Gendered Innovations Exercise

Booklet of Case Studies

GenderEX School 2022

GENDEREX
GENDER FOR EXCELLENCE IN RESEARCH
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HOW TO INTEGRATE SEX AND GENDER ANALYSIS INTO RESEARCH

What are Gendered Innovations?

The current structure of research models risks not being bias-neutral concerning sex, gender, ethnicity, or disability and prevents innovations from scrutinizing the differences that characterize individuals. Gender bias in research hampers the results' quality, excellence, and creativity and the number of individuals to whom innovations are targeted.
"Gendered Innovations" refers to the process of introducing an analysis of the relevance of sexual and gender differences into all stages of research to ensure the quality of the results. The idea of gender innovations is to challenge research methods by harnessing sex and gender as a resource for creating new knowledge and achieving excellence in science. Gender analysis stimulates the creation of innovative learning and technologies, opens up new opportunities for research teams, and produces usable services for all members of society. In general, gender innovations improve excellence in science, medicine and engineering, social sciences and humanities, multiply the possibilities of science and technology to improve the lives of individuals, and create theoretical models that more closely match empirical reality.

The booklet

This booklet contains 10 case studies investigating how gender analysis improves and enhances knowledge and technology design. These case studies offer new insights related to science, engineering and technology development, environmental issues, design, economics, medicine, and politics. The case studies that have been collected come from 4 different sources:

- **GENDERED INNOVATIONS:** How Inclusive Analysis Contributes to Research
- **GENDERED INNOVATIONS 2:** How Inclusive Analysis Contributes to Research and Innovation
- **Gendered Innovations** in Science Health & Medicine Engineering and Environment
- **What is the gender dimension in research?** Case studies in interdisciplinary research

Gendered Innovations Exercise

Along with your group, please select one case study that you found particularly interesting. Discuss your selection on day 1, addressing the following questions: what was the problem? What methods were used? What were the main findings? Why did you find it interesting?
Prepare a short 5-minute presentation for the rest of the class (presentations will be on the second day).

Alternatively, you can propose a case study not contained in this list that is of particular interest to you (by following the link to the above sources, you can find many more examples to take inspiration from).

List of case studies:

PRESCRIPTION DRUGS: ANALYSING SEX AND GENDER

European Commission 2020. *GENDERED INNOVATIONS 2: How Inclusive Analysis Contributes to Research and Innovation.* Directorate-General for Research and Innovation

The challenge

Historically, drug development has followed a 'one size fits all' model. Drug testing has been conducted predominantly on males, from pre-clinical research in rodents to clinical trials that include few women (Mazure and Jones, 2015). As a result, women report more unwanted, and sometimes deadly, side effects than men. In the late 1990s, 10 drugs were withdrawn from US markets. Of these, eight showed greater health risks for women (US General Accounting Office, 2001).

Gendered innovation: Including females and males in all stages of drug development

Female and male bodies metabolise drugs differently. For example, female bodies tend to take longer to digest food and to expel waste through their kidneys. Female and male livers process proteins and other molecules at different speeds (Franconi and Campesi, 2014). Because female-typical and male-typical bodies process drugs at different speeds, people with female-typical bodies may be at higher risk of side effects and overdose than people with male-typical bodies (Freire et al., 2011). In a recently published study, researchers reported that 76 out of the 86 drugs investigated displayed higher concentrations in female-typical bodies (Zucker and Prendergast, 2020). This was not explained by differences in body size but seems to relate to complex physiological differences. The two main types of medications are small molecules (that bind to receptors in the body) and biologics (proteins, antibodies and other substances already found in humans). Small molecules may have sex-specific pharmacokinetics (how the body metabolised the drug) and pharmacodynamics (how the drug affects the body; see Figure 1). Female-typical bodies and male-typical bodies may also respond differently to biologics, since the production and function of immune cells and antibodies can be affected by an individual's sex chromosomes and levels of oestrogens and androgens.

Women tend to have a smaller body size and more fat tissue than men, which affects drug distribution, as well as smaller kidneys, which leads to slower drug elimination. Liver enzymes may behave differently because of oral contraception and some hormone therapy. Women's heart rhythms are different from men's (longer QT interval), which makes women more susceptible to fatal heart disturbances, called arrhythmias.

If female cells and animals are not included in the early phases of drug development, sex-specific differences in efficacy and toxicity will not be detected. And, if women are not included in clinical trials, the real-world effects of a medicine will not be detected before it is released to the market.

Recognising these problems, the United States created the Food and Drug Administration Office of Women's Health (FDA-OWH) in 1994 to advocate women's inclusion in clinical trials (Obias-Manno et al., 2007). The 1993 US

Women tend to have smaller body size and more fat tissue than men, which affects drug distribution, and smaller kidneys, which leads to slower drug elimination. Liver enzymes may behave differently because of oral contraception and some hormone therapy. Women's heart rhythms are different from men's (longer QT interval), which makes women more susceptible to fatal heart disturbances, called arrhythmias. © Sabine Oertelt-Prigione.

NIH Revitalization Act also mandates the inclusion of women and minorities in clinical trials (Mastroianni et al., 1994). Despite these important steps, female cells, animals and human participants are still not properly included in all stages of the drug development process. The British Journal of Pharmacology recommends that all future studies either include both sexes in the experimental design or explain why researchers believe sex and gender are not relevant (Docherty et al., 2019). Other journals and funding agencies have developed similar policies to promote sex analysis in drug development (Schiebinger et al., 2011–020).

 # Method: analysing sex in tissues and cells

Female and male cells are affected by their sex chromosomes and by the hormonal influences in their environment. Furthermore, certain types of cells, e.g. liver cells, produce different amounts of metabolic enzymes. If sex differences are not taken into account, experimental results will probably be irreproducible. Analysing the cell response to medication in a sex-specific manner can offer early indications of potential differences that should influence the drug development process (Docherty et al., 2019).

Conclusions

Addressing sex and gender in drug prescribing can start with relatively simple yet powerful steps, from including female and male cells, tissues and organisms throughout the testing process to reporting all data disaggregated by sex. These approaches will provide the knowledge needed to develop sex-specific dose adaptations of existing drugs, such as desmopressin or zolpidem, and may lead to sex-specific treatments in the future. Physicians, pharmacists and patients should consider gender differences in how symptoms are experienced and expressed. What is reported and how it is reported affect which diagnostic steps occur and which medications are prescribed.

>> Next Steps

Accelerating these developments needs the following steps.:

1. Regulatory agencies should require (not simply recommend) sex-disaggregated reporting of all drug trial results by the pharmaceutical industry. Regulatory agencies should also ensure that sex-specific information is available to prescribers and patients on websites and drug labels.
2. Post-marketing surveillance studies should aim to detect sex-specific side effects and differences in response. Many pharmaceuticals currently on the market were tested and approved in years when women were excluded from clinical trials. Post-marketing surveillance is the only way to obtain data on sex differences in efficacy and toxicity in these drugs.
3. Researchers and physicians should further investigate gendered norms, identity and relations in medical communication and prescription outcomes.

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THE IMPACT OF SEX AND GENDER IN THE COVID-19 PANDEMIC

European Commission 2020. *GENDERED INNOVATIONS 2: How Inclusive Analysis Contributes to Research and Innovation.* Directorate-General for Research and Innovation

The challenge

Although infectious diseases can affect everyone, sex and gender can significantly impact immune responses and the course of the disease in the human body. Importantly, the biological impacts of the pandemic intersect with broader social and systemic challenges, such as limited healthcare, and economic and logistic resources. In the case of COVID-19, current worldwide statistics show more men than women dying of acute infection (GlobalHealth5050, 2020), while women are projected to suffer more than men from the health, economic and social consequences of the pandemic in the long term. Innovative solutions beyond health, such as economic re-entry strategies, product development and AI solutions, also need to consider sex and gender.

SEX refers to biological attributes that distinguish female, male, and/or intersex according to functions that derive from the chromosomal complement, reproductive organs, or specific hormones or environmental factors that affect the expression of phenotypic traits in sexually reproducing organisms

GENDER refers to sociocultural norms, identities and relations that shape behaviours, products, technologies, environments, and knowledges. Gender attitudes and behaviours are complex, changing across time, with education, age and socioeconomic status, and are specific to cultures, religions, ethnicities, and infrastructures

Definitions of terms: Sex & Gender, 2020.

Gendered innovation: Focusing on dosing and sex-specific side effects of vaccines and therapeutics

Women appear to experience a higher overall incidence of medication side effects than men. This might be related to biological differences, differences in therapeutic choices or differences in reporting. Potential sex differences in response to and the efficacy of novel therapies and vaccines need to be taken into account (Tannenbaum et al., 2017).

Different doses of vaccine may be needed for females and males, and side effects may occur at different rates. For example, females are at higher risk of developing irregularities in heart rhythm (QT prolongation) due to physiological differences in the heartbeat. This risk increases with the use of heart medication and many other therapies, such as hydroxychloroquine and azithromycin, currently being tested for use against COVID-19.

In addition, sex-specific issues, such as the provision of potentially life-saving therapies to pregnant women while preventing foetal complications, need to be considered in the design of clinical trials. This is particularly relevant in countries with limited healthcare resources, and where fertility rates might be higher, thus significantly increasing the numbers of potentially pregnant COVID-19 patients.
The Horizon 2020 project Improving the guidelines for informed consent (i-Consent; i-Consent, 2020) investigates the intersection of the gender dimension and ethics in informed consent. It addresses the relationship between ethics and safety when people are participating in clinical trials, including co-decision-making between partners and the impact of self-determination and power (Persampieri, 2019).

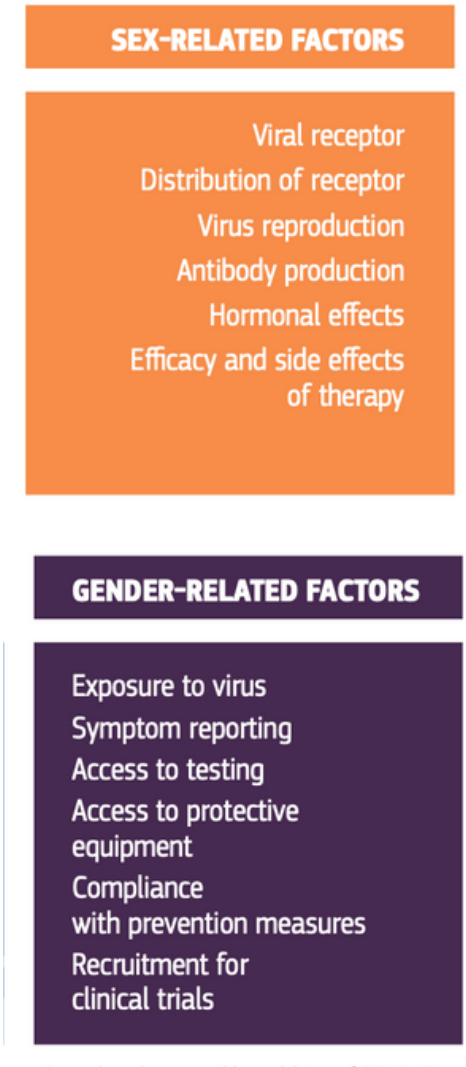
 # Method: analysing sex

All data related to COVID-19 morbidity and mortality should be disaggregated by sex (Wenhamet al., 2020). Females generally respond more intensely to contact with viruses such as SARS-CoV2, including both natural infection and vaccination (Klein and Flanagan, 2016), and the potential impacts of these differences should be considered in:

- identifying and reporting symptoms,
- developing diagnostics and testing,
- validating therapeutics.

All study of COVID-19 needs to integrate sex as a biological variable. This includes using female and male cells and experimental animals in drug discovery and development and in preclinical research, as well as using women and men in clinical trials. Females develop side effects to medications more frequently than males (Obias- Manno et al., 2007), and all drug and vaccine trials for COVID-19 should include sex-specific analyses.

SEX AND GENDER AS POSSIBLE MODULATORS OF COVID-19



Sex and gender as possible modulators of COVID-19.
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Conclusions

The SARS-CoV2/COVID-19 pandemic highlights the urgent need to incorporate sex and gender analysis into research and innovation processes. More men than women appear to die of the disease, but women are more frequently employed in high-risk jobs and disproportionately responsible for caring for those who are unwell. Sex differences in immunology and response to therapies can help elucidate disease-specific pathways, which could benefit everyone. Considering the gender dimensions of the pandemic could help mitigate the acute and long-term inequities that stem from its socioeconomic consequences.

>> Next steps for SARS-CoV2/ COVID-19 national and EU- funded research

Sex as a biological variable needs to be integrated into research on SARS-CoV2 infection patterns, the development of the disease and COVID-19 treatments. COVID-19 pathology demonstrates sex differences
in host susceptibility and clinical course. Including sex analysis in all reporting can offer new insights for the development of targeted therapies.
Sex needs to be recorded in all COVID-19 clinical trials. This should not be limited to balanced participant rates but, most importantly, should include sex-disaggregated reporting of response, side effects, dosage adaptations and long-term effects.
Approaches to prevention should be gender-sensitive to ensure broad adoption. SARS-CoV2 is projected to circulate in the general population for some time, and there is currently uncertainty about the extent
and duration of immunity. Preventative measures, such as hand washing and the mandatory wearing of masks, should be implemented in a gender-sensitive fashion, and personal protective equipment used should be designed for a range of users. The development of digital preventative solutions should focus on gender preferences and barriers. Aspects relating to domestic and gender-based violence have been highlighted in the recent EUvsVirus hackathon and tandem Move It Forward for Women vs. COVID19 hackathon.
The gender dimensions of the outbreak in terms of unemployment, care duties and associated social inequity need to be considered for long-term management of the disease and for economic re-entry strategies. Adequate access to social, economic and health services needs to be ensured for all.

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CLIMATE CHANGE: ANALYZING GENDER, AND FACTORS INTERSECTING WITH GENDER

European Commission 2013. *GENDERED INNOVATIONS: How Inclusive Analysis Contributes to Research*. Directorate-General for Research and Innovation

The challenge

Strategies for managing global warming fall into two broad categories: mitigation and adaptation. This case study focuses on mitigation in industrialized countries because these countries are responsible for the "largest share of historical and current global emissions of greenhouse gases" (United Nations, 2002). Mitigation involves strategies to slow anthropogenic climate change, typically by curbing emissions of greenhouse gases through changes in energy supply, transportation, agriculture, and urban infrastructure, as well as lifestyle (Barker et al., 2007). The European Institute for Gender Equality (EIGE) states that "there is a lack of awareness of [...] the gender aspects of mechanisms to mitigate climate change" as well as "a lack of research to inform debates on these issues" (EIGE, 2012).

Analyzing gender in climate change can support:

- Equality: Environmental legislation, policies, and programs may have different effects on women and men —as well as people of different income levels, ages, and geographic locations (Denton, 2002). Gender analysis can contribute to policies that remedy—or at least do not exacerbate—existing social inequalities.
- Effectiveness: policies and programs aimed at reducing energy consumption are likely to be more effective if gender analysis ensures that they reach both women and men (Alber, 2011).
- Efficiency: All stakeholders (scientists, policy makers, consumers) should be involved in decision-making to help minimize the economic harm and maximize the ecological benefits of mitigation policies (Mearns et al., 2010; O'Neill et al., 2010).

Gendered innovation: Understanding the Importance of Analyzing Gender in Relation to Intersecting Factors

This case study focuses on methodological approaches to gender analysis in climate change. From the start, gender analysis must avoid essentialism and over-emphasizing differences between women and men. Looking at women as an undifferentiated group and opposing this to men as an undifferentiated group (simply disaggregating data by sex) misses important factors influencing behaviours in relation to the environment. These factors include income, age, and geographic location.

 # Method: Analyzing Factors Intersecting with Gender Methodological Issues

Stereotype	Factors to Consider
Men have larger "climate footprints" than women.	Consider the following methodological factors when analyzing automobile-related emissions. 1. Attributing emissions? This may not be straightforward if multiple people (such as families or co-workers) ride together. For example, in private vehicles, women are more likely to be passengers, and men are more likely to be drivers (Ironmonger et al., 2007; Sarmiento, 1996). In this context, attributing all driving-related emissions to drivers might inflate men's apparent emissions. Similarly, women drive more often in support of other family members (children and the elderly) than do men. In this context, attributing all driving-related emissions to drivers might inflate women's apparent emissions. 2. Gender behaviours vs. income? Men do not necessarily have a higher marginal propensity to emit (mpE) than women—that is, men do not necessarily emit more greenhouse gases (GHGs) per unit of earned income. For example, in New Zealand, where data are available, women drive on average 8,000 km/year and men 12,000 km/year (New Zealand Ministry of Transport, 2011). But median incomes are NZD 19,100 for women and 31,500 for men (Statistics New Zealand, 2012). Using a linear model, women drive 0.42 km per NZD of income, whereas men drive 0.38 km per NZD. Therefore, if one considers a woman and man earning the same amount of money (for example, NZD 25,000), a woman would be expected to drive farther than a man: 10,500 km vs. 9,500 km. This disparity is not universal: For example, in Sweden, estimates suggest that men drive farther than women both in an absolute sense and relative to their incomes (Johansson-Stenman, 2001).

Stereotype	Factors to Consider
	3. Distance vs. fuel efficiency? Women and men may, on average, drive cars of differing fuel efficiency, fuel types, and so on. some studies report that women consider fuel efficiency more than do men when evaluating vehicles (Achtnicht, 2012). Other studies find "no statistically significant effects" related to age, gender, or education (Popp et al., 2009). 4. Distance vs. driving conditions? Women and men might, on average, drive under differing conditions (city vs. highway, low vs. high traffic congestion, etc.). Such conditions influence fuel efficiency and complicate the process of converting distance driven into fuel consumed (Barth et al., 2008).
Women care more about the environ-ment than men, and therefore produce lower emissions	Consider the following methodological factors: 1. Differences in attitudes are important, but often small. For example, in a EU-wide study, 69% of women and 67% of men stated that climate change was "a very serious problem." Women (50%) and men (51%) are similarly likely to consider climate change to be among "the most serious problems currently facing the world as a whole" (Eurobarometer, 2009). 2. Income may intersect with gender as a predictor of climate concern (Franzen et al., 2010). 3. Education level and political affiliation may intersect with gender as a predictor of climate attitudes. In the US, where data are available, education and political affiliation interact: among self-identified Democrats, climate concern rises with increasing education; among self-identified Republicans, it declines with education (Hamilton, 2011).

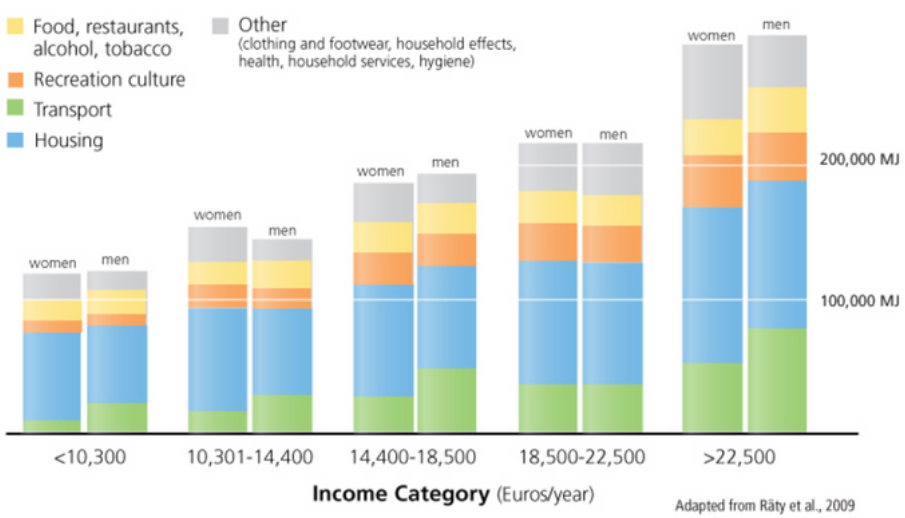
Stereotype	Factors to Consider
Men have more knowledge than women about technical topics, including climate change.	Consider the following methodological issues: 1. Survey design: Survey instruments may affect judgments about women's and men's climate change knowledge. Surveys indicate that women are more likely to report "false positives" (incorrectly believe that a given factor does cause climate change), whereas men are more likely to report "false negatives" (incorrectly believe that a factor does not cause climate change) (O'Connor et al., 1998). 2. Self-reported vs. actual knowledge: In self-report studies, men may assert a greater level of climate knowledge than women (Eurobarometer, 2009). In tests of actual knowledge, results differ, with some studies showing no signifcant difference (McCright, 2010; Sundblad et al., 2007).

Sample Study

The chart below shows differences in energy use between single women and single men in multiple income categories. Single persons were selected to avoid methodological challenges in attributing energy use to a specific individual within a multi-individual household.

These data are:

1. Sex-disaggregated, allowing comparisons between women and men.
2. Income-disaggregated, allowing comparisons between people of different socioeconomic statuses.
3. Disaggregated by specific forms of energy consumption.



Data supporting this type of analysis are rare (EIGE, 2012). In lieu of comprehensive data, figures from Germany are presented. methodological challenges in interpreting available data include:

1. Data do not directly reflect climate impact, as different forms of energy use have different climate impacts per megajoule (MJ) delivered (Granovskii et al., 2007).
2. Data are not necessarily representative of all Germans, as energy use patterns differ between single- and multi-person households (Brounen et al., 2012).
3. Data are likely to be non-representative of Europe as a whole, given that energy use—particularly for transport—differs between European countries (European Environment Agency, 2011).
4. Data do not reflect indirect climate impacts, which are significant for many energy sources. For example, transportation data consider only the direct release of GHGs from combustion engines—not the indirect release of GHGs associated with oil drilling, petroleum refining, fuel transportation, pipeline construction, and other production activities (Charpentier et al., 2009).
5. Data do not necessarily reflect energy usage or climate impact incurred outside Germany itself (Davis et al., 2010; Mahesh et al., 2010).

Data do not reflect climate impact incurred through mechanisms other than GHG emission, including: a) deforestation, which reduces absorbance rates of CO2 in the biosphere (Watson et al., 2000); and b) changes in terrestrial or atmospheric albedo (Piekle et al., 2002).

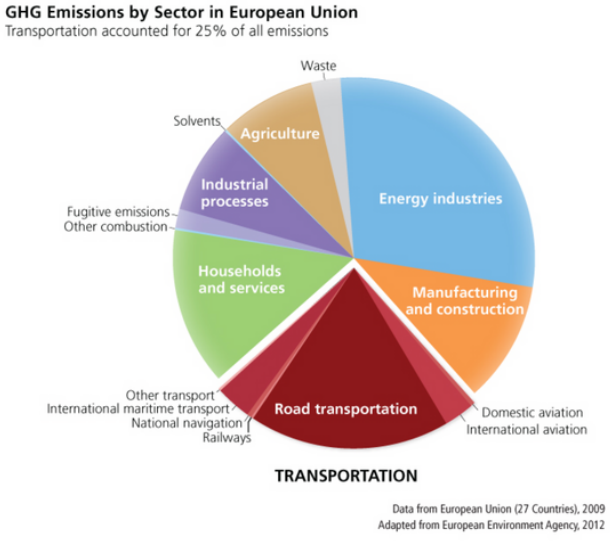
In Germany, single men consume on average 147,000 MJ/year, 37% more than single women's 108,000 MJ/year (not shown in graph above) (Räty et al., 2009). The majority of this difference disappears when data are corrected for income. For example, in the lowest income category, single men consume only 1% more energy than single women (119,601 MJ vs. 118,368 MJ). In the highest income category, single men consume 2% more energy than single women (292,221 MJ vs. 285,234 MJ). Highest-income women consume 141% more energy than lowest-income women; for men, the figure is 144%. Income is therefore an important factor to analyze when looking at women's and men's energy consumption.

We highlight the Räty et al. study because it is one of the few to consider gender behaviours in relation to other social factors. Looking at single women and men, however, does not take into consideration asymmetries in family relations: Women more often than men care for dependents (children and the elderly). An ideal study would compare women and men, controlling for all other relevant factors, including age, socioeconomic status, education, partnering status, household configuration (number of children and other dependents), geographic location (including density of settlement), and types of available transport. Occupation, age, geographic location, and household composition have all been shown to correlate with transport-related emissions in the United Kingdom (Brand et al., 2008). Future studies of gender in

relation to climate change might consider these as other important intersecting factors.

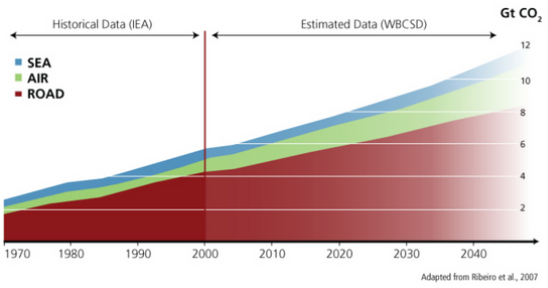
Transportation

Within any given income group (see chart discussed above), energy consumption differences between women and men are most pronounced in transportation. in the lowest income category, men expend 160% more energy on transport than women (21,372 MJ vs. 8,220 MJ). In the highest income category, men expend 48% more energy (75,624 MJ vs. 50,964 MJ). These differences shrink as income increases, but they do not disappear. They are significant because transportation is a major source of GHG emissions—see below.



Policy Implications

Integrated public and private transportation systems will be an important part of the solutions. The International Energy Agency (IEA), United States Energy Information Administration, and World Business Council on Sustainable Development (WBCSD) all project worldwide transport energy consumption to increase 2% per year in the coming decades. as "almost all of this new [transport] consumption is expected to be in petroleum fuels [...] Co2 emissions will essentially grow in lockstep with energy consumption" (Ribeiro et al., 2007)—see below.



Individual Consumer Choice

Individuals can do their part to reduce emissions. They can choose to walk, bicycle, or take public transportation when possible. They can choose smaller, more energy-efficient cars. They can carpool, or travel shorter distances for leisure. But user choice goes only so far. Urban planning and design are central to minimizing the need for transportation, to maximizing efficient public transportation, and to mitigating gender inequality.

Examples of projects include:

Cycling Promotion Projects: state and local governments are working to promote cycling as a form of transportation in order to reduce GHG emissions and promote health (Andersen et al., 2012; Bauman et al., 2008). For example, the Danish government is studying cycling through its "Bikeability: Cities for Zero Emission Travel and public Health" project. The project supports research into how demographics, bicycle infrastructure, and overall city design influence cycling (Bikeability, 2012). Analyzing gender may be important to planning new cycling infrastructure—considering women's and men's travel patterns and behaviours may enhance cycle route planning.

Other factors, however, may intersect with gender. These include:

Geographic locations: available data suggest that women's and men's cycling behaviours differ substantially by location. In Denmark, for example, women are more than twice as likely as men to report commuting to work or school by cycling—36% versus 17% (Madsen, 2010). In the UK, women are only slightly more likely than men to report commuter cycling (Foster et al., 2011). In the US and Australia, men are about three times as likely as women to report commuting by cycling (Garrard et al., 2012; Garrard et al., 2008).

Age: In Washington State, cycling was observed to be most common among adults age 25–45, declining at both lower and higher ages (Moudon et al., 2005).

Body Mass Index: In a study of 13 countries, cycling was observed to be correlated to healthy weights (Bassett et al., 2008).

Income: In Flanders, Belgium, low median income was associated with higher rates of commute cycling (Vandenbulcke et al., 2011).

Large-scale comprehensive studies provide limited information on the interaction between gender and other factors—more research is needed to increase understanding (Pucher et al., 2011).

Gender Budgeting in the Canton of Basel-Stadt, Switzerland: The Statistical Office of the Canton of Basel-stadt collects sex-disaggregated data to inform transportation policy. Other variables are also considered—for example, the office has examined how both women's and men's transit expenditures change with age. The office also estimates how public funds spent on transport infrastructure benefit women and men (Office for Gender Equality of the Canton of Basel-Stadt, 2008).

Conclusions

Researchers are beginning to study climate change mitigation from a gender perspective. Efforts to analyze factors that intersect with gender—including income, age, travel patterns, geographic location, and environmental attitudes—contribute to a better understanding of climate impacts and responses to mitigation measures. This understanding may improve the effectiveness of mitigation strategies by ensuring buyin from all energy users. It may also support efficiency and equality by achieving mitigation at the lowest possible social and economic cost, and by ensuring that costs are shared in equitable ways.

SMART ENERGY SOLUTIONS: ANALYSING INTERSECTIONALITY

European Commission 2020. *GENDERED INNOVATIONS 2: How Inclusive Analysis Contributes to Research and Innovation.* Directorate-General for Research and Innovation

The challenge

Over the past few decades, governments and intergovernmental agencies have set ambitious energy efficiency and reduction targets. For example, the EU's Directive on Energy Efficiency sets a target of 32.5 % increase in energy efficiency by 2030 (Directive 2012/27/EU, amended by Directive (EU) 2018/2002; European Parliament and Council of the European Union, 2012, 2018). These targets are part of the United Nations' global effort to ensure access to affordable, reliable and sustainable energy for all. The UN aims to substantially increase the share of renewable energy in the global energy mix by 2030, which will require expanding infrastructure and upgrading technology (UN, 2015).

Despite energy-efficient construction and smart home installations, energy targets for the EU building sector have not been met. Consumers are often blamed for not using the technologies correctly. At the same time, smart technologies are often complex and frustrating to users. To overcome these problems, engineers and design experts need to integrate user perspectives in the design of technologies for homes and public buildings.

This case study analyses how energy-efficiency projects can integrate gender perspectives, along with sensitivity to age, socioeconomic and other social factors, into design. Getting it right for a broad user base will help realise the potential of smart technologies that support EU and global energy targets.

Gendered innovation: Designing energy-efficient tools that integrate gender perspectives

Over the past few decades, product developers have integrated user-centric perspectives to better meet user needs and expectations. The field of energy efficiency, however, has lagged behind.

Danfoss, an international manufacturer and service provider for energy-efficient smart heating solutions, experienced low sales figures for one of its new products. When looking at its customer base, the company realised that women should constitute 50% of their users, but they were, in fact, significantly underrepresented. To address the problem, Danfoss teamed up with design-people, a Danish design agency, to investigate the values, motivations and needs of women in relation to technology.

The agency used surveys to cluster users into five segments, characterised by different attitudes to technology.

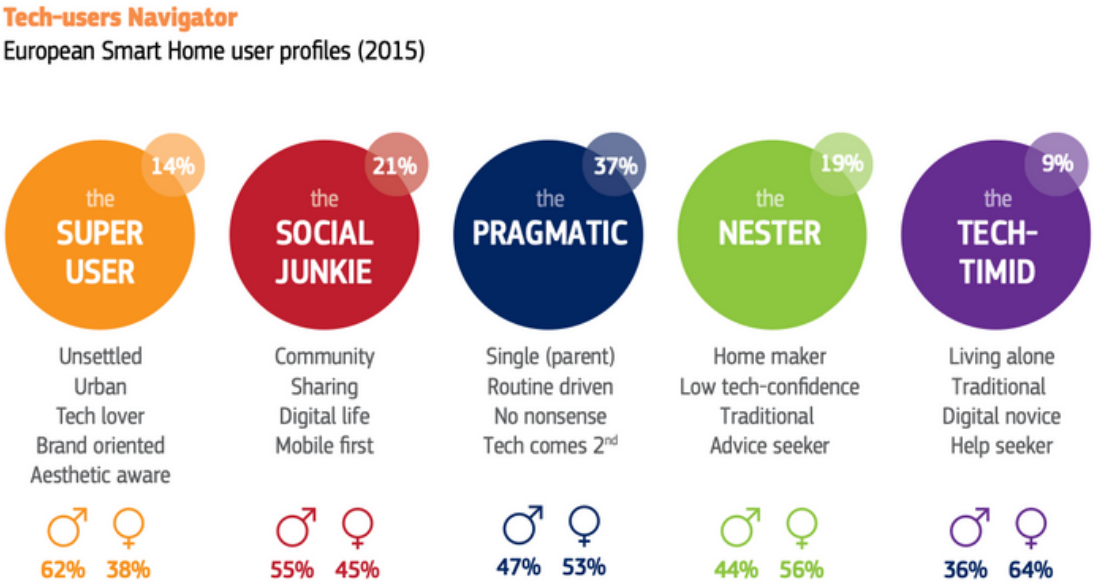
The largest segment was characterised as pragmatic tech users (37 %, finely balanced with 53 % women and 47 % men). Danfoss chose this group as the target for the company's new entry-level smart thermostat.

The company created a persona, named Johanna, to represent this group. A careful focus on Johanna's preferences along the entire customer journey allowed the design and engineering team to create an award-winning user experience for the new Danfoss ECO thermostat (https://www. design-people.com/portfolio/danfoss-eco/).

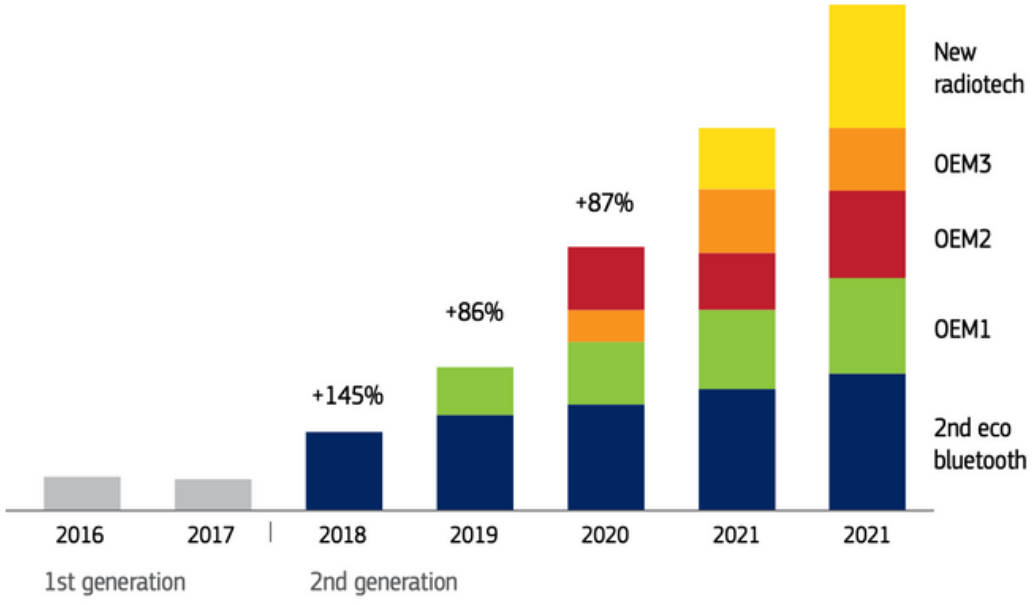
Two years after introduction, the sales figures of the new thermostat – a good

proxy for user adoption – exceeded Danfoss's expectations.

This approach can be made more inclusive by including other social identities in the survey. The H2020-funded project Energy system transition through stakeholder activation, education and skills development (Entrust; Entrust, 2017) (Dunphy et al., 2017) has broadened the design approach to include users of different ages and socioeconomic backgrounds (see below). Other relevant variables may include educational level, race/ethnicity, sexual orientation and non-binary gender identity.



Five customer segments.
Source: design-people (2015), with permission



Danfoss Eco App Thermostat Sales Curve.
Source: Danfoss, with permission

Method: engineering innovation processes

1. Evaluating past innovation practices

By analysing the traditional engineering innovation process of Danfoss smart home appliances, the engineering team identified a lack of diversity in user perspectives as a problem. Without a clear focus on target personas, engineers and designers may subconsciously use themselves as a benchmark for the user experience.

2. Building diverse development and design teams

The Danfoss case clearly demonstrates the advantages of including women and men with diverse attitudes to technology in the design process. Integrating a wide range of new and diverse perspectives will lead to further innovation. New research priorities and research questions can lead to new findings and innovative ideas (see Schiebinger et al., 2011–2020).

3. Analysing users and markets

User needs and behaviours can be identified through surveys, interviews, focus groups and direct observation. Engineers and designers can analyse gender by collecting quantitative survey data, as in the Danfoss example, or by observing user practices and learned behaviours. The best user research will include an intersectional approach to gender, ethnicity, age, socioeconomic status, etc.

4. Obtaining user input

In the Danfoss project, participatory research allowed designers to tap into users' tacit knowledge. User research revealed that women valued easy temperature control, air quality control and thermostat design. The engineers had not considered air quality or the aesthetics of thermostat design in the product development, and they had not been confronted with different experiences of the ease of use of their product.

5. Evaluation and planning

To improve the engineering innovation process, companies should assess the benefits and problems of current products and services in view of the users' expectations and abilities, including all gender types. They should then transfer the lessons learned to other areas of the organisation.

Discreet Indoor Climate Sensor.

Based on a 'female interaction concept', Danfoss and design-people translated their research findings and principles into a more user-responsive indoor climate solution, i.e. including not only temperature but also air quality controls. They replaced the wall-mounted control panels with more discreet sensors controlled from tablets and smartphones. This allowed users to balance climate comfort and energy saving by controlling their heating systems remotely.
In addition, Danfoss paid attention to air quality. The surface of the new thermostat and sensors ruptured into crystal patterns when air quality deteriorated, indicating that users should refresh the air.

Conclusions

The case study provides clear examples of how to improve R&I processes relevant to energy efficiency measures. It also shows how to improve new and existing technologies and enhance their market acceptance by integrating gender and diversity perspectives into development, design and testing.

>> Next Steps

- To reach the United Nations SDGs for energy infrastructure and technology, it will be important to implement gender and intersectional analyses as a cross-cutting issue. This will enhance the acceptance and usability of energy products and services, and stimulate the market uptake of energy solutions.
- We recommend regular and systematic audits to evaluate energy systems and solutions from a gender perspective and an intersectional perspective.

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AGRICULTURE: EMBEDDING GENDER NORMS IN INNOVATION PROCESSES

European Commission 2020. *GENDERED INNOVATIONS 2: How Inclusive Analysis Contributes to Research and Innovation*. Directorate-General for Research and Innovation

The challenge

Agricultural innovations tend to affect women and men differently. Most innovations focus on resolving technical problems, such as raising yields, withstanding environmental stress and managing poor soil or seeds. Such innovations often fail to account for how gender norms influence the implementation of technical solutions or how the implementation of technical solutions will influence gender norms. Consequently, innovations may not reach women and may even amplify gender inequality (Quisumbing et al., 2014; Bock and Van Der Burg, 2017; Lawless et al., 2017; Rola-Rubzen et al., 2020; Sachs et al., forthcoming).

Research shows that gender and other normative social structures often lead to unequal benefits from innovation opportunities. Restrictive gender norms are deeply engrained in institutions such as the family, education and banking. These constrain the agency of women, their access to resources and services, mobility, representation and decision-making capacity, especially for less privileged groups (Cole et al., 2015; Badstue et al., 2018). This is the case worldwide (Bock and Shortall, 2017), but solutions need to be context specific.

Gender-transformative approaches have been developed to address these issues by:

- fostering the critical examination of gender roles, norms and relations;
- recognising and strengthening positive norms that support equality;
- promoting the position of women, girls and marginalised groups;
- transforming underlying social structures, policies and broadly held beliefs that perpetuate gender inequality (Petesch et al., 2017; Badstue et al. 2018; Danielsen et al., 2019; see also Hillenbrand et al., 2015; Aregu et al., 2019; Van Der Burg, 2019; Fischer et al., 2019).

Agricultural science covers research on crops, livestock, fishing, forestry, horticulture, trees, soil, natural resources, food, biofuels and related production processes, as well as their management, such as natural resource management covering water, post-harvest processing, supply and added value chains, markets and consumption (Meinzen-Dick et al., 2010)

Gendered innovation: Gill nets in Bangladesh

To overcome food poverty, WorldFish led the United States Agency for International Development (USAID) funded project Aquaculture for income and nutrition, with local partners in Bangladesh (Keus et al., 2017). WorldFish is one of the institutes of the worldwide CGIAR. The project combined the introduction of new technology with a gender-transformative approach (Kruijssen et al., 2016; see also World-Fish, 2016)

Fish is the most important animal-source food in Bangladesh. Approximately 60 % of the population

eats fish at least every other day, with daily per capita consumption at 44 grams for the poorest households. In 2012, around 4.27 million households (20 % of rural households) had a fish pond (Belton and Azad, 2012).

Gender-related cultural and religious expectations prohibit women from harvesting fish even from their own ponds. Such tasks are seen as the responsibility of men. Women are also reluctant to enter ponds because they get their sarees wet, which then need to be laundered. As a consequence, women mostly feed the fish and help clean the ponds, while men harvest and market the fish, and make financial decisions for the household.

To support gender equality and to ensure food security, WorldFish started to introduce mola gill nets in the poorest parts of Bangladesh. Gill nets are fishing nets that are lightweight enough for women to cast from the bank of the pond, without getting into the water.

Gill nets come in meshes of different sizes. Mesh size determines the type of fish caught. A fish swims into the net but passes only partway through the mesh. When it struggles to free itself, the netting slips behind the gill cover to trap the fish. Since the nets are used to catch only nutrient-rich mola fish (Amblypharyngodon mola), men did not feel threatened, as there was little danger of netting the larger fish, which men catch and regard as theirs.

Women attended an 8-day training course on how to make and use a gill net. The nets were 7.5 metres wide by 1.8 metres high. Women were taught to make their own nets by buying low-cost mesh and rope from the market and using empty bottles (for floats) and rocks or broken bricks (as sinkers). Harvesting fish with these nets takes around 30 minutes from setting the net to pulling in the catch.

 # Method: co-creation and participatory research

Project researchers compared five nets with different mesh sizes to identify which nets performed best for catching small fish and which nets best met women's needs and preferences. They found that gill nets with 1.7-cm mesh were women's top choice.

Women were also taught to manage mola fish farming and were provided with nutrition education on mola. Mola is a small fish rich in vitamin A, iron and zinc. When eaten whole, including the head, organs and bones, mola is rich in micronutrients, which are important for good health and child development. The mola gill net allows frequent harvesting and consumption of mola. Just 17 mg of mola can provide the recommended vitamin A intake for a child under the age of 5 (Kataki, 2002).

 # Method: analysing gender

Crucial to the success of this project was recognising and transforming gender norms. Because fishing has traditionally been men's work, workshops addressed gender consciousness to ensure that husbands, in-laws and neighbours supported the new role of women in cultivating and catching fish with gill nets. These workshops addressed gender dynamics ranging from intra-household power hierarchies to food distribution. They also addressed gender norms that limited individual and family well-being and enhanced ways to collaboratively shift gender relations. These workshops are outlined in the manual Promoting Gender-Transformative Change with Men and Boys (Promundo-US and the CGIAR Research Program on Aquatic Agricultural Systems, 2016), discussed under 'Gendered innovation 2' below. Women were also coached in self- confidence, negotiating skills and assertiveness. Results showed changed attitudes among men and women, enhanced collaboration between family members and greater acceptance of technology uptake by women (Kruijssen et al., 2016). WorldFish also monitored changes in production, attitudes and practices (both technical and social) through surveys and interviews with women, their partners and other household members.

Conclusion

Early evidence suggests that gender equality is enhanced when the introduction of a technological innovation is accompanied by a gender transformative approach. Kruijssen et al. (2016) state that projects are able to trigger transformation in norms when focusing on the root causes of inequality, such as traditional attitudes and behaviour, internal functioning and outreach routines in institutions and gender-specific norms, that limit women's participation. An integrated systems approach that starts from the interaction of technological and socialdimensions may produce favourable outcomes, as demonstrated in the example of gill net fishing in

Bangladesh. It demonstrates how an agrifood or farm systems approach that integrates different participants and activities (diverse crop, livestock and natural resource management) is best equipped to include the gender dimension (Feldstein, 2000).

This gender-transformative approach gives new entry points to advance transformative change worldwide – including in European agricultural contexts – that goes beyond women's representation and includes addressing the root causes of existing inequalities. The methodologies developed for in-depth gender analysis and ex ante GIA combined with co-creation and participatory research are relevant to EU-funded projects, such as Farming tools for external nutrient inputs and water management (Fatima, http://fatima-h2020.eu; Fatima, 2017) (e.g. Osann, 2018), Social innovation in marginalised rural areas (SIMRA, http://www. simra-h2020.eu; SIMRA, 2020) (Ravazzoli et al., 2019), Small farms, small food businesses and sustainable food and nutrition security (SALSA, http://www.salsa.uevora.pt/about-salsa/; SALSA, 2020) (Sutherland et al., 2019), New entrant network: business models for innovation, entrepreneurship and resilience in European agriculture (Newbie, http://www.newbie-academy.eu; Newbie, 2020) and more in the future. The EU project Gender in science management of agriculture and life sciences, including research and teaching (Gender-SMART, https://www.gendersmart.eu; Gender-SMART, 2020) is further elaborating how to include gender analysis and address gender and other social norms in agricultural R & D. Gender-SMART is part of the science with and for society programme and funded by Horizon 2020 grant No 824546.

>> Next Steps

The good practices presented in this case study can be broadly applied in agricultural R & D. They can be further supported and expanded in the following ways.

- New designs of agricultural R&D projects should include gender and other social norms.
- European research on agricultural innovation will benefit from addressing the influence of gender and other social norms on access to and benefits from resources such as land ownership, training, credit, mobility, decision-making power, and support from family and community members (EIGE, 2016; Bock and Shortall, 2017).
- Research in this area calls for an intersectional perspective to address heterogeneity in women and men related to other social dimensions or identities, such as socioeconomic status, geographical location, family structures, religion, ethnicity, age and physical ability.

Policy

- Commission comparative research into the design and implementation of innovations that contribute to social and gender equality in agriculture, forestry, fisheries and nature management in various rural settings in Europe and around the world.
- Support coordinated awareness-raising about the influence of gender and other social norms in (inter)national agriculture related organisations and platforms such as European innovation partnerships, and provide them with instruction manuals on how to sustainably reduce inequality and achieve higher equality through innovations.
- Request context-specific ex ante GIA research as part of research and policymaking.

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HOUSING AND NEIGHBORHOOD DESIGN: ANALYZING GENDER

Schiebinger, L., Klinge, I., Paik, H. Y., Sánchez de Madariaga, I., Schraudner, M., and Stefanick, M. (Eds.) (2011-2020). Gendered Innovations in Science, Health & Medicine, Engineering, and Environment (genderedinnovations.stanford.edu).

The challenge

Planners, architects, and researchers from various fields have shown that gender roles and divisions of labor result in different needs with respect to built environments. These differences appear at various scales—individual buildings, neighborhoods, cities, and regions—and in the different domains of city building, such as housing, public facilities, transportation, streets and open space, employment and retail space (Sánchez de Madariaga, 2004). Gender analysis of space has identified the ways in which urban environments may enforce gender norms and fail to serve women and men equally (Hayden, 2005). Widely unrecognized gender assumptions in architecture and planning contribute to unequal access to urban spaces. While this Case Study addresses urban design in high-income countries, issues, such as safety in public space, or access to water, energy, transportation, and basic sanitation, become high priority in developing countries (Jarvis, 2009; Reeves et al., 2012).

Gendered innovation: Integrating Gender Expertise into Housing and Neighborhood Design and Evaluation

In 2009 and 2010, Vienna was rated as one of the cities with the "highest quality of living in the world" (Irschik et al., 2013). Gender analysis contributed to this excellence: Over the past two decades, gender expertise has become fully integrated into Vienna's urban planning (Booth et al., 2001):

- 1991 Two Viennese urban planners described the gendered aspects of urban design in an exhibition, "Who Owns Public Space–Women's Daily Life in the City."
- 1992 The Vienna City Council established the Women's Office.
- 1998 The City Planning Bureau established the Coordination Office for Planning and Construction Geared to the Requirements of Daily Life and the Specific Needs of Women.
- 2002 Vienna designated Mariahilf, Vienna's 6th district, a gender mainstreaming "pilot district," a test area where gender analysis became an integral part of urban planning (Bauer, 2009; Kail et al., 2006).
- 2010 Gender experts were moved from the Coordination Office directly into groups for "Urban Planning, Public Works and Building Construction." This final step brought gender experts "in-house," making them part of the core decision-making in the City of Vienna.

 # Method: Rethinking Priorities and Outcomes

The European Union prioritized gender mainstreaming in 1996 and funded sixty networked projects in efforts to develop gender analysis for urban planning (Horelli et al., 2000; Roberts, 2013). Policy makers and funders that make gender analysis a

requirement for funding potentially provide a platform for integrating gender-specific criteria into housing and neighbourhood planning.

 # Method: Analyzing Gender

The relationship between place, space, and gender is complex and involves a number of steps:

- Evaluating past urban design practices: Researchers recognized that urban design typically lacked a gender perspective, and was "blind" to differences between groups—women and men, people using different forms of transport and performing different kinds of work, etc. For example, design often focused on the needs of formally-employed persons who "inhabit the environment as consumers [...] expecting residential areas to fulfill only one function and judging them by their recreational and leisure value." This overlooks the needs of women and men who perform housework, child- and eldercare, etc. as well as the needs of "children, adolescents, and the elderly" (MOST-I, 2003; Ullmann, 2013).
- Mainstreaming gender analysis into design.
- Analyzing users and services: Designers may look at how various populations use space in relation to paid work, home life and work, social relations, cultural practices, and leisure. Designers may also examine the needs of various populations living in housing units and the needs of the people who service those units, such as cleaners and maintenance people.
- Obtaining user input: Using co-creation and participatory research techniques, designers may ask users about their daily lived experience. Researchers may use a variety of methods, such as surveys, interviews, or observation.
- Evaluation and planning

Vienna's example is being adopted by other European cities (Borbíró, 2011). This case study highlights only a few of the designs globally that have mainstreamed gender analysis into urban design and evaluation:

- At the regional level, the Central European Urban Spaces (UrbSpace) project, supported by the EU's Regional Development Fund, aims to improve the urban environments of eight Central European countries (Slovakia, Czech Republic, Poland, Hungary, Austria, Slovenia, Germany, and Italy) though renovations of open urban spaces, such as public parks and squares (Rebstock et al., 2011). UrbSpace uses a strategy of integrating the "gender perspective into every stage of the policy process – design, implementation, monitoring and evaluation. (Scioneri et al., 2009).

To this end, gender analysis is additionally used as a toolto contribute to other goals: environmental sustainability, public participation in planning, security of urban spaces, and accessibility (Stiles, 2010).

- At the national level, the British Royal Town Planning Institute (RTPI) has created a toolkit to promote gender mainstreaming (Greed, 2005 & 2006). The toolkit supports both information-gathering (e.g., collection of sex-disaggregated data regarding housing affordability, transportation modes, and priorities) and planning (e.g., creating development projects which support diverse users) (RTPI, 2007; Reeves, 2003 & 2005).

Conclusion

The example of Vienna presented in this case study highlights how integrating gender expertise into city planning led to pilot projects, such as Frauen-Werk-Stadt I & II and In der Wiesen Generation Housing that succeeded in incorporating everyday living and caring tasks into the specific housing and neighborhood projects. These projects can serve as a model for larger-scale planning.
A next step will involve moving beyond pilot projects toward fully integrating gender analysis into planning and budgeting at the municipal, regional, and national, and regional levels. Further research is also needed to understand how urban structures interact with gender relations, and how these differ across time and space.

FAIR TAX: GENDER EQUALITY AND TAXATION IN THE EUROPEAN UNION

European Commission 2020. *GENDERED INNOVATIONS 2: How Inclusive Analysis Contributes to Research and Innovation*. Directorate-General for Research and Innovation

The challenge

When designing tax laws, policymakers rarely consider gender inequalities, even though many aspects of taxation have a substantial effect on gender-related socioeconomic inequalities. Although most tax laws apply equally to men and women, some tax systems and fiscal policy decisions affect men and women differently. The persisting gender differences in employment rates and patterns, and gender gaps in unpaid care work, income, old age security, poverty and wealth, are all closely linked to the allocative and distributional outcome of tax regulations (Gunnarsson et al., 2017; Stewart, 2017).

The European Union was initially founded as the European Economic Community, and intended to harmonise economic policies between the Member States. Social aspects, including gender equality, played a minor role. Gender equality was largely restricted to particular policy areas, such as employment and occupation. Although social dimensions still lag behind economic policies, the Treaties of Maastricht, Amsterdam and Lisbon introduced new social values, objectives and specific obligations, and strengthened gender equality (Spangenberg et al., 2019). Gender equality is a core value of the European Union and is enshrined in its treaties. The European Commission also supports the promotion of gender equality through its commitment to the implementation of the SDGs (European Commission, 2016, 2020).

The basic problem, however, is that, even though numerous states and global organisations are committed to political and economic gender equality, tax policies and tax laws generally do not support those goals. This case study builds on research findings of the H2020-funded project Revisioning the 'fiscal EU': fair, sustainable, and coordinated tax and social policies (FairTax; FairTax, 2020).

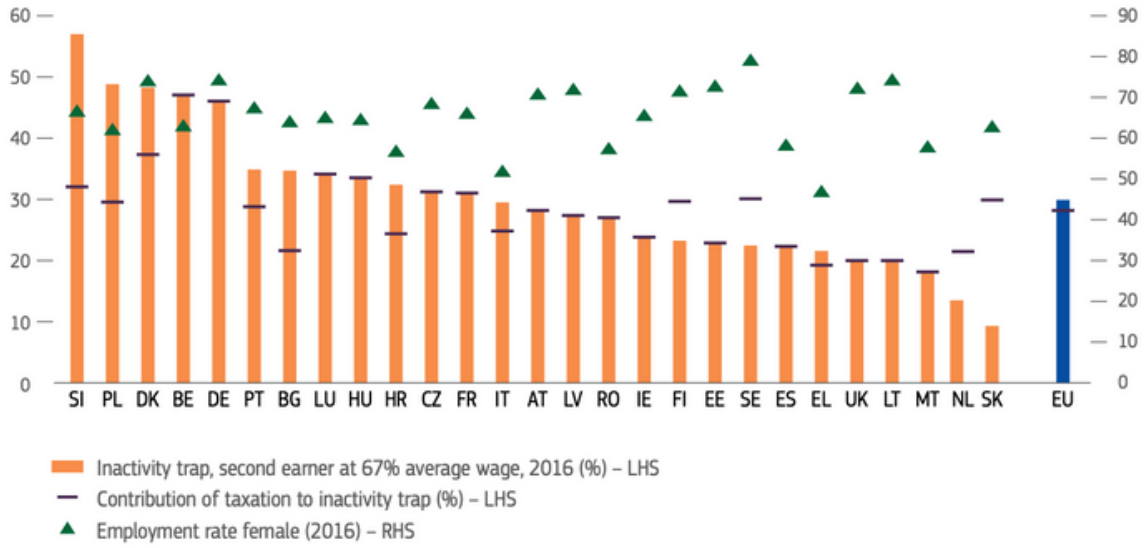
Gendered innovation: Understanding the impact of income tax systems on secondary earners

There is ample empirical evidence that female labour supply is responsive to taxation, particularly for married women with children (Apps and Rees, 2009; Thomas and O'Reilly, 2016). National tax systems of EU Member States have fuelled inactivity traps for secondary earners, hindering the equal participation of women in the labour market. The inactivity trap is the result of taxes kicking in (including the loss of tax relief from joint taxation provisions aiming to reduce the tax burden for sole earners) when employment is taken up after a period of inactivity, on the one hand, and of benefits withdrawn (particularly means-tested social assistance), on the other hand. It can be interpreted as an implicit tax rate on the return to the labour market of inactive persons and reflects the share of the earned gross wage that is taxed on the take-up of employment, thus measuring the financial incentives to take up employment. The size of the inactivity

trap can be increased by joint taxation provisions and other tax provisions alleviating the tax burden for couples where the earnings are distributed unequally between the partners, as well as by means-tested benefits for the non-earning or lower-earning partner (European Commission, 2018).

The majority of working women in mixed-sex couples, especially those with children, are secondary earners, earning on average about one third of the couple's joint income. Gender research based on microsimulation models demonstrates how the basic design of income tax schedules and social security contributions affects disposable post-tax income and incentives to work. In most EU Member States, the tax wedge and inactivity trap for low-income and, in particular, secondary earners remains one of the main disincentives to women's labour market participation.

A large number of economic studies based on microsimulation models prove that work incentives for women are impaired by joint tax provisions in family-based or household-based income tax systems. Joint provision was initially only applied to married couples but has been extended to include other forms of partnership. Another reason is the insufficient recognition of childcare costs. Replacing the income-splitting system with individual taxation would markedly increase female employment (Gunnarsson et al., 2017, pp. 26–32; Fink et al., 2019). Figure 1 shows the paid labour inactivity trap for secondary earners at 67 % of the average wage for 2016, assuming that the principal earner receives an average gross wage. It shows the share of a couple's earned gross wage that is lost to taxes when



Inactivity trap for second earners in EU Member States, 2016.
Source: Eurostat and European Commission tax and benefits indicator database based on Organisation for Economic Co-operation and Development data

Notes: The blue bars show the percentage of the average wage earned by secondary earners. In the EU this is about 67 % of the average wage in a two-earner family with two children; the principal earner earns the average wage. The red lines, contribution of taxation, refer to how tax policies influence the inactivity trap. The green triangles, the employment rate for women, are used as a proxy for second earners.

the secondary earner enters the labour market. The figure illustrates that, in most EU Member States, tax policies drive paid labour inactivity.

A comparative microsimulation of six selected EU Member States also shows that the introduction of a joint taxation system with income splitting would increase the marginal income tax rate for female second earners and thus decrease work incentives on average (Fink et al., 2019).

On the basis of these gender analyses, the European Parliament has recommended that Member States phase in full individual taxation in their income tax systems, including the elimination of tax expenditures and benefits based on joint income. The purpose of this policy guideline is to eliminate tax-related disincentives to female employment and the unequal distribution of paid and unpaid work (European Parliament, 2019, Articles 5, 6, 10).

 # Method: literature review and microsimulation

Gender-differentiated effects on work disincentives are measured using the marginal effective tax rate (METR), which is expected to influence decisions about how much to work, and the workforce participation tax rate (PTR), which is expected to affect decisions about whether to work or not. Statistical techniques and EU Statistics on Income and Living Conditions data comparable between the EU Member States have been used to obtain the values of METR and PTR by means of Euromod tax benefit and Organisation for Economic Co-operation and Development tax- benefit microsimulation models. These types of microsimulations have been applied in studies including all Member States (Rastrigina and Verashchagina, 2015) and to a limited number of Member States selected using a taxonomy for tax systems (Fink et al., 2019). The literature review has served as a theoretical frame for the gender analyses employed in the studies above and also to provide overviews of other microsimulation studies and models.

Conclusions

A key finding in gender research, is that if national tax systems continue to feed and stimulate tax traps for secondary earners, substantial gender equality will never be realised. To date, neither the European Union nor its Member States comply with the legal obligations or political commitments outlined as challenges in this case study. European institutions and Member States must – within their respective areas of authority over tax – implement legal measures to ensure gender equality. Complieance with these obligations needs, at least, regular impact assessments of all fiscal policies from a gender equality

perspective, including proposals for tax legislation and soft law procedures, such as the European Semester. Gender equality is not only a fundamental human right in itself, but would contribute to more inclusive and sustainable growth. Gender equality is an important dimension of fair and sustainable taxation, and a necessary part of the analysis of how tax systems could be a part of transition to sustainability for Europe.

>> Next Steps

- Promote and conduct research on gender aspects of taxation and ensure the availability of appropriate gender-disaggregated data.To adequately address gender aspects in taxation, it is important to tackle the many research gaps. For instance, further research is needed on the gender-differentiated distributional effects of net wealth, property taxes, inheritance taxes, value added taxes and excise taxes, corporate taxes, tax expenditures and gender-differentiated allocative effects of corrective taxes. Research should also address the compliance of tax measures with legal gender equality obligations. Although data on the taxation of labour incomes are readily available, most tax data are collected only at household level. There is also a lack of gender- disaggregated data related to the taxation of wealth, capital incomes, business and consumption, as well as on tax compliance and tax fraud issues.

- Ensure political commitment at EU level, and define targets and indicators to achieve substantive gender equality with regard to taxation. The exclusive focus of tax-related gender equality objectives on increasing female employment rates disregards persistent gender gaps in income, the share of unpaid work, old age security, poverty and wealth. The focus of specific gender equality objectives also depends on specific inequalities between Member States. Considering the gender gaps prevailing in all Member States, the design of tax systems and tax policies should contribute to promoting independent economic security throughout the course of a person's life, as well as to an equal distribution of paid and unpaid work between men and women. Tax systems and policies should also help reduce gender gaps in income distribution, old age security, poverty and wealth distribution.

- Make gender equality an integrated part of taxing for the future, combining social changes with an economy that works for people and a European Green Deal. From the perspective of five dimensions of tax policies for sustainability (economic, social, environmental, gender and institutional/cultural), Europe faces the following structural problems (Mumford and Gunnarsson, 2019):

- a prevailing focus on economic growth,
- the absence of tax measures that tackle inequalities in income and wealth,
- the high and increasing burden of labour taxes,

- a lack of EU-level environmental taxation,
- the decreasing importance of corrective Pigouvian taxes at Member State level, particularly of environmental taxes,
- intense tax competition including profit shifting,
- tax compliance issues and tax fraud, the decreasing progressivity of tax systems,
- unexploited potential to use taxation at EU level to promote sustainable growth and development in Europe,
- persisting intragenerational inequalities and lack of coordinated whole-life approaches to tax and social policies,
- persisting socioeconomic inequalities between men and women and lack of gender equality insights in national tax policies.

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VENTURE FUNDING: ANALYSING GENDER

European Commission 2020. *GENDERED INNOVATIONS 2: How Inclusive Analysis Contributes to Research and Innovation*. Directorate-General for Research and Innovation

The challenge

Globally, health, education, economy and politics show large disparities between women and men (World Economic Forum, 2018; United Nations Development Programme, n.d.). Focusing on economic issues, the World Economic Forum estimates that it will take more than 200 years to eliminate economic gender inequality. Entrepreneurship is one method that might help women to empowerment and economic citizenship, and at the same time ensure necessary products and services for all and thereby contribute to society's welfare development. However, all around the world women on average earn less than men, have fewer savings and own less property (where they are allowed to own assets independently – see for example Eurostat, 2019; U.S. Bureau of Labor Statistics, 2019), i.e. women tend to have less financial capital to put into venture creation. At the global level, business ownership and leadership are dominated by men. New business formation is also dominated by men. The Global Entrepreneurship Monitor (2018/2019), for instance, shows that, of the 48 economies participating in the study, only six have achieved gender parity in total entrepreneurial activities (TEA). TEA include both push (need to) and pull (want to) entrepreneurship. Even in the Nordic countries, which rank the highest in the UN Gender Inequality Index (http://hdr.undp.org/en/content/gender-inequality-indexgii), approximately 70 % of new businesses are founded by men12 (Global Entrepreneurship Monitor, 2018/2019). Science, technology, engineering, maths and innovation are largely dominated by men (Alsos et al., 2013, 2016). By contrast, personal services, including wellness and some health services, are among the few industries dominated by women entrepreneurs and owners (e.g. Nählinder et al., 2015).

These numbers suggest that women represent an untapped pool of potential contributors to business leadership, entrepreneurship and innovation. Women, who have different social experience from men, may also bring new perspectives to business and innovation.

Women around the globe are disadvantaged when it comes to capital ownership. They typically earn less and are less able to accumulate the capital (savings, shares, etc.) required to fund a new enterprise because they need to spend their money on food and other necessities to ensure family well-being. Ambitious women entrepreneurs, as well as many men entrepreneurs, must rely on external capital13.

The Venture Capital (VC) industry is highly gender-skewed (Carter et al., 2003; Babson College, n.d.). In the EU, firms with a woman CEO receive only 11 % of VC funding (EIB, 2020). In the United States, the per- centage is even smaller. Only 3 % of women-led firms in the United States receive VC funding and that number has not changed over the last two decades. Further, statistics from the VC industry itself show that women hold few

positions in the VC industry. Three per cent of managing directors are women, 4 % of vice presidents are women and 2 % of investment managers are women (Women in VC, n.d.). The relationship between the capital demand side (entrepreneurs) and the capital supply side (investors) should be a major concern for politicians and policymakers who want to understand – and change – how gender affects new venture funding.

Gendered innovation: Including gender analysis in theory on venture funding

Here we consider signalling theory, which examines communication between venture funding actors. Applied to venture capital, signalling theory investigates how investment decisions are made. These decisions are assumed to be governed by economic rationality and, as such, should be gender-neutral. Economic life, however, is socially situated in ways that make complete economic rationality impossible. Gender will – consciously or unconsciously – play a role in decision-making.

Signalling theory has been used in a number of studies of the entrepreneur–investor relationship (e.g. Davila et al., 2003; Elitzur and Gavious, 2003; Busenitz et al., 2005). The theory assumes that entrepreneurs communicate credible signals about a venture's good prospects (Busentiz et al., 2005), for instance by describing past performance (Ebbers and Wijnberg, 2012), the amount of money the entrepreneur will invest in their new business (Prasad et al., 2000), the quality of the team (Choen and Dean, 2005) and how much social capital the entrepreneur possesses (Khoury et al., 2013). These signals build trust on the part of the receiver of the signals, i.e. the investor (Maxwell and Levesque, 2014). The theory has four key aspects – signaller, receiver, signal and feedback – none of which yet considers gender.

Conclusion

This case study has demonstrated the importance of understanding how gender is embedded in what often appear to be gender-neutral theories (see for example Hoyt and Burnette, 2013). Understanding how gender functions in signalling theory is a first step to overcoming the gender gap in venture funding.

>> Next Steps

- Integrate gender analysis into research on business funding. Initiatives such as the international research network Diana (Babson College, n.d.) may play an important role in disseminating research findings and encouraging researchers to collaborate, thereby promoting gender analysis in research on business funding. In addition, the EU co-funded gender-aware research through GENDER-NET ERA-NET, where research projects, such as Overcoming the entrepreneurial ecosystem gender divide: a cross-cultural perspective (GENRE; ERA-LEARN, n.d.), will provide valuable knowledge of how female tech entrepreneurs, incubator managers and investors in

entrepreneurial ecosystems relate to one another. GENRE investigates and compares entrepreneurial ecosystems in four countries: Ireland, Israel, Norway and Sweden. The EU has also initiated some measures through the European Investment Bank. Gender equality, however, needs
to be on the political agenda at the national level too, in all EU and Entry/Exit System Member States. Statistics need to be provided.

- Ensure that stakeholders, policymakers and venture capitalists include gender analysis in funding systems at all levels. Initiatives should be taken to ensure that different stakeholders within entrepreneurial funding institutions (both private and public) include and report on gender. Examples of such measures are: How large a share of the funding is distributed to companies with female-dominated ownership? How large a share of the funding is distributed to women entrepreneurs? What is the turn-down rate of investments, with a women-to-men ratio? What measures are taken to ensure that women entrepreneurs are among the target groups for the funding institution? Measures need to be developed to address these issues. Model programmes have been implemented by several public funding institutions, such as Innovation Norway and Vinnova.

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FACIAL RECOGNITION: ANALYSING GENDER AND INTERSECTIONALITY IN MACHINE LEARNING

European Commission 2020. *GENDERED INNOVATIONS 2: How Inclusive Analysis Contributes to Research and Innovation.* Directorate-General for Research and Innovation

The challenge

FRSs can identify people in crowds, analyse emotion and detect gender, age, race, sexual orientation, facial characteristics, etc. These systems are employed in many areas, e.g. hiring, authorising payments, security, surveillance or unlocking phones. Despite efforts by both academic and industrial researchers to improve reliability and robustness, recent studies demonstrate that these systems can discriminate based on characteristics such as race and gender and their intersections (Buolamwini and Gebru, 2018). In response, national governments, companies and academic researchers are debating the ethics and legality of facial recognition. One point is to enhance the accuracy and fairness of the technology itself; another is to evaluate its use and regulate deployment through carefully implemented policies.

Method: analysing gender and intersectionality in machine learning

Bias in ML is multifaceted and can result from data collection, or from data preparation and model selection. In the first case, the data may contain human bias. For example, a dataset populated with men and lighter-skinned individuals will misidentify darker-skinned females at higher rates. This is an example of intersectional bias, whereby different types of discrimination amplify negative effects for an individual or group. 'Intersectionality' refers to intersecting categories such as ethnicity, age, socioeconomic status, sexual orientation and geographical location that affect individual or group identities, experiences and opportunities.

Bias may also be introduced during data preparation and model selection, which involves selecting attributes that the algorithm should consider or ignore, such as facial cosmetics or the faces of transgender individuals during transition.

Gendered innovation: Understanding discrimination in facial recognition

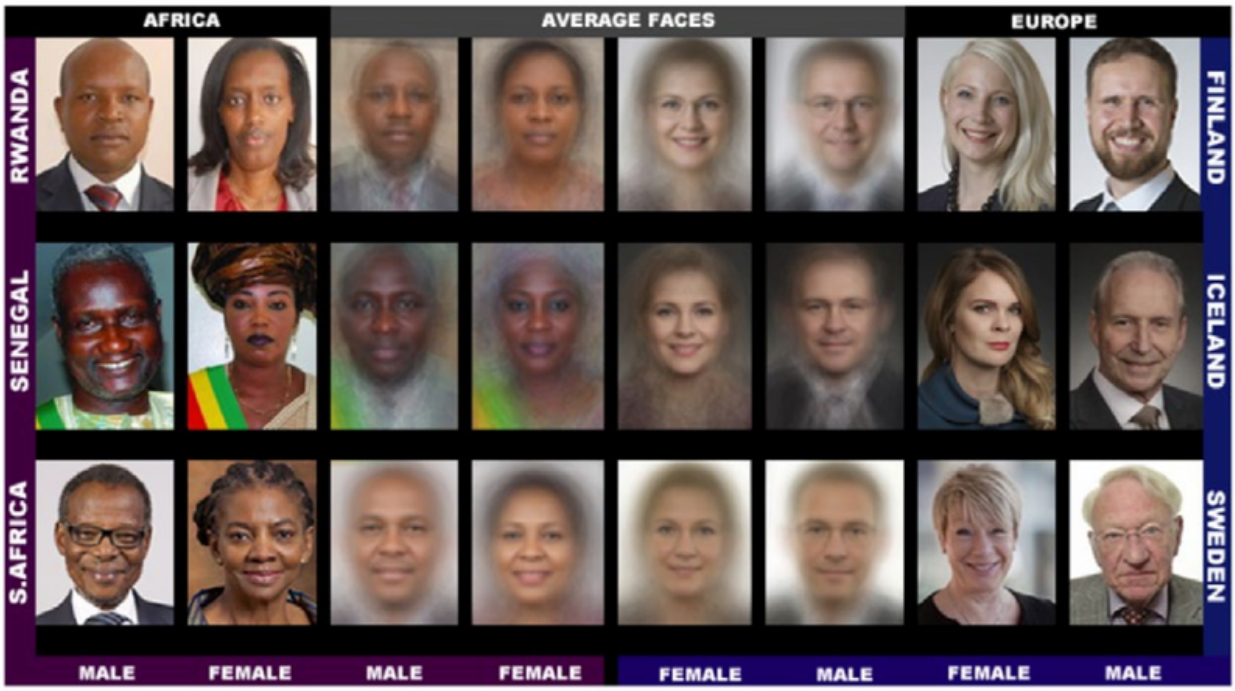
To understand discrimination in FRSs, it is important to understand the differences between face detection, facial attribute classification, facial recognition, face verification and facial identification.

Face detection can occur without facial recognition; however, facial recognition does not work without face detection. Face detection differentiates a human face from other objects in an image or video. Face detection systems have repeatedly been shown to fail for darker-skinned individuals (Buolamwini, 2017). For example, early versions of the

statistical image-labelling algorithm used by Google Photos classified darker-skinned people as gorillas (Garcia, 2016). If this first step fails, FRSs fail.

Facial attribute classification labels facial attributes such as gender, age, ethnicity, the presence of a beard or a hat, or even emotions. For emotions, a review of online recognition application programming interfaces showed that over 50 % of the systems used facial expressions to define emotions (Doerrfeld, 2015). To work, these models must be trained on datasets that are representative of the target population. Models trained on mature adults, for example, will not perform well on young people (Howard et al., 2017).

Facial recognition identifies a unique individual by comparing an image of that person to their known facial contours. One type of facial recognition is verification, often used to unlock a phone or to validate the identity of someone crossing an international border (see the EU-funded Horizon 2020 project Intelligent portable border control system (iBorderCtrl); see iBorderCtrl, 2017). These solutions are designed to decrease processing time. If, however, the FRSs are not trained sufficiently, for example on darker-skinned women (Buolamwini and Gebru, 2018) or transgender faces (Keyes, 2018), the technologies will fail for them. The other type of facial recognition is facial identification, which matches the face of a person of interest to a database of faces. This technology is often used for missing persons or criminal cases.



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

Conclusion

FRSs can perpetuate and even amplify social patterns of injustice by consciously or subconsciously encoding human bias. Understanding underlying intersectional discrimination in society can help researchers develop more just and responsible technologies. Policymakers should ensure that biometric programmes undergo thorough and transparent civil rights assessment prior to implementation.
The potential misuse of facial recognition has led to several actions: Belgium has declared the use of facial recognition illegal; France and Sweden have expressly prohibited it in schools. Companies, too, are pulling back: IBM has left the facial recognition business entirely, and Amazon has stopped police using its facial recognition technology in response to worldwide protests against systemic racial injustices in 2020.

>> Next Steps

- Algorithms are only as good as the data they use. Training datasets should be sufficiently large and diverse to support FRSs in diverse populations and in diverse contexts.
- In the face recognition vendor test published by the US National Institute of Standards and Technology (NIST, 2019), the 1:N report (most relevant to FRSs used in bodycams) does not include a detailed breakdown of accuracy metrics for factors such as race, age and gender. This should be corrected.
- Develop fair, transparent and accountable facial analysis algorithms.
- Many of the studies and systems still adopt a binary view of gender. Research and innovation in this field must acknowledge the existence of a large number of gender-diverse individuals and create technologies that work throughout all of society.

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SAFE SOCIETIES

Trine Rogg Korsvik & Linda M. Rustad 2019. *What is the gender dimension in research? Case studies in the interdisciplinary research.* Kilden genderresearch.no

Safeguarding societies against natural and human-made disasters is a relatively new field of study that since the turn of the millennium has received increasing political priority internationally. The field deals with the prevention, mitigation and management of risks, threats and crises. Enhancing the resilience of society requires more research on how to be prepared to deal with the unexpected, whether it is intentional acts such as terrorism and crime, or accidents and natural disasters. There is a need for research on how society can identify, understand and prevent risks and threats, and how crises can be dealt with after they have occurred.

Societal safety constitutes a cross-disciplinary field of research that involves various academic disciplines, including social sciences, humanities, health sciences and technology. Examples of research on societal safety range from mapping the consequences of hacking attacks in the energy sector and technical solutions related to tunnel safety, via the prevention of extremism and terrorism, human trafficking and sexual violence, to the coordination of international humanitarian operations and peace-building mediations (European Commission 2018-2020). Research and innovation activities to protect citizens and societies,including infrastructure,services and political stability, resonate with the UN's 16th Sustainable Development Goal to promote peace, justice and strong institutions.

The gender dimension in research on societal safety

According to the EU Commission, the gender dimension is relevant in research on societal safety. Despite increasing awareness of how risk,safety and vulnerability may have different implications for men and women, boys and girls, there are still not many research projects within societal safety in the Global North that have included the gender dimension. Relevant research questions may be:

- How do cultural and social norms of gender and sexuality govern behaviour related to societal challenges, such as migration and border control, accident prevention, road traffic safety and crisis management? What are the implications of gender relations in the armed forces?
- By what means can humanitarian aid be better organized so that the needs of both men and women, boys and girls, are met? How can sexual abuse and rape in conflict and disaster-affected areas be prevented?
- In which ways are extremism and terrorism related to gender? Is there a connection between masculinity and violence? Why are women joining extreme right-wing and Islamist terrorist groups that promote misogynist ideologies? How can gender analysis help us to understand how violent extremism can be prevented?

Men are also raped in war

After the civil war in the former Yugoslavia, the international community became more aware of how rape of the enemy's women is used as a strategic weapon in war. Later, a number of international campaigns were launched against war-related rapes in the Democratic Republic of the Congo. However, to understand the context of wartime sexual violence, it is not sufficient to conduct research only on the women who have been raped; it is also necessary to study the men who commit rape, as well as the men who are raped. A study from the civil war in Uganda shows that 30 percent of the victims of sexual violence were men (Lilleslåtten 2017). Files from the International Criminal Tribunal for the former Yugoslavia (ICTY) reveal that of the 30 convictions of sexual violence during the civil war, seven cases involved male victims and male perpetrators (Houge 2014).

To combat sexual violence in war and conflict, it is essential to see beyond gender stereotypes and oversimplified perceptions of gender roles in war. Men and women do not constitute homogeneous groups; men are not always the perpetrators and women are not always the victims. It is necessary to see every conflict situation in context. For example, in the former Yugoslavia sexual violence was used as part of a war strategy, whereas in other places sexual violence has occurred during chaotic situations, but without being sanctioned. Research in the field of women, peace and security has shown that overgeneralizations, such as assuming that women by nature are more peaceful than men, can enhance already existing gender inequalities (Kilden / The Research Council of Norway 2017). According to Élise Féron, who has carried out fieldwork in the Great Lakes Region of Africa, wartime sexual violence against men stems from the same logic under- pinning sexual violence against women, a logic that upholds and reinforces gendered social hierarchies (Féron 2018).

Gender equality, diversity and societal security

The Nordic research project Gender Equality, Diversity and Societal Security (2018-2021) explores how increasing levels of diversity in the personnel of Nordic security forces, i.e. the army, the police and other security organizations, relates to changing perceptions of trust and security, both within these organizations and in their broader interactions with society.

The Nordic countries are traditionally associated with high levels of societal trust, egalitarian values, and peaceful forms of conflict resolution through cooperation within and among political and corporative organizations. These characteristics also constitute the underpinnings for the ways in which security work is perceived and conducted in a Nordic setting, which is manifested in recent reforms that introduced conscription on formally equal terms for men and women in Norway and Sweden. The project combines empirical studies of Norway, Sweden, Denmark and Finland, with the aim of providing new knowledge about how actors and organizations in the field of societal security in the Nordic

region relate to increasing diversity in security forces in terms of attitudes, guidelines and everyday practice. In addition, the project will investigate the effects of an increasingly diverse composition of the security forces, including within related policy- and decision-making processes (STK 2018).

Women's contribution to informal disaster response

By Kristin Sørung Scharffscher, Department of Safety, Economics and Planning, University of Stavanger, Norway

In the aftermath of the tsunami on December 26, 2004, international relief workers arrived at the lagoon town of Batticaloa, on the east coast of Sri Lanka. Some four years prior, the UN Security Council had adopted Resolution 1325, which urges all UN organisations to respond to women's needs and recognize women's resources in all UN-controlled humanitarian activities. Manuals and guidelines on how to include the gender dimension in humanitarian operations were put in place, and throughout the 2000s the proportion of women in the UN system had increased considerably – at least in the field.

The lagoon town of Batticaloa in Sri Lanka was severely affected by the tsunami. Thousands of humans and farm animals died, there was major material devastation, and entire neighbourhoods found themselves without housing. The international community sent vast amounts of money, large quantities of equipment, and numerous personnel to assist in Batticaloa. However, in this small eastern town, several strong networks of women were already operative, having organised local relief work immediately after the tsunami to help those affected. These networks met regularly and had detailed knowledge of everything from functional means of transportation to which widowed fathers experienced alcohol problems or who would benefit from training in housework and childcare. The networks also created a soup kitchen, where women from different ethnic and religious groups came together to prepare and distribute hot meals. This was not mere relief work. It was also about re-establishing contact, mutual understanding and solidarity after 20 years of civil war.

The women of Batticaloa were experts on how emergency operations can be efficiently provided, how to reach those who need it the most, and how humanitarian aid may even work as reconciliation and peace-building mediation. However, the women of Batticaloa were neither consulted nor invited to the meetings organized by the UN. The few of them who attempted to establish contact with the international aid agencies had to cope with meetings that were exclusively held in English, and with social norms and rules of a Western character. The result was that local efforts in Batticaloa were undermined and partly dismantled by the good intentions of international relief (Scharffscher 2011).

Did you know?
Women develop post-traumatic stress disorder (PTSD) twice as often as men after terrorist attacks

In the aftermath of the terrorist attack on the Norwegian government building in Oslo on July 22, 2011, researchers interviewed people who were affected by the bombing. Ten months later, 12 percent of men and 31 percent of women had symptoms of PTSD (Birkeland et al., 2017). The study confirmed international research showing that a significantly greater proportion of women than men get PTSD, even when they have experienced the same life-threatening event, such as an earthquake.

Why is it so? The gender differences can be explained by biological and social factors (Løvereide 2018 [in Norwegian]). Because PTSD often entails reliving the trauma, one reason why women are more likely to get PTSD may be that on average they remember more details than men. Hormonal cycles can also affect how events are interpreted. At the same time, it is more culturally acceptable for women to show their emotions, while men are more often socialized to be tough and not show feelings of "weakness", and are thus more reluctant to seek professional help. Hence, more men may suffer from PTSD than the number who are diagnosed with the condition.

Psychological research also shows that a traumatic experience is reinforced by previously experienced trauma. For example, a person who has experienced sexual abuse or violence from someone close is more vulnerable to PTSD after other types of traumatizing events.

Also, it is perceived as worse to be exposed to trauma that other people have perpetrated intentionally than to be exposed to an "impersonal" accident. Therefore, people exposed to family violence have PTSD more often than soldiers in war. To give people adequate treatment after traumatic experiences, it is important to consider both sex and gender differences in research on PTSD symptoms.

Far-right white supremacist groups and gender

A great deal of research on far-right movements shows a connection between racism and conservative attitudes about gender. However, views on gender roles and women vary greatly among the various far-right extremist groups. According to Kathleen Blee, a professor of sociology at Pittsburgh University and a specialist in far-right racist groups in the US, racism is often connected to misogyny. On the other hand, racism has also been used to promote women's rights, as the Ku Klux Klan did when they advocated for women's suffrage as a way to make up for the votes of black men in the early 1900s. Also, there are significant differences between far-right groups in the US and Europe. One deals with the tendency of some European nationalist groups to claim that "our" gender equality is threatened by Muslim oppression and homophobia, even organizing their own anti-Islamic far-right LGBT sections. This "homonationalist" current is less prevalent in the US (Lilleslåtten 2018 [in Norwegian]).

Far-right groups are generally male dominated. While it is estimated that approximately 20 percent of the members of Ku Klux Klan and neo-Nazi groups are women, their role in these groups is less visible. Kathleen Blee has specifically investigated the role of women in far-right extremist and neo-Nazi groups in the US, their motivation for joining them and also for leaving them. Recruitment to far-right groups usually takes place through personal relationships, and women and men have somewhat different motivations. Often, women are attracted to the groups through a personal connection, or because they are promised the power and influence to make a difference on behalf of women, as well as on behalf of the family.

Within far-right white supremacist groups, women may have important roles related to organizing and recruitment. Since men usually have the visible positions, women's roles in the extremist groups are often underestimated. During police interventions in violent situations, only the men are usually arrested, while the women are sent home because they are thought to be "just" the girlfriends. According to Blee, women participate more in the planning of crime than in the violence itself, but it is possible that they perform more violence than the police assumes.

To reduce the threat that the far-right poses to democratic and safe societies, it is just as important to understand why people exit them as to know why they join. In a study of former white supremacists in the US, Blee and her colleagues found that for most women, leaving is a three-step process:

becoming disillusioned, imagining that leaving is feasible, and seeing life on the outside as possible. Often, women first become disillusioned because of a conflict with other members (Blee, Simi, Latif and DeMichele 2018).