ACT ON INTEGRATING SEX AND GENDER ANALYSIS IN RESEARCH & INNOVATION

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CONSORTIUM

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Introduction

Integrating sex and gender analysis into research and innovation (R&I) enhances the quality and impact of scientific results as well as products and services developed for the market. Given the historic under-representation of women in science and certain areas of the labor market, it is not surprising that knowledge itself is biased, having a higher male footprint.

The failures to consider and integrate gender dimensions in study design and innovation processes perpetuates significant biases and gaps in knowledge which limit the relevance of science to society at best or is outright dangerous and life-threatening at worst.

A recent example for the need to integrate sex and gender analysis in research concerns the impact of the Covid-19 pandemic (Cousins 2020; Buckee 2020). Sex differences exist in terms of more men dying from the acute infections caused by the virus than women (Klein et al. 2020); however, "women are projected to suffer more than men form the health, economic and social consequences of the pandemic in the long terms" (Oertelt-Prigione 2020). The global pandemic also exhibits important differences from a gender perspective. Gender stereotypes drive persistently more women into caring professions than men (International Labour Office 2016), with the consequence that frontline workers being exposed to the virus are predominantly women. The United Nations Office for Project Services (UNOPS) has drawn attention to the fact that many women have less job security and less access to social protection than men, making their livelihoods more likely to be affected by lay-offs, which in many countries have concentrated on the services sector, where the majority of workers are women (Morgan et al. 2020). In addition, the pandemic has increased domestic violence against women and girls, urging for example the UN Secretary General António Guterres to call for a "ceasefire" of domestic violence against women and girls during lockdowns (UN News 2020).

Although a EU's regulatory framework has been put in place to address gender equality in society and within the European Research Area in particular, progress has been slow. As the Genderaction policy brief for example argues, the gender dimension is still absent to a large degree from policy documents dealing with Open Science and Open Innovation policies (Institute of Sociology of the Czech Academy of Sciences 2019). Similar, the policy brief by Standing Working Group on Gender in Research and Innovation concludes that innovation policy at the EU level "does not adequately address gender issues" (ERAC Standing Working Group on Gender in Research and

Innovation 2019).

Given the importance of integration sex and/or gender analysis into research and innovation, the following booklet summarizes the key arguments and presents selected examples with the aim to facilitating researchers a first approximation and reflection within their field. Many excellent guidance documents exist already (European Commission. Directorate General for Research and Innovation 2020; LERU 2015; LIBRA 2018; Schiebinger et al. 2016). Our focus is on the added-value of integrating sex and gender in research and innovation from a Community of Practice approach.

Why is this important?

Integrating sex and gender analysis into research processes and into applications of knowledge for innovation is needed to help identify when, why, and how female-male differences influence results. It may be that sex/gender are not relevant at some level. For example, the particles making up matter and radiation have no sex or gender, but considered from a systemic point of view sex/gender may be very relevant at another level, e.g. the safe use of ionizing radiation in cancer diagnosis and therapy where sex and gender differences matter for the correct calculation of the dosage (Olson 2017), which in turn has implications for procedural standards, and public health, among others. One example of the costly consequences of a gender 'blind' approach is the cancelled NASA space-walk by a woman astronaut in 2019. Since the available spacesuits had been modelled for men, they were too large to be used safely by the woman astronaut (Cantor 2019). The withdrawal from the market of 10 prescription drugs, eight of which were more dangerous to women, exemplifies the potentially deadly nature of ignoring sex/gender differences in medical research (U. S. Government Accountability Office 2001).

Sex and gender differences capture fundamental aspects of our biological and social reality. In humans, "sex" refers to the biological attributes that distinguish male, female and intersex which involves the chromosomal make-up, the germ cells and morphology (European Commission. Directorate General for Research and Innovation 2020 – hereafter GI2). For example, sex differences are tied to different metabolic profiles for women and men, which are significant for diagnosing diseases linked to metabolic disorders such as diabetes and Alzheimer's (Siegert et al. 2012). Similar, the differential role of sex hormones, specifically estrogen, has been described as having an impact on the clinical course and treatment of schizophrenia (da Silva and Ravindran 2015). The importance of sex differences is not limited to humans but equally applies to animals and has to be considered already on the level of individual cells (Shah, McCormack, and Bradbury 2014; Pollitzer 2013). Importantly, recent research has highlighted that "sex" is not to be conceived as strictly binary, but involves rather a more fluid and

wider spectrum than “male” and “female” (Ainsworth 2015) which is of increasing importance for example in the study of intersex in marine species.

“Gender” on the other hand refers to the socio-cultural attitudes, behaviors and identities. Gender provides a basic vector of our interpersonal communication and interaction. “Gender reveal parties” (Gieseler 2018) draw our attention to the whole set of gender norms and expectations that exist before we are even born, including gender adequate names, cloths, colors, toys. These expectations become stronger with age, channeling for example women and men into “suitable”, i.e. gender-conforming professions: Computer Science is an almost exclusive reserve of men while nursing is a predominantly carried out by women (International Labour Office 2016). Gender stereotypes condition also individual desires, aesthetic preferences, and self-concepts with men usually being perceived as more agentic and competent and women more communal (Eagly et al. 2019). Importantly, gender is about social (in)justice as access to resources, decision making positions and political power are distributed on the basis of these gender differences, predominantly to the disadvantage of women (Ridgeway 2007; Fraser 2003).

Recent efforts are increasingly directed to take into consideration “intersectional” aspects, that is, how gender and sex overlap with other categories of social discrimination such as class, age, sexual orientation, ethnicity or disability (World Health Organization 2020). Intersectional analysis explores how factors of privilege and penalty may alternate between contexts or occur simultaneously and shape individual life experiences. For example, Canadian indigenous people are more severely affected by cardiovascular disease compared to non-Indigenous Canadians due to their lower socioeconomic status, higher levels of alcohol and drug addiction and lack of sufficient access to health services (Kapilashrami and Hankivsky 2018). Given that heart failure also is conditioned by sex and gender differences (Regitz-Zagrosek 2020) illustrates the importance of combining a sex and gender analysis that differentiates between women and men with other categories such as social class, ethnicity, religion or disability.

Overall, as the recently published Gendered Innovations 2 report summarizes (GI2), the integration of sex and/or gender analysis into research and innovation:

- adds value to research in terms of excellence, creativity and business opportunities;
- helps researchers and innovators question gender norms and stereotypes, and rethink standards and reference models;
- leads to an in-depth understanding of diverse gender needs, behaviors and attitudes;

- addresses the diverse needs of citizens of the European Union and thereby enhances the societal relevance of the knowledge, technologies and innovations produced;

- contributes to the production of goods and services better suited to new markets.

In the words of Londa Schiebinger,

> "This is my main message: integration sex, gender and intersectional analysis into research is one crucial component contributing to world class science and technology. Research done right adds value to research by enhancing excellence, by offering new perspectives, posing new questions, and helping to ensure that research contributes to social and environmental justice." (Source: ACT video interview)

Recent News and Insights from Research

Considerable ground has been covered since the publication of *Gendered* Innovations in by Londa Schiebinger (Schiebinger 2008). This first edited volume contained several case studies on the benefits of integrating a sex and gender analysis in research, ranging from car design, to archaeology or Geographic Information Systems which inspired comparable explorations across many other disciplines in science and engineering. The dedicated website hosted at Stanford http://genderedinnovations.stanford.edu/index.html is as well known repository of case studies across the sciences, health & medicine, engineering and the environment.

Health & Medicine & Life Sciences

The integration of sex and gender analysis in medicine and health has covered considerable grounds and produced solid evidence of its impact. Among the standard examples of the benefits of "fixing" the scientific knowledge from gender bias is the case study on the symptoms, diagnosis and theory of heart diseases which differ along sex and gender (Regitz-Zagrosek 2020). Other, equally convincing case studies exist for Osteoporosis which remains "under-diagnosed and under-appreciated" in men (Adler 2018), the "enigma of male eating disorders" (Murray et al. 2017), (organ) transplantation research (Laprise et al. 2019), or dementia (Tierney et al. 2017) to name just a few. Overall, as Oertelt-Prigione argues, sex and gender differences affect all dimensions of human health ranging from the biological basis of the disease to therapeutic access, choice and response (Oertelt-Prigione and Mariman 2020).

A fascinating area of study especially in terms of the intertwined nature of sex and

gender factors is the study and treatment of chronic pain (Dance 2019; Mogil 2020). The fact that most patients of chronic pain are women has been explained in part by gender differences in terms of women's high willingness to report pain and seek help. At the same time, basic pain research relies predominantly on male rodents – thus possibly "providing an accurate picture of underlying biological mechanisms in males only" (Mogil 2020). Indeed, research has shown that pain processing pathways are diverse including different immune-cell types that differ across the sexes. Thus, ignoring sex and gender analysis in pain research could be biased on a basic level and hence affecting the quality of downstream research and innovation in terms of drug development and its effectiveness.

Machine Learning – Artificial Intelligence – Big Data

One area which is receiving an increasing amount of attention is the gender dimension in artificial intelligence. Machine learning is increasingly informing human decision making for example during medical diagnosis (Larrazabal et al. 2020), recruitment processes (Raghavan et al. 2020), credit scoring (Onay and Öztürk 2018), learning processes (Selwyn 2019), policing (Moses and Chan 2018) or criminal justice (Završnik 2019) to only name a few. Completely autonomous systems such as self-driving cars for example can supplant human decision making altogether (Badue et al. 2021). With this widespread use of AI technology comes also heightened scrutiny regarding its implications. Even though machine based decision making enjoys an aura of "impartiality" – the truth is more complicated. As a growing literature shows, algorithms take decisions that are not necessarily "fair" (Mitchell et al. 2021) but rather propagate existing bias or actually amplify these (Douglas 2017).

For example, the analysis of gender and race bias in AI is relatively well established. As the *Gender Shades* project has shown, face recognition algorithms exhibit a considerable bias towards white male faces. Face recognition for women and especially women with darker skin is up to 33.8% less accurate than for white men (Buolamwini and Gebru 2018) - highlighting at once the intersectional nature of gender and race in AI for face recognition. Natural Language Processing tells a similar story. As the analysis of Google Translate has shown, the underlying machine learning algorithms default to "masculine" pronouns like "him", "he", "his", "himself" because these pronouns do occur more frequently in the historical text corpus used for training the translation algorithms (see Prates, Avelar, and Lamb 2020; Gendered Innovations case study on Machine Translation[1]).

Important bias has also been detected in the way search (meta) data is handled. As Datta and colleagues (2015) reported, Google's channeled men more often to high-

1 See http://genderedinnovations.stanford.edu/case-studies/nlp.html

income job ads than women. In a similar experiment, a STEM job advertisement that was purposefully constructed as gender neutral was served in a discriminatory way to more men than women (Lambrecht and Tucker 2019). The underlying problematic of gendered associations between "women" or "men" with certain professions, salary expectations or other stereotypical word associations thereby forms part of wider problem of AI to mirror existing racial or gender bias in society. Addressing these issues is an urgent problem, as the impact of biased algorithms is huge, potentially reaching billion users a day. The auto-complete functions of search engines for example, appears biased (Roy and Ayalon 2020), as do the automatic speech captions for videos (Tatman 2017) or abusive language detection algorithms (Park, Shin, and Fung 2018).

Environment & Sustainability Science

In the last five years a new urgency to apply gender lenses to science knowledge has emerged by the need for evidence to help implement the 17 goals of the UN Agenda 2030 agenda. A group of 15 independent scientists (Messerli et al. 2019) appointed by the UN to produce the 2019 Global Sustainable Development Report (GSDR) identified critical gender biases and gaps in knowledge sources used to establish interlinkages and synergies between different Sustainable Development Goals (SDGs), as a way of identifying the co-benefits and trade-offs of possible implementation strategies.

Half of the SDGs are 'silent' on gender and have no gender-related targets or indicators. As a consequence, gender equality objectives of the Agenda 2030 are under-measured and under-reported. An analysis of the indicators in the Global SDG[2] Indicators Database reveals that for 4 of the 17 goals, less than half of 194 countries, or areas, have internationally comparable data. This lack of country-level data is particularly worrisome for Goal 5 - Gender Equality where on average only about 4 in 10 countries have data available[3] and the "*promise of a world in which every woman and girl enjoys full gender equality and all social, economic and legal barriers to their empowerment have been removed, is under risk of being unfulfilled*".

Science is expected to contribute knowledge and solutions for SDG implementation efforts, but the current body of sustainability science is largely blind to sex/gender differences and how they are affected by the environment. This is critical not only for humans but also for sustainability of natural environment and the wellbeing of natural ecosystems as a source of livelihood and health. For instance, Marine Ecosystems can be disturbed by climate change effects, which combined with human action, can disrupt the reproduction and survival rates of individual species, potentially resulting in systemic instability. And although the sex ratio of a population is key for its resilience to

2 See https://unstats.un.org/sdgs/indicators/database

3 See https://unstats.un.org/sdgs/report/2020/The-Sustainable-Development-Goals-Report-2020.pdf

environmental disturbances, sex as a variable of marine ecosystems is only addressed in less then 4% of studies dealing with ocean acidification, temperature changes or CO2 levels are addressed (Ellis et al. 2017). For certain species of turtles for example, their sex is determined by incubation temperature during embryonic development (Jensen et al. 2018). Rising temperatures can lead to the feminization of the population which then can reduce the reproductive capacity of the species and harm how species co-exist in an ecosystem (Lindström and Kokko 1998).

The COVID19 pandemic has underlined and amplified many gender-based vulnerabilities. The pandemic is a reminder that our health, our economies, animal health and the natural environment are all interlinked. Nature and habitat loss and large-scale land conversion for food and livestock production combined with environmental degradation have increased the risk of future pandemics and weaken our resilience against climate change and other disasters.

Engineering & Innovation

Early examples regarding the importance of sex/gender analysis in engineering featured the safety tests of cars. Crash test dummies modeled on data for men without taking into consideration different size of female bodies is unsafe. The woman's spine has smaller vertebra that are separated by larger distances than man's, which can explain the observed sex differences in car crash injuries. Historically, cars have been less safe for women (48% higher risk) but newer cars can be even less safe for women (70% higher risk) because the seat has been re-designed to be harder to protect the driver in high-speed frontal crashes, which advantages men who drive fast but not women who drive more slowly and experience more tail-end crashes resulting in high numbers of whiplash injuries suffered by women. More recent approaches along these lines target to construct more inclusive and sex/gender aware innovation scenarios from the outset. As indicated in the recently published Gendered Innovation 2 Report, these participatory methods have been applied in the design of waste management systems, high quality urban spaces and new transport systems (GI2, p.114ff). Mobility patters in particular are gendered in terms of when, where and why people make trips. This is true from a historical perspective and remains true in more recent developments such as "smart cities" and "smart mobility" in the sharing economy (Singh 2020; Uteng, Christensen, and Levin 2019). Women tend to do multiple short trips and favor the mobility patterns of men who tend to do single and longer journeys (de Madariaga and Zucchini 2019). Rethinking mobility patterns that are sustainable and more safe requires the integration of sex and gender into research.

The Role of Communities of Practice

Although research on sex and gender differences across scientific disciplines is thriving, these initiatives lack formal organization. There exists for example an International Society for Gender-Specific Medicine[4] and the Israeli Society for Gender Medicine[5], but similar professional bodies specific to sex and gender analysis are rare in other disciplines. Hence, important research is carried out by individual scientists in more or less isolated fashion, often on the margins of their academic field.

A Community of Practice can provide an alternative forum for integrating sex and gender analysis in research. As knowledge is constantly evolving, there are not ready-made recipes to be applied. In many fields, adequate methods need to be developed, for example to determine sex in a non-invasive fashion such as mussels (Ellis et al. 2017). Often, what is required is a willingness to question established knowledge, standardized procedures and benchmarks. An interdisciplinary dialog is necessary between subject specific experts in a given domain and gender experts.

A community of practice can provide an informal forum where these questions can be explored and critical ideas regarding the established "wisdom" of the field be tested. As a Community of Practice is primarily defined by a shared interest or "domain", it allows for flexible configurations of members across scientific disciplines and practitioners within certain areas. As Sabine Oertelt-Prigione emphasizes (Source: ACT video interview), only through the collaboration between disciplinary experts and gender/sex experts can we advance knowledge and provide convincing examples, anchored in practice, that create awareness and help others to get started with sex/gender analysis.

The integration of a sex and gender analysis touches upon many different aspects of the research ecosystem. It not only involves researchers, i.e. those who actually conduct research. Scientific publishers and their editorial policies play an important role in overseeing quality standards for sex and gender reporting which reverberate back to the design, data collection and analysis stage of research. The Sex and Gender Equity in Research (SAGER) guidelines serve as a standard in this respect (Heidari et al. 2016). An other important player in the research ecosystem are funding organizations. The ACT Community of Practice FORGEN[6], for example, has an internal working group to explore how the integration of the gender dimension into a research proposal can be evaluated during the pre-funding stage. Many different types of Communities of Practice can be imagined that address these different aspects in more detail.

4 See https://gendermed.org/the-international-society-for-gender-medicine/

5 See https://www.isragem.org.il/english

6 See https://forgen.act-on-gender.eu/

Recommendations and Institutional Best Practice

Gender Equality Plans (GEP) are an important instrument to support the integration of sex/gender analysis in research and teaching.

- Information campaigns can raise awareness regarding the importance of sex and gender analysis in research and innovation and its associated benefits or costs.

- Supportive policies create the necessary mandate to integrate the gender dimension into teaching and research. These policies can create a favorable environment where discussing sex and gender in research is a sign of excellence.

- GEP can foresee capacity building exercises and seminars to train professionals in sex and gender analysis during each stage of the research process.

- GEPs can also provide incentives for the integration of sex/gender through internal awards for best thesis or research project.

- Institutional policies can stipulate the creation of a forum or Community of Practice across the scientific disciplines; interdisciplinary work or collaborations between gender scholars and other disciplines is costly and need to be adequately supported.

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