On the Use of Innovation Arguments for Getting Gender Research into STEM[1]

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Abstract

Recent international top-down initiatives invoke the integration of sex and gender into the governance of all fields of science and technology, from funding to research and development to publication policies, and to the assessment of the impact of scientific knowledge and technical products in society. But how can these initiatives be assessed relative to the call for a new governance of science and technology by inter-disciplinary research? The *Gendered Innovations* project is a main resource for these governmental actions. This article elaborates on contents and concepts of 'gendered innovations' in relation to the findings and scope of knowledge available from feminist science and technology studies. It contrasts the separation of sex and gender in this project with current changes in dialogue between feminist science and technology studies, and science, technology, engineering and mathematics fields that can guide transdisciplinary exchange and the acknowledgement of research for sex/gender interactions and intersectional categories. Finally, the strategic invocation of innovation is questioned and the article offers approaches to include feminist epistemologies and postcolonial perspectives in science, technology, engineering and mathematics.

1 STEM stands for Science (including Biomedicine), Technology, Engineering, and Mathematics.

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Keywords

Feminist Science and Technology Studies, Gendered Innovations Project, Sex/Gender, Governance of STEM, Innovation, Intersectionality, Postcolonial Perspectives, Feminist Epistemologies

1 Sex and Gender in STEM: A Window of Opportunities for Governing Science?

In September 2015, the *League of European Research Universities (LERU)*,[2] published an advice paper titled *Gender Research and Innovation: Integrating Sex and Gender Analysis into Research Processes* (Buitendijk and Maes 2015). Likewise, the *European Research Area Roadmap (ERA)* (European Union 2015)[3] and the guidelines from the US *National Institutes of Health (NIH)* (NIH 2016)[4] have put the inclusion of sex and gender on the agenda for funding and publication policies. These recent top-down initiatives from leading academic and funding institutions consider sex and gender research as innovative for science and technology; the results, in turn, should inform the governance of these fields at several levels. Firstly, the inclusion of gender research can promote cultural change within science, technology, engineering and mathematics fields, which is a necessary prerequisite for the better inclusion of female scientists, the latter being a motor for achieving excellent research in international competition (European Union 2015; Buitendijk and Maes 2015). Secondly, the integration of sex and gender aspects into health research and therapy could

2 The *LERU*, a consortium of 21 research universities established in 2002, aims at "furthering the understanding and knowledge of politicians, policymakers and opinion leaders about the role and activities of research-intensive universities" (League of European Research Universities n.d.).

3 Part of the European research funding programme, the *ERA Roadmap's* "purpose is to identify a limited number of key implementation priorities which are likely to have the biggest impact on Europe's science, research and innovation systems" (European Union 2015, p. 13–14). "Gender equality and gender mainstreaming in research" is positioned as priority 4 (amongst 6) for funding applications in *Horizon 2020*.

4 Part of the United States Department of Health and Human Services, the *National Institutes of Health* is the US major funding agency for medical research. It calls for the integration of sex and gender into the governance of health-related issues (National Institutes of Health 2016).

reduce costs in the health sector caused by inadequate diagnoses and treatments (Buitendijk and Maes 2015; NIH 2016). Thirdly, gender research improves the social inclusion of all members of society into developments of technical innovations and gives them access to the latest scientific findings (Buitendijk and Maes 2015; European Union 2015; NIH 2016). In this article, I will discuss these initiatives under the framing of a new governance of science and technology that stresses the need for more integrated research and policies to solve global problems, and consequently calls for interdisciplinary approaches from different disciplines (Lyall 2005). Gender research can be seen as an innovative approach to these problems because of its genuine inter- and transdisciplinary perspective for targeting these objectives. The question, however, is to what extent sex and gender is taken up by science and technology, which actors take sex and gender into the governance of science and technology, and which concepts have been integrated so far.

The European and international initiatives can be read as based on a definition of 'social innovation' that

> "refers broadly to innovation in meeting social needs of, or delivering social benefits to, communities – in creation of new products, services, organizational structures or activities that are 'better' or 'more effective' than traditional public sector, philanthropic or market-reliant approaches in responding to social exclusion" (Moulaert et al. 2013, p. 1).

Recent gender initiatives such as the *Gender-Net ERA-Net* programme[5] similarly use the notion of social innovation to position the 'value of gender research' for achieving scientific excellence "through structural change by developing and implementing gender-equality plans […] and consequently improving the recruitment and career paths of female scientists" and through the "integration of sex and gender analysis into all phases of basic and applied research" (Gender-Net 2013).

Last but not least, besides the improvement of numbers and knowledge, critical reflectivity and positioning is at the core of social innovation because "debate, controversy and imagination will be the key to methodological improvement" and "the final reason is probably the most important and also the most challenging for researchers: it is about how to position themselves in the 'social arena' and how to contribute to its transformation" (Moulaert et al. 2013, p. 3).

Sabine Hark (1998) and Gudrun-Axeli Knapp (1998) show how the first phase of academic institutionalisation of women and gender studies in Germany during the 1990s was partly successful because it was linked to the branding of universities

5 *Gender-Net*, funded by the *7th European Union's Framework Programme*, particularly targets transnational networking (Gender-Net 2013).

when it came to promoting their innovative standing in interdisciplinary encounters. Nevertheless, Hark and Knapp point to the limits of this institutionalisation. Gender research should be more than a mere interdisciplinary complement to disciplinary research which leaves borders intact. Instead, at its core there should be a transdisciplinary traversing of concepts, methods and terms (Knapp 1998, p. 43). Transdisciplinarity always includes critical reflection on the social and cultural impacts on the mechanisms of scientific knowledge production. Both Hark and Knapp ask how far transdisciplinarity as a deconstructive practice of gender research (Hark 1998, p. 16) has been lost on its long march through the institutions – and how its reflective impetus is inevitably silenced when institutionalisation is labelled *innovation* (Knapp 1998, p. 51).

Therefore, the particular question I take up in this article is about the benefits and the disadvantages of the recent initiatives for the integration of sex and gender, particularly into science, technology, engineering and mathematics, which are again driven and legitimized from both governmental and gender actors in advertising the *innovative potential of gender research*. This analysis will lead to the question of the (strategic) use of the innovation argument per se: is it a help or a hindrance for feminist concerns, and at what cost?

The recent advice for a new governance of science *with* sex and gender, i. e. the *League of European Research Universities*' paper in particular, and also the *European Research Area Roadmap*, the *National Institues of Health's* guidelines and even the *Gender-Net ERA-Net*[6] refer to the *Gendered Innovations* project (Schiebinger et al. 2016a) as their main source of information and guidance. Taking this project as a case study, I will first outline the setup of the *Gendered Innovations* website, elaborate how it addresses the term *innovation*, and point to the demands arising from a perspective of science and technology studies to consider mechanisms of knowledge production (section 2). I will then analyse some challenges that result from relating the knowledge presented by *Gendered Innovations* to the concepts and findings of feminist science and technology studies: its definitions of sex and gender as well as its concepts of female versus male needs and the question of how far intersectional and epistemological approaches could be implemented and disseminated into the initiatives of academic governance (section 3). In section 4, I will consider the aims and decisions of the *Gendered Innovations* developers concerning the strategic use of innovation arguments. Section 5 will deal with the argument of utilisation and usability of a new governance of science and technology which is advertised to develop to its fullest under the rules of a free market (Rothbard 2015), i. e. decisions

6 The *Gender-Net Era-Net* is the only initiative which also refers to another resource: the *Gender Toolkit* (European Commission 2009) to which I will return in section 6.

for funding a particular type of research should be based on the expectation of its economic benefit. Should the integration of gender research follow this call to be an innovative supporter for economic benefit, and could it reach gender equity with this strategic movement? Based on these analyses, I will finally (in section 6) take up the question of the potential and the limits of the strategical use of the innovation argument to open up a window of opportunities for the integration of sex/gender studies, particularly into science, technology, engineering and mathematics, and will call for a pluralism of strategies instead of one 'master's tool'.

2 *Gendered Innovations* – Innovative for What?

The *Gendered Innovations* project, fully titled *Gendered Innovations in Science, Health and Medicine, Engineering, and Environment,* was initiated in 2009 by Londa Schiebinger from Stanford University and has been co-opted by the European Union in 2012, based on her collaboration with Ineke Klinge and Martina Schraudner. The project's website presents case studies to inform science, technology, engineering and mathematics disciplines on how they could benefit from considering the categories of sex and gender in research and development. Definitions of "terms" and "methods" (Schiebinger et al. 2016a) are provided in subsites and are linked to the case studies. Further rubrics address "design thinking" (including advertising tips for 'gendered products'), "policy recommendations" and ideas for "institutional transformation" (Schiebinger et al. 2016a).

Schiebinger is a historian whose papers and books on the inscription of gender in the emergence of science as an academic discipline from the 17th to the 19th centuries (Schiebinger 1989) inspired feminist science studies. Recently, she edited a four-volume handbook with relevant papers in this field of research (Schiebinger 2014). Klinge, a biologist by training, is professor of Gender Medicine at Maastricht University. She has a long-standing engagement in the EU governance of biomedicine and works on the multiplicity of differences concerning sex, gender, ethnic origin, age, sexual orientation and (dis)ability (Klinge and Bosch 2005; Klinge and Wiesemann 2010). Schraudner, an expert in biology and biotechnology, heads the *Centre for Responsible Research and Innovation* at the Fraunhofer Institute and is professor for Gender und Diversity Aspects in Organisations at the Technical University of Berlin.[7]

7 I outline the research backgrounds of the developers of *Gendered Innovations* here because of their self-positioning within a critical feminist agenda.

Already in 2006, Schraudner disseminated an approach to include gender for technological developments under the slogan of the "innovative potential of gender" (Bührer and Schraudner 2006, p. 3). When Schiebinger started the *Gendered Innovations* project, she also invoked the notion of innovation to affirm the qualitative improvement of scientific research through the introduction of a reflective standpoint from a gender perspective.[8] Such a strategic usage of the innovation argument could turn Hannah Arendt's philosophical-political question whether the

> "activity of thinking as such, the habit of examining whatever happens to come to pass or to attract attention, regardless of results and specific content, could this activity be among the conditions that make men abstain from evil-doing or even actually 'condition' them against it?" (Arendt 1978, p. 5)

into a scientific-political statement, i. e. that the ability to think, debate and obtain critical reflexivity should be introduced as a necessary requisite for any emancipatory scientific work, or in short: think gender, and you begin to think critically about your own practices and their outcomes.[9]

As a consequence, this invocation of innovation could call (again) for epistemological reflections, particularly within the science, technology, engineering and mathematics scientific programme. Thomas Kuhn's influential work (1962) on the mechanisms of knowledge production unmasked the long-held Enlightenment paradigm of a step-by-step discovery of more and more objective knowledge. Instead, he identified knowledge production as a process of historically and socially embedded negotiations. Ian Hacking (1983) explained how every kind of scientific research is an *intervention* as much as it claims to be a *representation,* because all experimental procedures are part of laboratory negotiations that produce results. According to Sandra Harding (1991), every experiment derives from a preceding theory (the theory-ladenness of observation), and the same scientific results can be used to support contradicting theories (the indeterminacy of theory). Since then, science and technology studies have produced an abundancy of analyses (Hackett et al. 2007) to show *how* scientific knowledge production is influenced by political, economic and social power relations, as well as by the researcher's objectives – both consciously and unconsciously.[10]

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8 Personal communication at a *Gendered Innovations* expert workshop in Brussels, 2012.

9 Sabine Hark already described a similar argument (1998, p. 15) for the first phase of gender institutionalisation.

10 That does not mean that scientific knowledge production is not applicable, but that it is constructed and socially situated.

For more than 30 years feminist science and technology studies, a transdisciplinary discipline, has differentiated these approaches by uncovering the gender-ladenness of Western scientific knowledge production. Scholars of feminist science and technology studies pointed out the gendered social impact and the cultural norms transported into science and technology and, conversely, the impact of scientific knowledge on gendered beliefs and social power relations, with both trends resulting in in- and exclusions of individuals according to their categorisation in particular gender groups; in short, as Evelyn Fox Keller defined it, "gender in science" (Keller 1995, p. 86) is – as well as in society – a structuring component of knowledge production. After that, standpoint approaches called for the inclusion of various intersecting categories of difference such as gender, ethnicity, class, age or dis/ability into scientific research. Where now can these facets of feminist science and technology studies – its definitions of sex/gender, its intersections with other categories and its epistemological perspectives – be found in the *Gendered Innovations* project?

3 Contrasting *Gendered Innovations* with Feminist Science and Technology Studies

The introductory webpage of *Gendered Innovations*, *Why Gendered Innovations?* begins by saying, "'*Gendered Innovations* employs methods of sex and gender analysis to create new knowledge" (Schiebinger et al. 2016a, author's emphasis), establishing a link to the benefit of gender research for new knowledge in science and technology and to the term *innovation*. For my analyses of the innovative value of gender research for a new governance of science and technology, particularly concerning its demands for inter- and transdisciplinary research to solve global problems (see section 1), the obvious question is: what kind of innovation is targeted by *Gendered Innovations* and what newness of knowledge is created by it? In the following, I will discuss the arguments and concepts of the *Gendered Innovations'* website in relation to the scope of knowledge already available from feminist science and technology studies. My analysis addresses three mutually interconnected challenges: (1) the sex and gender concepts and how they are assigned to women and men, respectively, (2) the inclusion or neglect of sex/gender interactions, and (3) the integration of intersectional perspectives and feminist epistemologies. Throughout this analysis, I consider how the *Gendered Innovations* project impacts on the recent European and US initiatives to the new governance of science due to its dominance as a reference.

3.1 Challenge 1: The Two-Sex Model and Its Assignments to Women and Men

Feminist science and technology studies have uncovered reductionist sexisms in scientific research and technological development (Schiebinger 2014). They unveiled the primary scientific focus on sex difference research and, simultaneously, the neglect of contrary or null results (i. e. the lack of mentioning differences between or the variations within the two sex groups). The referencing practice of that scientific knowledge, i. e. the so-called publication bias, established a binary two-sex model and the notion of behaviour, attitudes, preferences and desires as determined by biological sex. Feminist science scholars in primatology, behavioural studies, evolutionary and sociobiological research, developmental biology, immunology, endocrinology, and the fields of neurosciences analysed biases and distortions in the selection of the research objects, the research methodologies, the inclusion or exclusion of data in analyses, and the interpretations of results. They discovered inaccurate generalisations from animals to humans, from small participant groups to the general sex categories, and the maintenance of the two-sex model with its inherent homogeny and proposed differences of women versus men (Schmitz 2016).

So far, feminist science and technology studies have not only provided a theoretical and methodological framework for critical reflection of knowledge production in the science, technology, engineering and mathematics disciplines, but have also uncovered its social entanglements. During the 1980s, feminist scientists revealed that the assumptions that women have less intellectual capacities for scientific work reach as far back as classical antiquity. The interwoven mechanisms of gender discrimination served systematically to exclude women from particular disciplines throughout the history of science. The separation of public and private spheres in 19th-century bourgeois society, the masculinisation of the public sphere and the feminisation of the private sphere relegated women to simply their roles as housewives and mothers, and the naturalisation of social gender relations was manifested by linking femininity to nature and objecthood (Keller 1985; Merchant 1980).

The contributions of feminist science scholars in exchange with feminist sociologists increasingly challenged the legitimisation of gender roles, gender norms and gendered societal structures by naturalisations. The separation of biological sex categories from psychosocial gender categories beginning in the 1970s helped explain how differences between female and male groups result from 'doing gender' within gendered social power relations. As such, gender differences are constructed but nevertheless become real. However, this was not only an emancipatory step for women's empowerment and for promoting gender equity. It was perhaps even more important in terms of *social innovations*, because it pointed out the variability

within the gender groups; the intersections of discriminations by sexism, rassism and classism; and the possibility of crossing gender borders. All of these perspectives require much more differentiated research than a binary concept in order to solve intersected demands of discriminated groups, to reach beyond a simple ascription of different needs of women and men, or to utilize their capacities as human resources for economic benefit.

The criticisable binary assignments to women and men that resulted from the two-sex model, however, are still present in most of the case studies in the *Gendered Innovations* project, and the embeddedness of gender relations in powerful societal structures are only mentioned very rarely in some of them. The same critique holds for the *Discover Gender* project, launched by the Fraunhofer Institute (Bührer and Schraudner 2006) which derives its guidelines for research and technical developments from the same binary two-sex model with its assignments to distinct two-gender needs and its ignorance of all research on inherent variabilities and entanglements of gender within powerful social structures (Bath 2007).

The European Commission described the message of *Gendered Innovations* as follows:

> "The case studies presented in this report demonstrate that differences between the needs, behaviours and attitudes of women compared to men really matter, and accounting for them in research makes it relevant to the whole of society." (European Commission 2013, p. 5)

A closer look into the *League of European Research Universities*' advice paper (Buitendijk and Maes 2015) – which calls for the inclusion of sex and gender at all levels of research and development, from funding to research design to methods to data analyses and interpretation and up to the assessment of their impacts on all individuals and on social levels – reveals the following: the paper mostly takes up the binary assignments to different needs of women and men from the case studies of *Gendered Innovations*. However, it also briefly hints at some possible discriminatory outcomes by stating that "the risk of exaggerating existing small differences, or of wrongly claiming differences […], can result in perpetuating stereotypical views and/or in unjustifiably treating men and women differently" (Buitendijk and Maes 2015, p. 12). What becomes obvious here is the notion that possibly discriminatory consequences are due to social beliefs and norms, and are not anchored in the scientific knowledge itself.

Already in the 1980s, feminist scientists scrutinized the biologically determined two-sex model, calling for the de-pathologisation of intersex variety and of other than female/male sex categories (Fausto-Sterling 2000). A recently published paper (Ainsworth 2015) stresses the variety of sex in the genome, counts the many

variations in chromosomal settings other than xx and xy as 'normal', and denies their definitions as pathological. This paper could be called innovative as it was published in the leading science journal *Nature*. Keeping the focus on sex-based individual development, however, it follows a sex-line for biomedical research which was already determined by the US *National Institutes of Health* around the turn of the millennium (Wizeman and Pardue 2001). Following the recent appeal to research, "Sex in Every Cell" (Clayton and Collins 2014), most analyses continue to research sex (only) but not gender, and mostly stick to the traditional two-sex model (e. g. McCarthy et al. 2012).

3.2 Challenge 2: Sex/Gender or Sex and Gender?

The separation of the categories of sex and gender has led to its own problems as the sex-gender dualism follows the notion of a nature-culture dichotomy with far-reaching consequences. Alongside the assignments of sex analyses to the biomedical disciplines for decades, sex retained its status as an ontological category prior to culture and, in consequence, was deemed not a fitting research category for gender research. Vice versa, gender research, which was primarily based in the social and cultural disciplines, neglected analyses of sex until the 1990s, precisely to avoid the essentialism and naturalisation of sex research.

In recent decades, however, two major changes in conceptual and methodological approaches have turned the sex *or* gender debates into sex/gender debates. Firstly, since the 1990s the appropriateness of the separation of the categories of sex and gender has come into question within scholarly feminist debates. Poststructuralist notions stressed the constructed nature of sex as well as that of gender (Butler 1993) and feminist science and technology studies, by showing how gender influences become embodied, explained 'sex/gender' as always indivisible (Fausto-Sterling 2000). Using the term of *embodying,* concepts and research of the bio-socio-cultural interactions in sex/gender development aimed at bridging the nature-culture divide. Today, corporal sociology analyses bodies both as products as well as producers of society: social experiences form bodily materialities and functions; bodily dynamics influence individual and social praxis; bodies carry social values and cultural norms (Cregan 2006); gendered and sexed bodies only become intelligible through performative interpellations (Butler 1993). Such perspectives inevitably lead to the notion of diversity instead of sticking to a binary division of women versus men. Moreover, analyses of the dynamics of embodying establish methodological frameworks for researching the dynamic incorporations of the social and the socialisation of corporal materiality beyond pure construction or

determinism (Schmitz and Degele 2010). Not least, the upcoming feminist materialisms conceptualise the intra-actions of material dynamics, agencies, discourses, meaning-making processes and norms as constitutive for the becoming of any worldly phenomena (Dolphijn and van der Tuin 2012).

Secondly, the scientific and technological disciplines also increasingly struggle with the nature-culture divide. Today a variety of biomedical and technological fields work at the intersection of nature, technology and culture. They address aspects of diversity, of social and cultural forming of the biological and technical matter, and of categorical intersections as crucial targets of their research. For example, the neurosciences try to explore the mutual interchanges of brain development with social experience through brain plasticity; embodied cognition more and more focusses on the intersection of corporeal, affective and rational processing; nature-culture transgressions reach far into the body down to gene regulation in current debates of epigenetics (Schmitz 2016). Gender medicine not only increasingly acknowledges sex/gender interactions in the development, diagnosis and therapy of diseases, but also starts to account for the mutual and intersected social impacts of ethnicity, class and gender in health research, as Nancy Krieger (2012) shows in her eco-social embodiment approach.

In consequence, at least some of the science, technology, engineering and mathematics fields today seek dialogues with the humanities and the social and cultural sciences when interdisciplinary programmes target global challenges, as for example was recently advocated in *Nature* (2015). They meet the call of a new governance of science for innovative interdisciplinary intersections as, for example, with the *Gender-Net ERA-Net* initiative which points to the necessity of networking transnationally to find solutions to fight global gender discrimination. Even the *League of European Research Universities*' advice paper argues for transdisciplinary exchange for "creating new knowledge and to finding solutions to global challenges" (Buitendijk and Maes 2015, p. 3). Therefore, it has to be questioned whether such advocating of inter- and transdisciplinary approaches conjoin with sex/gender perspectives to assess whether they can lead to an anti-discriminatory governance of science.

The *Gendered Innovations* website refers separately to the categories of sex and gender in its sections titled *Methods* (Schiebinger et al. 2016a, author's emphasis) and *Terms* and always positions sex ahead of gender and analyses of sex ahead of analyses of gender (Schiebinger et al. 2016a, author's emphasis). The section *Sex and Gender Are Distinct Terms* is the first subsite in *Terms*, although at the end of this subsite, it states that "[i]n reality, sex and gender interact (mutually shape one another) to form individual bodies, cognitive abilities, and disease patterns, for example" (Schiebinger et al. 2016a). Another subsite states that "'[s]ex' and 'gender'

are analytically distinct but not independent terms" (Schiebinger et al. 2016a). Thus, the *Gendered Innovations* project, while referring to sex/gender interactions, insists first and foremost on the analytical separation of the categories of sex and gender when it comes to pointing out the innovative potential of the project.

This separation and order is adopted by the European position that starts with sex definitions followed by gender definitions (European Commission 2013, p. 43–47). The *National Institutes of Health* take up exactly the same separation in their online newsletter of May 2016: "Many people use the words sex and gender interchangeably, but they're distinct concepts to scientists" (NIH 2016).

The *League of European Research Universities*' advice paper, however, besides referring to the sex and gender separation, includes the following sentence:

> "Biological sex differences and behavioural gender differences – and the interaction between the two – can produce very different […] outcomes […] Interaction often occurs between sex- and gender-relevant factors and it can be hard to distinguish between the two." (Buitendijk and Maes 2015, p. 6)

This short hint at sex/gender interactions can – in my view – be singled out as the most innovative part of the *League of European Research Universities*' paper. It could guide transdisciplinary research between gender research, science and biomedicine to explore exactly these interactions.

However, most recently intra-science publication policies seem to follow the invocation of separation and, even more strikingly, recall sex analysis as *the* domain of the sciences, legitimized by the governance of science through the advice from the *National Institutes of Healt*h. In November 2016 the pre-published version of a special issue of the *Journal of Neuroscience Research (JNR)* was launched online with the title *An Issue Whose Time Has Come: Sex/Gender Influences on Nervous System Function*. But despite sex and gender or even sex/gender interactions, guest editor Larry Cahill presents a sample of 73 (!) papers which exclusively refer to sex differences in the brain. In his editorial he points to the journal's new policy aligned with the guidelines of the *National Institutes of Health*:

> "Coinciding with this issue (which will be permanently open access), *JNR* is announcing editorial policy changes whereby all new submissions to the journal must carefully attend to potential sex influences (see *Editorial Comment* by Prager 2017). These new policies dovetail nicely with the new *NIH* requirements regarding the

consideration of sex as a biological variable (see Clayton and Collins, 2014)." (Cahill 2017, p. 13, author's emphasis)[11]

This launch of a special issue, however, also has another herstory. In the past 10 years the international *NeuroGenderings* expert network (NeuroGenderings 2014) has implemented constructive concepts and research methodologies for sex/gender research (Schmitz and Höppner 2014). Coming from critical analyses of neurosexisms in brain research, the network developed approaches for a more adequate empirical neuroscience that could account for the mutual interactions of biological, psychological, social and cultural aspects of sex/gender. Appropriate analyses (e. g. Joel et al. 2015) and guidelines have been published in prestigious neuroscience journals (e. g. Rippon et al. 2014), and *NeuroGenderin*gs can be considered as having gained more acknowledgement within the brain research community. However, every recommended publication from the *NeuroGenderin*gs experts almost always triggers anti-genderisms from within the neurosciences, the foremost being from Larry Cahill (e. g. the debate between Cahill 2014 and Fine et al. 2014).

One could argue that the publication policies for sex difference research in line with the *National Institutes of Health* recommendations set back the sex/gender discourse by 30 years (see above in section 3.1) and distort the upcoming dialogue between feminist science and technology studies and science, technology, engineering and mathematics on the inseparability of nature/culture, which I previously elaborated on. This form of a new governance of science to sex-only research hinders the inclusion of the innovative potential of such an integrative dialogue. At the same time, however, the sex-only policies turn out to have a logic in themselves. As long as *Gendered Innovations* advocates researching sex *and* gender separately (as recently proposed in the high-impacted biomedical journal *The Lancet*, Schiebinger et al. 2016b), it is a legitimate position to say: OK, then we (*Journal of Neuroscientific Research*) research sex and you (feminists) may research gender. Anne Fausto-Sterling (2003) precisely points out that the allocation of sex research to the science disciplines and of gender research to the social and cultural

11 The *Journal of Neuroscientific Research (JNR)* explicates its sex-difference-related publication policy: "We recognize that sex fundamentally influences the brain and have now established a policy requiring all authors to ensure proper consideration of sex as a biological variable." (Prager 2017, p. 11) Along with serious advice to include male and female subjects into every analyses (down to cells), it states further: "*JNR* understands the real risk of false-positive errors associated with subgroup analysis, but that risk is balanced by the equal or greater risk of false-negative errors resulting from a failure to consider possible sex influences." (Prager 2017, p. 11, author's emphasis)

disciplines will persist as a problem as long as feminist discourse does not overcome its own sex-gender separations.

3.3 Challenge 3: Lack of Intersectionality and Epistemology

Sex and gender research has been challenged for leaving discriminatory policies against other categories out of focus. Intersectional approaches have shown that sex, gender, ethnicity, cultural background, class, age, education, dis/ability, preferences of desire and gender identifications have to be accounted for to assess impacts through privileging and discriminating categories. Gendered and intersected categories (and ascriptions of who is able to do and think what) within social relations (which are hierarchical and powerful inclusive and exclusive practices) are impacted by scientific knowledge production and technological developments. Cultural norms, beliefs and social structures, conversely, impact science and technology. In consequence, intersectional 'gender' research, even in science, technology, engineering and mathematics, has to be more than that on men and/or women. Moreover, intersectional approaches could be taken up to call for the inclusion of diversity instead of binaries.

Intersectional debates have been introduced recently on the *Gendered Innovations* website with a particular subsite under *Methods* (Schiebinger et al. 2016a) and a subsite on *Race and Ethnicity* under *Terms* (Schiebinger et al. 2016a). They offer some discussion and reference related literature. Interestingly, there are links to case studies on the subsite for intersected aspects, but no case studies are included for questions concerning racism.

The neglect of connected impacts of sexism and racism in mostly all of the new initiatives for the governance of science I mentioned can be interpreted as being part of a long-held Western epistemic power, i. e. the negligence of colonial-based hierarchies inherent to the notion of what counts as intelligible knowledge and, following that, the disregard for non-Western knowledge production. Particularly from the perspective of postcolonial[12] feminist science and technology studies (Harding 2011), the following question can be posed: what kind of knowledge should

12 Postcolonial discourse does not designate a historical 'after' but is rather a politically motivated category for analyses of the historical, political, cultural and discursive aspects of the enduring colonial discourse. The concept of *othering* functions to assert white Western subjectivity and collective identity of civilisational superiority against a non-Western non-white perception of the uncivilized.

be acknowledged in science, technology, engineering and mathematics and how can this acknowledgement be reached?

One of the most genuine and important influences of feminist science and technology studies at the epistemological level have been the debates and concepts on how to develop some form of anti-discriminatory knowledge production which can be used more adequately for world problems. Feminist epistemologies in the late 1980s, such as Helen Longino's 'contextualized empiricism' (Longino 1990), Sandra Harding's 'strong objectivity' (Harding 1991) and Donna Haraway's 'situated knowledges' (Haraway 1988) did not reject the applicability of knowledge, but stressed its always constructed 'nature'. Not aiming at following a metaphysics of the Enlightenment and not claiming to make progress in gathering objective truth, they developed concepts for the integration of a variety of actors and their standpoints in negotiating knowledge. Feminist epistemologies urge making these processes of meaning-making visible and transparent (among academics as well as to the general public). One important step was to uncover scientific practices and research as being indivisibly enacted in producing knowledge through the "apparatus of bodily production" (Haraway 1988, p. 591) which includes experimental procedures and techniques as well as the bodily prerequisites of the researchers. In consequence, these perspectives deconstruct the myth of knowledge as being a transcendent truth. To say it in the words of recent feminist materialisms: knowledge is always a phenomenon that constitutes itself through matter *and* meaning (Barad 2007). The framework of feminist materialisms from the mid-1990s onwards highlights the pluralisms of its perspectives, applicable to different research objectives (Schmitz 2017).

Epistemological reflection should be a central part of scientific research. On the *Gendered Innovations* website, I could not find any epistemological reflections related to knowledge production or to the questioning of the scientific paradigm of objectivity. Only a subsite under *Methods* on *Rethink Concepts and Theories* explains:

> "The point of rethinking central concepts and theories in relation to sex and gender is to ensure:
> 1. that any assumptions made or issues addressed are based on the best available evidence and information,
> 2. and that the concepts and theories adopted do not blind researchers to important aspects of sex and gender that could be a fertile source for innovation." (Schiebinger et al. 2016a)

These epistemological shortenings are remarkable as Schiebinger, a historian, has provided long-standing and prominent input into feminist science and technology studies. For her part, Klinge recently related the project precisely to the feminist epistemologies of strong objectivity and of situated knowledges (Singh and Klinge 2015).

4 *Gendered Innovations* (Only) as an Eye-opener?

Why did the developers of *Gendered Innovations* choose a strategy of addressing sex and gender and female versus male needs? Not wanting to speculate, I take some hints from an interview with Schiebinger (Zemp et al. 2015), where she explained the reason for the neglect of grounding the *Gendered Innovations* project in feminist epistemologies as follows. Her aim, she said, was to fight against reductionist biological determinism and to get people to understand "how knowledge is gendered" (Zemp et al. 2015, p. 119), but "the public is not *captured* by political debates" (Zemp et al. 2015, p. 121, author's emphasis). In order to reach "policy makers, government funders, and the general public we [gender theorists] need elevator speech" (Zemp et al. 2015, p. 120). In order to catch the attention of these target groups as well as that of researchers, senior and junior scholars, and students, she used "Google analytics to learn how people use our website. Some people stay for 10 seconds only. Even if they are there only for 10 seconds, I want them to learn something!" (Zemp et al. 2015, p. 123) Therefore, the titles and case studies of *Gendered Innovations* are designed as "eye-catching examples" (Zemp et al. 2015, p. 120). Asked about the still-reifying distinction of sex and gender in the selected case studies, Schiebinger justified this with their use as "*teaching moments*" (Zemp et al. 2015, p. 124, original emphasis) and "yes, we [first] distinguish sex and gender, and then we discuss how they interact" (Zemp et al. 2015, p. 124).

However, several questions still remain. Firstly, what exactly is the something (see above) that 'people' can learn in 10 seconds? Is it that men and women are different, bound in their opposite sexes, habits and needs; is it that sex and gender are distinct categories? Schiebinger herself admits that "I don't think that I communicate well, or what people don't get, is that gender analysis goes through the whole research process" (Zemp et al. 2015, p. 124).

Secondly, are policymakers, government funders, researchers, scholars and students, and the general public really naïve and gender blind to that extent? My experience from science, technology, engineering and mathematics dialogues and governmental engagement (e. g. ZAG 2016), and from public lectures on sex/gender aspects suggests that this is more a naïve view of the developers of the *Gendered Innovations* website than is true for their target groups. But insisting on a superficial entrance via the sex and gender separation again bears the danger that common knowledge and gender awareness remain on exactly that level: women and men are different and have to be treated differently.

Thirdly, who are the people who are specified as the target groups, and can a strategy really be developed and applied to catch them all in the same way? *Gendered Innovations'* strategy may be successful in making policymakers and funding

agencies aware of the need to include sex and gender analysis in the governing, funding and research of science, technology, engineering and mathematics. However, the inclusion of sex/gender-adequate and intersected concepts and methods into research practices, as well as the development of inter- and transdisciplinary communication, need a more differentiated approach to guide the governing actors of science and technology to anti-discriminatory research. For example, the guidelines from the *NeuroGenderings* expert network were developed from an abundant scope of previous analyses and based on intensive transdisciplinary discussions within the network (Rippon et al. 2014). Therefore, the argument of naïveté as a guide for the *Gendered Innovations*' strategy and website setup either seems a bit naïve itself, or we have to look for other reasons.

5 *Gendered Innovations* Pays Off

A search on the *Gendered Innovations* website reveals the following: "[t]he goal of the *Gendered Innovations* project is to provide scientists and engineers with practical methods for sex and gender analysis." (Schiebinger et al. 2016a, author's emphasis) The invocation of innovation is the highlighted term for advertising:

> *"Why Gendered Innovations?* [red coloured]
> 'Doing research wrong costs lives and money. […] Doing research right can save lives and money. […]
> *Gendered Innovations* [red coloured]
> - *Add value to research and engineering* by ensuring excellence and quality in outcomes and enhancing sustainability.
> - *Add value to society* by making research more responsive to social needs.
> - *Add value to business* by developing new ideas, patents, and technology'." (Schiebinger et al. 2016a, italic emphases are bold in the original)

Gendered Innovations captures an economic challenge of the healthcare system. The bullet points establish a link between excellence as a criterion for valuable research and knowledge and the prospect of economic benefit (patents and technologies), both connected by the ability of research to address social needs.

Thus, the branding of the *Gendered Innovations* project can be read in several ways: it targets the responsibility of science and technology for society (social innovation) as well as it fits to the economisation and commodification of research for entrepreneurial universities and their outsourcings. One particular sub-site under the header *Design Thinking* offers advice for companies on how to develop

and advertise their products to their best benefit, e. g. "[a]ccounting for gender differences can increase your market share" (Schiebinger et al. 2016a).

This combination of possible readings under both marketability and social innovation aspects seems to be a central strategy of the *Gendered Innovations* project. It has to be analysed in more detail how this establishing of a connection to economic valuing could open or close reflexive consideration of the innovation argument. At the very least, it has to be debated to which kind of innovation – if any – feminist discourse aims to connect, and what would be the costs of the pressure to permanently produce 'innovative' outputs.

6 How to Deal with *Gendered Innovations*: A Call for Pluralism?

Science and technology studies have characterised academic disciplines as powerful *systems of knowledge production* (and that holds for biology, medicine, chemistry, physics, engineering and technology as well as for the social and cultural sciences and for the humanities). They all are embedded in and impacted by social, political and economic systems, and so are the scientists (the experts, the young scholars and the students) with their aims, beliefs, targets, financial needs or career objectives – even with their aims to make the world a better place. Not to criticise scientific disciplines, research and development, but to recall Hannah Arendt from the beginning of this article, I wish to stress the need for a reflective and also critical standpoint that scientists should develop with regard to their own system.

From my analysis of the *Gendered Innovations* project and its impact on recent initiatives of the governance of science, I conclude that the attempts to integrate 'gender' research (in its intersected understandings) into science, technology, engineering and mathematics still face similar constraints to those that Sabine Hark (1998) and Gudrun-Axeli Knapp (1998) recognized for the first phase of gender institutionalisation: it ends at the latest at the barrier of epistemic concepts that question the paradigms of objectivity and neutrality in science, technology, engineering and mathematics.

The crucial question then is: should we trade off *situated knowledges* (Haraway 1988) for a minimum of consensus in order to include sex and gender in science and technology? And conversely: how far can critical approaches of postcolonial feminist science and technology studies be introduced into science, technology, engineering and mathematics – more precisely, how can we break through the wall

of the still-existing metaphysics of Enlightenment to allow for the immigration of other epistemologies on knowledge production otherwise?

The oscillation between the objectives and the limits of the inclusion of transdisciplinary gender research into science, technology, engineering and mathematics mirrors these two positions. The *Gendered Innovations* project focusses on acting as an eye-opener: to integrate knowledge on sex and gender as distinct categories first, while ignoring epistemological considerations for the time being. This strategy aims at raising awareness and perhaps the acknowledgement of gender research in science, technology, engineering and mathematics. The other side of the argument is illustrated by Audre Lorde's famous words, "[t]he master's tools will never dismantle the master's house" (Lorde 1984, p. 110). She argued that powerful and discriminatory systems can only be changed from the outside.

The recent changes within feminist debates and within science, technology, engineering and mathematics, when it comes to research *naturecultures* in intersection, and the increasing dialogue between both academic fields to integrate transdisciplinary approaches to face local and global challenges (as outlined in section 3.2), show that reflective approaches of 'gender' research are neither unknown nor incomprehensible. Therefore, I advocate for approaching the problem otherwise: to combine the benefits of feminist science and technology studies with a critical postcolonial perspective. Postcolonial feminist science and technology studies (Harding 2011) can help explain the co-construction and mutual influence of scientific knowledge production, gendered and intersected beliefs and norms, enacted in social, economic and political structures upon each other.[13] It can uncover the mechanisms of power which establish a ranking of better over worse knowledge. It questions not only the colonial heritage of epistemic violence but also the putting of scientific knowledge (seemingly objective) above feminist knowledge (seemingly ideological). How now can such an approach with its far-reaching objectives fill the gap between the two positions outlined above?

Gayatri Spivak (2012, p. 4) calls for strategies of "affirmative sabotage" to subvert the powerful science systems using their own tools and policies, but only those "with which we are in sympathy, enough to subvert!". Based on her detailed analysis of the various standpoints in Enlightenment discourse over the past 200 years, Nikita Dhawan follows Spivak in arguing that "the Enlightenment ideals are eminently indispensable, and we 'cannot not want them', even as their coer-

13 The postcolonial feminist science and technology studies' approach has been gaining more influence recently, e. g. in a noticeable section of panels and talks on the joint conference of the *Society for Social Studies of Science (4S)* and the *European Association for the Study of Science and Technology (EASST)* in Barcelona 2016.

cive mobilisation in service of the continued justification of imperialism must be contested" (Dhawan 2014, p. 71).

Coming back to the positioning of the *Gendered Innovations* project to include sex and gender strategically step by step, its dissemination, referencing and publicity confirms it as an entrance to a new governance of science, technology, engineering and mathematics. The *Gendered Innovations* project has been used to justify the promotion of women in higher academic positions in science and technology (Buitendijk and Maes 2015), and it was a first step in making actors aware of sex and gendered aspects, particularly within those disciplines which are still far away from gender knowledge (Buitendijk and Maes 2015). The fact that debates are beginning about how to integrate gender studies broadly into the studies of the sciences and technologies is also worth mentioning (Buitendijk and Maes 2015; NIH 2016; European Union 2015).

In my view, the problem, however, is that the *Gendered Innovations* project turns out to be the *only* resource when advocating for the inclusion of sex/gender into science, technology, engineering and mathematics. Its branding as the only reference point for innovative, intelligible gender research silences other approaches and standpoints – and has led recently to the legitimisation of counteractions as illustrated by the case of the sex-line of the *Journal of Neuroscience Research* (*An Issue Whose Time Has Come).*

Critical reflexivity – a core of gender research – should also be a target of the new governance of science and technology. "Government, control of science, government planning of science, is bound to result in the politization of science" (Rothbard 2015, p. 12). Reflective approaches of transdisciplinarity as a deconstructive practice (Hark 1998, p. 16) are deeply grounded in the recognition of multiple standpoints, of the communication between multiple perspectives and of dissenting voices. This is not to generally criticise the *Gendered Innovations* project per se, but to caution against its being considered and advertising itself as the one and only 'master's tool'. Instead, and following the line of current debates of feminist materialisms (see section 3.3), this is a call for strategies of plurality. At least two strategies could be combined here. Firstly, other resources could and should be communicated more actively in national, European and other contexts to actors of the governance of science. The already-mentioned *Gender Toolkit* (European Commission 2009), for example, contains differentiated gender-relevant and even epistemologically based literature. It has developed further specifications for particular fields, e. g. the *CARE Gender Toolkit* with a particular focus on "reflections on analysis of gender and power" in intercultural exchange (Picard and Gillingham 2012, no pagination). Secondly, the *Gendered Innovations* website is changing dynamically. Having gained acknowledgment so far in current top-down initiatives of the governance

of science, technology, engineering and mathematics, the authors of the website could and should now integrate more reflective components, e. g. addressing the interaction between sex and gender more pronouncedly and right from the beginning, pointing to the intersections with other categories of discrimination such as racism, classism and dis/ablism with case studies, highlighting their embeddedness in the social order and cultural norms, and referencing epistemological frameworks of postcolonial feminist science and technology studies.

As a first step, feminist actors in this field could enter into a discussion about using the innovation argument, and begin a debate on how *not to silence critical reflexivity*, but how to develop *constructive perspectives based on criticism.*

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