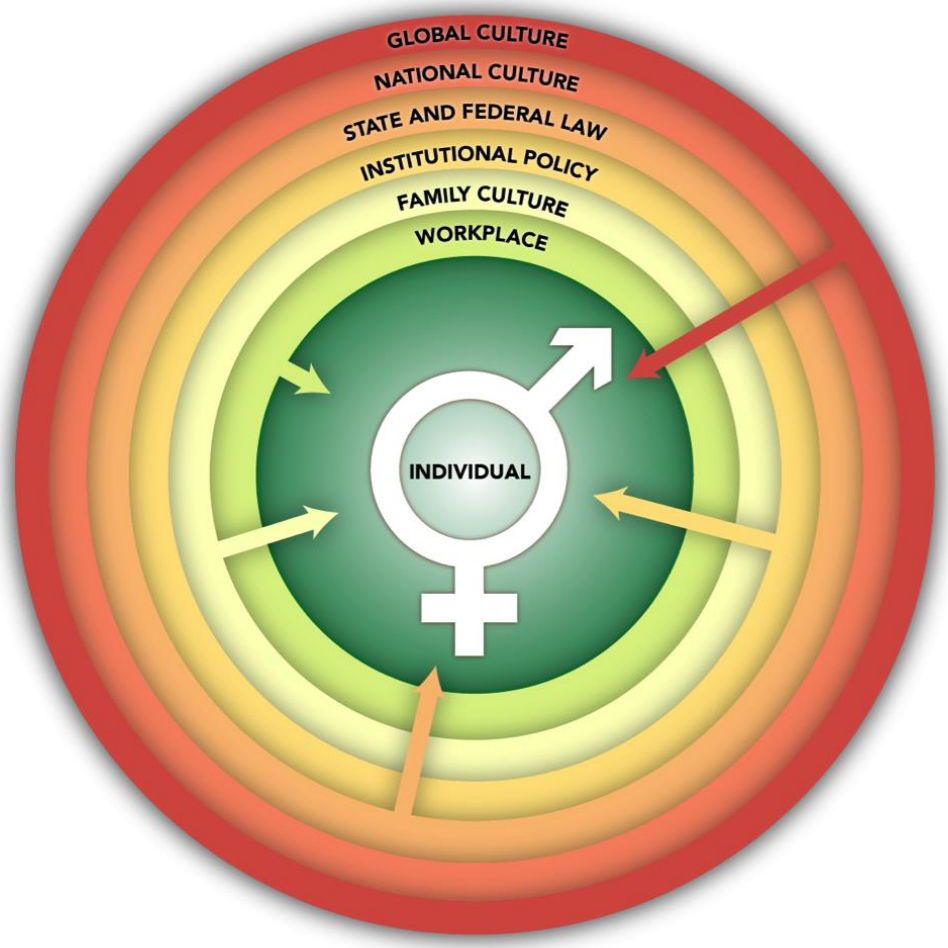
Class
Culture
Ethnicity
Language
Education
Political beliefs
Philosophical beliefs
Religion
Race
Gender

Sexual Orientation
Age
Abilities
Disabilities
Handedness
Body measurements
Environment
Location
Connectivity
Modern technology

The Robots are Coming!

- Should robots be gendered?
- What genders a robot?

GENDER NORMS



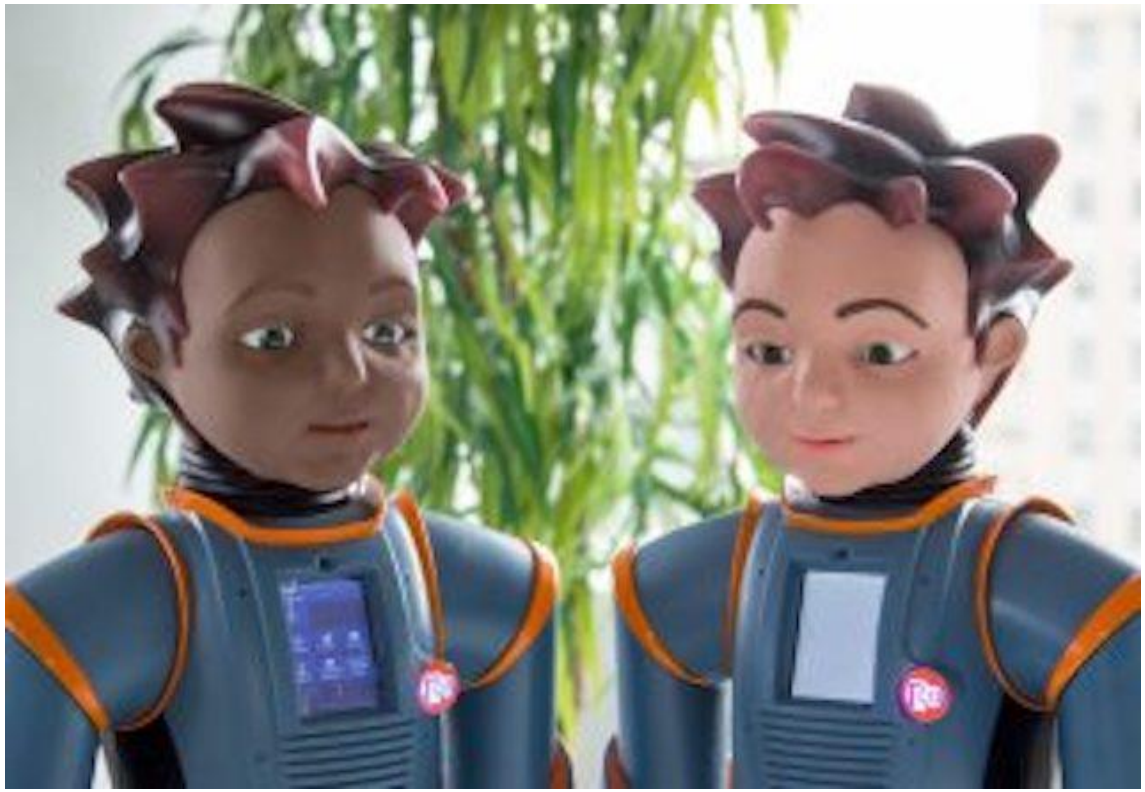
DANGER!

- Gendering robots may reinforce gender inequalities.
- Designing hardware, i.e., robots, toward current stereotypes may amplify these stereotypes into the future.

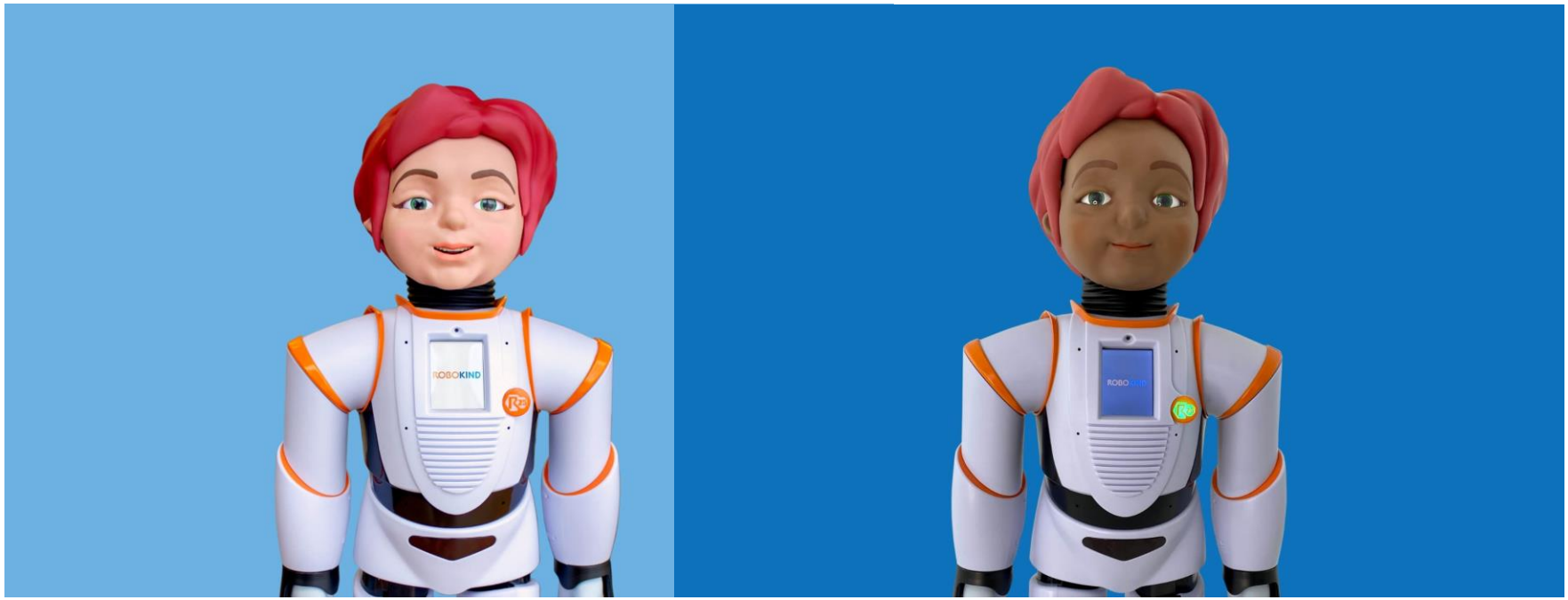
The Challenge for Designers is:

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

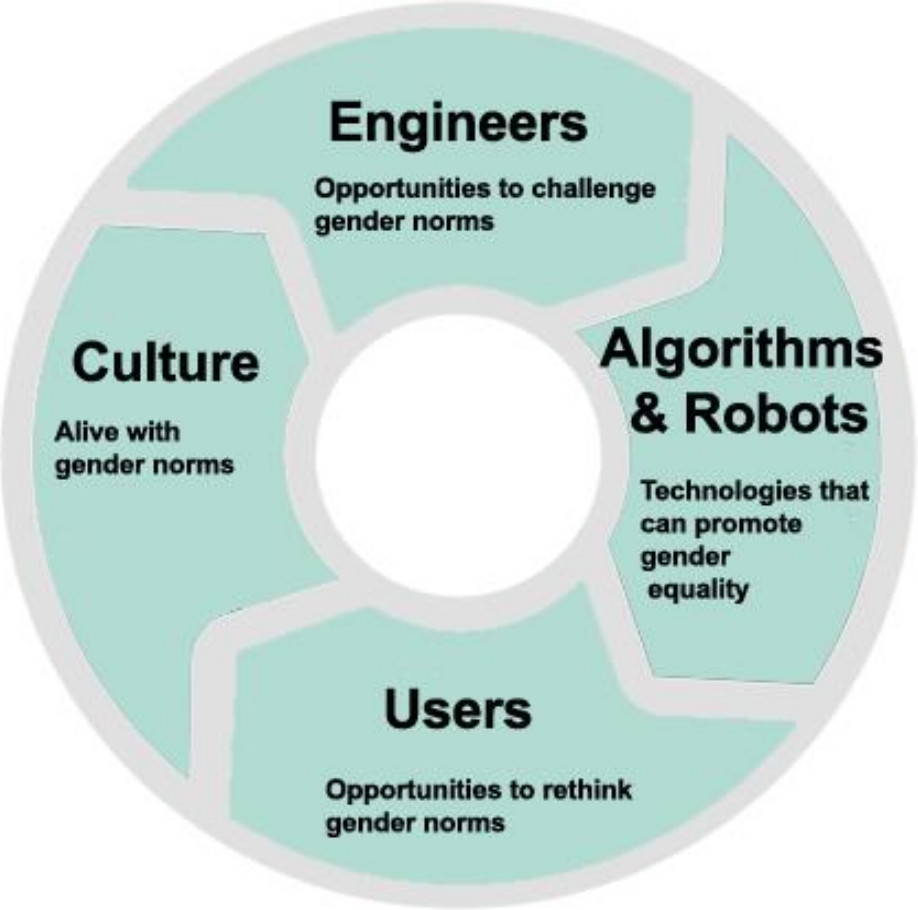
Carver & Milo



Veda & Jemi



Creating a Virtuous Circle: Robotics as a Catalyst for Changing Gender Norms



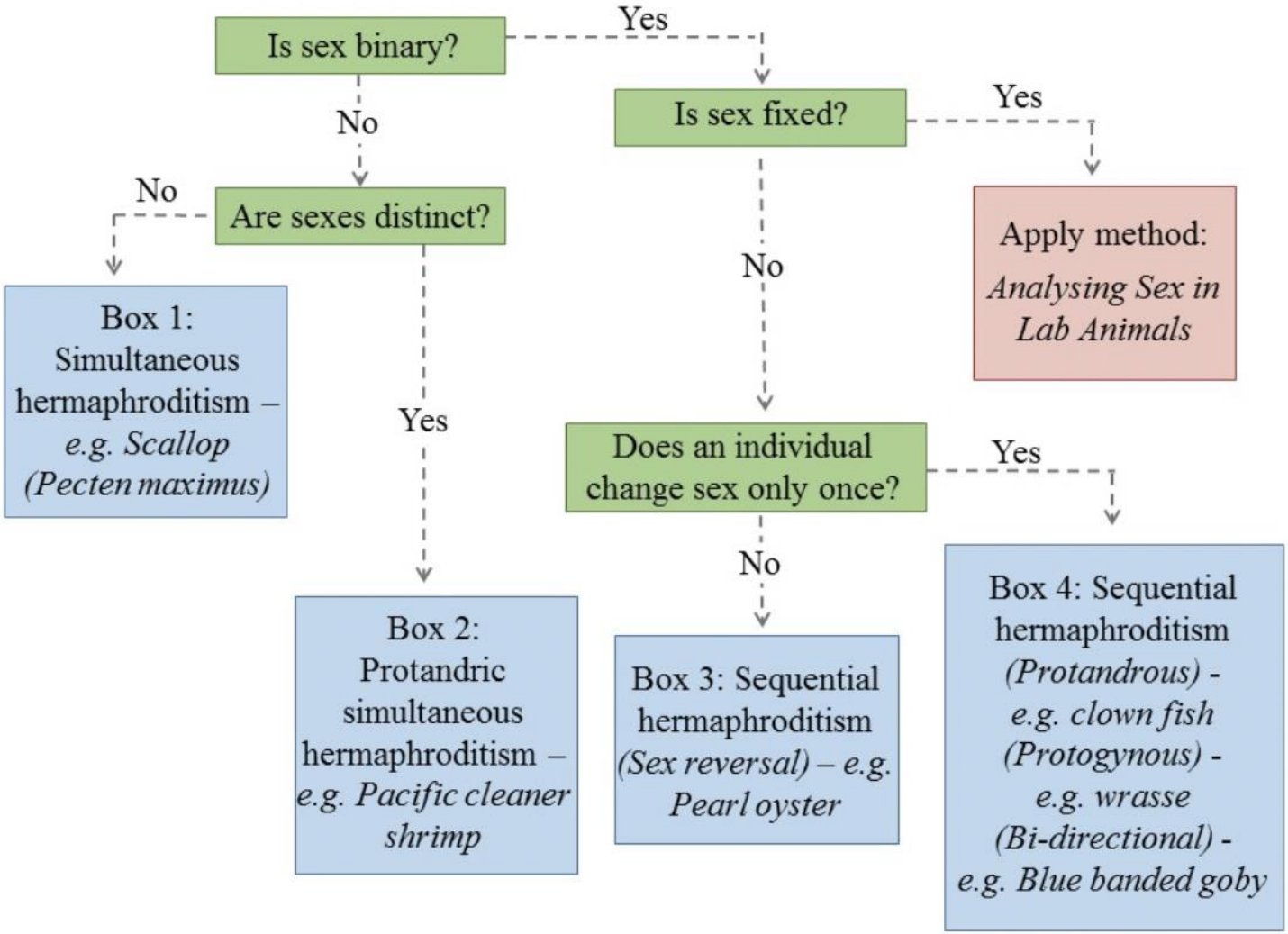
Sex in Marine Organisms

- Simultaneous hermaphrodites
- Sequential hermaphroditism
- Protandric hermaphrodites
- Males
- Protogynous hermaphrodite
- Females

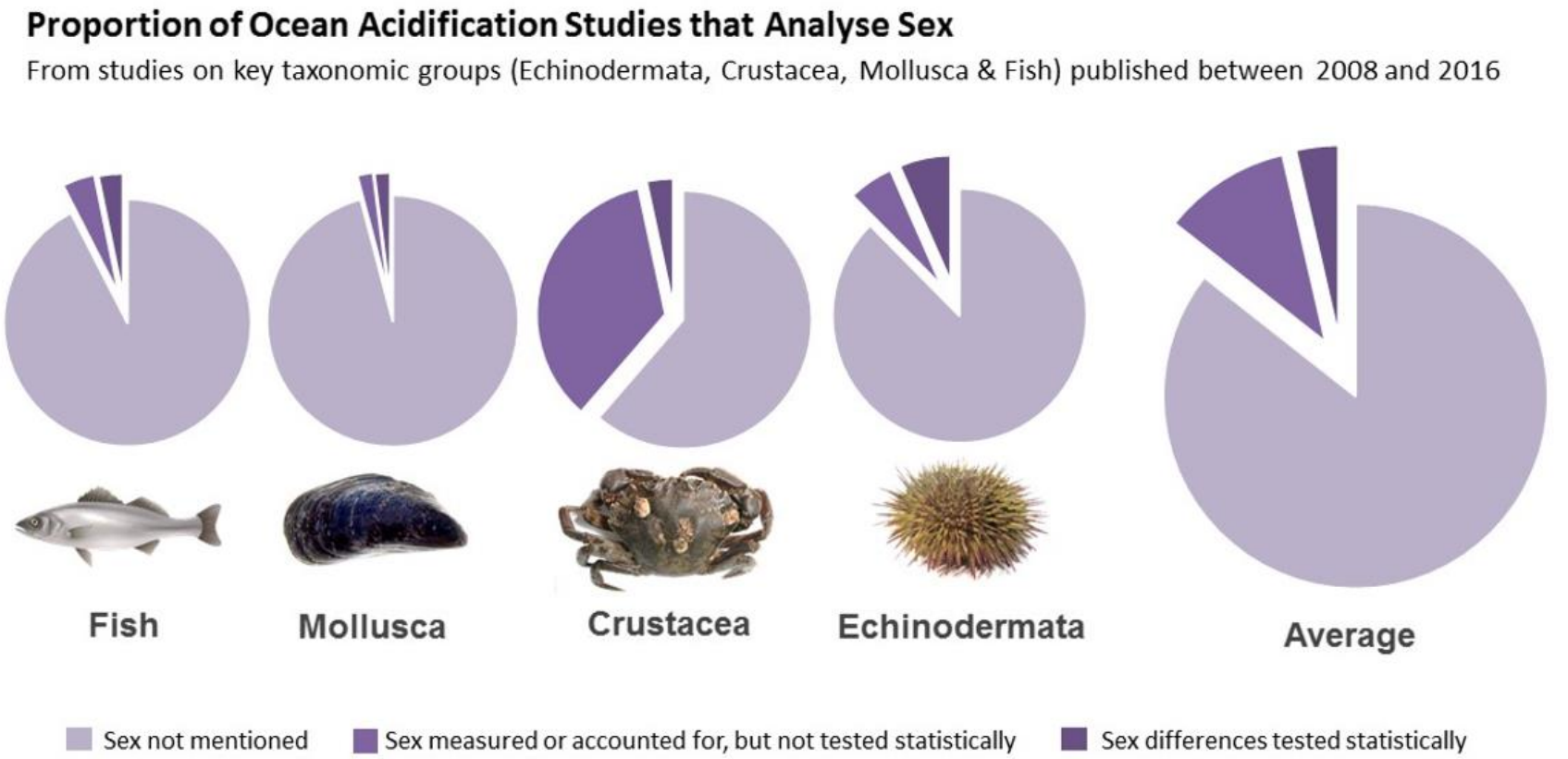
Terminology

- Hermaphrodite for animals
- Intersex for humans

Decision tree for sex analysis



Marine Science: Only 4% of Studies Analyze Sex



Data Ellis et al., 2017. With permission

Turtle Populations are 99% Female in Some Areas

Why is this important?

- Analyzing sex-based responses to climate change enables better modeling of demographic change among marine organisms and downstream impacts on humans.

Waste

SUSTAINABLE DEVELOPMENT GOALS

17 GOALS TO TRANSFORM OUR WORLD

1 NO POVERTY

2 ZERO HUNGER

3 GOOD HEALTH AND WELL-BEING

4 QUALITY EDUCATION

5 GENDER EQUALITY

6 CLEAN WATER AND SANITATION

7 AFFORDABLE AND CLEAN ENERGY

8 DECENT WORK AND ECONOMIC GROWTH

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

10 REDUCED INEQUALITIES

11 SUSTAINABLE CITIES AND COMMUNITIES

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

13 CLIMATE ACTION

14 LIFE BELOW WATER

15 LIFE ON LAND

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

17 PARTNERSHIPS FOR THE GOALS

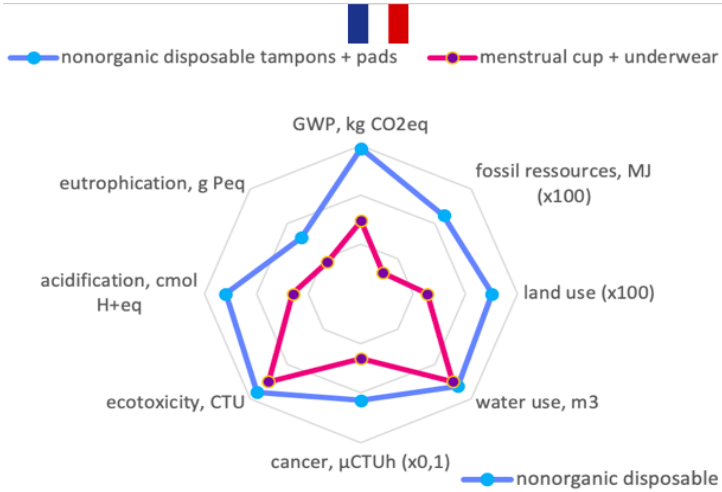
SUSTAINABLE DEVELOPMENT GOALS

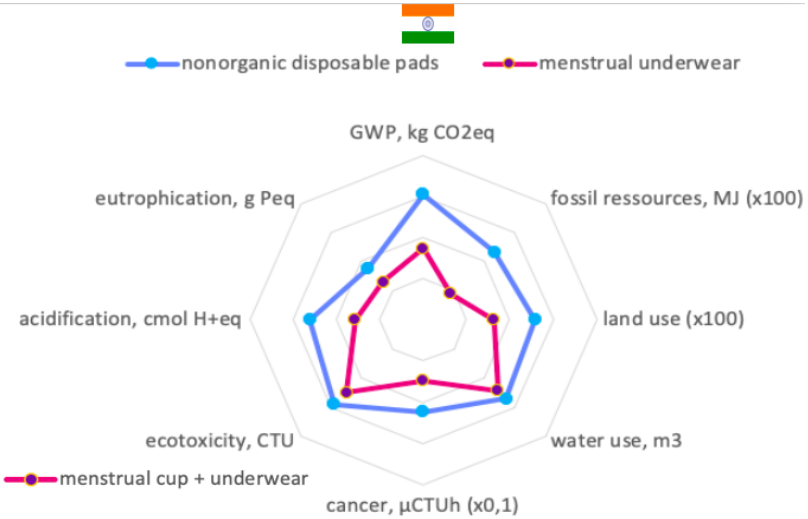
Menstrual Products: A Comparable Life-Cycle Assessment

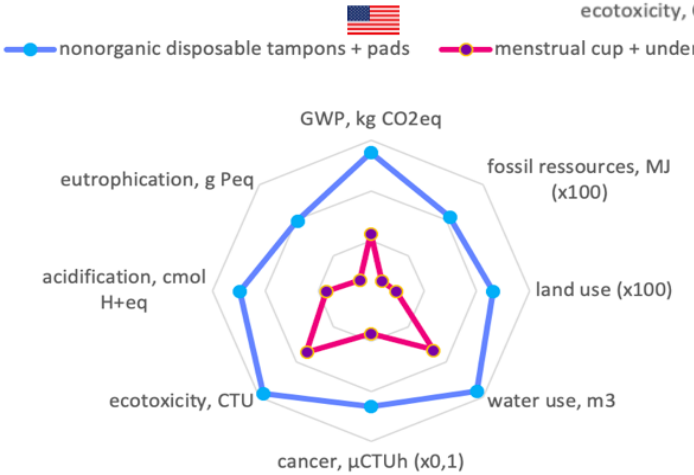
- Compared 6 products: Pads (organic and non-organic), tampons (organic and non-organic), menstrual cups, and menstrual underwear.
- Across 3 countries: France, India, and the US
- Analyzed 8 environmental factors, such as land use, water use, energy, the likelihood of cancer risk, the likelihood of water acidification, etc.

What’s Best for the Environment

Fourcassier, S., Douziech, M., Perez-Lopez, P., Schiebinger, L., Menstrual Products: A Comparable Life-Cycle Assessment, in press.



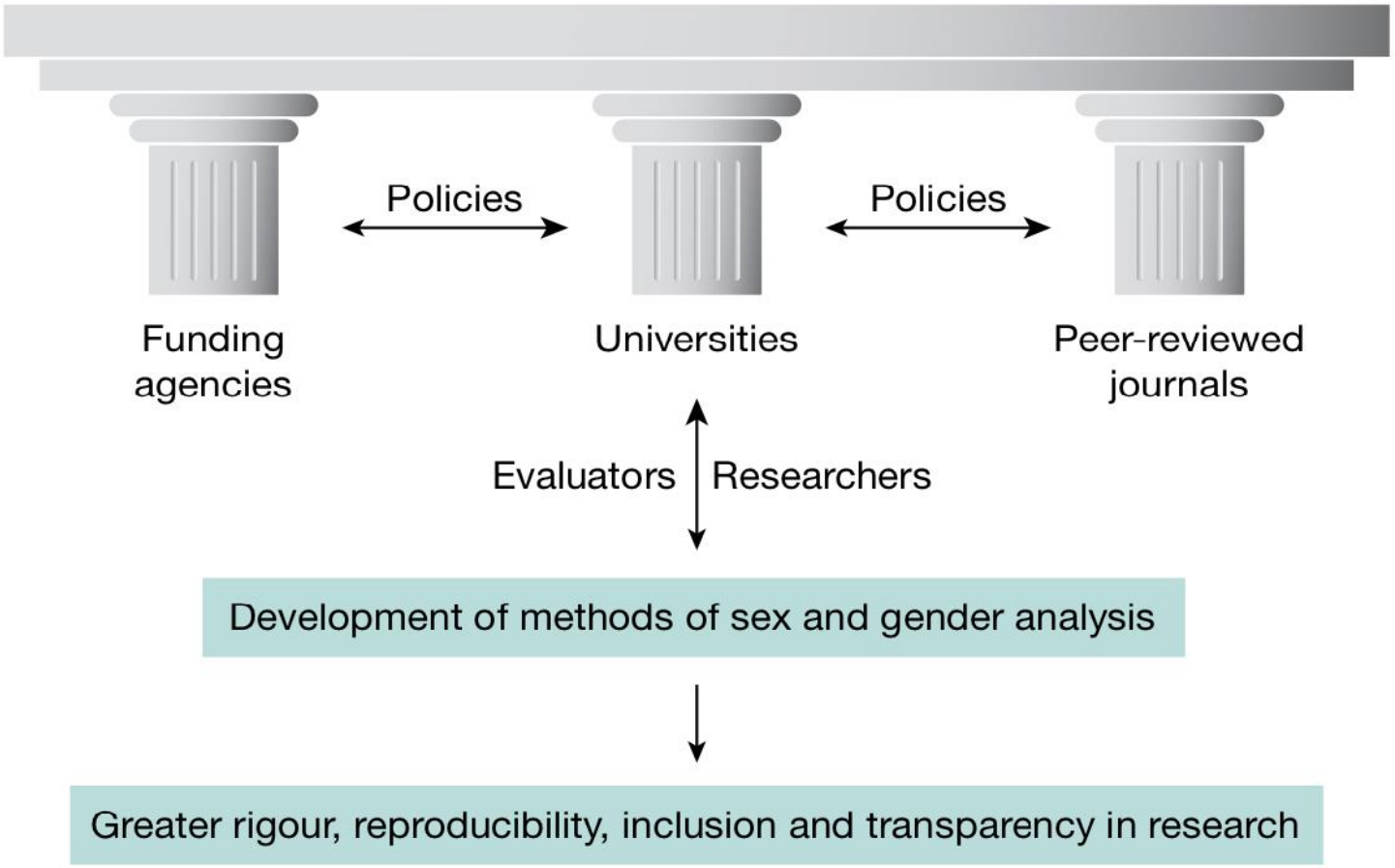




Stanford University

- For gender equality: Put menstrual products in all restrooms.
- For environmental sustainability: These should be reusable!

Integrate SG&D Analysis across the Science Infrastructure



Global Review of Sex, Gender, and Diversity Analysis in Funding Agency Policy

- Goal of study:
  - to identity standard practices across global regions, tailored where necessary to country-specific cultures and regulatory landscapes.
  - to provide a road map for agencies that wish to develop quality policies and practices in this area.

Hunt, L., Nielsen, M.W., Schiebinger, L. (2022). A framework for sex, gender, and diversity analysis in research: Funding agencies have ample room to improve their policies. *Science*, 377 (6614) (2022), 1492-1495.

POLICY FORUM

DIVERSITY

A framework for sex, gender, and diversity analysis in research

Funding agencies have ample room to improve their policies

By **Lilian Hunt[1], Mathias Wullum Nielsen[2], Londa Schiebinger[3,4]**

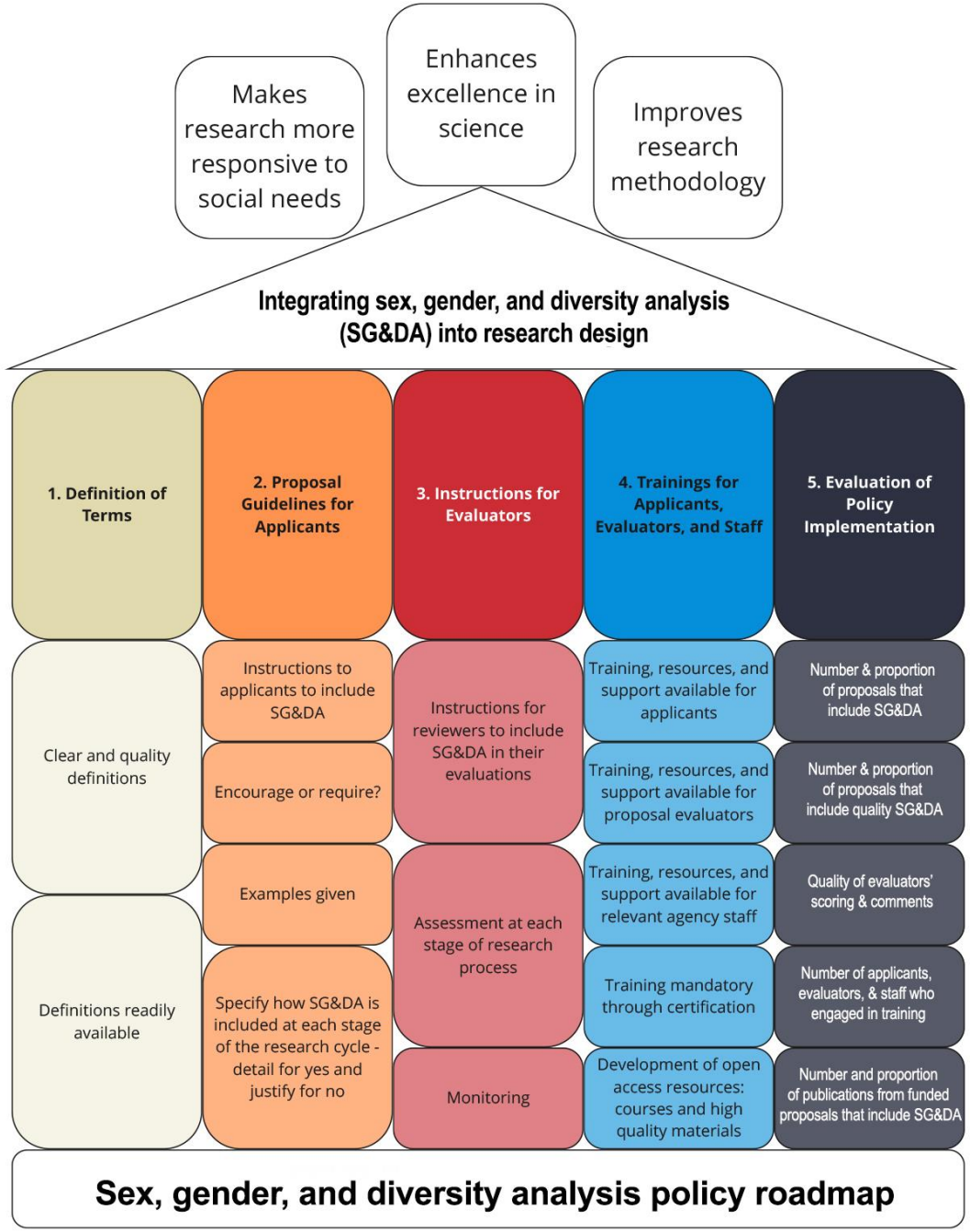
National research agencies are responsible for promoting excellent research that benefits all of society (*1*). Integrating sex, gender, and diversity analysis (SG&DA) into the design of research, where relevant, can improve research methodology, enhance excellence in science, and make research more responsive to social needs (*2*). National funding agencies—encouraged by scientists and social movements—have thus begun to implement policies to integrate sex, gender, and, more recently, diversity analysis into the grant proposal process, where these factors have been shown to play a role. We develop a five-part analytical framework for implementing and evaluating SG&DA policies, and use clude sex-based analysis in nonhuman animal and human preclinical and clinical research, gender-based analysis in patient–physician relationships and, more recently, analysis of different racialized groups and ethnicities in clinical treatment (*3*, *4*).

SG&DA informs each phase of the research process—from establishing project objectives (e.g., considering the characteristics of target populations and the social implications of the project), to developing methodologies (e.g., ensuring appropriate and unbiased measures and instruments), gathering data (e.g., sampling sufficient participant numbers across categories), analyzing data (e.g., considering within- and between-group differences and intersecting factors) to reporting results (e.g., considering language use and specifying how categorical data were collected and annotated) (*5*).

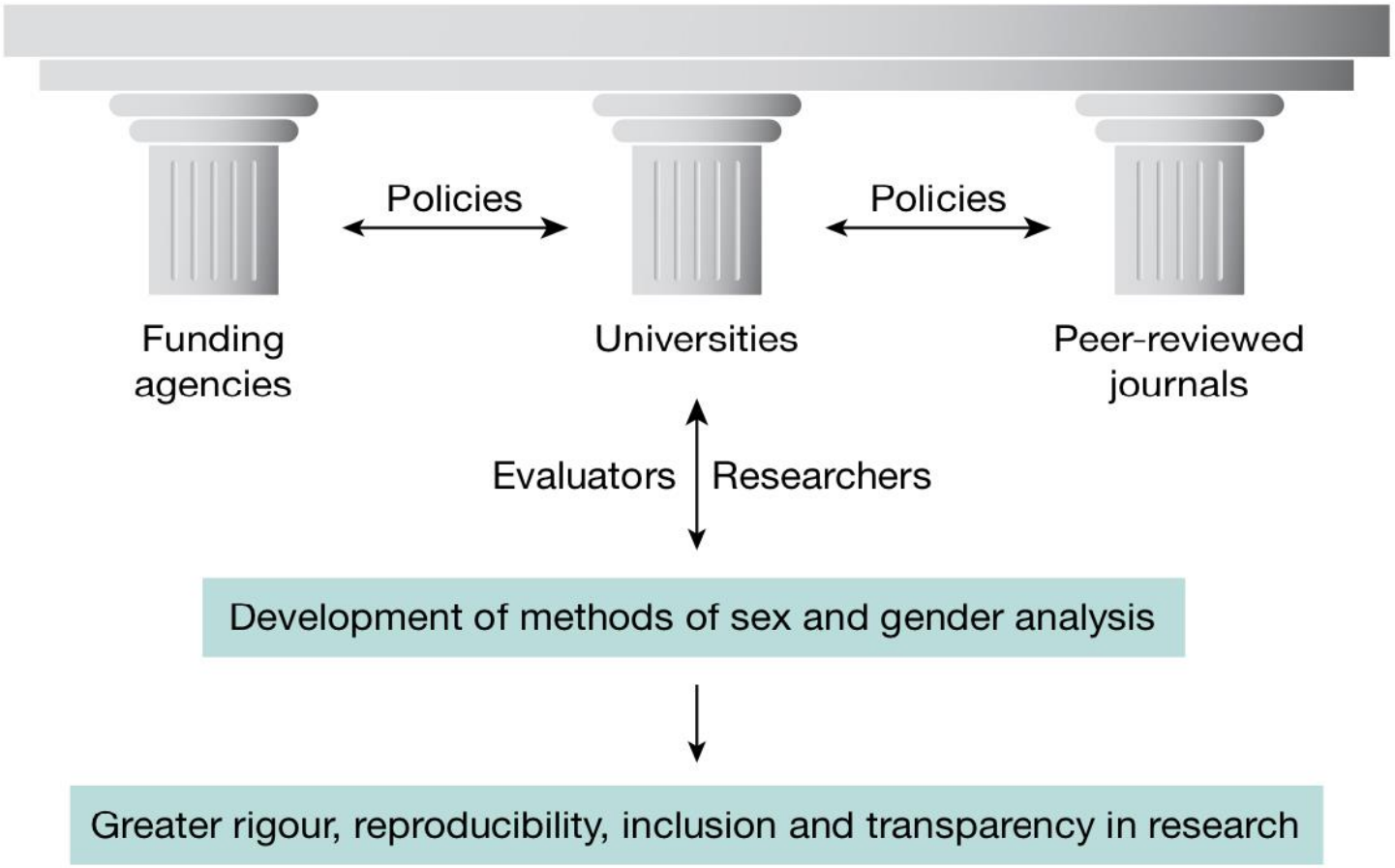
This study focuses on funding agencies and develops an analytical framework to evaluate the uptake of policies for integrating sex, gender, and diversity—which covers intersectional characteristics such as age or life course, indigeneity, race and ethnicity, sexuality, socioeconomic status, and other axes of inequality—into research design. Previous studies have analyzed single funding agencies in depth (*1*, *8*–*9*) or focused narrowly on particular regions such as sub-Saharan Africa, or more often Europe and North America (*10*, *11*). One international study included questions on SG&DA policies in their larger survey focused on gender equity in research teams (*12*). Ours is the first to develop a cross-disciplinary analytical framework for policy development and to apply it globally.

DEVELOPING THE POLICY FRAMEWORK

We conducted an investigation in three stages: (i) document analysis, (ii) global survey, and (iii) policy analysis. Based on a documented analysis of SG&DA-related policies and guidelines and prior research (*6*), we developed our analytical framework, a five-part guide for implementing and evaluating SG&DA policy (see the box) (for a full outline of the development process, see supplementary materials (SM) S1). We convened an international advisory group that included representatives from public funders, expert researchers, and policy specialists from five global ar-


Makes research more responsive to social needs
Enhances excellence in science
Improves research methodology
Integrating sex, gender, and diversity analysis (SG&DA) into research design
1. Definition of Terms
2. Proposal Guidelines for Applicants
3. Instructions for Evaluators
4. Trainings for Applicants, Evaluators, and Staff
5. Evaluation of Policy Implementation
Clear and quality definitions
Definitions readily available
Instructions to applicants to include SG&DA
Encourage or require?
Examples given
Specify how SG&DA is included at each stage of the research cycle - detail for yes and justify for no
Instructions for reviewers to include SG&DA in their evaluations
Assessment at each stage of research process
Monitoring
Training, resources, and support available for applicants
Training, resources, and support available for proposal evaluators
Training, resources, and support available for relevant agency staff
Training mandatory through certification
Development of open access resources: courses and high quality materials
Number & proportion of proposals that include SG&DA
Number & proportion of proposals that include quality SG&DA
Quality of evaluators' scoring & comments
Number of applicants, evaluators, & staff who engaged in training
Number and proportion of publications from funded proposals that include SG&DA
Sex, gender, and diversity analysis policy roadmap

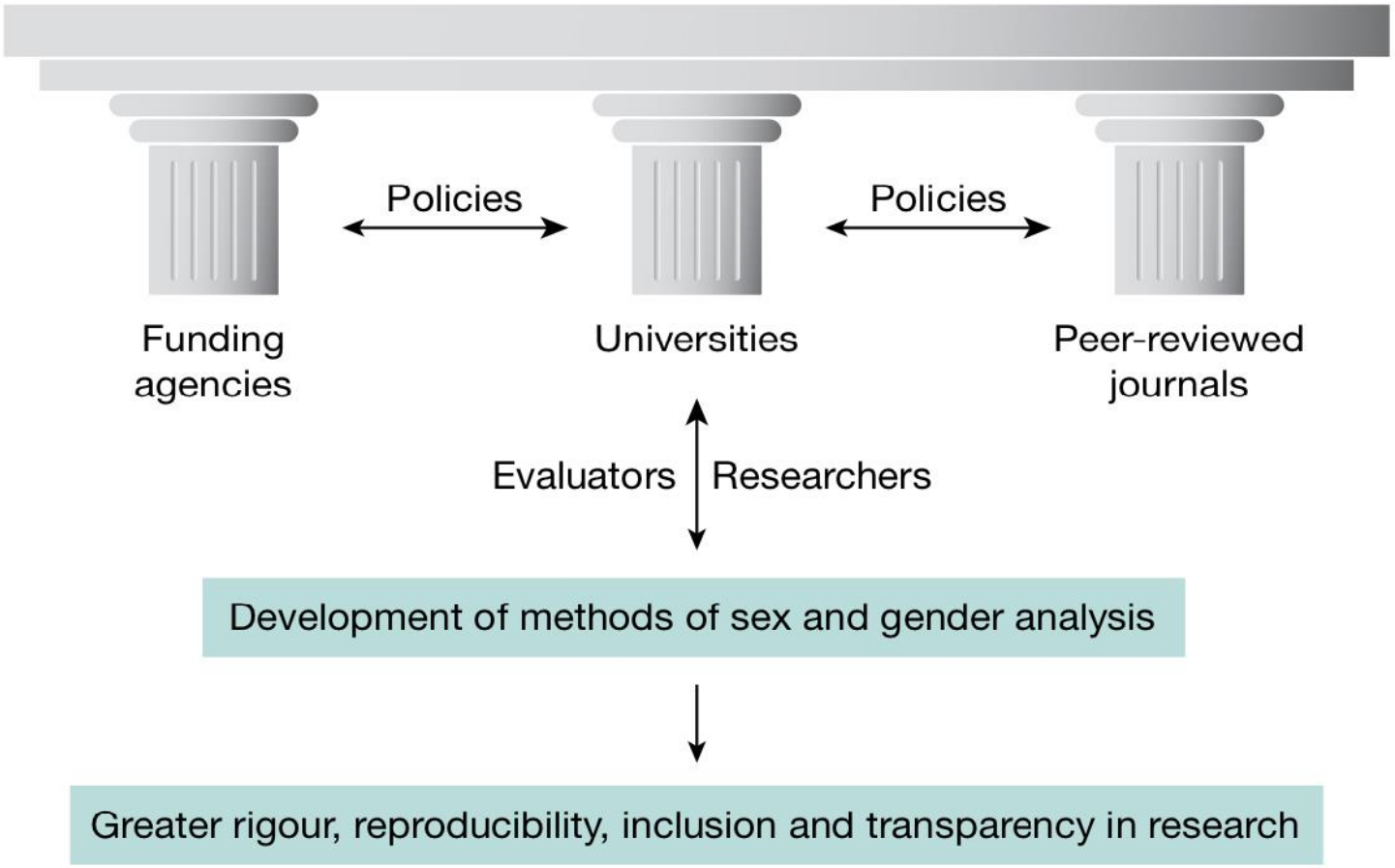
Integrate SG&D Analysis across the Science Infrastructure



The Lancet and ICMJE Guidelines for Authors, December 2016

1. use the terms sex and gender correctly
2. report the sex and/or gender of study participants
3. describe the methods used to determine sex and gender
4. separate reporting of data by factors intersecting with sex, such as age
5. discuss the influence sex and/or gender on your findings
6. discuss limitations of the data

Integrate SG&D Analysis across the Science Infrastructure



Charité University Hospital in Berlin, Germany

- successfully integrated sex and gender analysis throughout all six years of medical training from early basic science to later clinical modules (Ludwig et al., 2015).

Computer Science Curriculum

- Embedded EthiCS, 2017, Barbara Grosz, Harvard. A collaboration between CS and Philosophy. Grosz, B. J., Grant, D. G., Vredenburgh, K., Behrends, J., Hu, L., Simmons, A., & Waldo, J. (2019). Embedded EthiCS: Integrating ethics across CS education. *Communications of the ACM*, *62*(8), 54–61.

- Responsible Computing, 2022, Collaboration between CS and Humanities and Social Sciences. U.S. National Academies of Sciences, Engineering, and Medicine. (2022). *Fostering Responsible Computing Research: Foundations and Practices*. The National Academies Press.

Value Frameworks for remaking the computing research ecosystem:

1. **United Nations' Human Rights** (UN, n.d.): Human rights are rights inherent to all human beings, regardless of race, sex, nationality, ethnicity, language, religion, or any other status. Human rights include the right to life and liberty, freedom from slavery and torture, freedom of opinion and expression, the right to work and education, and many more. These rights, as the UN articulates, apply not only offline but also online.

2. **AI Principles** (e.g., as articulated at the Asilomar Conference, 2017, and endorsed by 5720 signatories) include: safety, responsibility, human values, rights, dignity, and freedoms.

3. **Responsible Computing Research** (U.S. National Academies, 2022). Responsible computing refers to both "intrinsic ethics," including autonomy and freedom, well-being, relational and material equality, justice and legitimate power, collective self-determinism, and thriving natural environment; and "instrumental ethics," including fairness, trust, verifiability, safety, security, transparency, inclusiveness, and diversity.

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