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Can Computers be Non-Binary?
Studying the role of gender in the four research areas of VRVis Vienna

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1. Introduction

Contemporary society leaves hardly any aspect of human lives untouched by technology. Visibly, we constantly carry around tech in our pockets and spend most of our working days behind a computer screen. On the other hand, invisibly, through datafication and algorithms, decisions are constantly made for and about us. The COVID-19 pandemic has further made visible the reliance of society on technology. Examples include the medical interventions that were quickly developed during the pandemic, and allowing education at all levels, different types of industry, conferences, and social happenings to function whilst people were confined in their homes during the lockdowns. Although technology tends to offer a sense of neutrality and objectivity because it was developed through computer programming and raw calculation (Bath, 2014), this definitely is not always the case. A big topic within the field of science and technology studies (STS) is showing how technology can both be shaped by and reinforce negative social structures such as harmful racial and gender stereotypes.

When it comes to developing technology, even though men and women have differing needs, end-products are often skewed towards the male-default. For example, female drivers have a 47% higher chance to sustain severe injuries during car crashes because crash dummies are based on average male proportions (Bose, Segui-Gomez & Crandall, 2011). This also shows in other technologies such smart phones on average being too large for female hands and Virtual Reality (VR) headsets being too large for female heads (Criado Perez, 2019). An explanation that is given for the development of this male-skewed technology is because people active within the Science, Technology, Engineering and Mathematics (STEM) fields are predominantly male. “When it comes down to the tech that end up in our pockets, it all comes down to who is making the decisions. And like the world of venture capitalists, the tech industry is dominated by men” (ibid, p. 180).

Because awareness about such gendered factors in science and technology is rising, a growing number of initiatives vouch for including sex and gender analysis in innovation processes. Research shows that including sex and gender analysis in experimental and technological design “[...] foster[s] scientific discovery, improve[s]
experimental efficiency and enable[s] social equality” (Tannenbaum et al., 2019, p. 137). Therefore, frameworks such as Responsible Research and Innovation (RRI) are of increasing relevance. Furthermore, gender is also becoming an important topic in other layers of science such as funding agencies. These agencies put external pressures on scientific and research institutes to incorporate sex and gender analysis into their research design. Since these criteria are at times handled quite rigorously, ignoring them can therefore have negative consequences such as the loss of funding.

In line with these initiatives and types of research, VRVis Zentrum für Virtual Reality und Visualisierung forschungs-gmbh, a visual computing company located in Vienna, was looking for a master student who could write their thesis about the role of gender in the technology development at the company. Part of the reason being that this was strongly encouraged by the funding programme VRVis is part of. The funding programme, called COMET, aims to fund projects that carry out high-quality collaborative research between industry and science that is situated more on the industry side than university groups would normally be. It was by request of COMET to encourage research about the possible role of gender within the projects it funds. Within VRVis, the work and projects are divided between four different research areas: Visual Analytics, Smart Worlds, Multiple Senses, and Complex Systems, and COMET funds projects in all four of these areas. Therefore, this thesis aims to uncover the answer to the question: Does gender play a role within the development of technology in each of the four different research areas at VRVis? And if so, how? In order to answer this question, separate subquestions will focus on the conceptualizations of gender the VRVis researcher hold, what steps they take in order to prevent or counteract potential gender issues in their work, how much importance is given to gender considerations in projects, and where in the project process they identify possible gender aspects playing a role.

**Structure of thesis**

This thesis is structured along seven main chapters. The next chapter sets out different strands of STS literature that serve as a context in which the research in this thesis can be placed. It explores the historical emergence of and defines the concept of gender. Then it
engages in an exploration of specific STS literature that focuses on the role gender plays in the development of science and technology, and how science and technology can have an influence in determining gender relations in society. The chapter finishes with an explanation of the Responsible Research and Innovation framework, which, amongst others, has a focus on developing gender inclusive research and innovation.

Chapter 3 of this thesis elaborates on existing methodologies for analyzing sex and gender in specifically computer science and engineering fields. These methodologies come from three specific pieces of literature: (1) two Gendered Innovations reports written by the European Commission describing specific case studies in which sex and gender analysis led to more socially robust research and innovation, (2) a publication in Nature by Tannenbaum et al. (2019) that describes when and how to engage in sex and gender analysis in research, and (3) a book chapter from Corinna Bath (2014) describing four ‘pitfalls’ computer scientists could fall in which leads to the development of gendered technology.

Chapter 4 gives a broad elaboration of the materials and methods utilized for the research in this thesis. It starts with a description of the visual computing field and the VRVis company. This is then followed by the research questions asked in this thesis, and by a description of the method used to answer them, namely qualitative interviews.

Chapter 5 features the empirical analysis of the conducted interviews. It starts with a broad description of the specific practices and projects within each of the four VRVis research areas, which is then followed by an elaboration of the findings ranging from the conceptualizations of gender the VRVis researchers have, to specific practices they employ to circumvent any possible gender bias in their work.

Because it was a specific wish of VRVis to look at each of the four different research areas instead of one specific one, chapter 6 will tie the findings to each of the specific areas, and elaborates how they associate with the literature described in chapter 3.

Finally, chapter 7 shortly summarizes the main findings of this thesis, and makes some suggestions for possible future research. Then it reflects on the experiences I have had as a researcher during this thesis process, as the COVID-19 pandemic has had overall influences that I think are relevant to share for anyone who reads this thesis after these challenging times.