Expert paper

Gender-Responsible Research and Innovation for Small and Medium-Sized Enterprises: Nanotechnology, ICT, and Healthcare

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RESPONSIBLE INNOVATION COMPASS

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Content

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1. Introduction

Governments, universities, and, increasingly, corporations in the US and Western Europe have taken three strategic approaches to gender equality over the past several decades:

1. "Fix the Numbers of Women" focuses on increasing the numbers of women participating in science and engineering.
2. "Fix the Institutions" promotes gender equality in careers through structural change in research organizations, such as dual-career hiring and family-friendly policies.[1]
3. "Fix the Knowledge" or " Gendered Innovations" stimulates excellence in science and technology by integrating sex and gender analysis into research.[2]

This report focuses on this third strategic approach. It's the newest and the most important for the future of science, engineering, and innovation.

2. Why should gender equality be an issue in research and innovation of SMEs?

How can companies harness the creative power of gender analysis for discovery and innovation? Integrating gender and sex analysis into all phases of basic and applied research assures excellence and quality in outcomes. As the former European Commissioner, Márie Geoghegan-Quinn put it, "gender analysis contributes to excellence; it stimulates new knowledge and technologies; opens new niches and opportunities for research teams and results in products and services that all members of society need and demand."[3] In other words, Gendered Innovations stimulate creativity, innovation, and gender equality.

Considering gender and sex adds:

- **value to research** by ensuring excellence and quality in outcomes and enhancing sustainability.
- **value to society** by making research more responsive to social needs.
- **value to business** by developing new ideas, patents, and technology.

Gendered Innovations stimulate gender-responsible science and technology, thereby enhancing the quality of life for both women and men worldwide.

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3. How can SMEs deal with the multiplicity of sex/gender (transgender, intersex people, …)?

Dealing with the multiplicity of the sexes and genders (by Facebooks count there are ~51), requires social science methods aimed at understanding your market. Many companies now collect user data to understand user preferences, patterns of behavior, purchasing choices, etc. Products might be personalized to an individual user's preferences or needs. In this case, their specific attitudes and behaviors will be important, not their social identity, such as transgender, cisgender, etc. If researchers cannot personalize products or services, then they must analyze who their users are and design toward that demographic. Social science methods (data collection and analysis, surveys, focus groups) are useful as is participatory research.[4]

Quick Definition of Terms: Analyzing Gender[5]

Analyzing Gender: Points to Keep in Mind

Gender refers to cultural attitudes and behaviors traditionally ascribed to women and men.

1. Gender consists of:
   a. **Gender Norms** (spoken and unspoken cultural rules in the family, workplace, society, institutional or global culture that influence individual attitudes and behaviors).
   b. **Gender Identity** (how individuals and groups perceive and present themselves in relation to gender norms).
   c. **Gender Relations** (the power relations between individuals of different gender identities).
2. Gender attitudes and behaviors vary by culture, historical era, ethnicity, socioeconomic status, geographic location, and other factors. For example, gender norms may be very different on the US West coast vs. East coast, or in Italy vs. India.
3. It is important to consider factors intersecting with sex and gender (e.g., age, socio-economic status, or ethnicity).
4. There is no necessary relationship between gender characteristics and sex.

Sex = biology (size, weight, genes, hormones, etc.). Sex includes male, female, and intersex (<2% of population). See Method Analyzing Sex.[6]

Gender[7] = culture (gender behaviors and attitudes, such as diet, nutrition, exercise, education, socio-economic standing, religion, occupation, etc.). This may include men, women, and transgender persons. In the US, it is estimated that 0.6% of adults, or 1.4 million people identify as transgender. **Transgender** (vs. cisgender) is defined as a person whose personal identity and gender does not correspond with their birth sex.[8]

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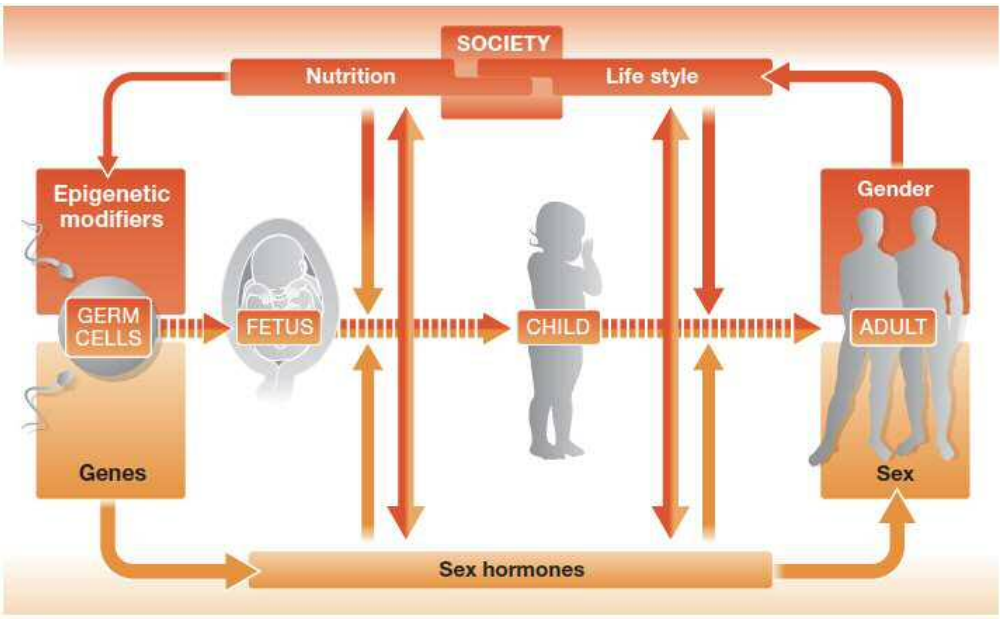
Importantly, **sex and gender interact**[9] throughout the human life cycle. Gender can influence biology. For example, exercise (which differs by gender) can influence bone strength. Biology can influence gender; for example, only women give birth and company policies need to allow for leave policies designed to keep men and women in the workforce during the child bearing and rearing years.



Complex interdependency of sex and gender throughout the human life.[10] *If we take health status, for example, sex influences health by modifying behavior. At the same time, gender behaviors can modify biological factors.*

Analyze but do not overemphasize sex or gender. Men's and women's characteristics overlap. For example, if we look at a simple sex difference such as physical height, we see differences between women and men. However, we also find variation among women—some women are very short, some very tall and even taller than many men. And men also difference from one another. Not all women are the same and not all men are the same. While it is important to analyze sex differences, it is important to consider within-group variation and between-group overlap. This is also true for gender differences.

These bell curves would look different if we adjusted for ethnicity or geographical location.[11] Data for Japan, for example, would differ from data for the US.

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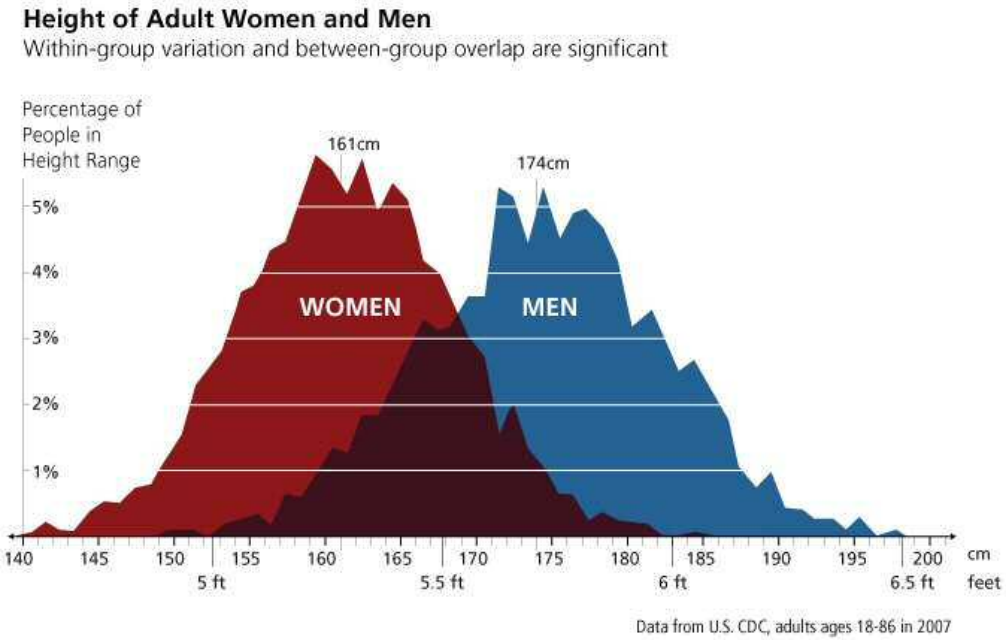
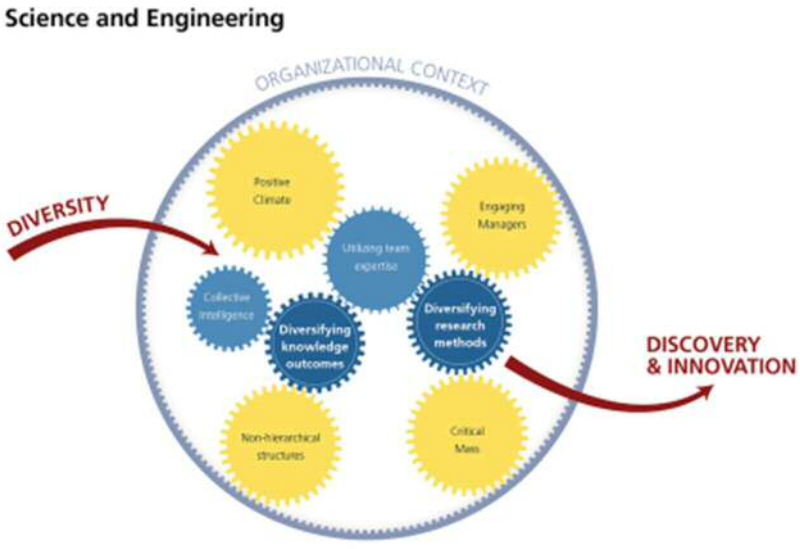


Managing Team Diversity: To manage diversity, managers need to create a positive climate, effectively engage the expertise of each member on the team, create non-hierarchical structures, recruit a critical mass of any social demographic to the team, and diversify research methods—as shown in the chart.[12]

Instead of focusing on "women," or "transgender people," or "men, or "gender-fluid people," it is better to create communication flows, supportive atmospheres, etc., where diverse opinions are valued. Team-members' beliefs about the potential benefits of diversity can be crucial for performance outcomes. A recent study showed that teams briefed on research showing the benefits of diversity in decision making performed better than teams that believed that team homogeneity was important. To make diversity work (no matter who constitutes that diversity) requires motivated team members trained to reap the benefits of diverse viewpoints and perspectives. Active management is important.



Nielsen, M., et al. "Gender diversity leads to better science." *Proceedings of the National Academy of Sciences* 114.8 (2017): 1740-1742.

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4. Why may intersections of sex/gender with other dimensions of difference (such as age and disability) be important in research and innovation?

It is important to analyze sex and gender, but examining how other factors intersect with sex and gender[13] is also necessary. These factors or variables can be biological, socio-cultural, or psychological aspects of users, customers, experimental subjects, or cells. These factors include but are not limited to:

- Genetics
- Age
- Sex Hormones
- Reproductive Status
- Body Composition
- Comorbidities
- Body Size
- Disabilities
- Race/Ethnicity
- Nationality
- Geographic Location
- Socioeconomic Status
- Educational Background
- Sexual Orientation
- Religion
- Lifestyle
- Language
- Family Configuration
- Environment

Researchers need to consider the intersection of an individual's social characteristics. For example, I am a woman, white, well educated, over age 60, physically fit, married, live in California, cis-gender, with 2 genetic abnormalities that impact my health, etc. When considering a product or process, researchers need to define their market. Who exactly are they designing for? To design for "women" is too vague. As the chart on physical height (above) shows, women come in all sizes and shapes, and many of them are the same size and shape overall as men. Researchers need to develop tools to understand their target clients. Surveys, interviews, focus groups are useful, depending on the product. For physiological-based products, sex, age, hormonal status, BMI, etc. is important.

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5. How can SMEs implement a (simple and affordable) routine of a sex/gender analysis in order to foster the internal gender competence of the experts involved?

It is crucially important to consider sex and gender from the very beginning. One should not simply develop a product, discover gender bias, and iterate. Some companies claim that they develop quickly and then iterate often. However, not analyzing sex/gender in the discovery phase means that you potentially make a costly mistake (similar to Apple's Healthkit—see below) or that your company does not see anything unique related to gender. You may be leaving value on the table. For example, some researchers use only female stem cells (simply because of unconscious bias—see below). This means that researchers cannot detect anything unique to male stem cells. Nor can they detect important differences in function between male and female cells.

The Gendered Innovations project: 1) develops state-of-the-art methods of sex and gender analysis; and 2) provides case studies to provide concrete examples of how gender analysis leads to discovery and innovation. Methods and examples can be conveyed to employees by offering seed grants or incentives for integrating gender and sex analysis into their R&D. Staff should apply for incentives in a competitive fashion. In order to apply, they will be required to attend an information session. This session may consist of a presentation on Gendered Innovations—examples and methods (30 minutes). A coffee break for informal discussion (15 minutes). Then staff breaks down into working groups to discuss how gender or sex analysis applies to their research/product (30 minutes). Staff return to the plenary and each group reports out on their findings (45 minutes). This format works extremely well and can be accomplished in about two hours.

Staff receiving incentives can have lunch-time seminars several times a year to exchange information. An annual forum to exchange best practices can be very interesting.

6. How can SMEs deal with different forms of resistance concerning gender issues in research and innovation?

The seed grants and supporting collaborative work described above avoid resistance. Employees are invited to participate in a collaborative, somewhat competitive, process supported by top management and offering resources. As we say in the US, we use the carrot (a reward) and not the stick (a punishment). I have done these workshop in many contexts (university science and engineering schools, granting agencies, etc.). They are short and fun. You need a presenter who sets the tone—using data and humor. Upper management can set a positive tone.

Management could also offer a bonus or prize for the best execution. We are considering offering a Gendered Innovations prize internationally.

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7. Examples and methods[14] for effective R&D.

For a quick overview, watch our three-minute video: Gendered Innovations in Design[15]

A. Method: Analyzing Sex[16]

Example 1: Developing Seat Belts for Pregnant Women—An Overlooked Market

Where sex matters, it is important to define the population for which a product is being produced. For seatbelts, for example, need to work for everyone. It's important that all automobile passengers are safe.

Matt Reed's http://humanshape.org/AdultShape/ models sex, age, and weight.[17] Drivers shrink in height (for the same weight) as they age. Obese drivers tend to slip under the steering wheel in automobile crashes.

Two aspects of sex differences still need to be taken into account. Women have breasts, which determine the fit of the belt. More importantly, many women become pregnant. Gendered innovations have led to the development of pregnant crash test dummies that enhance safety in automobile testing and design.[18] Yet, there is still room for innovations: Conventional seatbelts do not fit pregnant women properly, and motor vehicle crashes are a leading cause of fetal death related to maternal trauma. Automobile designers need to develop a seat belt for pregnant women.

Example 2: Tech Wearables

A tech company is planning to design a wearable to detect early signs of heart disease for hospital use. They have not considered sex differences. Because men and (younger) women have different patterns of heart disease, they will miss half their market.

Underlying pathophysiology may differ between women and men.[19]

Analyzing Sex and Gender in each step of the research process:

- Rethinking Research Priorities and Outcomes
- Rethinking Concepts and Theories
- Formulating Research Questions
- Analyzing Sex
- Analyzing Gender
- Analyzing how Sex and Gender Interact
- Analyzing Factors Intersecting with Sex and Gender
- Engineering Innovation Processes
- Designing Health & Biomedical Research
- Participatory Research and Design
- Rethinking Standards and Reference Models
- Rethinking Language and Visual Representations

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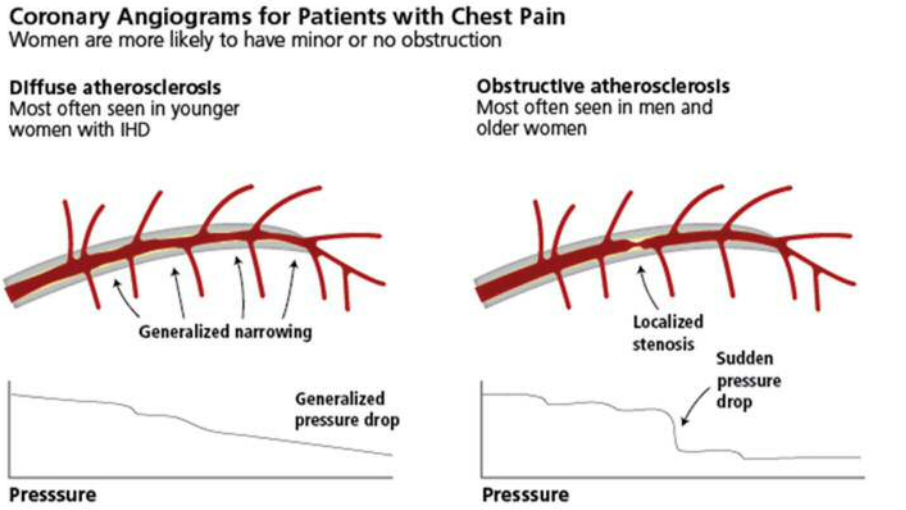

Adapted with permission from (K. Lance Gould, 1999).

Recognizing that men and women have different patterns of heart disease can enhance the usability and uptake of the device.

Example 3. Stem cell Therapies[20]

There are many reasons why drugs fail—and fail more often for women. One reason is that most research is done in males whether human, animal, or cells and tissues, and in many instances sex is not reported. This is R&D wasted.

Consider stem cells. Why might the sex of the cell be relevant? Research shows that there are sex differences in the therapeutic capacity of stem cells. For example, stem cells taken from muscle tissue indicates that female cells are more regenerative than male cells. Yet, very few researchers consider the sex of the cell—which can lead to failed research. An international research team from Norway and Australia worked with stem cells in mice. They appropriately used male and female mice (using both animals in basic research is excellent design). But they used all female stem cells—which was an unconscious and arbitrary decision.

It means that in the discovery phase, they did not see anything unique to male stem cells. Nor did they detect important differences in function between male and female cells.

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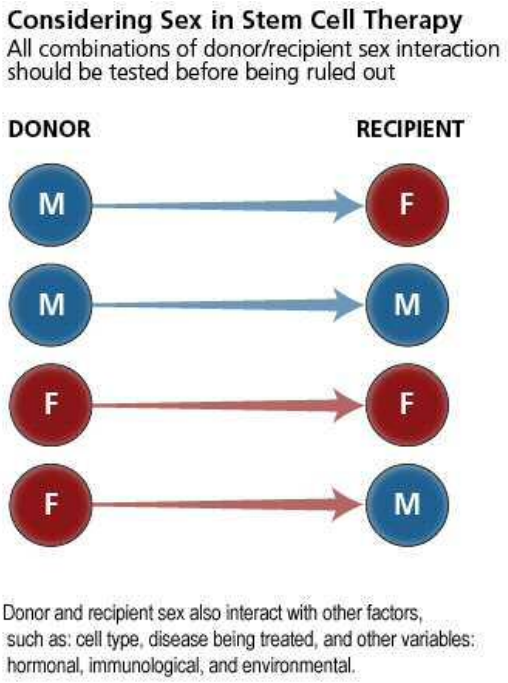

The result of not considering the sex of the stem cells was that their male mice died—and they didn't know why. They thought maybe the postdoc made a mistake. Eventually, through a Gendered Innovations workshop in Norway, the team realized they should also consider the sex of the stem cells. They found that sex-matching of donor and recipient yielded the best results. But all combinations of donor/recipient interaction should be tested before being ruled out.

But, of course, it's never that easy. Analyzing sex needs to be combined with analyzing factors intersecting with sex. In the case of stem cells these factors may include cell type, disease being treated and other variables: hormonal, immunological, and environmental.

Example 4: Nanotechnology

Nanotechnology is a vital area—one in which we have not done a peer-reviewed case study. Let me make a few observations. Considering gender in relation to nanotechnology, we might point to the many applications of nanotechnology and nanomaterials in cosmetic products including moisturizers, hair care products, makeup, and sunscreen.[21] Needless to say, women use these products more than men.

Analyzing sex (or biological outcomes), we might consider in utero exposure to chemicals, such as silver nano, which accounts for about 12% of all nanoparticles used in cosmetics. Absorbed through the skin, such chemicals may act as endocrine disruptors or toxins. Risk assessment should be heightened, especially for pre- and post-natal toxicity for infants.

B. Method: Analyzing Gender[22]

Example 1. Analyzing Gender in Animal Research[23]

Sex must be taken into account, but this time it's not the sex of the animal, but the sex of the researcher. It's called the "male-observer" effect. The method is analyzing gender relations[24]—or, in this case, how organism of different sexes interact. This example focuses on pain research. Importantly, experimenter sex may be a confounding variable in rodent research where stress is a significant factor. Sorge et al.—a lab at McGill—study pain by inducing pain in rats and mice.[25] What they found was amazing. They found that rats and mice demonstrated a reduced pain response in the presence of a male experimenter, as compared with an empty room, whereas the presence of a female experimenter produced no differential response. Both male and female rodents showed this response. The researchers identified this as the "'male-observer' effect." The animals smell male pheromones—and don't show their pain. According to Jeff Mogil (whose lab this comes out of), this phenomenon may throw into question all prior results from pain research.

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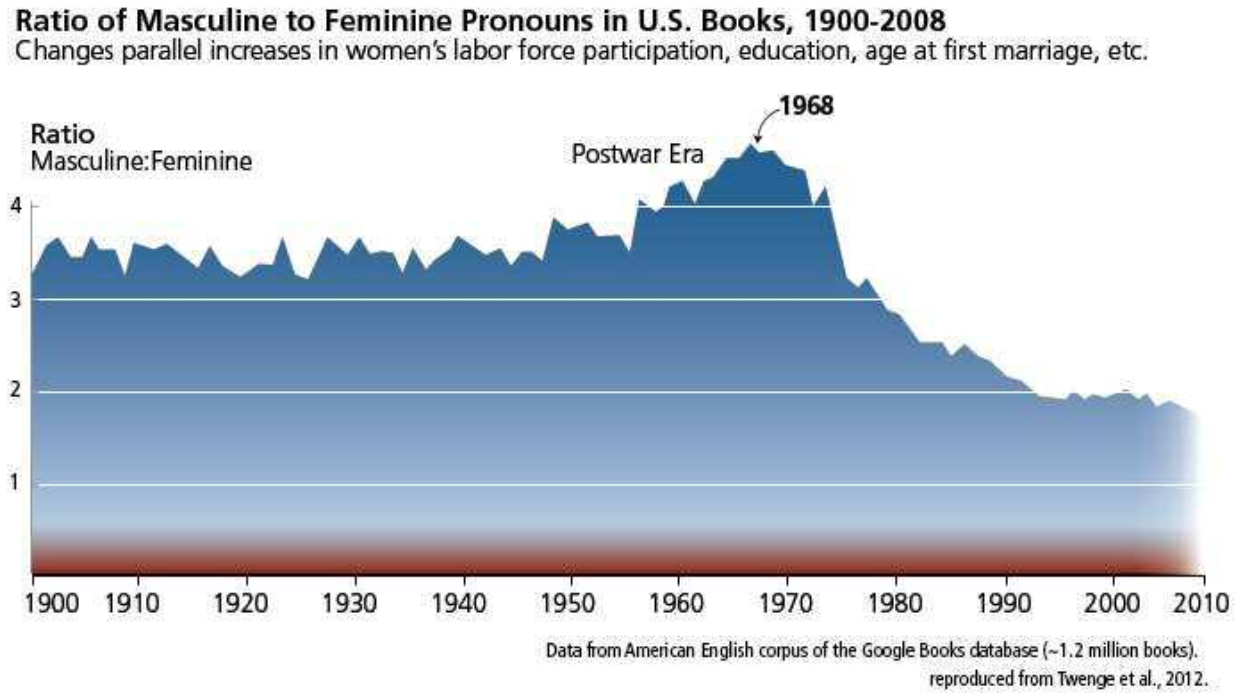
Example 2: Machine Translation (Natural Language Processing)[26]

Gender is a primary linguistic, cognitive, and analytical category. Yet gender assumptions often go unquestioned and hence remain invisible to scientific communities.

Take for example, Google Translate (or Systran). A couple of years ago I was in Madrid and interviewed by some Spanish newspapers. When I returned home, I put the articles through Google translate and was shocked that I was referred to repeatedly as "he." Londa Schiebinger, "he said," "he wrote," and, occasionally, "it thought." Google Translate has a male default.

How can such a cool company as Google make such a fundamental error?

Google Translate defaults to the masculine pronoun because "he said" is more commonly found on the web than "she said." The method or tool of analysis in this example is *Analyzing Gender*. We know from NGram (another Google product) that the ratio of "he said" to "she said" has fallen dramatically from a peak of 4:1 in the 1960s to 2:1 since 2000. This parallels exactly the women's movement and robust governmental funding to increase the numbers of women in science. With one algorithm, Google wiped out forty years of revolution in language **and** they didn't mean to. This is unconscious gender bias.



The fix? A couple of years ago the Gendered Innovations project held a workshop where we invited two natural language processing experts, one from Stanford and one from Google. They listened for about twenty minutes, they got it, and they said, "we can fix that!"

Fixing it is great, but constantly retrofitting for women is not the best road forward. Some products can be fixed, but what if Apple, Google, and other companies started product development research by incorporating gender analysis? What innovative new technologies, software, and systems could be conceived?

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The point I want to make is that this unconscious gender bias from the past amplifies gender inequality in the future. When trained on historical data (as Google Translate is), the system inherits bias (including gender bias). It turns out that even though Google wanted to fix the problem, they have been unable to. It is often harder to fix something once the basic platform is set. Importantly, Google translate is creating the future (technology, i.e., our devices, programs, and processes shape human attitudes, behaviors, and culture). In other words, past bias is perpetuated into the future, even when governments, universities, and companies themselves have implemented policies to foster equality. So the big question is: how can humans intervene in automated processes to create the society we want?

Analyzing ethnicity

Software engineers are now offering many examples similar to the Google Translate problem. Nikon, for example, developed a camera software to not take pictures when a person blinks. The software misread images of Asian people as blinking.

Solutions

Numerous solutions to these problems are developing.

1. Hard debiasing. In "Removing Gender Bias from Algorithms", a Microsoft Research team discusses their methods: Google developed Word2Vec to look for patterns of how words appear together. This is important for machine translation, for example.[27] Simple vector algebra returns various relationships. Man: king; woman: queen. It also, of course, returns traditional gender roles: father: doctor; mother; nurse. Man: computer programmer; woman: homemaker. A team at BU and Microsoft Research call it "hard de-biasing."

Step 1. The team search for gender bias in vector space.

Step 2. They used Amazon's Mechanical Turk to ask if the analogy was biased or not. If half the Turks thought so, the pair was considered sexist.

Step 3. The team compiled a comprehensive list of gender-biased word pairs.

Step 4. The team removed from vector space the biased warping. Sexism can be thought of as a kind of warping of vector space. The solution is to apply the opposite warp in a way that preserves the overall structure of the space. Other solutions are being developed by Professor Cynthia Dwork at Harvard University.[28]

C. Method: Analyzing How Sex and Gender Interact[29]

Example: Assistive Technologies for the Elderly[30]

"Sex" and "gender" are distinguished for analytical purposes. In reality, sex and gender interact to form individual bodies, cognitive abilities, and disease patterns, for example. Sex and gender also interact to shape the ways engineers design objects, buildings, cities, and infrastructures. And, sex and gender intersect in important ways with a variety of other social factors, including age, educational background, socioeconomic status, ethnicity, geographical location, etc.

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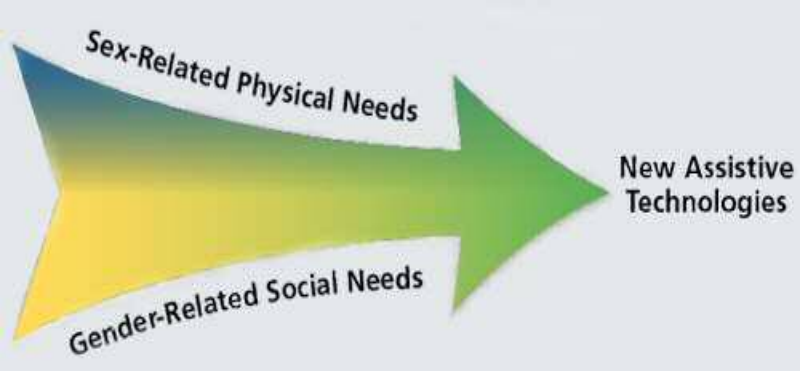
Take the example of Assistive Technologies for the Elderly. The world population will age dramatically by 2050. Large elderly populations will place a growing strain on human caregivers, health, and social systems. This example looks at the "value added" of considering both sex and gender when designing assistive technologies.

Assistive technologies support independent living for the elderly. When developing these technologies, it's important to look at *sex* differences. Women, for example, tend to live longer, but may have more debilitating diseases than men; men, for example, may lose their hearing early. In addition, it is also important to look at *gender* differences: As they age, women and men have different partnering patterns (elderly women more often live alone), men and women have different experience in household management, and elderly men and women have different receptivity to technology. Researchers who analyze how sex and gender interact in individual women and men will design the most effective and marketable products.



Gender issues become particularly important as assistive technologies become more personalized. Engineers in the U.S., Europe, and Japan are developing robots for elderly people. Georgia Tech, for example, has created a robotic nurse, named "Cody" that can bathe elderly people. Bathing is an intimate relationship that requires careful thought—for women and for men. Carnegie Mellon is developing HERB (Home Exploring Robot Butler) that can fetch household items for you, remind you to take your medicine, or even clean up the kitchen.

As these robots enter our lives, we humans will gender them. Studies of machine voices—synthetic or machine-generated voices—show that human listeners assign gender to machine voices; that is to say, we interpret these machine-generated voices as the voice of a woman or a man, even when designers have tried to create a gender-neutral voice. As soon as humans interpret a voice as masculine or feminine, we tend to overlay our cultural stereotypes onto the machine.

Considering sex and gender when designing new assistive technologies will be one important factor to ensure that products embody non-stereotypical and forwarding-looking notions of gender.

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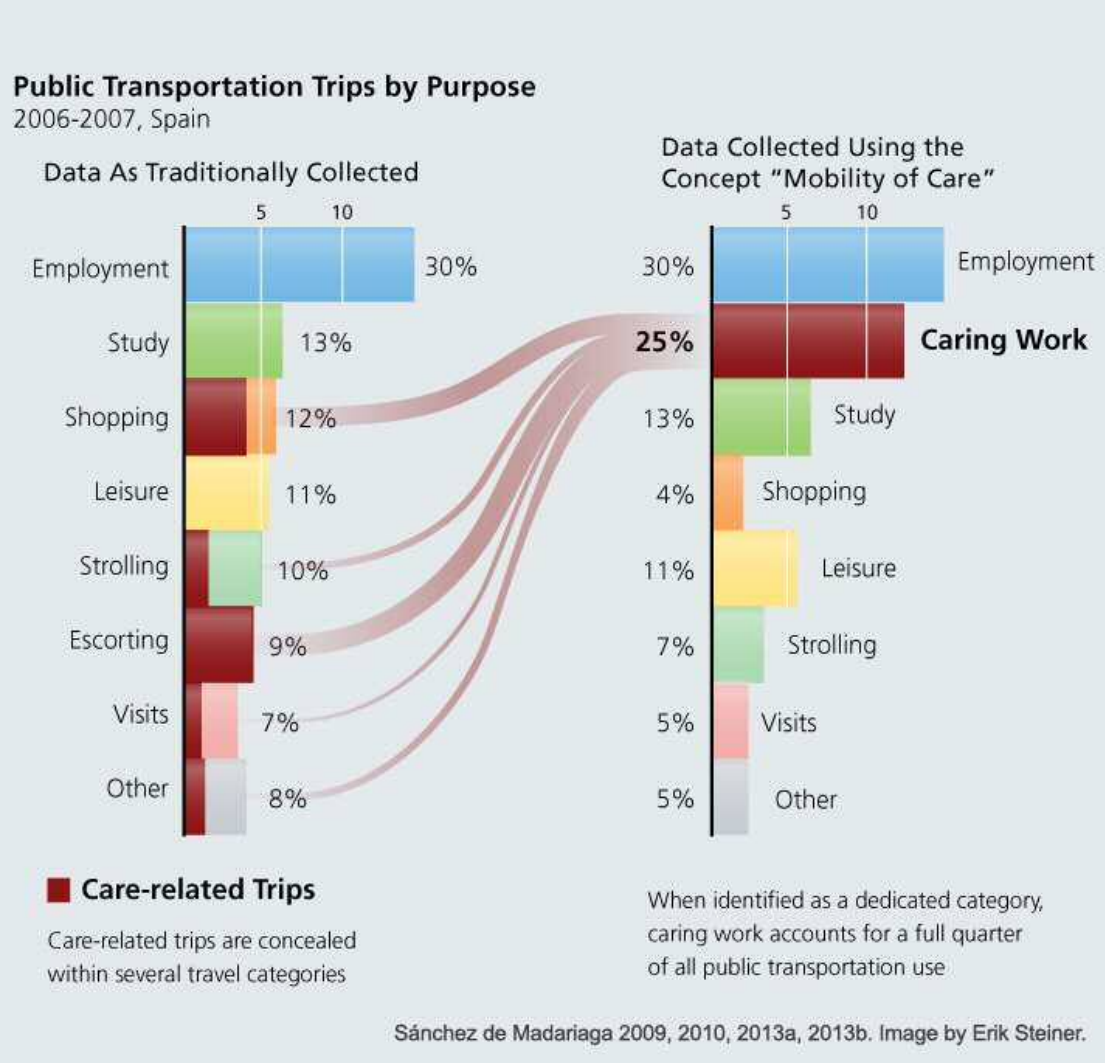
D. Method: Rethinking Concepts[31]

Example: Big Data

Basic concepts can embed unconscious gender bias. Basic concepts often need to be reconsidered. For big data, concepts relate to how data are described and interpreted, including how particular phenomena are categorized.

In this example, we look at public transport systems.[32] Governments and civil engineers collect data to understand how people use trains, subways, and bus systems. The gendered innovation in this case study is reconceptualizing how data are collected.

Traditionally, governments collect data in eight trip categories: employment, education, shopping, leisure, and the like (see image left). People who travel solely for employment tend to travel directly from home to work and back again.



The chart on the right (above) shows what happens if you conceptualize "caring work" as a category in data collection. It becomes the second largest, and one that needs to be considered when designing travel routes.

None of these traditional trip categories captures caring work—caring for children, the elderly, or households.

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People who travel for employment plus caring work have different travel patterns. They tend to travel from home to daycare and on to work. Leaving work, they may stop at the food market, the dry cleaners, and daycare before returning home.

Conceptualizing the "mobility of care" as a category of analysis creates more efficient transportation systems, reducing costs and enhancing the quality of life.[33]

E. Analyzing Sex, Analyzing Factors Intersecting with Sex and Gender, Rethinking Reference Models

***Example:* *Osteoporosis Research in Men*[34]**

Methods often combine when approaching R&D. This example uses the three methods listed above.

Analyzing Sex: Osteoporosis has long been defined as a disease primarily of post-menopausal women. As men live longer, they too suffer from the disease. Men over age seventy five account for a third of hip fractures—and when men break their hips, they die more often than women. Because screening, diagnosis, and treatment were developed using a female norm, appropriate diagnosis and treatments for men lag behind.

Despite the relatively high numbers of men who suffer from osteoporosis, the basic diagnostics for the disease were developed using young, white women (aged 20-29 years). An important method here is *Rethinking Reference Models*.[35] The gendered innovation in this particular case study came in 1997 when a reference population of young men was established to diagnosis osteoporosis in men. Although reference populations for men have been developed, disease in men is still identified using the female diagnostic cut-off. It remains unclear whether this cut-off applies to men or not.

The discerning reader will have zeroed in on the fact that reference populations discussed above are white. The method *Analyzing Factors Intersecting with Sex and Gender*, pushes researchers to look beyond sex and gender to consider differences among men with different life styles. Bones respond to biological preconditions and also to lifestyle (diet, smoking, exercise). Lifestyles can differ dramatically across cultures, ethnicities, and socio-economic class. Current studies analyzing cohorts of men from the U.S. and Denmark, for example, are presumably looking at "white men." Researchers have found, however, that widely used BMD reference values for white U.S. men have proven inappropriate for white Danish men. Differences in diet and exercise (commuting by car vs. bicycle, for example) can influence bone development and durability across cultures. The goal is to maintain healthy bones in diverse populations.

While it is important to analyze sex and gender, and how they interact, other factors also intersect with sex and gender. This method applies to nearly every research project—and it is often a game changer. As we have seen in this example, intersecting factors, such as ethnicity or socioeconomic background, may reveal sub-group differences among women and among men that are obscured by analyzing only gender or only sex.

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F. Method: Participatory Research[36]

Example: Water Infrastructure[37]

Nearly one billion people worldwide lack reliable access to water. In sub-Saharan Africa, women and girls spend some 40 billion hours annually carrying water.

Gendered Innovation through Participatory Research:

Here the gendered innovation is tapping into this local knowledge. Because carrying water is women's work, many women have detailed knowledge of soils and the water they yield—knowledge that is vital to civil engineers when placing wells and water taps. Below we see a woman in Ghana mapping well sites. Such community participation vastly improves water services.

A woman in the Volta region of Southeast Ghana mapping well sites. Image courtesy of the Afram Plains Development Organisation (APDO) and water.org

G. A cautionary tale: Sex or gender may not be the most important factor to consider

Example: Overemphasizing sex differences can be a problem[38]

When considering sex or gender, it is important not to "pink and shrink it," i.e., design toward stereotypes. Here our Engineering Checklist[39] is helpful.

While analyzing sex differences is important, overemphasizing sex to the exclusion of other intersecting factors can lead to problematic outcomes.

In 2007, an estimated 500,000 total knee arthroplasty (TKA) procedures were performed worldwide—about two-thirds in women.

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In the 1990s, with increased attention to women's health research, manufacturers began producing “gender-specific” knees, and marketing them directly to women. Does this lead to better healthcare quality?

Sex may appear to be the most important variable in choosing a knee implant until height is considered. Specifically, research shows that two anatomical sex differences (greater Q-angle and lesser anterior condylar height in women) disappear when corrected for standing height. This suggests that height may be more important than sex in determining the knee implant a patient should receive.

It is important to analyze sex differences before ruling them out. Many additional factors, however, influence outcomes in TKA, including age, body composition, comorbidities, preoperative knee mobility, ethnicity, and surgeon or hospital volume.

8. What are the costs of ignoring sex and gender during research and innovation processes in SMEs?

Doing research wrong costs lives and money, and may result in missed market opportunities.

Drug Development. Between 1997 and 2000, ten drugs were recently withdrawn from the US market because of life-threatening health effects; eight of these posed greater threats for women.[40] Not only did these drugs cost billions to develop—but when they fail, they cause death and human suffering.

Health Apps. When Apple released its health app, HealthKit, in 2014, the app tracked lots of things: blood pressure, steps taken, daily calories, blood alcohol content, percent body fat, respiratory rate, intake of sodium, magnesium, calcium, fiber, iodine, chromium, etc.[41] But what didn’t it track? Women’s menstrual cycles. Apple missed half of its market. Apple fixed and released the app in 2015. But what was the cost in terms of profit, poor publicity, and team morale?

Automobile Design. Considering short people (many women, but also men of shorter stature, such as Asian men) “out-of-position” drivers leads to greater injury in automobile accident.[42]

City Planning. In city planning, not collecting data on caregiving work leads to inefficient transportation systems.[43]

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9. What are the benefits of gender/sex analysis for SMEs?

Doing research right saves lives and money.

Health care. An analysis of the US Women's Health Initiative Hormone Therapy Trial—a large, government-funded trial done in the 1990s—found that each $1 spent on research, returned $140 to US taxpayers in health care savings. This research also saved lives: There were 76,000 fewer cases of cardiovascular disease, 126,000 fewer breast cancers, and 145,000 more quality-adjusted life years. While most of the results were positive, the analysis did find 263,000 more osteoporotic fractures.[44]

Diversity in teams plus gender analysis leads to innovation. Under the right conditions, teams may benefit from various types of diversity, including scientific discipline, work experience, gender, ethnicity, and nationality. Diverse groups exchange a wider range of information given differences in background and perspectives. Encouraging greater diversity allows scientific organizations to derive an "innovation dividend"; diverse teams are more creative and open the door to new discoveries.[45]

10. Conclusion

Gendered Innovations add value to research and engineering by ensuring excellence and quality in outcomes and enhancing sustainability. Sex and gender analysis add value to society by making research more responsive to social needs, and they add value to business by developing new ideas, patents, and technology. The goal is to stimulate gender-responsible science and technology, thereby enhancing the quality of life for both women and men worldwide. Can we afford to ignore such opportunities?

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