Transforming Technocultures: Feminist Technoscience, Critical Design Practices and Caring Imaginaries

Linda Paxling

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Linda Paxling

Department of Technology and Aestetics
Blekinge Institute of Technology
Sweden

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Abstract

The digital era has brought forward many innovative technologies but their contribution to resilient, inclusive and sustainable societies remain ambiguous. Innovation has often been considered a key component for production and economic growth, but this notion is gradually changing. Innovation is turning into a practice for societal responsibility and sustainable development, transforming the directionality of the grand challenges of our time. I address this transformation of directionality by focusing on the norms and values which are embedded in technology design. The main objective of this thesis is to develop knowledge on how norms of innovation, technology and development are embedded in technoscientific storytelling and how these narratives affect and are affected by technocultural practices. I have approached this objective by engaging with technocultures in Uganda and Sweden where I have explored how assemblages of people, technologies and infrastructures merge, overlap and contrast with each other in technological development. The empirical work has been quite different in scope and context and have tackled norms and values differently. In Uganda I met with representatives from the urban ICT community to discuss the challenges and possibilities with the mobile phone infrastructure. I held an Open Space Workshop on mobile development, and met with the co-founders of two women's tech initiatives. In Sweden I did a pilot study on a norm-critical game culture and worked with critical design practices in a higher learning context.

The different projects present a complex scenario of how technoscientific stories are power-laden, contradictory and messy. I have located several dominant narratives that affect, and are also affected by, the actors in the different technocultures. The dominant narrative of a linear development of economic growth and technological advancement creates technocultures of marginality and inequality that have ethical implications for individuals and infrastructures in Uganda. Working with feminist and postcolonial technoscience I challenge the binary innovation systems of science and modernity and argue for a more heterogeneous approach to development and epistemology. Another dominant narrative concerns the norms and values of how games and media technology can and should be performed. Working with critical design practices I encourage a learning platform that creatively critiques design processes of 'the no longer and the not yet'.

The historical present has created unjust relationships that are systematically power-laden and violent. We cannot ignore these relationships. When we choose to re-imagine science, technology and innovation as transformative with the possibility of subverting these violent relationships, we may be able to foster more response-able and caring relationships. When we acknowledge knowledge production as situated, partial and located we learn to listen for more stories than one.

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PART A

Introduction

Whenever we try to envision a world without war, without violence, without prisons, without capitalism, we are engaging in speculative fiction. All organizing is science fiction. Organizers and activists dedicate their lives to creating and envisioning another world, or many other worlds. [...] Visionary fiction encompasses all of the fantastic, with the arc always bending toward justice. We believe this space is vital for any process of decolonization, because the decolonization of the imagination is the most dangerous and subversive form there is: for it is where all other forms of decolonization are born. Once the imagination is unshackled, liberation is limitless.

(Imarisha, 2015, p. 3-4).

'Norms' are rules and expectations of what is considered normal and abnormal in a society. Norms are embedded in everything we do from how we relate to technology, infrastructure and workplaces to how we value concepts of development, innovation and culture. While norms provide specific guidelines for how people should or shouldn't behave in various social contexts, 'values' can be seen as more general standards that are determinative of good and bad behaviour. Norms are almost always linked with social norms – the body language of an individual or group, behaviour, lifestyle and so forth (Bicchieri, 2017; Ehrnberger, 2017). Norms can be used to exercise a large degree of social control as they regulate human behaviour. What is considered 'normal' relates to the cultural context in which social relationships occur. When we conform to a norm we are accepted in the context of our surroundings, but when we deviate from that norm we become stereotyped and can be reprimanded by those in our surroundings. The norm becomes an act of punishment, where the normal becomes good, and the abnormal (that which deviates from the norm) becomes bad and needs to be corrected and punished. When we deviate, we become 'the Other'.

Those with the power to decide what is normal can exercise considerable control over our world.

The relationship between human bodies and social institutions permeates society as a whole, where the body is a creation of social and political structures shaped by oppression and unequal power structures (Harding, 2008). Several decades of feminist research into technoscientific practices has shed light on how these structures have been constructed by patriarchy, colonialism and capitalism (Haraway 1991a; Harding, 1986; Hekman, 2010; Keller, 1992; Trojer, 2018, Wajcman, 2006). The ongoing power relations within academic institutions have created a positivist practice, in which normative objectivity is disembodied and absolute. Researchers are discouraged from using 'I' or 'We' in scientific articles: this gives the impression that they are fully replaceable and that their norms and values don't matter in the production of knowledge. The epistemology of feminist technoscience critiques this absolutism and argues for an objectivity that is local, partial, and situated, and takes responsibility for technoscientific development.

Let me introduce you to my research practices and the reason why I gave you this slightly provocative, yet necessary, introduction. My research has explored zones of transformation with the intent of democratising science and technology. I use the term 'transformation' to refer to the making and unmaking of boundaries transforming power relations in everyday life, in global communities and in knowledge production. Haraway (1994, p. 16) explains how "[t]echnoscience provokes an interest in zones of implosion, more than in boundaries, crossed or not. The most interesting question is, what forms of life survive and flourish in these dense, imploded zones?". I respectfully paraphrase Haraway's 'zones of implosion' to position my work as an enactment of transformation. It is not that her zones are any less transformative than the ones I reside in; I only mean to be explicit in how realities are transformed through relationships rather than created from binary ontology where subjects and objects exist and are marked by *a priori* characteristics. For example, when an individual learns a new

programming language (a relation), this individual can then create a mobile application (another relation) used by other individuals (relations). Within this example exist many more relationships, more than I can even imagine. Technology is a myriad of relations – an assemblage – we tend to compartmentalise into shiny, metal gadgets. But technology is so much more. Still, I too am bound by the popular definition of the term. When I say I love technology, I often think of it in relation to the physical applications of science. When I say I love technology I make my relationship explicit, which is exactly my point. Instead of acting as an invisible partner of being nowhere, I want to acknowledge and take responsibility for my relationships. I love how machines can help save lives. I love computer games for the immersive and playful experiences they bring. I love how mobile devices can improve communication and support activism. I love how robots captivate me, both socially and emotionally. I love cyborgs because they are pushing the boundaries of what it means to be human.

My love for humans and technology, together with a commitment for justice, has helped me to better understand the dark side of technology. People suffer when they are forced into categories that exclude and discriminate, and ultimately oppress. I too have been discriminated against throughout my life as I am categorised as a woman. The categorisation of a woman has structural implications as women usually earn less than men, even when they are doing the same job. It is much more common for men to get jobs in leading positions such as prime minister, professor and director, even though women often have more education than men. Dominant narratives in the gender and technology discourse taught me early on that I wasn't allowed to aspire to, or even engage with, certain technical practices. I challenged these narratives in certain contexts and ended up abiding to them in others. When I grew up I liked playing video games but the game culture I was familiar with at the time didn't encourage girls to play games. This led me away from a culture I have now returned to, some twenty-five years later. These narratives are unfortunately still alive today although they are gradually changing thanks to structural and individual interventions. These are just a few examples of structural and cultural inequality from a Swedish context. Gender inequality in a global context is much, much worse. Sadly, when I was kid, I wasn't always aware that I was being discriminated against. Individuals are internalised so they think and act as if they don't belong, that their knowledge does not suffice or that their bodies are wrong or even that they are in some way abnormal. When we have global technocultures with no-go zones for more than half the population, something is seriously wrong with society.

I am part of the movement which intends to correct this injustice.

The prevailing assumption of technology as neutral means that any ethical implication can only be located in how technology is used. However, the moral choices made by scientists and engineers affect the design of technology which can have "a direct bearing on how people can use a technology or on how people can be affected by a technology" (van der Velden, 2009, p. 3). Our analysis of technology cannot focus only on how technology is used, but must also include how technology is designed in order to deepen our understanding of "the ethical implications of a technology" (ibid, p. 4).

In my research, I have tried to open up new ways of thinking about the interactions between users, designers, scientists and technologies, and how they can be transformed into more caring and responsible practices.

The concept of innovation is prominent in my research regarding how both I and my research collaborators relate to how technology can and should be designed. Innovation is a fluid concept and has been interpreted and used quite differently over time. It has often been considered a key component for production and economic growth, but this notion is gradually changing. Innovation is turning into a practice for societal responsibility and sustainable development, re-thinking the directionality of the grand challenges of our time (Gulbrandsen, 2016). In 2015, the 2030 Agenda for Sustainable Development was formulated. The agenda provides a model for all United Nations member states on how they can work together for peace and welfare. At the centre of the Agenda are 17 Sustainable Development Goals (SDGs) that operate as directives for improving health and education, reducing inequality, tackling climate change and promoting economic growth. Re-thinking the directionality of innovation is identified in one of the six transformations presented in a report by the International Institute for Applied Systems Analysis (IIASA) as necessary to achieve the sustainable development goals (SDGs):

> *Science, technology and innovations (STI) are a powerful driver but the direction of change needs to support sustainable development. The digital revolution symbolizes the convergence of many innovative technologies, many of which are currently ambivalent in their contribution to sustainable development, simultaneously supporting and threatening the ability to achieve the SDGs. There is an urgent need to bring the sustainability and the digital and technology communities together to align the direction of change with the 2030 Agenda and a sustainable future beyond. There is also a need to implement forward-looking roadmaps and governance structures that allow the mitigation of potential trade-offs of a STI revolution, particularly relating to its impact on the workplace, on social cohesion, and human dignity.* (TWI2050, p. 6)

I argue that the ambivalence of science and technology as mentioned in the above quote is vital for present and future technoscientific practices. Through my research, I unfold this ambivalence and open up dialogues on changing norms and values in technology design. This approach is coherent with the report *Transformations to achieve the Sustainable Development Goals (2018*) which expresses: "[t]he SDGs require collective action, and so it is not surprising that political and social institutions, pioneering actor constellations, and *discourses and dialogs on changing norms and values must play a large role in the transformations* alongside economic policies" [TWI2050, p. 24, my emphasis]. My research is trying to bring forward new ways of seeing and engaging with technology design using an onto-epistemological framework of feminist postcolonial technosciences and critical design practices. I disrupt the dominant narratives of technology, science, innovation and development by mixing them with ethics, politics and justice. When we acknowledge that categorisations as grand and broad as technology and development are temporarily stabilised in one context only to be interpreted and embedded differently in another context, we can open up to conversation and a plurality of (epistemological) stories. We can include more voices and design sensibility and disrupt a development discourse partaken by an elite few. We can democratise science. Rethinking innovation is a challenging task. We have been trying to solve problems

concerning the grand challenges but "without acknowledging the possibility that we ourselves "in here"/our established research & innovation systems may be part of the problem" (Gulbrandsen, 2016, p. 4). The effects of these implications are deeply entrenched with the ambiguity of innovative technologies and their role in sustainable development. Situating myself as a knowledge producer means I need to hold myself accountable for the choices I make in my research. The majority of research practices "are left with judging only the consequences of what we partake in creating: modern science and technology. We have not developed the means to act and transform while we are 'at it', while we are producing science and technical solutions" (Trojer & Gulbrandsen, 1996, p. 136). It is easy to presume that I am always part of the solution and never the problem. This assumption has to stop. "We are living in 'a world of sciences' where "modernisation is not identical to westernisation" (Harding, 2009, p. 414). I conducted part of my research in Uganda, where I engaged with the local ICT community. I was curious to learn how mobile phones were changing human interactions and sociotechnical infrastructures, and what kind of mobile innovations were being made at a grassroots level. However, I was bound, and still am, by a Eurocentric knowledge tradition permeating my research questions, my language and every conversation I've had. Instead of erasing myself and the context from which I originate, I use my self-implication as a resource[1] in my pursuit of justice in technocultures.

At the beginning of my PhD training I worked with qualitative methods, including interviews and participatory observation, with the intent of analysing my data through a familiar set of analytical tools in sociology. I didn't know then that I would come to change (almost) everything in my knowledge production – change how I: relate to epistemology and ontology (theory), gather data (method), study my data (analysis), and formulate solutions (conclusion). The bracketed terms, once so familiar and easily recognisable, started taking on a life of their own, and made my empirical data much harder to pin down. My empirical data became entangled with my readings on situated knowledge and diffraction. How on earth was I supposed to analyse my interviews? I was no longer supposed to reflect, to mirror an already existing category or theme in my data. I was encouraged to diffract my data (Barad, 2007; Haraway, 1997) so as to avoid the production of sameness once again, where the grand narrative of a traditional, objective truth is kept in place. Thinking and writing diffractively makes us more attuned to the differences being created in the world and how these differences affect subjects and their bodies. Instead of referring back to the binary systems of negative difference such as man/woman, culture/nature, white/black, developed/developing, I challenge these dichotomies and propose alternative methodological concepts seeking new ways of engaging with the world. I see now how important this kind of engagement is. If we continue to adhere to the same old categories that have controlled society for the last few decades, some for a few centuries, then we can never subvert structures of oppression, hegemony and patriarchy. Language is entangled with actions. Actions are entangled with technology. Technology is entangled with culture.

1 Trojer and Gulbrandsen, (1996) use the term 'implicatedness as resource' to consider the political and ethical consequences and obligations engaged in knowledge production.

Once we stop alienating ourselves from ourselves we can start imploding boundaries and really get somewhere.

My desire to become a nomadic (Braidotti, 1994), disruptive researcher that engages with cultural, ethical and epistemological issues is not an easy task. Actually, it's quite daunting and I have more than once longed to be a part of a research team following the clear requirements and standards of their discipline, and abide by a traditional, positivist epistemology. I would then be situated within a research community, where I would know from day one what the research objective is, how I will procure my data and probably know what the expected outcome is. I don't need to be held accountable for the epistemological concerns of my research because they don't even exist in a world where one (epistemological) truth rules us all. But then my stubbornness (and activism) awakens and I tell myself that I cannot settle. I cannot settle with being disciplined by a scientific truth of misogyny, oppression and discrimination. Scientific truth is not a constant. It is built upon models[2] that have been reproduced and verified systematically - many models of which I am extremely grateful for. But we must be allowed to be uncomfortable and question the models that are not so great as well as the models that are great but have been applied in questionable ways - models in which bodies become categories and are thought less upon and therefore disciplined more rigorously. Wilsdon and colleagues (2005, p. 34) express how "it is about moving away from models of prediction and control, which are in any case likely to be flummoxed by the unpredictability of innovation, towards a richer public discussion about the visions, ends and purposes of science". We need spaces – zones of transformation – where we can discuss and critique power relations and design more responsible, open and inclusive models for scientific innovation. I use my zones of transformation to explore, transgress, question, falter, play with, affect and transform worlds. My research journey has become a process of unlearning and learning anew - extremely infuriating and forever necessary.

This thesis is my figuration of that process.

2 Model is referred to the scientific modelling of physical, mathematical and conceptual models. The design of these models has ontological consequences for how they are interpreted and used in different contexts.

A brief overview

The research presented in this thesis is motivated by a need for creating more inclusive and sustainable technocultures, as motivated by the 2030 Agenda for Sustainable Development. I aim to show how norms of innovation, technology and development is embedded in technoscientific storytelling and how these norms affect everyday practices among actors in the ICT community in Kampala, and in the media technology education in Karlshamn. Furthermore, I aim to show how the actors in these contexts relate to, and transform norms. Through my trying research transformations, I show how researchers can become more visible in their research practices and thereby take responsibility for their choices.

The thesis is organized in four parts.

Part A contains four chapters:

- Introduction
- Research objectives
- The wondrous worlds of feminist technoscience
- A diffractive framework.

This part provides my motivation for the study, main research objectives, theoretical framework and methodological framework.

Part B contains two chapters:

- Zones of transformation I
- Zones of transformation II

This part covers my research practices in Uganda and Sweden and are closely connected with the papers in Part D.

Part C contains one chapter:

- Zones of transformation III

This part is an epilogue that summarizes my findings from Kampala and Karlshamn and discusses ways forward for ethical research practices.

Part D is a collection of six papers that have been published in international academic journals and presented at international conferences between 2013-2017.

- Paper 1: A conversation on mobile phone practices and development - writings by a feminist postcolonial technoscientific scholar
- Paper 2: Exploring the technological imagination among young entrepreneurs in Kampala: a feminist postcolonial technoscientific perspective
- Paper 3: Women's tech initiatives in Uganda - doing intersectionality and feminist technoscience
- Paper 4: A norm-critical game culture: exploring norms among media technology student
- Paper 5: Exploring Situated Making in Media Technology Education
- Paper 6: Design fiction as norm-critical practice

Research objectives

Main objective and aim

The main objective of this thesis is to develop knowledge on how norms of innovation, technology and development are embedded in technoscientific storytelling and how these narratives affect and are affected by technocultural practices.[1] I have approached this objective by engaging with technocultures in Uganda and Sweden and by exploring relations with humans, technologies and infrastructures.

The overarching aim of this thesis is to contribute to transformations of normative[2] practices in different technocultures through feminist technoscientific interventions.

The specific objectives of the thesis are:

- To analyse norms and values in technology design;
- To transform norms through situated interventions;
- To develop critical design practices in media technology education.

The following questions guided the study:

- How can feminist figurations transform technoscientific storytelling in ICT4D?
- How can critical design methods reconfigure media technology education?
- How can caring imaginaries transform research towards more response-able[3] research practices?

The purpose of my study is not to produce an extensive representation of certain processes in technological development, but rather to show how different methodological and analytical lenses makes visible - and change - the practices, subjectivities and assemblages of technology, innovation, development, design, and feminism.

1 When using the verb 'to affect' I refer to how norms and values within a specific context are influencing the behaviour and action of individuals. I am not referring to affect theory.

2 When I write about normative practices, I refer to the norms that exclude, discriminate and limit actors from pursuing the actions they desire (for instance women who want to work with ICT). I also refer to the normative practices that limit actors from creating the conditions that enable them to create the actions they desire (for instance, a dysfunctional mobile network due to limited resources). The normative practices differ from context to context, and so also between individuals. I work with situated knowledges, so as to contextualise norms and what they do with actors in a specific context (ICT community in Kampala and media technology education in Karlshamn).

3 The term response-able refer to an attentiveness to how research is conducted and to how researchers choose to intervene or not to intervene in research practices. The term is dicussed in more detail in the subsection *Response-able engagement*, pages 113-115.

Significance

> *In the past 100 years, people in all lines of work have jointly constructed an incredible, interlocking set of categories, standards, and means for interoperating infrastructural technologies. We hardly know what we have built. No one is in control of infrastructure; no one has the power centrally to change it. To the extent that we live in, on, and around this new infrastructure, it helps form the shape of our moral, scientific, and aesthetic choices. Infrastructure is now the great inner space.* (Bowker & Star, 1999, p. 319)

Categorisations become ethical concerns when the normative category falls into the hands of the powerful and "when one group's visibility comes at the expense of another's suffering" (Bowker & Star, 1999, p. 320). Inequality in classifications leads to a violation of human welfare, which has dire consequences for individual and collective development. Inequality takes many shapes and has numerous implications; poverty, illness, discrimination, subjection, humiliation, exclusion from knowledge, individual capabilities and social interaction (Acevedo, 2018). Inequality is a multifaceted relationship embedded in social, cultural, political and technoscientific contexts which affects our possibilities of participation in society. Bowker and Star (1999, p. 326) argue that it is of great ethical importance that we realise the role of infrastructure in our "built moral environment". What we recognise as natural is built upon human interaction.

This study aims to make a modest contribution and intervention to the challenges posed by unequal power relations in different technocultural contexts. The technocultures used in my study are the ICT community in Kampala, Uganda and the media technology education in Karlshamn, Sweden. Together with my research collaborators, I develop knowledge on the conditions and consequences of local and global technoscientific infrastructuring. The historical presence of postcolonialism, patriarchy and geopolitical divide of the Global North and Global South create unequal conditions for individuals working in the ICT community in Kampala. I have identified how members of the ICT community are positioning, resisting and transforming their ICT practices in relation to these conditions. In Karlshamn I have worked with critical design practices to intervene and transform the conditions of the technocultures game culture and media technology. Within these technocultures lies normative conditions that have consequences for the educational context and the students in particular. Dualisms in media technology, such as digital and analogue and theory and practice, have created unequal power relations, where one category is valued as better, or more right, than the other. Together, we have worked with norm-critical perspectives, critical making and design fiction to disrupt these dualisms and others, and to situate ourselves in knowledge production. Together with my research collaborators I have worked towards progressing alternative learning processes of media technology wherein norms and values in technology design are foregrounded and design becomes adaptive.

> *"What is the meaning of going beyond feminism if, in the Harawayan schema, feminism is itself the ultimate thinking of beyond and elsewhere?"* (Grebowitz, Merrick and Haraway, 2013, p. 8)

I am aware that the prefix in feminist technoscience risks positioning the field only within the realm of feminist research. I want to stress how that is not the intention.

The genealogy of feminist technoscience began with a feminist critique of the gendering of science and technology in the 1970s and 1980s but the field has expanded since then. Referring to the above quote, I suggest that feminist technoscience is not interested in limiting itself to certain disciplines or epistemic communities. As a post-discipline, the field moves in many different directions co-evolving with many communities of practice. I proclaimed in my introduction that I wanted to be a part of the movement that intends to correct the injustice taking place in technocultures. For me feminist technoscience is that movement.

The wondrous worlds of feminist technoscience

Background

Feminist technoscience is a trans-disciplinary research field that analyses techno-scientific practices and develops new ways of engaging with the world. Born out of decades of feminist critique of science and technology, the field challenges traditional knowledge production and motion towards alternative, more socially robust models (Hekman 2010; Lykke 2010; Nowotny, Scott & Gibbons, 2001; Trojer, 2018; Weber 2006; Åsberg, Hultman & Lee, 2012). The research field is engaged with the theory of knowledge (epistemology), how things and categories are performed[1] (ontology) and a response-ability[2] towards Others[3] (ethics). In other words, it's about moving beyond the kind of practices we have in place now and proposing new ways of thinking, acting and caring. "[T]echnoscience, in partnership with global capitalism, generates major historical transformations, including new ways of conceptualising what it means to be an embodied human subject in a globalised world" (Åsberg, 2010, p. 300). Feminist technoscience provides a research platform for studying phenomena such as ICT for development (Gulbrandsen et al., 2004; Elovaara, 2004), bioethics and education (Hultman & Lenz, 2010). For me, feminist technoscience has provided an epistemological platform for transgressing boundaries that have long remained untouched. It has further helped me to understand how global phenomena such as climate change and digital divides (divided by gender, race and class) affects bodies differently in different contexts (Åsberg, 2010).

Feminist technoscience studies intervene with the social, cultural and political conditions of omnipresent technoscientific practices and provide alternative (epistemological and ontological) models for learning to live on a damaged planet (Tsing et al., 2017). Still, the field lives in the margin of other, more well-established disciplines, including feminist studies, engineering sciences, media technology and design. Feminist studies is sometimes considered a post-disciplinary discipline (or post-discipline) "keep[ing] alive the tension that is embedded in defining itself both as a field of knowledge production in its own right *and* as a field characterised by total openness to transversal dialogues" (Lykke, 2010, p. 18). I would suggest that feminist technoscience also can be regarded as a post-discipline that provides an epistemological framework relevant for all epistemic communities. Still, there is a friction between the desire to move beyond disciplinary boundaries while at the same time pushing for academic and political

1 I discuss performativity and intra-activity in more detail in the chapter *A diffractive framework*, pages 5-55.

2 I discuss response-ability in more detail in the subsection *Response-able engagement*, pagees 113-115.

3 Others should not be read as one part of the human Self/Other from Western philosophical tradition. Karen Barad suggests that the ethics of the Other doesn't exist *a priori*; the otherness is created through relations – "between the world and its beings" http://newmaterialism.eu/almanac/e/ethico-onto-epistem-ology

Donna Haraway urges for an ethical response, which she calls response-ability, that opens up experiences of a shared suffering. Ethical decisions of right and wrong are often made beforehand, and from a distance, whereas Haraway's ethical practices calls for a more somatic responsibility that looks for more caring ways of conducting research (Greenhough & Roe, 2010).

recognition. This friction acknowledges the entanglement of epistemologies, ontologies, ethics and methodologies that flourishes within feminist technoscience and which keeps me as a scholar alert to the world-making practices humans create (and prefer).

I'm very fond of lists and thus I created a list presenting primary objectives and characteristics for the technoscientific field. When Åsberg and Lykke (2010) introduced feminist technoscience studies in the European Journal of Women's Studies, they presented a list of characteristics for feminist science studies written by Mayberry, Subramaniam & Weasel (2001). I was inspired by their list and the theories of many well-established feminist scholars – Donna Haraway, Karen Barad, Susan Leigh Star, Lena Trojer and Maria Puig de la Bellacasa to name but a few – when formulating my own. I propose the following key issues for contemporary feminist technoscience:

- A transdisciplinary field that seeks to advance knowledge production in science and technology.
- A scholarship that moves beyond the constructed gender politics of men and women and focuses on how to understand and transform the onto-epistemological politics of agency, bodies and ethics.
- A feminist epistemology based upon situated knowledge – a worldview that affirms knowledge as embedded in a specific cultural, material, geographic and political context.
- A research space akin with feminist theory, feminist science and technology studies, posthumanism and agential realism.
- Works with feminist figurations as methodological devices that disrupt and transform established disciplines, categories and structures.
- A diffractive framework that intervenes in how differences are made and studies how these differences affect individuals and their bodies.
- A political commitment to responsibility, accountability and care for more liveable worlds.

This was my modest attempt of condensing the whole field into a few key characteristics. But don't worry, I will elaborate on the topics in this chapter and the following chapters, *Zones of transformation I, II* and *III*. I know there will be scholars in, and related to, the research field that will question some of the key issues made here. Perhaps their ontological politics differ from mine, but I welcome this.

"The analytic ingenuity of modern states has been directed towards refining what we may call the 'technologies of hubris'. To reassure the public, and to keep the wheels of science and industry turning, governments have developed a series of predictive methods (e.g., risk assessment, cost benefit analysis, climate modelling) that are designed, on the whole, to facilitate management and control, even in areas of high uncertainty" (Jasonoff, 2003, p. 238). Rather than aiming for mastery and control I want to formulate a collaborative research practice wherein uncertainty, ambiguity and affinity are allowed to co-exist. I want to partake in formulating a more societally robust technoscience together with ethics and politics. I welcome an approach of technologies of humility (Jasanoff, 2003).

A transdisciplinary field

As science and society are heterogeneous world-making practices, we need a knowledge production that provides room for the involvement of the public and a higher degree of transparency – namely mode 2[4]. A mode 2 epistemology makes a shift from reliable knowledge to socially robust knowledge. Reliable knowledge is located in a mode 1-epistemology where the scientific research process follows the practices and methods that resides within a certain discipline. As Nowotny (2006, p. 4) explains, reliable knowledge is an important model for scientific production and it will stay with us because we need models where we can answer the question: "does it work or not?" However, in this time of uncertainty, a more problem-oriented and trans-disciplinary form of knowledge production is fruitful (Gibbons et al., 1994; Nowotny et al., 2001). Knowledge is produced through the negotiations of a heterogeneous group of practitioners, or in other words, knowledge production happens in the context of application (Gibbons et al., 1994). The context of application should not be read as commercial development for an already existing market, but should be understood in a much broader sense. The knowledge production in Mode 2 Science becomes diffused with societal interests, which go far beyond any commercial interest. In my research practices, the context of application is visible in how I've worked with young entrepreneurs in Kampala with the aim of foregrounding social and technological norms that affect their practices in mobile application development. The aim of my research has not been to address a problem beforehand and solve it straightaway. On the contrary, working with others - in different geopolitical spaces - I argue for an ongoing research process that disrupts the imagined linearity of traditional scientific knowledge and its persistent boundary-making practices. Nowotny, Scott and Gibbons (2001) explain how modernity's categorisations of science and society are eroding and being replaced with co-evolutionary processes. Science is not the only one speaking, society is talking back.

One of the key characteristics in Mode-2 is trans-disciplinarity. A trans-disciplinary approach transgresses academic boundaries and acknowledges knowledge producers outside of the academic realm. The approach formulates an epistemological shift in research where the theory-as-usual and method-as-usual is problematised and new epistemologies and ontologies are developed to study and engage with the world differently. Feminist technoscience as a research field is inherently trans-disciplinary. It challenges a positivist, mono-disciplinary epistemology, works with formulating new epistemologies and ontologies and emphasises a heterogeneous, co-evolutionary approach to science and technology. Feminist technoscientific interventions can change realities through theories and methods and thereby provide a different direction for science and technology. Mörtberg (2003, p. 61) asks: "What are the obstacles to reform or how can we give science other directions than the prevalent ones?"

4 The term mode 2 was created by Michael Gibbons, Camille Limoges, Helga Nowotny, Simon Schwartzman, Peter Scott and Martin Trow in their book *The new production of knowledge: the dynamics of science and research in contemporary societies* (1994).

The co-founders of women's tech initiatives in Kampala that I met are re-configuring dominant narratives of gender and technology in Uganda by providing transformative spaces whereby women can engage with technology through education and networking. In my research practices, I position my research collaborators (not subjects!) as experts of their own situation. Together, we share experiences and knowledge that generate new knowledge in the context of application. The recognition of lay perspectives shifts knowledge from being 'solely scientific' to becoming 'socially robust', thereby transgressing the lay/expert divide and creating new society-science relations (Klein, 2015).

Feminist interventions in science and technology

Genealogically, feminist technoscience has close ties with science and technology studies (STS), cultural and postcolonial studies and feminist theory (Åsberg, 2010). During the 1970s and 1980s Science and Technology studies (STS) emerged within, and alongside, various disciplines including philosophy, sociology, history of ideas, and political science. One of the aims of STS was to study scientific results and technological artifacts as a social activity. STS scholars began problematising the social practices behind 'objective' and 'truth-worthy' research results and claimed knowledge to be politically and culturally produced. The research went from text analysis of historical documents to working with anthropological and sociological methods. The scholars travelled to laboratories to study how scientists construct scientific truths, artifacts and systems (Bijker et al., 1989; Felt et al., 2017; Harding, 2008; Jasanoff et al., 2007; Latour, 2005). Latour and Woolgar's anthropological study at the scientific laboratory at the Salk Institute in San Diego, United States showed how scientific 'facts' are constructed through negotiation and interpretation of unstable results (Latour & Woolgar, 1979). Alongside these STS studies feminist analyses of science and technology were developed. Traweek's (1988) research on high energy physicists in North America and Japan explains how physicists see the world, and how this world view is embedded in a research community that produces knowledge. The examples from the two countries show how the physicists' culture is formed differently, which creates different knowledge-producing practices. Thus, these researchers are included in different reality productions. Traweek (1988) is explicit in helping us to understand the traditional university culture as a 'culture of no culture'.

A strong incentive in natural sciences is developing theories that push knowledge towards a few clean-cut and generic laws (Trojer, 2018). For example, this is seen in genetics, where the central dogma is one encompassing law that illustrates the function of genes through a one-way connection of genetic balance. Evelyn Fox Keller (1983) writes about Barbara McClintock, winner of the Nobel Prize in Medicine in 1983, who opposed this dogma and showed how the molecules - jumping genes - are not always as stable as the central dogma suggested they are. Trojer (2018) points out that McClintock disapproved of a scientific culture where researchers confine themselves

to a central dogma and hypothesis and neglect to study the anomalies taking place in the production of knowledge. Another problem is publication bias, or the so called 'file drawer' problem. The bias occurs when the results don't support the hypotheses outlined by researchers, and the results end up in the researchers' file drawers. This leads to only 'significant' results being published in the academic publication system and literature reviews, including meta-analyses, will portray stronger effects of research findings than actually exist (Salkind, N.J., 2010). These problems have serious political implications for how research is conducted and for whom.

Trojer (2018) emphasises how feminist research as a knowledge resource in science and technology puts the spotlight on how the processes of politics creates realities for us all and challenges the structures and individuals, who wish to keep knowledge production and politics separate. However, positing that technoscience is political is controversial, and it can be quite difficult "to gain a hearing for this understanding, since this field of research steps right into the discourse of technoscientific knowledge production and makes well-hidden relations of power and privileges visible" (Trojer, 2018, p. 16).

Situated knowledge

Situated knowledge is an epistemological framework that positions knowledge as situated, partial and local and criticises a disembodied and neutral knowledge production. Knowledge produced within a specific context can at first glance seem more limited than the disembodied objective knowledge but situated knowledge takes into account the myriads of information constituting the context. Situated knowledge encourages a collaborative approach to knowledge practices where knowledge is shared, can grow in co-production and become more comprehensive. A disembodied objectivity discourages that kind of shared practices as it enacts a binary mindset where one truth is absolute or null (Haraway, 1988). Situated knowledge includes critique on the idea that researchers are modest witnesses of reality and that their bodies somehow cease to exist when observing reality. Seeing is always a bodily experience. The body from which you see, is shaped by experiences and knowledges of the world (Haraway, 1997). Objectivity from a feminist epistemological standpoint becomes situated and embodied. When I make myself visible in my research process, I strengthen my objectivity. Reality-producing practices are always partial and I take responsibility for my research action by acknowledging this partiality.

Feminist figurations

> *Figurations are not graceful metaphors that produce coherence out of disorder but rather cartographic weapons that tear through the orderliness of humanist language; they scatter sureties; they prod and poke at positivities and foundations; and they perform curious transitions between disjunctive proximities.* (St. Pierre, 1997, p. 407)

Within feminist technoscience figurations are common methodological tools for studying and disrupting the discourses of science and technology. They are used as cartographic devices that help to implode boundaries such as man/machine, developed/developing, culture/nature and centre/periphery (Haraway, 1997) with the aim of seeing and relating with the world differently. They intrude and disrupt the foundations of socio-material structures and work to reconfigure concepts, relations, disciplines and normative systems of thinking. There have been many figurations created throughout the years that critique and transform power relations in and across different disciplines. I've chosen to explain a few figurations that relate to my research aims and some of which I've used in my own research practices.

Diffraction is a feminist figuration presented as an alternative to reflection, and originates from Haraway (1997) and is further elaborated by Barad (2007). Whereas reflection in research bounces separate entities between each other and the researcher remains an outside observer, diffraction is an interference "of practices/doings/actions" (Barad 2003) establishing connections of heterogeneous and embodied practices (Barad 2003; Haraway 1997).

Haraway referred to the diffraction of light when she introduced diffraction as a figuration. When light enters a slit, the light splits and diffracts into several beams moving in different directions. This slit, a diffraction grating, is usually a piece of glass or metal that consist of closely drawn parallel lines. A familiar example is the rainbow pattern that appears when light hits the tracks on a CD. Geerts and van der Tuin (2016) suggest that Haraway doesn't want to dissolve reflexivity, seeing as Haraway works with and beyond reflective discourses of bureaucracy, science, and social movements, but that she considers diffraction to be more critical in that it is a commitment to understanding how differences are made, how they matter, and for whom. It is a critical practice of engagement, not a distance-learning practice of reflecting from afar (Barad, 2007).

Braidotti (1994, p. 4) works with nomadism, or nomadic subjectivity, as a figuration "of a situated, postmodern, culturally differentiated understanding of the subject in general and the feminist subject in particular". The nomad stands at the loci of differentials such as gender, class, race, ethnicity, age and so on. Braidotti uses the nomadic subject to transgress boundaries and explains how nomadism is a theoretical framework that translate into an experimental mode of thinking and writing. The nomadic mode is framed around the key concepts cartographic accuracy, bodily materialism and the politics of location. Cartographic accuracy requires the knowledge producer to be explicit of one's location, namely space (social, political, geographical) and time (genealogical and historical). Braidotti departs from Foucault when analyzing locations where power is distinguished both as restrictive (potestas) and as affirmative (potential) or empowering (Braidotti, 1994). Nomadism helps me to keep me on my toes and think of power relations as transformative rather than an exterior object or essence. The politics of location are embodied, self-critical accounts transforming my understanding of myself and the world. The experiences of the co-founders of the women's ICT movements in Kampala have made me see the limitations of my location. We need to

de-familiarise ourselves from the familiar and the known in order to understand and transform the ethical agency of the Other. Bodily materialism in nomadism should not be read as some essential subject: on the contrary, it refers to the overlapping of the symbolic, the sociological and the physical and as a site of complex, sometimes contradictory, experiences.

The use of figuration diffraction and the nomadic subject can work as interventions in system design where they contribute to making materiality, the techniques and methods in the production of a technical product or service visible. They open up design processes and explore possibilities of new techniques and methods in the field. For example, figurations can be used to discuss different decisions, results and consequences in programming. They can also help designers and users understand which concepts and criteria have been taken into consideration and how they are part of a design (Mörtberg, 2003).

Patchworking is another figuration Lindström & Ståhl (2014) have used for their research activity *Threads – a mobile sewing circle* – that puts together materials, technologies and stories. They work with patchworking to explore the question *what if*, which is central to the design field. The question *what if* foregrounds the boundary-making practices of design. For example, who are the participants and what are the problems and when does the design process start and end? It matters which figurations you use because they will figure discourses in different ways. Lindström & Ståhl (2015) have worked with figures from the field of science and technology studies (STS) – network, fire and fluid – to formulate stories that involve the entanglement of objects to engage with collaborative design differently.

The cyborg figuration

In this subsection, I provide a historical background on the feminist critique of science in relation to the cyborg figure, and in the chapter Zones of transformation III I discuss the cyborg figuration in relation to my research.

One of the earliest and most well-known figurations in feminist technoscience is the cyborg. The cyborg, as developed by Donna Haraway, became a feminist figuration that changed the relationship of nature and culture by imploding the social constructed dichotomy between the two (Haraway, 1991b). The cyborg is a complex type. Cyborg stands for cybernetic organism (Gray et al., 2009) and is a hybrid of man and machine, flesh and steel (Åsberg, 2010). In popular culture cyborgs are often overtly gendered as a sexy, feminine bot or a masculine killing machine. The cyborg figure has been prominent in the world of science fiction for decades: Terminator, Ghost in the Shell, Blade Runner, Robocop, Battlestar Galactica and Iron Man are but a few examples, where cyborgs have prominent, leading roles as either saviour and/or destructor. Sure enough, cyborgs visually and physically imploded the boundaries of biology and technology, but how did it become such an important figure for feminist techno-

science? The cyborg manifest was written in the late 1980s but we need to go further back in time to properly understand the feminist critique of science.

In 1960 the term cyborg was coined by two scientists contracted by NASA, namely Manfred Clynes and Nathan Kline, in their article "Cyborgs and Space" (1960). In their article they envisioned altering the human body to be able to endure space exploration. Their article was written during the cold war, when international relations were extremely tense and the two world powers, the USA and the Soviet Union (today Russia), wanted more power, more control of the world and of outer space. Clynes and Kline imagined that the cyborgs would help the USA conquer space and 'win' over the Soviet Union. The cyborg was born as a figure of the cold war and neo-colonial science. Cybernetics stems from the Greek word kybernetes - pilot or steersman and from kybérnēsis –government, indicating that politics is involved. In her historiography of the cyborg, Åsberg (2010) refers to Michel Foucault's term 'biopolitics' when explaining how the cyborg figure is involved in the power of life and how we can regulate and discipline bodies. The shift from science fiction - cyborg fantasies of superior bodies - to science fact was swift. Today, humans are living with prosthetics, artificial organs and pacemakers, women use birth control, regulating their hormonal levels, and animals have electronic implants and can be controlled remotely. The cyborg embodies the fears and promises of modern science through reproductive cloning, genetic manipulation, organ donation, artificial insemination and fertilisation and biochemical warfare. The discourse of biology became masterfully redefined, which had serious implications for how knowledge was being produced. Birke (2000, p. 1) explains it well: "(w)omen have long been defined by our biology. It is a familiar story; anatomy is destiny, our hormones make us mad or bad, genes determine who we are". These dominant narratives of difference were deemed natural and preordained and biology became the way of organising and learning about society. Haraway (1991b) uses the cyborg as a figuration to challenge these differences - these unjust boundary-making practices - and proposes new ways of staying with the trouble of technoscientific development without resorting to 'unity-through-domination' or 'unity-through-incorporation' (Haraway, 1991b).

Haraway (1991b, 154) exemplifies how different perspectives of how a cyborg world plays out. One is "the final abstraction embodied in a Star Wars apocalypse waged in the name of defense, about the final appropriation of women's bodies in a masculinist orgy of war". The other perspective is "a cyborg world in which people are not afraid of their joint kinship with animals and machines, not afraid of permanently partial identities and contradictory standpoints". Haraway argues that one needs to see and consider both perspectives – preferably many perspectives - as they will contain risks and possibilities that would be impossible to imagine if we only abide to one perspective – one single story. Performing many perspectives – or better yet, situating knowledge – in the infrastructuring of technoscience is crucial for creating sustainable worlds. I embrace the cyborg figuration as a move away from dualisms who uphold unjust technocultures towards transgressive practices filled with risks, speculation, possibilities and companion species.

Posthumanism and agential realism

In order to understand posthumanism I first need to explain humanism. A common denominator of humanism is an anthropocentric view that positions the human at the centre of the world. This illusion essentialises the human as a generic trope without nationality, gender or class which masks differences - and asymmetrical power relations - between human beings. A post-human framework challenges the anthropocentric worldview by broadening the agency of the world to include non-human actors (animals, nature, things, and technology) and to underscore that humans are equal to all actors in the world. One of the core themes for a post-humanistic perspective is a refusal of *a priori*, creating dichotomies of nature and culture or researcher and research object (Åsberg, Hultman & Lee, 2012). The theorists within post-humanistic plethora consider methods to be performative - performative because of how methods themselves construct and interfere with how knowledge is acquired (and created). Barad (2003, p. 802) explains that "a performative understanding of discursive practices challenges the representationalist's belief in the power of words to represent preexisting things". Åsberg, Hultman and Lee (2012) suggest post-humanism as a critique of anthropocentrism and imperialistic logics of humanism. Humanism is often viewed as a universalism, which becomes very problematic since universalism traditionally has implied a European cultural imperialism - a very racist and discriminatory perspective to the world and its inhabitants. This cultural essentialist view holds an illusion of a generic person, an abstraction behind categorisations such as class, nationality or gender, and disregards the physical environment.

It is important to note that the prefix "post" in post-humanism should not be read as something that comes after humanism.[5] On the contrary, post-humanism is grown out of humanism and continues to overlap and include the implications of how humanism was once constructed. Post-humanist studies are often tentative, meaning making, partially mapping and seeking ongoing processes (Åsberg, Hultman & Lee, 2012). For example, to understand how mobile development is enacted, we have to map how the socio-technical practices are created. Development, just as economics, is not static. It takes different shapes depending on context. Development strategies, mobile phones, SIM cards, and sellers together generate one set of realities. A material-discursive practice is part of the onto-epistemological turn, where objects of study are entangled with the enactment of the researcher. In my research, I work against proper objects and subjects as I question the normativity of essentialised research objects. The performative positioning in post-humanism proposes an onto-epistomological ethics. Barad (2003, 2007) writes about how ontology and epistemology cannot be viewed separately; the categorisation of those entities existing in the world, and knowledge production, belong together. She explains this inseparability as an intra-action in her

5 Post-humanism has several definitions and I want to clarify that my research does not refer to the definitions of trans-humanism or anti-humanism. I work with the theoretical framework of post-humanism that challenges an anthropocentric and imperialistic worldview and moves towards more inclusive and rhizomatic societies.

theoretical framework agential realism. Just as power is relational, so is agency. They are not inherent properties to an individual, but dynamic forces enacted through relations. Agency is an ongoing material-discursive practice constantly changing, diffracting and entangling with all 'things' (Barad, 2007). Barad presents an onto-epistemological ethics using the concept of intra-action, which transforms classical objectivity where an apparatus (a technology for measurement or a person using a certain method) are not visible in the (research) results. A researcher that takes intra-action into consideration acknowledges the interactions and processes occurring during a study, and not only the 'end-results'.

As I understand Barad, she argues for a more dynamic interaction with matter ('things') that can transform how we relate to ourselves and to the world around us. Standardisations, policies and laws are put in place to conform the regulations concerning who is allowed to sell mobile phones and subscriptions, how people access the mobile networks and what kind of software content will be available. Barad (2003, 2007) explains how we are constantly making agential cuts that differentiate relations occurring through intra-action. My agential cuts concern all the choices I've made throughout my research process - who I've chosen to talk to, how I've transcribed interviews, how I've worked with figurations to fit my politics of location, and which methods I've chosen to work with. Agential cuts posit that there is room for change but we need to recognise the cuts – call them out – so as to acknowledge who creates the cuts and how they affect us all (Barad 2007; Lindström & Ståhl 2014).

Technoculture is culture

Technoculture is a neologism I use to stress the entanglement of technologies and culture, and how they transgress and come together in the co-evolving processes. Technoculture and technoscience are closely related but not the same. Technoscience constitute the entanglement of technology and science and scientific knowledge as socially and historically situated. This situatedness leads to the formation of a technoculture wherein social norms and values are embedded. In this thesis I use the term technoculture as a means of addressing the social, politica, technical and material dimensions of the cultural life located in the ICT community in Kampala and the media technology education in Karlshamn.

Although technoculture doesn't have an official definition in standard dictionaries, it is mentioned in online dictionaries as a "[c]ulture as influenced by technology, especially computer technology and the Internet"[6] and as "[a] culture as informed or defined by its technological activity, especially a culture characterised by a high level of technological development; (also) the practices, attitudes, etc., characteristic of those proficient in the use of information technology"[7].

6 https://en.wiktionary.org/wiki/technoculture [Accessed: 2018-11-13]

7 https://en.oxforddictionaries.com/definition/technoculture [Accessed: 2018-11-13]

Technoculture is also being used in the academic context. For instance, several North American universities use technoculture to describe programs, courses and subjects. The University of Californa, Davis in the U.S. has a program called 'Technocultural Studies' which intersects humanities, technology, the arts, and science. In Canada, the Western University has an undergraduate program named Media, Information & Technoculture. The program is presented as critical, creative and cross-disciplinary and an exploration of how "relations between humans and technology create different kinds of cultures or "technocultures"" Another place where technoculture is used is the academic journal Technoculture: An Online Journal of Technology in Society, which publishes work on how technology impacts society. The book Technoculture: Key concepts (2008) by Debra Benita Shaw critically explores the relationship between technology and culture and how technology influences politics, economics and aesthetics of everyday life. Anne Balsamo (2011) works with the concept technoculture to address the dynamics of certain design practices that form technocultural innovation. Consistent in these different uses of the word technoculture is the relationality of technology, culture and society. Similar to Haraway's (2003) 'naturecultures' I recognise the inseparability of technology and culture and use technoculture to formulate my research engagements in different geopolitical contexts (Kampala and Karlshamn).

From Science and Society to society in science

This subsection discusses how innovation models of management and control affect science and society relations and suggests an approach of care that recognises the co-evolution of society and science.

In September 2013 the standing committee for the Social Sciences of The European Science Foundation presented the Science Policy Briefing, *Science in Society: caring for our futures in turbulent times* (Felt et al., 2013). The policy briefing captures the challenging techno-political context of which I, and many other academics, reside in, and provides recommendations close to my research aims. Felt and colleagues (2013, p. 3) explain how they wrote the briefing at a time of two unique, yet closely entwined, challenges:

- science and technology are increasingly governed at multiple sites, by diverse actors and in disparate ways.
- the sense of austerity and crisis across Europe has important consequences for the governance of science and technology.

These challenges have great implications for science-society relations and how research can, and is allowed to be conducted. The narrow understanding of science persists in many policy measures and the authors of the report explain how science is conceived as an institution that upholds and produces objective knowledge, and society is a stable and consistent entity that is differentiated along familiar categories (e.g. age, gender, ethnicity, religion). Research over several decades has shown that science and society are not, *a priori*, static entities (Gulbrandsen, 2016; Jasanoff & Society

for Social Studies of Science, 2007, Nowotny, Scott & Gibbons, 2001). Science and society are fluid, heterogeneous, context-specific activities that make worlds. Through their world-making practices they engage and govern spaces where values and norms, and by extent power relations, are negotiated and formulated. However, many policy measures push research and innovation towards a space of management and control (public management logics) where futures are destined to be imagined and controlled through a strict set of guidelines. In addition, indicator-driven procedures in academic environments create tensions between formalised accountability (excellence) and societal relevance (responsibility): i.e. *whose research matters?* versus *how is my research caring for the development of science and technology?* Furthermore, there is a tendency to control engagements between science-society relations and boost rapid innovation models that formalise and promote certain research activities while others are pushed aside or ignored.

Innovation has become the remedy for crisis and is still very much thought of in technological terms. Albeit that social innovation has gained some recognition, thinking of innovation as an organisational or social change is limited. A central concern that is visible across many sites is "the discrepancy between broader value systems employed by societal actors to assess science as a public good and the often narrow evaluation criteria used in research, innovation and education policy. It is these narrow interests and visions – rather than the broader perspectives and values – that are currently most strongly shaping our future" (Felt et al., 2013, p. 3). There are concerns in the scientific community where collaboration with the public is seen as slowing down development and innovation. This creates the risk of separating science-society practices. These concerns are voiced louder in times of crisis and the more familiar, traditional forms of producing knowledge is valued higher. Shutting down discussions where questions are asked including *which innovation matters*? and *for whom*?, endangers democratic processes of development and narrows the path of possible futures.

Unfortunately, we cannot assume that critical interventions with science-society concerns are always approved or even allowed to exist. I am grateful that I have been allowed to formulate a space for science-society interactions. As a scholar in feminist technoscience, I challenge the values and norms that have been negotiated and formulated in positivist epistemology - where science as an upholder of objective knowledge has been allowed to roam free for centuries and has provided very narrow, exclusive spaces where only a select few are allowed to enter. I argue for an alternative epistemology that considers the subjectivity of objectivity, where knowledge production is partial, located and situated, where research activities care for the development of science and society while taking different experiences, knowledge and interests into consideration when making technoscientific decisions.

Felt and colleagues (2013) advocate for a change from 'logic of choice' that is based on a premise of clear-cut risk management towards an approach of 'logic of care' that recognises the processes and messy practices of a co-evolving science and society. Instead of making rules and principles and abiding by a contract restricting all parties involved, a care perspective has more of a harmonious bond where the co-evolvement of

science and society together defines the ends and means - an ethics of care changes the way we understand citizenship. Citizens are commonly recognised for their embodied, political and ethical subjectivity. With an ethics of care they would also be recognised as technological and ecological. All citizens – government officials and private citizens alike – would then have an asymmetrical relationship where everyone is interdependent of each other (Groves, 2015). The concept of logic of care comes from Anne-Marie Mol's (2008, 2010) research in healthcare. Care is not a fixed category but a term understood as a doing what can only be interpreted through practice. Change should not be seen as a function for controlling bodies or technologies but as part of healthcare practice. Mol, Moser and Pols (2010) argue that improving (health) care is best conducted in practice. Good care is not always a sign of patient autonomy or successful welfare politics, but a collective effort that involves "persistent tinkering in a world full of complex ambivalence and shifting tensions" (Mol, Moser & Pols, 2010, p. 14).

Jasanoff (2004, p. 3) draws our attention to the co-production of society and science by expressing how "the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it". Society and science are already entangled, and we only need to recognise it as such. The researcher represents this entanglement by being part of different communities in the role of a knowledge producer and a citizen (Felt, 2009). When we acknowledge that society is intertwined with research we learn that values, methods and epistemologies frame and narrate knowledge-producing activities (Felt, 2009). Scientific knowledge "embeds and is embedded in social practice, identities, norms, conventions, discourses, instruments and institutions – in short, in all the building blocks of what we term the social" (Jasonoff, 2004, p. 2-3).

A diffractive framework

The point is, in short, to make a difference—however modestly, however partially, however much without either narrative or scientific guarantees. In more innocent times, long, long ago, such a desire to be worldly was called activism. I prefer to call these desires and practices by the names of the entire, open array of feminist, multicultural, antiracist technoscience projects.

(Haraway 1994, p. 62)

Messy Matters

In 2016 I attended a PhD course named Messy Matters.

For our first assignment we discussed our research projects together with another participant. Laura and I joined forces and began a dialogue on cyborgs, co-design and future-making. I started writing about techno-deterministic perspectives of technology and how I consider this perspective to be far too narrow-minded and anthropocentric.

Linda: When you write "can anything provoke anything anymore at all" I wonder what you mean. What is it that can no longer be provoked? I connect provocation with emotion. I feel, I care, I am enraged and I get provoked all the time. In my own research practices for instance, I am provoked by the stronghold that techno-determinism and informatics of domination has in fields such as ICT4D (Information and communication technologies for development).

Technology X will save the world.

It is presumed, although this perception is gradually changing, that the benefits of ICT are inherently positive and a lot of problem-solving focuses on how ICT supports development. The myths of technology as a saviour object persist because many have a desire for an easy solution, the power of technology is seductive, the narcissistic inventor is looking for ingenuity and the investor wants a solution that can multiply everywhere without contextual consideration. Instead of thinking of ICTs (i.e. mobile phones, computers and networks) as ready-made tools created for a specific purpose, we can use figurations such as the cyborg to re-think and re-imagine our narratives of technology and development. The cyborg - this ambiguous creature created of fiction and reality - relates to the wonders of technology. Haraway presents science fiction storytellers as "exploring what it means to be embodied in high-tech worlds" (Haraway, 2004, p. 173). As I mentioned with the myths above, the stories of ICT4D are part of what creates the field. They are filled with political imagination, failed practices, future visions, needs and desires and technological gadgets. The cyborg figuration helps me resist working only with the dominant narratives of ICT4D, and helps me to look for alternative narratives and to create new ones.

I think these lines of thought can be directed to your [Laura's] research practices. You mention the physical design in public spaces as creatures of fiction – and I couldn't agree more. So much is connected into a place – temporal, spatial, different kinds of matter, embodied experiences, memories, touch. Your work with co-design and the sharing of expectations and hopes in a co-design project is part of the physical space. I was looking at your website and I came across your project Byer for mennesker. Borgernes Hus. I think the first few lines of the project description stressed my point with the importance of narratives and multiplicity (the inclusion of many):

If the modern city must be liveable, the lives of citizens must be the focal point for both urban planning and architecture. They must be involved in the process so that socio-cultural conditions, technology and welfare are combined. [my translation]

I am excited thinking about the ontology the above example suggests. If knowledge production is to be understood as a co-constitution of different matter, lines, knots and relationships if you will, then messiness must be involved. We need to show how processes and projects falter, change, iterate, create laughter and frustration. And I would suggest that all projects already contain these elements but we rarely get to see them. In research the end result means everything and the process is rendered irrelevant.

The layering of the product becomes fixed, the methods are accepted and the process is forgotten […].

Laura asked me: Working with co-design and design anthropology I often use terms such as 'designing the future' and 'future-making'. You mention that Haraway suggests science fiction storytellers as 'exploring what it means to be embodied in high-tech worlds'. I am curious if you see here possibilities for contextual considerations? The cyborg helps you resist working only with the dominant narratives of ICT4D, but can you elaborate on how we can create the new (collective) narratives you are talking about?

Linda: I've been struggling with this question for a while now. It's very important and close to me and my research and I don't know how to provide you with a satisfying answer. I'm thinking about ethics, the individual versus the collective, how 'we' perceive ontology and epistemology (and reality!), the separation of subject and object and what this does to science, how much 'we' are prone to boundary-making, what a strong grip anthropocentrism has over my mind and body, how prone 'we' are towards quick fixes, how careless 'we' can be to neglect history, and how seductive it is to create stories with a beginning, a middle and an end. These are all worlding practices that we are right in the middle of and which I want to transform. But how can we do this? In writing? In making? One could start by acknowledging oneself as not the individual but as many. Another possibility could be to think and act in plural - realities, futures, relationships, bodies. A third possibility could be to create relationships with matter, stories, people and places.

Heterogeneous research practices

In his book 'Making a mess with method', John Law (2004) talks of the methodological cleanliness occurring in research. Social and natural sciences are trying with great effort to repress the messiness of research findings and to work closely with methodological norms and rules in order to achieve best practices. Law (2004) argues, as do I, that to clean your data is to suppress the world – because the world is messy, heterogeneous and to some extent unknowable. My research practices have been quite heterogeneous and very messy indeed. My answer to the question 'What research do you do?' has changed quite a lot throughout the years. In the beginning, I replied that I was working on an ethnographic study of the ICT community in Uganda with a specific focus on mobile communication. Then I changed my answer slightly and talked about inequality, future-making, agency and socio-technical infrastructures. After my licentiate degree the answers changed once again. I was looking into norm-criticality, innovation and game culture. Suddenly I was positioned as a game researcher in the news. Then my research motioned towards design, pedagogy and maker culture and critical design methods in media technology. At the moment, while finishing this doctoral thesis, I'm inclined to say that I work with feminist epistemology and responsible research and innovation. For me, to talk and write about messiness is to become aware of exclusive practices, or in other words, the (un-) intentional making of the Other[1]. The invisible, the uninteresting, the obvious and, perhaps first and foremost, that which is being repressed. I am not suggesting we should stop using conventional research methods. Not at all. What I am proposing is exploring new ways of defining and relating to method, relations where methods are part in generating the world (Law, 2004). In this chapter I want to connect Law's performativity of method with Karen Barad's concept of intra-activity to explain how my research practices have moved me in certain directions.

The concept of intra-activity departs from the term interaction that separates subjects and objects as pre-existing entities and motions towards a relational ontology of material-discursive practices. Intra-action reworks the notion of causality by shifting focus "from questions of correspondence between descriptions and reality (e.g., do they mirror nature or culture?) to matters of practices /doings/actions" and "bring to the forefront important questions of ontology, materiality, and agency" (Barad, 2003, p. 802). Intra-actions are performative in that all actions create realities. Intra-actions open up the black boxes of technology and call for material-discursive practices wherein norms are affecting the design of technology and the design of technology are affecting our norms and values. "[I]ntra-actions are constraining, but not determining. Intra-activity is neither a matter of strict determinism nor constrained freedom. The future is radically open at every turn" (Barad, 2003, p. 826). Method is not just a set of tools, yet another questionnaire, it is performative. Method is never purely a technical

1 Again, I want to mention how the Other is not defined as a Self/Other or worse a Man/Other. I firmly argue that Other is performed through intra-action. The Other does not exist a priori but is created through relations.

entity since it always changes things and makes it different from before the method was used (Law, 2004). I have tinkered with method with the intent of creating new ways of engaging with the world. Ways that can disrupt boundaries and push for more just technocultures. Interest and care has had an important role in my research endeavours and Isabelle Stengers (1997, p. 82-83) captures my thoughts on interest when writing:

> *No scientific proposition describing scientific activity can, in any relevant sense, be called 'true' if it has not attracted 'interest'. To interest someone does not necessarily mean to gratify someone's desire for power, money or fame. Neither does it mean entering into preexisting interests. To interest someone in something means, first and above all, to act in such a way that this thing – apparatus, argument, or hypothesis…- can concern the person, intervene in his or her life, and eventually transform it. An interested scientist will ask the question: can I incorporate this 'thing' into my research?*

I move to Haraway's cat's cradle to perform how these 'things' can be put into play. Haraway uses the game cat's cradle[2] as a figuration to create a pattern of discourses (cultural studies, feminist, multicultural, antiracist science projects, and science studies) that entangle metaphor and materiality, narration and intervention (Haraway, 1994). Law (2004, p. 152) mentions how the rules of method in a conventional project plan are "a means to an end for knowing better or intervening. The practicalities of knowing are bracketed and treated as technique". From the perspective of the cat's cradle method is a process where we cannot know in advance how a pattern will play itself out. I didn't know beforehand how this thesis would play out. I'm learning how worlds are built and the methods I use to learn about this worlding practice are part of a knowledge production. The point is not to merely read the knots in the cat's cradle – as in a traditional discourse analysis - but to reconfigure knowledge itself (Haraway, 1994). When Lindström & Ståhl (2014) used the figuration patchworking in their research on publics-in-the-making, they stressed that patchworking was not only about understanding and reflecting mess, but also about intervening through speculation and participation and being a part of a liminal process – in creating realities. Another figuration that has helped me in my tinkering with method is diffraction.

Diffraction makes a difference

> *Because 'nothing comes without its world' we do not encounter single individuals, a meeting produces a world, changes the colour of things, it diffracts more than it reflects, distorts the 'sacred image of the same'* (Haraway, 1997, p. 137).

I use diffraction as a methodological device for my thesis with the aim of transgressing the boundaries of how research can and should be formulated and conducted. If I had chosen a more reflective and conventional approach to my research, I could for instance have analysed how women (A) and men (B) change their work patterns (C) using a mobile phone (D) and then compared this data with similar data from other

2 A cat's cradle is a game in which you use a loop of string to put around and between the fingers to create patterns. You can move the string from one person's fingers to the next continuously creating complex patterns.

regions (E) and countries (F). A comparative data set would have located similarities and differences but the categories - created for and in a specific context - would have remained the same and be left unquestioned. A diffractive perspective investigates and questions how categories are made and how they affect bodies and structures. My understanding of diffraction corresponds to Björkman's (2005) interpretation:

> *…if I am the grating, where my different positions and perspectives are the slits through which the material I study, as well as my experiences, pass, this will create many images on the 'screen', i.e. the stories that I tell. This is thus a diffraction pattern, where some stories are stronger than others, some stories disappear, but many stories exist. The broad light beam (the initial story, the source) is diffracted into several stories. The slits make it possible to see parallel and different, diffracted, stories* (Björkman, 2005, p. 37).

Diffraction has provided me with an open-ended research space where I've worked with different perspectives, interpretations and narratives of technocultures. Stories can overlap but they can also clash and contrast with each other – they don't need to assimilate. Each practice and interpretation is a diffraction and contains its own history: its place of origin, who created it and in what context it was created. Pirjo Elovaara (2004, p. 30) expresses how "[d]iffractions also reinforce the irrelevance of trying to understand information technology as an either/or phenomenon, something which all my empirical material had already made clear to me. Diffraction as a metaphor can release me from the modern dualistic principle of the modern world order". I have released myself from the boundaries of working with one and the same kind of method, empirical or otherwise. I've worked with ethnographic methods such as interviews and participatory observation. I've analysed conversations and digital content. I've held Open Space, participatory, writing and design fiction workshops. I've worked with text. I've worked with different analytical frameworks such as feminist figurations (Haraway, 1997; Lykke, 2010), doing intersectionality (De Vita, Sciannamblo & Viteritti, 2016) and postcolonial computing (Irani, Vertesi, Dourish, Philip & Grinter, 2010). The reason I've worked like this has been to transgress the modes of thinking and conducting research. Instead of having a preordained research outline connected to a specific method, I have experimented with different analytical and methodological perspectives to learn how differences are made and how they can be unmade.

One of the core objectives within feminist technoscience is the critique of a universal and objective knowledge production. This critique is articulated in research when trying different theoretical and methodological questions, where knowledge production is always considered to be partial translations. Rational knowledge is formulated through an ongoing process of interpretations that become power-sensitive conversations (Haraway, 1991; King, 1987). Method is part of this translation, layered with values and rules, yet hidden in sight because of the popular notion of a method as a tool and nothing else. Another performativity in this partial connection is writing. Just like any normative system, academic writing includes certain relationships and excludes others. Within the critical tradition which feminist research has evolved, the style of academic writing becomes important to analyse (Lundberg & Werner, 2014).

Critical thinking and academic writing

> *It is very difficult, almost impossible at times, to write and think outside the language of humanism, our mother tongue that constructs and perpetuates with such transparent ease binaries, hierarchies, dialectics, and other structures that are not just linguistic but that have very material effects on people.* (St. Pierre, 1997, p. 406)

This quote captures my struggle with academic writing. My research journey began with a language bound by binaries, hierarchies and dialectics. Although I made conscious attempts to challenge these binaries, I was still bound by them in my writing. I have, for example, chosen to use concepts and methods familiar to the context I was situated in, so as to make myself understood and, in the long run, make interventions that would be meaningful for the international research community. This choice posed certain paradoxes as I positioned myself within certain narratives that I also wanted to critique. For instance, when discussing innovations with mobile application developers, we discussed innovations in terms of local/global and success/failure without problematising what is implied in the concept innovation. Throughout my text I have selected certain stories to critique and transform and when doing so let others go.

When I began my PhD I didn't know how much diffraction would affect my writing. Rather than presenting a perspective of a text or situation as something good or bad critical thinking embodies different perspectives and voices for understanding phenomena and their consequences. Foucault (1990, p. 8) writes "[there] are times in life when the question of knowing if one can think differently than one thinks, and perceive differently than one sees, is absolutely necessary if one is to go on looking and reflecting at all". When going through my data I wanted my writing to depict how power structures take shape in society. The conversation taking place between me as the critic and the observed phenomena changes knowledge. I am never outside the practices I critique, which means that I am part of re-constructing the phenomena I study. My research activities have political consequences, which imply that my critique is embedded with an ethical responsibility.

I have zigzagged my way through my theory and data in an attempt to open up and expand knowledge (Jackson & Mazzei, 2012). Mazzei & McCoy, 2010, p. 505) express how "[the] zigzag is the lightning bolt spark of creation and the 'crosscutting path from one conceptual flow to another', a path set off by the spark of creation, unpredictably, undisciplined, anti-disciplinary, and non-static"[3]. In the chapters *Zones of transformation I, II* and *III*, my empirical data is plugged in with new theoretical perspectives, different to those I worked with in my research articles. I move from one conceptual flow to another, simultaneously prone to serendipitous ways of not knowing where I am headed next and deadly serious about my risky practices.

3 Mazzei and McCoy are citing Stivale within the quote (Stivale, 2003, p. 32).

A transformative research process

I guess you could say that I began my research journey as a social scientist mesmerised with the wonders of technology and frustrated with global inequality (Acevedo, 2018) and the digital divide (Clarke, Wylie & Zomer, 2013). I thought I could reduce global inequality by 1) learning about socio-technical interactions in a developing context, and 2) working together with my research collaborators towards technical solutions that could subvert the digital divide. I started reading about information and communication technologies as a tool for social and economic development, and reading up on the Millennium Development Goals[4] (MDGs) and their focus on ICT as an indicator for eliminating poverty and hunger and improving education and women's rights. However, my research practices in Uganda and Sweden motioned me in a new direction. Global inequality still remains an important cornerstone for my research objectives but my initial ideas of problem-solving and prototyping technical solutions have changed. The rushed pace of science has led to a development narrative where competitiveness, opportunism and conformism is highly valued, and where governments and scientific institutions are prominently focusing on 'deliverables' (Stengers, 2018). I too was caught up in this narrative when I began my research. Since then I have moved away from this narrow and destructive way of producing science and I have instead pursued a different direction. I certainly don't oppose the creation of technical solutions but what I do oppose is the lack of reflection involved in scientific and technological advancement. In the introductory chapter I introduced one of the six transformations as necessary for achieving the SDGs. This transformation concerned, amongst others, an urgent need for bringing together the digital and technology communities with the sustainability communities. I argue that we need to change the pace of science if we are to create these kinds of transversal dialogues. We need collaborative re-thinking where many perspectives are allowed to take place when major and sensitive issues are discussed so as to provide time and space for stakeholders to anticipate the implications their choices will have. We need society-in-science relations that discuss "what science do we need in the world?"[5]

My trying transformations for creating zones where multiple, partial and contradictory perspectives plug into each other and co-produce knowledge can be read in the chapters *Zones of transformation I, II* and *III*. In chapters *Zones of transformation I* and *II*, I

4 The Millennium Development Goals (MDGs) were eight goals that the 191 UN member states agreed to reach by the year 2015. The MDGs where derived from the United Nations Millennium Declaration, which was concerned with the issues of poverty, disease, hunger, climate change, women's rights and education. The MDGs worked as a guideline for all the world's countries to share a set of common goals for instance eradicate poverty, provide universal primary education and combat HIV/AIDS, malaria and other diseases by the year 2015. See complete list of MDGs here: http://www.un.org/millenniumgoals/ [Accessed 2018-11-05] The Sustainable Development Goals as part of the 2030 Agenda for Sustainable Development are an elaboration of the former MDGs.

5 https://scijust.ucsc.edu/2016/01/15/jenny-reardon-and-sjrc-appear-in-le-monde/ [Accessed: 2018-11-28]

discuss how boundaries are made by foregrounding norms, values and standardisations in different technocultural practices. In the chapter *Zones of transformation I*, I revisit my research material from Kampala where I discuss infrastructuring, imaginaries, idiosyncrasies, resistance and transformations occurring in the ICT community. The papers connected with this chapter were written for the ICT4D community, and this is noticeable in my style of writing. Although I entangle my empirical material within a feminist technoscientific framework, the structure sometimes resembles more of a traditional research outline which many publication systems follow. This style of writing is of course something I've chosen to conform to in order to publish my research articles. I have deliberately chosen to keep this format with the purpose of providing the reader with an understanding of how scientific writing differs between different epistemic communities. Furthermore, I want this chapter to be comprehensible and relatable for a person engaged with the ICT4D community, whilst at the same time providing the epistemological base of feminist technoscience. In the same way that I am generative, so too are my research practices. In the chapter *Zones of transformation II*, my pedagogical and designer roles come into focus where I work together with students in Karlshamn asking questions such as *'what if?'* and *'who benefits?'*, generating existing and imagined possibilities of technocultures. The style of writing is quite different from the *Zones of transformation I* chapter. I present blog posts on open-ended processes of working with norm-critical perspectives in game culture. I post fragments of ideas and visions for the situated making course, and I contextualise design fiction in a manner that I wasn't allowed to do in the related paper on design fiction because of a restrictive publishing format. I imagine that these different styles of writing can sometimes leave the reader feeling confused, out of bounds and even distorted. That's okay.

Today, I no longer consider myself a social scientist. I have become a feminist technoscientist[6] concerned with ethics and justice and caring for liveable worlds. In the chapter *Zones of transformation III*, I entangle my research practices with response-able ethics and matters of care. I discuss making kin in cyborg worlds and the viscosity and relationality of numbers and technology. I ask the readers to play with my adaptive design manifesto.

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6 In my trying transformations, I am turning into a material-discursive assemblage that doesn't want to be deconstructed in an either/or identity but is committed to multiple memberships simultaneously.

In their work on and with Haraway Grebowicz and Merrick (2013, p. 4) refer to Haraway as "the critic/theorist/biologist/feminist/historian/humourist/ironic storyteller/sportswriter/dog trainer". These are not separate identities or modes of address that can be dearticulated, and one of the challenges we face as we read/write "with" Haraway is staying true to her commitment to all these mode simultaneously". In my practices I want to stay committed to all my modes at once, some of which are researcher/critic/storyteller/ethnographer/innovator/designer/teacher/traveller/feminist/gamer/maker.

PART B

Zones of transformation I

How might scholars take on the challenge of freeing critical imaginations from the specter of neoliberal conquest – singular, universal, global? Attention to the frictions of contingent articulation can help us describe the effectiveness, and the fragility, of emergent capitalist - and globalist - forms.

(Tsing, 2015, p. 77)

To the reader

In this chapter I weave together stories of my research experiences in Uganda. I begin the chapter with an introduction to postcolonial technoscience with a brief background concerning the (post-)colonial era in Uganda, and the different stages of information and communication technologies for development (ICT4D) according to Richard Heeks (2009). I then continue with a subsection that provides a general overview of the mobile infrastructures of Uganda. The following subsections are then provided: Stories of infrastructural inversion, The technological imagination and Women's tech initiatives in Kampala.

The demographics of Uganda[1,2]

Independence 1962

Former British colony

Government type: presidential republic

Population: 42,900,000

Urban population: 23.8%

Median age: 15. 8 years

Life expectancy: 55.9 years

Population growth rate: 3.2% 5 in the world

Unemployment, youth ages 15-24: 2.6%

Unemployment rate (total): 9.4%

GDP: $88.67 billion

Geography: landlocked; fertile, well-watered country with many lakes and rivers

Land use: agriculture 71.2 %

Languages: English (official national language), Ganda or Luganda, other Niger-Congo languages, Nilo-Saharan languages, Swahili, Arabic

Refugees (country of origin): 1,065,094 (South Sudan) (refugees and asylum seekers); 316,968 (Democratic Republic of the Congo) (refugees and asylum seekers); 40,765 (Burundi) (refugee and asylum seekers); 37,193 (Somalia) (refugees and asylum seekers); 15,266 (Rwanda) (refugees and asylum seekers) (2018)

Uganda's Telecommunications Sector (2017)[3]

Fixed lines subscription: 262,286

Mobile subscriptions: 24,948,878

Prepaid mobile subscribers: 24,860,872 (99.6 % of mobile subscribers)

Mobile subscription (data): 10,028,847

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1 In the chapter *Zones of transformation III* I discuss my relation with this demographics box and the relationality of numbers.

2 The World Factbook, CIA https://www.cia.gov/library/publications/the-world-factbook/geos/sw.html and World Bank Data https://data.worldbank.org/country/uganda [Accessed 181026]

3 Uganda Communications Commission Quarterly Market Report 4Q17, https://www.ucc.co.ug/wp-content/uploads/2017/09/Quarterly-Market-Report-4Q17-V002.pdf [Accessed 181026]

Postcolonial technoscience

A postcolonial perspective provides insights into how the dichotomies created under colonial eras continue to effect ICT practices in Uganda. When I think of postcolonial theory, I think of it in a similar way as posthumanism. There is no end to colonialism. We are still residing in an anthropocentric worldview, where imaginaries of technological determinism and cultural essentialism uphold unequal power relations. The prefix 'post' distinguishes a time before and after colonialisation, but it doesn't necessarily break with contemporary cultural, technological or capitalist borders. The term postcolonial is highly debated as it is very difficult to conclude who and what should be included or excluded in the discourse (Harding, 2011). Still, the term is useful for its crucial engagement of current social and technological practices which are genealogically bound by centuries of European colonialism. Postcolonial theory is a critical theory like feminist technoscience, but what makes the postcolonial perspective particularly important is the focus on a geographical, political and historical problematisation of Western institutionalised knowledge and how these epistemic structures can be reconfigured (Rydhagen, 2002). The modernist dichotomies "still operate in terms of global/local, first-world/third-world, Western/Indigenous, modern/traditional, developed/underdeveloped, big science/small-science, nuclear/non-nuclear, and even theory/practice" (Anderson, 2002, p. 644). Postcolonial theory changes the epistemic structures of Western knowledge production "by writing against them, over them, and from below them by inviting reconnection to obliterated pasts and forgotten presents that never made their way into the history of knowledge" (Shome & Hegde, 2002, p. 250).

This subsection relates to the paper *A conversation on mobile phone practices and development - writings by a feminist postcolonial technoscientific scholar* (see PART D, pages 121-133). In the paper, I discuss how positivist objectivity in research practices tend to categorise science, technology and development as neutral place-holders for innovation and entrepreneurship, thus making it difficult to question their embedded norms and values. When we acknowledge technology as relational we can place attention on the norms embedded in the design of ICTs. The dynamics of transformation is one of the cornerstones of development and economic growth. In an attempt to disrupt the linearity of this transformation I posit that a relational ontology should underscore all knowledge production. A relational ontology suggests a development narrative as a conversation rather than a singular, fixed directive as to what constitutes socio-economic development. We, as researchers, are implicated in the narration of what development is and the embedded metrics of failure and success. These actions motion the narrative of technological development in one direction and by doing so closes the door to other storylines and directions. Working with feminist technoscience, I suggest that situated interventions in knowledge production and in the development discourse can provide an epistemological platform where more narratives are encouraged to grow and strive.

The (post-)colonial era in Uganda

The British state began taking economic control of the region that now constitutes Uganda in the early 1860s. It wasn't until 1891 that an agreement with the ruler of Buganda was reached and a treaty was signed. Before the British colonialization, the Ugandan region consisted of many, smaller, ethnically or traditionally organised societies. As was the standard way of the European imperialists, they divided the African continent without any consideration of how this would affect the local communities and the different regions.[4] The British colonies were an economic resource, nothing else. The state of Uganda received independence in 1962 and the country has since then struggled with ethnic tension and regional internal conflict. During the colonial era the British chose the Buganda region as their primary place for governance (Lwanga-Lunyiigo, 1987). This led to preferable treatment for the rulers and people living in this area, a political and economic divide still prominent today several decades after Uganda's independence. A privileged minority of the Ugandan population has gained economic development and stability but the vast majority struggle with poverty and conflicts (Lomo & Hovil, 2004). Through my empirical work in Uganda, the local/global and urban/rural dichotomies are noticeable in how my research collaborators are geographically located in the Ugandan capital Kampala, which lies in the Buganda region. Colonialism is entangled with ethnic fragmentation and political instability in present day Uganda and provides an important perspective for understanding how information and communication technologies are transferred, interpreted and used differently in different regions of the country.

The different stages of ICT4D

The acronym ICT4D stands for 'information and communication technologies for development'. It refers to the ICT-related practices that try to eliminate the digital divide and work towards social, economic and political development. Unwin (2009) suggests that ICT4D has a moral agenda wherein the marginalised can benefit from ICT development and propose a focus on infrastructure, long-term partnerships, situated design solutions, sustainability and accessibility. Richard Heeks is one of the founding academics in the development of the ICT4D field and has worked with a Design-Reality gap model to analyse underlying factors of success and failure in ICT4D projects. Heeks (2009) provides a general overview of the historical progress of ICT4D in three stages - from ICT4D. 0.0 to ICT4D 1.0 to ICT4D 2.0. ICT4D 0.0 begins with the installation of the first digital computer in India in 1956. At this time, the government was the key actor and the software was intended for economic growth in the private sector. The next phase, ICT4D 1.0, came in the 1990s when the use of the internet extended to the general public and the MDGs were created. The key actors became international development institutions and NGOs and the priority was how ICTs could be applied so as to realise the MDGs.

4 African Studies Center, University of Pennsylvania, East Africa Living Encyclopedia, Uganda - History, http://www.africa.upenn.edu/NEH/uhistory.htm [Accessed: 2018-11-28]

The period of ICT4D 1.0 stretched from the mid/late-1990s to the mid/late -2000s and was characterised by "a quick, off-the-shelf solution that could be replicated in poor communities in developing countries" (Heeks, 2009, p. 4). Heeks (2009) presents three different reasons from phase ICT4D 1.0 for why priority to ICT was given to the poor in the Global South. Firstly, the ICT4D pratitioners had the moral argument. The poor people were those most affected by our global problems – climate change, conflict, hunger and poverty. ICT was already benefiting the rich, and politicians and ICT practitioners in the Global North argued that the rich should be sharing their benefits with the poor in the Global South (decreasing the digital divide). Secondly, we had an enlightened self-interest. The problems poor people have today in terms of water shortage and a limited oil supply could become the problems of the rich tomorrow. Also, when more people from the Global South started buying goods and services from the 'developed' countries, the rich became richer. This resonates well with the catching-up approach I mentioned in the chapter *Postcolonial technoscience*. The catching-up approach is a flawed and hegemonic model since the economic growth in the Global North depends upon the exportation of goods and services to the Global South. Thirdly, personal self-interest. Heeks (2009) suggests that designing a system for an African community was a much more morally satisfying experience than doing the same for a company in the global North.

The overview Heeks presents of the ICT4D 1.0 stage is filled with prevailing unequal power relations, wherein leading institutions and companies in the Global North decided what the appropriate means of development were for the Global South. Heeks (2009) expresses the outcome of ICT4D 1.0 with the words failure, restriction and anecdote. The lessons learned from the so-called failed ICT4D projects include a need for increased sustainability, scalability and evaluation. ICT4D 2.0 is where we are at now.[5] In the ICT4D 2.0 stage, focus is less on content and more on services and production. People who were formerly categorised as a passive, homogenous group are now becoming a heterogeneous, knowledge-producing group of innovators and producers. Key actors exist in all sectors and multi-stake partnerships between actors are encouraged. Innovation models formerly taking a top-bottom, out-of-context approach are now turning into situated innovations taking place in many different contexts.

Centre-periphery imaginaries

"[I]in an old colonial way, that the 'local' would be a property only of what used to be called the 'periphery' – but the 'centre' in the multi-sited imaginary of postcolonial accounts is just as local and should be considered as another node in a network" (Anderson, 2002, p. 652). My research collaborators and I use terminology such as *local* innovations in our conversations. The concept of providing a prefix, such as local, risks

5 Another term being used for ICT Development is digital development. The term digital development reconfigures the characteristics of development from a focus on the Global South towards a global development. Although I am fond of term because of its transformative and more inclusive connotations, I have chosen to work with the term ICT4D as it is the one most commonly used for the ongoing power relations between the Global North and the Global South.

abiding to hegemonic practices that reconstitute a story of where the centre of power is. This centre is a colonial imaginary and a forceful one. Anderson (2002) proclaims that multi-sited, interdisciplinary studies of technoscience are needed now more than ever. He refers to the decline of the nation-state and how the notion of a centre of power has become less sustainable. The situatedness of technoscience suggests that all infrastructures are local for someone or something. In my research I seek to understand and disrupt the complex architecture of grand narratives. When I talked with a representative from the Ministry of ICT he explained the challenges of creating an ICT infrastructure with few other infrastructures to plug into.

> *No, they [E-government] are not copy-paste because first of all they [South Korea] are already too far for us. So I cannot copy America or Sweden. They've been doing data things for 300 years. There's no way I can get to that level. The other time we were looking at land management in Sweden. They are managing their land since the 16th century. So every square inch of Sweden is documented. There is a general plan for Sweden that flows over the centuries.*
>
> *That this area will be abandoned, this will be industrial, the road will pass here, the water will be here. You know, that kind of thing.*
>
> *Computers just came in to help but there was already a system organized for doing things.*

The representative from the Ministry of ICT tells a story of inadequacy and comparison. Uganda's mobile infrastructure cannot easily copy a system from another country because of the extent to which the overall ICT infrastructures differ. There are several, overlapping narratives taking place in this story. One narrative tells of Uganda's past and a lack of classification systems, which has existed over a long period of time. Another narrative suggests that a lack of existing ICT infrastructure, i.e. computers, makes it difficult for Uganda to catch up and reach a standardised ICT model, as constructed by governments and organisations in countries such as Sweden or the USA. When I began writing about my research practices in the Ugandan ICT community, I started wondering what kind of development we humans are aiming for. Whose development are we aiming for and why?

A dominant narrative in development is the 'catching-up' approach where nations formerly colonised, or categorised as less developed than countries in the Global North, should strive for a lifestyle model existing in the Global North. This narrative has serious implications for technoscientific development because it suggests that modernization is equal to westernization (Harding, 2009). Mies and Shiva (2014, p. 56) explain "that the poverty of the underdeveloped nations is not a result of 'natural' lagging behind but the direct consequence of the overdevelopment of the rich industrial countries, who exploit the so-called periphery in Africa, South America and Asia". Within the catching-up approach resides a strong norm of negative difference since the progress of the Global North is largely based upon the (former) exploitation of the Global South (Ekdahl & Trojer, 2002). Postcolonial perspectives of unequal power relations are furthermore visible in the underlying reasons behind the field information and communication technologies (ICT4D) as mentioned by Richard Heeks on the different stages of ICT4D.

Mobile infrastructures of Uganda

The mobile phone is embedded in the social arrangements of the Ugandan society where millions are using it as an everyday communication device. The country got its first internet connection in 1995, and mobile phones were introduced a few years later (Mulira, Kyeyune & Ndiwalana, 2010). The number of mobile phones has steadily increased since then, and the formation of the Ministry of ICT in 2006, together with its agencies, are managing this emerging infrastructure through the establishment of several policies and strategies. Like many other African countries, Uganda did not build its mobile infrastructure upon an existing landline structure. An already existing landline infrastructure can assist in the positioning of Wi-Fi antenna masts or fibre cable. Instead, all the mobile infrastructure had to be built from scratch in Uganda. The telecom infrastructure first began with the mobile network company Celtel (now Zain) in 1995, which was then followed by MTN in 1998 (Hellström & Tröften, 2010). The early ICT reform was effective in expanding mobile coverage and in creating a competitive market for telecom operators. Some of the challenges Uganda continues to face in the further development of its ICT infrastructure include optimising the tax burden on the industry and reducing costs of broadband services (Ranganathan & Foster, 2012).

Everyday practices concerning the mobile phone include providing an affordable pay-as-you-go card, locating where one can recharge the phone, and determining when and where the network is reliable. At the ITU Regional Standardization Forum for Africa in 2014, Patrick Mwesigwa, a representative of the Uganda Communications Commission (UCC) addressed some of the ICT-related issues the UCC is facing nationally. According to Mwesigwa (2014), the standardisation process is proving to be challenging, and there is a need for coordination between different standardisation bodies, and to address inadequate capacity (including staff, tools and relevant, updated documents on standards), and unclear processes for the formalisation of standards.

The mobile infrastructure is akin to internet infrastructure. With regards to internet infrastructure, we have already identified democratic and legal issues concerning access (World Bank Group, 2016). We also need to consider who regulates and manages the mobile phone infrastructure and what kind of norms designers and engineers are building into the technology. Haraway shares her views on components in an infrastructure when she says: "[n]o objects, spaces, or bodies are sacred in themselves; any component can be interfaced with any other if the proper standard, the proper code, can be constructed for processing signals in a common language" (Haraway, 1991a, p. 212).

Stories of infrastructural inversion

In this subsection, people, politics and technologies are interwoven into the stories told by a project coordinator at the non-profit organisation Text to Change, a university

lecturer at Makerere University, a representative for the telecom company Warid Telecom, and the project manager for the NGO the Busoga Rural Open Source and Development Initiative (BROSDI). I argue for the relevance of storytelling as infrastructuring is both a relational and ecological concept (Star, 1999). 'Infrastructure' means different things to different people. A study by Burrell (2008) shows how rural villagers in Uganda view the phone as an alternative to transportation technologies. Rather than taking a bus to Kampala you can give the person you want to meet a call instead. Infrastructure is a construct of multiplicity, responsibility and controversy. Star (1999) argues that infrastructuring is both relational and ecological and is an inseparable part of the actions, objects and environment surrounding us. The complexity and vastness of infrastructuring suggests that one person alone cannot be in charge.

The stories I share from my interviewees and through my diffractive writing are part of understanding and producing realities (Haraway, 1991; Law, 2004). Situated knowledge is an onto-epistemological framework for taking responsibility for the subjectivity and partiality of knowledge production. A story does not provide a universal answer for all things involved. Bearing in mind my partiality and situatedness of knowledge production, my methodological proposition seeks knowledge in a plural sense. Just as the stories map an open and growing infrastructure, so do my investigations. The majority of interviews took place in urban Kampala and the stories told situate our different politics of location (Braidotti, 1994). Just as I am partial and constantly interpreting the ongoing mobile infrastructuring, so are my interviewees. They have their agendas and visions and I have mine. Sometimes they converge, and sometimes they differ. Star & Ruhleder (1996, p 114) stress that "[a]n infrastructure occurs when the tension between local and global is resolved. That is, an infrastructure occurs when local practices are afforded by a larger-scale technology, which can then be used in a natural, ready-to-hand fashion." My aim is not to look for synergies, where there is no more tension. On the contrary, I ask for difference and controversy. I ask for hints in order to uncover the socio-material norms that form the global information ecosystem. In relation to Barad's intra-action, I've chosen to address the generic properties of an infrastructure by Star and Ruhleder (1996) as part of my agential cuts when discussing how the infrastructures align, or more often diverge, with standardisations of an infrastructure. I have shortened the list of generic properties by removing the examples given for each property.

- Embeddedness. Infrastructure is sunk into and inside of other structures, social arrangements, and technologies.
- Transparency. Infrastructure is transparent to use, in the sense that it does not have to be reinvented each time or assembled for use.
- Reach or scope. This may be either spatial or temporal. Infrastructure has reach beyond a single event or one-site practice.
- Learned as part of membership. The 'taken-for-grantedness' of artifacts and organisational arrangements is a sine qua non of membership of a community of practice.
- Links with conventions of practice. Infrastructure both shapes and is shaped by the conventions of a community of practice.

- Embodiment of standard. Modified by scope and often by conflicting conventions, infrastructure takes on transparency by plugging into other infrastructures and tools in a standardised fashion.
- Built on an installed base. Infrastructure does not grow de novo; it wrestles with the inertia of the installed base and inherits strengths and limitations from that base.
- Becomes visible upon breakdown. The normally invisible quality of working infrastructure becomes visible when it breaks: the server is down, the bridge washes out, there is a power blackout.
- Is fixed in modular increments. Not all at once or globally. Because infrastructure is big, layered, and complex, and because it means different things locally, it is never changed from above. (Star & Ruhleder,1996, p. 381-382)

When analysing an infrastructure, Bowker & Star (1999) introduced a methodological concept called infrastructural inversion focused on change in technical networks, standards and knowledge production and politics. The inversion foregrounds the conventions and constraints of an infrastructure enabling us to see both classification systems and the standardisations formed in areas and unclassified spaces in between categories. Bowker & Star (1999) refer to this as the ubiquity of classifying and standardising, and it can be seen in certain ICT-related practices. For example, when network failure prevents a person getting in touch with another person using an SMS, or when cars and pedestrians try to signal to each other because the traffic lights are broken. When studying mobile infrastructuring the list runs long if we are to consider the classifications enlisted for a mobile phone - different types of hardware and software, operation systems, code categories, cellular network categories, sim card variations, keypad layout, channel frequency bandwidth, gateway providers, ISO standards and so on. Thinking of infrastructure as both material and symbolic requires a material-discursive language wherein the relationship is central (Bowker & Star, 1999). Eunice Gray, project manager at the non-profit organization Text to Change, provides an example concerning the issue of introducing smart phone technologies to Village Health Teams (VHTs).

> Eunice: *I think health workers have been given all these nice smartphones and two days ago I was in Jinja [town in Eastern Uganda] where I was trying to train these VHTs. A VHT is a person who not all of them have gone school you know and I'm trying to force them to use this smartphone which has also taken me a long time to learn. The VHTs fears to touch a button, what if I mess up everything and I don't have this person [Eunice] to train me again tomorrow.*
>
> *I like it, it's really good, it's going to help us, especially with data collection in the field but at the end of the day, is this technology going to be an inconvenience for the VHTs? Is this technology going to put VHTs off the original task that they are supposed to do? If I spend the whole day trying to navigate a phone, where I just answer five questions, instead of helping the health worker or the village, the patients, how do we make sure that technology is not derailing the health workers away from doing the work that they are supposed to do?*

In the example provided by Eunice Gray, mobile evaluation is presented as a steep learning curve and a potential intrusion to everyday healthcare work. From the multiplicity of experiences with the introduction of the mobile phone as a monitoring and evaluation tool in a healthcare project, it is important to avoid creating a network hegemony where only indicators of efficiency and economy are mentioned. Instabili-

ties are a part of the infrastructure and important to acknowledge when changing the infrastructure (Elovaara, 2004). For Gray the mobile phone is a part of her work life and she has learned to work with it as part of her everyday practices. However, her experience with the education of healthcare workers indicates that the mobile phone is not yet a familiar artifact, or a member, of the practices of the health community and as such still remains somewhat of a barrier. The inversion of this infrastructuring is shown in how the collision of two worlds comes together: the healthcare workers and a smartphone application. The tension of translating one system of practice to another involves maintaining or adapting to the new community of practice for the purpose of stabilising the infrastructure (Star & Ruhleder, 1996). In the case of Text to Change, more training may be needed or the healthcare worker will get accustomed to the application over time. The mobile phone, as part of the global ICT infrastructure, presents a forceful presence and a sense of robustness in the informatics of domination.

The intricate system of sim cards being used among the people I met in Kampala was, for me, far from embedded or transparent. Below is a conversation between Lydia, a lecturer at Makerere University, and myself, on the intricate system of sim cards. I had just received a call from a research collaborator and I didn't recognise the number. Since I didn't have it listed on my phone, the person appeared as unknown when calling me. When I had finished the call and hung up I exclaimed out loud to Lydia sitting next to me.

> Linda: *Ah, all these numbers. There are so many for each person. I already had two numbers for Ednah. Now a third.*
>
> Lydia smiles and replies: *That's how it is. I have five sim cards.*
>
> Linda*: Five?! But I haven't seen you changing sim cards since I came in.*

Then she starts showing me all her phones. She has three phones. Two dual sim card phones (Nokia and Tecno) and one single sim card phone (HTC). Lydia explains to me how she uses her different phones and I'm stunned. It's all about understanding the offers from the different operators, but that's not all. The offers create different modes of communication. For example, if Lydia receives a call from a Warid number she might not pick it up. She knows that Warid has an offer where one can pay 1000 Ugandan shilling (less than 1 U.S. $) with unlimited talk for 24 hours. She doesn't want to get stuck on the phone with someone who wants to talk for a long time. Her MTN number is her main number. This is the number she has had since 1999. All her contacts are connected to that number and it's the most important number to her. She always carries the phone with the MTN number with her. Furthermore, since Warid predominantly targets the youth market, it is more likely that her students will have Warid numbers than her colleagues. I asked Lydia what she does if she has a friend who has both MTN and Orange numbers, and the friend accidentally calls her with a MTN number to her Orange number. She said that she would cancel the call and instead call the friend back from her own Orange number. Orange to Orange is cheaper. She doesn't want her friend to lose money.

What is visible in one context becomes invisible in another. I've been connected to the same operator in Sweden for several years now. I have no clue what kind of offers they

or the other operators have. I'm a monthly subscriber and receive an SMS each month that notifies me how much my bill is, and the amount to be automatically paid via my online banking. Lydia mentions 'that's how it is'. Having several sim cards is for her more embedded into the conventions of mobile phone practice than it is for me. The entanglement of Lydia's social and economic capital, the knowledge of how to put different offers from mobile companies into practice, her relations with other human actors affecting each other and embodied into a situated infrastructuring. The Warid offer of paying a fixed price for unlimited talk during a 24 hour-period resembles an offer of one of the Swedish telecom companies in the 1990s. Their offer consisted of receiving bonus money the longer you spoke to the person that had called you. At the time, there where people in Sweden who created a system of calling your mobile phone from a work phone, allowing the line to remain open for long periods in order to receive more bonus money. This led to many workplaces receiving extremely high phone bills from their telecom provider.[6]

Infrastructuring shapes, and is shaped, by the conventions of practice. In Gray's story mobile data collection shapes healthcare practice, and in Lydia's story offers from mobile companies shape mobile communication practices. Peter Muwanga, Warid Telecom, introduces another story of how a popular offer called 'Pakalast' shaped calling practices. Pakalast initially provided the customer with a 24-hour slot for 1000 shilling, but the offer has changed over time.

Peter: *Basically in the African market, and Uganda in particular, we have so many mobile products. So, so many.*

Linda*: Which one is the most popular?*

Peter: *For us, our starting point was the Pakalast.*

Linda*: That's the 24 hour...*

Peter*: Exactly. But of course, at the beginning it used to be 24 hours of talking at 1000 shillings. But it was purely an enticement, to bring on the customers. The customers kept on coming in, the numbers grew, the access network started choking. You know, Ugandans like conversations so much. Someone is talking on the phone, and if I've paid 1000 shilling on my subscription, on Pakalast, I can talk with them on the phone for 24 hours.*

Let's look at housewives. She will talk with her friend, maybe another housewife, in another house they talk, they converse, she goes to cook, and she's going into the bathroom. She says "I'm going to bed". She will leave the phone on, connected.

She goes to shower for like thirty minutes, finishes and then resumes the conversation, you understand.

Linda: *But can't she hang up and just call back?*

Peter*: At that time, when things were free there was no need to hang up and call back, as I have explained. Now the number of mobile subscriber is steadily growing so we start getting what they call congestion. The mobile numbers share the same limited network resources and the congestion grows in the network which affects the access entry. Nowadays when you want to enter the network it is more challenging. So when you are able to access the network you don't want to release the connection.*

6 Swedish article on the http://wwwb.aftonbladet.se/nyheter/0008/19/fusk.html [The article is in Swedish] [Accessed 2018-11-09]

So what happened with the Pakalast offer was that we started getting issues of congestion because people got into the mentality of being connected for ten hours or more. The phone is there and I begin to cook. I put the loudspeaker on as I'm cooking. [...] So what happened? Warid started cutting the number of hours for the same amount, going from 24 hours to 12-13 hours. Warid then realised the congestion levels were still shooting up so they cut down the offer to 60 minutes, but you can utilize it in 24 hour division. This means that you can use your have several calls as long as they amount to 60 minutes within a 24-

The example of the housewife who didn't hang up presents an installed base on a socio-cultural convention. Warid could not beforehand know the Pakalast offer would create a culture where people didn't hang up. Network congestion and traditional patterns of communication created a situation where housewives could be social and talk on the phone whilst continuing with their work at home. Therefore, because network congestion continued to rise, Warid changed their offer. They decreased the talk time available under the offer, which meant that people could no longer afford to keep calls going for long periods of time. Once again, there was a shift in patterns of communication and phone calls became more time-efficient.

The mobile phone is much more than a communication device and becomes part of an assemblage wherein different human and non-human actors perform. The telecom operators play a role in the changing patterns of communication over time, and techno-cultural practices are in part responsible for transforming the infrastructures. Ednah Karamagi, representative of the NGO BROSDI, gives an example of local adaptation from their project involving farmers:

When we first sent text messages to Butaleja (district in Southeast Uganda) we found that it was a waste because there was no telecom network there. So the use of SMS had to be confined to other districts. You have to study your population: age, academic situation, location. Do they have telecom companies there? Do they have electricity to charge the phone?

Let me give you an example:

Butaleja has just got electricity, they didn't have electricity before when we started the project. So when we send text messages we tell the farmers: Every Monday switch on your phones. Every Monday. The reason? The farmers have places where they can charge their phone but they don't leave it on. They switch it on and find the missed calls and the missed SMS and reply.

But sometimes when we send an SMS it can take two or three days before the farmer charges his phone. Now, if we send the message on Monday and the farmer checks their phone on Wednesday, it will have bounced back. So the farmer misses it. So what we do is we tell them you can switch off your phone all other days but not Monday.

So all of them know, every Monday they must leave their phone on so that the message can come through. Or, if he has to switch off his phone he knows that if he switches it on again before midnight, the message will come through and will not bounce back. There is a 24-hour limit with our system. Then it bounces back.

And the farmer will never ever know that you have sent a SMS.

An infrastructural inversion becomes an approach of resistance to how artifacts and technologies can be transformed. Through trial and error the BROSDI project team found a way of using SMS services in their communication with the farmers. The situatedness of this story is expressed in an understanding of the local context. The regions differ so much when it comes to language, age and network connection so

that each project needs to build its own infrastructure. Ten years from now, when the demographics between the regions will have converged further, the project infrastructures will most likely look more similar. The BROSDI story is an example of the here and now. In order to affirm mobile phone use with the farmers, the project managers analyse their specific context. If it's best to send an SMS within a certain time frame during a certain day, then the project will adjust to this. The intricate relationship of farmers, connectivity, battery life, text messages and network systems suggests that in order to achieve a sustainable infrastructure, all actors (human and non-human) need to be considered.

Infrastructuring as a hybrid practice

The stories presented alongside Star & Ruhleder's (1996) generic properties build an assemblage where people and things are enacted through relationships. The infrastructural inversion of the mobile infrastructuring in Uganda presents a ubiquity of standardisations, or perhaps a lack of standards, where stakeholders from the Ministry of ICT and Text to Change are working to decrease the tension between members and non-members of the ICT community. Materiality and texture is expressed in the story of the housewife who didn't hang up. The behavioural patterns of the housewife converged with the materiality of the mobile phone and the offers of the telecom operator, providing a beneficial social pattern during a limited time. Lydia explains how she and many others have created a communication system of multiple sim cards. This system was created as a disruptive response to the high fees imposed by the telecom operators.

How we choose to relate to the constraints and possibilities of mobile phone interactions is important because of who is included or excluded, and how accountability, or lack thereof, is performed. The agential cuts enacted by politicians, policies, telecom operators, standardisation agencies, NGOs, healthcare workers and researchers are engaged in a complex apparatus of ICT development. I argue that when we take responsibility for how we intervene in reality-producing activities, we can disrupt dominant narratives of what and who matters and partake in more inclusive infrastructuring.

Infrastructures accommodate everyday practices and often uphold the categorical boundaries of the other or that which cannot be categorised. They also tend to become distant abstractions where scientists and engineers of a technical system are removed from the equation of implementing the system in a specific context (Forlano, 2016). Laura Forlano (2016, p.1) argues that "[a] feminist approach to infrastructuring as critical technoscientific practice that emphasizes concerns about social justice remediates this distance by integrating aspirations and ideals with actions". I invoke the cyborg as a speculative figure in infrastructuring and argue for a reconfiguration of technology design wherein maintenance, repair and care is embedded in the design process. The cyborg figures the activities of thinking, making and building in infrastructuring as a hybrid practice asking for tensions and complexities (Forlano, 2016). The technoscientific stories by the different communities of practice (healthcare workers, farmers and housewives) remediates the infrastructure as a distant abstraction and transforms users into active participants. Infrastructuring matters.

[the hybrid self]

During my stay in Kampala I wrote a research blog where I described my interactions with different people in the ICT community and my experiences with the Ugandan culture. These detailed research notes helped me relate to my researcher role and my attempts to try and transform technological development. Below is a blog post that I wrote after I had been in Kampala for a few weeks.

Posted by: thehybridself on 22 October 2012
Blogpost: Where am I?
Where have I been?
Five weeks have gone by so fast.

I've met with people from Warid Telecom, Makerere University, Uganda AppLab, Hive CoLab, Witu, Brudan, Wougnet, BROSDI, Muni University Project, UCC (Uganda Communications Commission), Girl Child Initiative Uganda, SMADA (South Mawokota Development Activist Organization), Victoria University, MTN, Orange, Outbox, Mobile Monday, UConnect, Kola Studios, An Xiao Studio and Text to Change.

I've attended a Wougnet workshop, a Mobile Monday Uganda event, travelled back and forth to Arua and set up plans to connect with some student projects at the Faculty of Technology, Makerere University.

The family and I have visited Munyonyo resort, found some lovely art at MishMash, celebrated our kiddo's first birthday, visited Kampala's 2nd Food festival, travelled to Jinja for a few days and stared at the source of the Nile, were invited to Dr Lating's home where we ate lovely Ugandan food, hung out with friends of friends from back home, caught a glimpse of the expat community in Kampala, and walked all the stairs in the minaret of the Gaddafi mosque.

Where am I going?

I want to meet with the following people/organisations/projects before going back to Sweden: the Ministry of ICT, ICT Cluster, Airtel, Maureen Agena, UNFPA, Unicef, Ureport/MTRAC, I-network, Gender studies @ Mak Uni, Mara Launchpad, Media folks (PCTech magazine). I have some more people I want to connect with but nothing is booked yet.

I'm also planning an Open Space workshop at Outbox next Wednesday evening. I haven't decided on the topic yet, but it will be something along the lines of Mobile Futures: Challenges and opportunities…

Virtual PAR (participatory action research)?

On November 6-7, I'm attending Wougnet's Web 2.0 training as a guest speaker. This happened as a result of my meeting with Moses, youth ICT4D coordinator @ Wougnet. We talked about the possibilities of me connecting with a group of young people where I could use visual and digital ethnography as a method for gaining first-hand

material on mobile use in everyday life. This project is still very much in the idea phase. I need more time to consider if a virtual PAR approach is the way to go. I might just present my ideas at the training, and discuss with the participants what they think would be a good approach. Why not have a collaborative and engaging direction from the start? :)

I've got different research strands that I want to pursue. I haven't even mentioned my hopes of following some of the design students, from the Art Center College of Design, currently planning and implementing design projects in Uganda. Several of them have specific projects connected to mobile systems and would be interesting to follow long-term.

Materiality and society

Aside from recorded interviews, interview notes, general notes, photos, news articles, books, research articles, and podcasts, I've got this blog. I'm so happy to have it now and will be even happier to have it when I go back to Sweden. Of course, there have been many evenings when I wish I would have had the energy to sit down and write more, share more images and videos, but if it hasn't come across, yet it is quite an intense experience being here. Not only the research and the intensity of living in central Kampala, but also going about your everyday life with a small kid. My husband and I can't just go out in the evening for a walk or to a restaurant. Just the other day we were invited to a cultural evening but we had to cancel because the kiddo would have been too tired and too restless to enjoy it. The kiddo is one year old, can't sit still for more than two minutes and usually goes to bed between six and seven.

Still, I'm so happy for this arrangement, that I could bring my family so we could stay here for a longer time so that I could connect with more people in the M4D community. I'm happy to share my husband's experiences with living in Kampala, it's his first time visiting an African country and the pace of development and the difference in cultures is mind-blowing for him. It's mind-blowing for me too. In the past, when I've done research in my undergraduate studies, I've had a more narrow approach and focused on certain aspects of society (i.e. an internship for a Health Communication project in Tanzania), but having a technoscientific, transdisciplinary, approach this time makes me want to include everything and everyone (i.e. political history, educational system, religion, corruption, urban, public spaces, maternal health). You name it, I want to have it all.

I'm looking forward to going back to BTH (Blekinge Institute of Technology), to sit down with my research colleagues, and to ask them for advice on how on earth I'm supposed to put this all down in a chronological, linear text. I'm also looking forward to meeting with my supervisors again and discussing Mode 2 approaches in design and society.

But for now, I have to locate the national ICT policy for Uganda somewhere on my hard drive, read through it and prepare questions for tomorrow's meeting at the Ministry of ICT.

The technological imagination

In this subsection I explore the empirical data from the paper Exploring the technological imagination among young entrepreneurs in Kampala: a feminist postcolonial technoscientific perspective (PART D, see pages 135-152) together with a conversation with the project manager at Outbox, and discuss the normativities of user-centered design methods. The paper is based on conversations from an Open Space workshop that took place at the tech hub Outbox in Kampala in 2012. The theme of the workshop was "The mobile futures of Uganda: sharing visions and challenges for today and tomorrow". Working with my empirical material and different theoretical perspectives, I formulate technoscientific stories in which I discuss the agency of developers, postcolonial trajectories of technology transfer and embedded norms in design methods. Working with different theoretical approaches - feminist technoscience, postcolonial computing and critical technical practices - helps to foreground the values embedded in technology development and design. Through these expositions I motion towards a difference of relationality where our differences are not, and should not be, held separately but performed as a continuum. Asymmetrical power discourses in international development urge us to find alternative ways of imagining and enacting mobile application development and the stories I have written provide such a practice.

I lived within walking distance of the tech hub Outbox in central Kampala and so one day I went over to talk with the project manager about the work they do at the tech hub. The project manager was glad for the mobile application development taking place in the city, but was also concerned for, as he called it, the thought process. He explained the process and how he had noticed a trend where entrepreneurs were building applications for themselves and for an imaginary American market. Since the entrepreneurs are based in Uganda it would be preferable if they can get the app to work in the Ugandan context first. The manager expressed a personal determination for encouraging app developers to address problems locally – to work towards a local solution and then scale up.

I was curious to learn more about how the entrepreneurs relate to current and future mobile development practices. Therefore, I organised an Open Space workshop. The theme of the workshop was "The mobile futures of Uganda: sharing visions and challenges for today and tomorrow". Drawing upon theories of feminist postcolonial technosciences, my research objective is an exploration of how technoscientific stories affect, and are affected by, power relations in mobile development. In my analysis I worked with the technological imagination as a feminist figuration (Balsamo 2011). Balsamo (2011, p. 31) explains technological imagination as a "mindset and a creative practice of those who analyse, design, and develop technologies".

Bearing in mind the previous subsection *Stories of infrastructural inversion*, the workshop participants mentioned similar concerns of technological and bureaucratic infrastructures. They discussed the type of structures affecting them individually and as a group of entrepreneurs. The topics ranged from mandatory sim card registration, what it means to develop for the local market, the complexity of working with different platforms, to what kind of applications they should be producing. Mobile application

development infrastructures, including programming languages, internet communication protocols, interfaces, wireless network, and hardware support, are all more or less transparent models intertwined with the actions and directions of how a developer designs its application. I worked with the concept of postcolonial computing to critically engage with the consequences of how postcolonial relations affect contemporary design practices as well as to point towards "sites of creativity and possibility" (Philip et al., 2012, p. 7).

A workshop participant gave an example of how a Ugandan company was in need of a software developer and chose a developer located outside of the country. The example sparked a discussion on job opportunities and the conceptualisation of the national identity. The discussion brought forward how norms in the national tech community are transforming from a situation of missed job opportunities towards a practice where Ugandan software developers are becoming a viable option for international organisations and national software companies.

Transforming designers and users

User-centered design[7] is a normative method used among many designers and developers in the global tech community. Several workshop participants brought this design practice forward as a useful approach in application development. Below is a discussion between two workshop participants on user design:

> [Participant 1]: *One thing about the way we build our platforms here is that we do not look at this thing, the end-user experience. When we build we assume that the guy who is going to use the application is an elite guy. For example the Farmer's application that was built by Grameen, tell me how many farmers are using that application?*
>
> [Participant 2]*: The thing with Grameen, they go and interview the guys, I think I wouldn't front Grameen because these guys know what they are doing. They have experience dealing with the poor, so at least they go down to the grassroots and find out how we do it, this is how we should do it, and they train those guys.*

This discussion resonates with the conversation I had with the project manager at Outbox. He expressed concern of how some developers tend to imagine themselves as their future users rather than involving other actors earlier in the design process. The assumption of the 'elite guy' reflects a bias towards male, urban city users accustomed to smart phone interfaces.

All of us, the participants and I, brought with us gendered, racial, and class-based assumptions to the workshop. These assumptions are embodied experiences that tend to go unnoticed in design processes. When Balsamo (2011) discusses the gendering of the technological imagination, she refers to all the interactions taking place in a design process. These interactions determine the outcome of a mobile application, and by understanding differences between actors and context it makes it easier to design context-relevant mobile applications. I suggest that understanding and relating to the

7 User-centered design is an iterative method that involves users throughout the design process. The designers focus on the users and their needs so as to create as relevant and accessible products and services as possible for them.

social and cultural embeddedness of technological development becomes an important resource for designing situated and democratic technocultural innovations.

I argue for a more critical engagement of the roles of designer and user. A mobile application can be designed for different actors for different purposes without boxing the actors into the categories of rich or poor, old or young, urban or rural. Actors are more than their relationship with technology. Designers need to understand and acknowledge how their methods and interactions with different actors, or lack thereof, affect the end-results of a mobile application. Design matters.

Gendering the ICT community

In this subsection I discuss my self-reflective writing strategies in relation to my empirical data from the paper Women's tech initiatives in Uganda – doing intersectionality and feminist technoscience (see PART D, pages 153-168.) and further entangle gender and technology relationships. In the paper I explored how the start-up of the women's ICT initiatives Women in Technology Uganda (WITU) and Girl Geek Kampala uses structural adaptation and resistance through the theoretical framework of intersectionality and situated knowledge. Today in 2018, WITU still remains but Girl Geek Kampala has transformed into new groups such as Women Passion Program (WOPA) and InnovateHer Africa.[8]

When I met with the co-founders of the initiatives I initially wanted to talk to them about their work with ICTs in their work-life. During the interviews we started talking about their initiatives for women and ICT, and I was curious why they had chosen to create these gender-separatist arenas. I began writing about the experiences of the co-founders and tried out different analytical perspectives when formulating technoscientific stories. My writing strategy followed the nomadic writing practices of Laurel Richardson (1997) and Elizabeth Adams St. Pierre (1997) wherein I pay attention to the process of my work. In the words of Adams St. Pierre (1997, p. 408) - "as I write, I think, I learn, and I change my mind about what I think". I tried transforming the girl geek trope into a figuration but it didn't work out because my cultural preunderstandings of what a geek is, as well as the stereotypical images of a geek in popular culture, got in the way of what the co-founders were trying to accomplish through their initiatives. My writing practices were certainly not an easy path – "[i]ndeed, I wonder sometimes whether I am writing my way into a catastrophe. How can I presume to interpret and represent the lives of these women? Who am I to do this work?" (Adams St. Pierre, 1997, p. 405). It is precisely those thoughts that led me to re-evaluate how I should approach the stories of the co-founders. I started working with Amartya Sen's capabilities approach, as suggested by one of my reviewers. The capabilities approach challenges the growth-focused view of development by defining development as "a process of expanding the real freedoms that people enjoy" (Sen, 1999, p. 3). I liked

8 http://www.enstartup.com/2017/03/06/girl-geek-kampala-rebrand-innovateher-africa/ [Accessed 2018-11-11]

the processual aspects of the approach and how freedom of choice considers personal, social, economic, and political spheres, and places individuals at the centre of how development should be pursued. Still, I wanted to address the gender-technology narrative that the initiatives intervenes with, and I wasn't sure how I could do this with the capabilities approach. I then realised that I wanted to work with intersectionality as an analytical perspective.

Intersectionality works as a theoretical and methodological concept that shows how different categories are entangled with each other, and by belonging to different categories you will be discriminated differently, for example as a white, heterosexual woman versus a black, gay woman. However, I wasn't entirely comfortable working with categories such as gender, class and race at the risk of cementing them further, and only re-affirming a binary system of negative difference in society. Delving into the writings on intersectionality, I learned that several feminist theorists had developed and reconfigured the concept of intersectionality towards a "nodal point" (Lykke, 2010), or as, de Vita and colleagues (2016) put it, a "discursive site" for creating critical dialogues with different feminist perspectives. I was inspired by de Vita, Sciannamblo and Viteritti's (2016) concept of doing intersectionality - where processes of categorisation (i.e. gender, class, and ethnicity) are not distinguished by being either disadvantaged or privileged, but are formulated as an assemblage (Puar, 2012). An assemblage is a different way of approaching the world where social categorisations are relational, not essential (Barad, 2007; Deleuze and Guattari, 1987). I drew upon the concept 'doing intersectionality' in my attempts of transformations of an assemblage of WITU and Girl Geek Kampala, and used the analytical categories space and practice to study how Barbara and Maureen (and the members of the initiatives) move or remain still in their ICT-related activities, and how these activities reproduce and transform gender-technology relations. Difficult and disconcerted meanings and histories are inherent in the relationship between gender and technology. Gender is often viewed in popular thought as being composed of the fixed binary components of "male" and "female", and technology has been separated from the social and strongly associated with masculine norms and scientific 'truth'. The cultural notion of the phenomenon of technology as something masculine, neutral and objective has been fundamental to modern science (Haraway, 1991; Latour; 1979; Traweek, 1988).

> *Sometimes I go for those hackathons. You enter the room, and you look around and in a group of fifty there are three girls and they are always the same girls. Because when we go for tech events you will find Christine, Emily and myself. You will find, yeah just the common faces. So that's a very huge challenge. There are very many girls out there who are so good but you know the confidence, the issues of being bullied. You can't blame them because it starts from home.* - Maureen, co-founder of Girl Geek Kampala

The stories presented by Barbara and Maureen, and through my diffractive writing, form an assemblage of resistance, adaptation and transformation. By interfering with social norms and male-dominated IT spaces, the initiatives provide a space for transforming the agency of the members of WITU and Girl Geek Kampala, and have an impact on the larger ICT community. Innovative practices are a feminist concern in that they tend to focus on singular individuals, places and things which enforces an

unequal relationship of who is recognised (for example white, privileged men residing in elite academic institutions) and those who are not recognised (black women in the periphery of an urban ICT community). Suchman (2005, p. 1) suggests that one way of moving away from this unjust relationship is "to decenter sites of innovation from singular persons, places and things to multiple acts of everyday activity". I suggest that the women's tech initiatives in Kampala decenter traditional sites of innovation by providing collective everyday activities for their members. I further argue that by acknowledging new sites of innovation, such as those performed by the women's ICT initiatives, new possibilities of political and social accountability arise.

Gender as a category

In the epilogue of my licentiate thesis (Paxling, 2015, p. 86) I wrote: This text was a transitional work on my behalf. My ambitions encompassed being respectful towards the political relevance of women-oriented arenas in technology while including feminist technoscientific visions of the science question in feminism (Harding, 1986). The initiatives are creating access points for women in networks formerly exclusive for men. They are pushing physical and mental boundaries in women's agency and members of the initiatives are gaining knowledge they aren't given anywhere else. They are also at risk having their efforts of access and agency remained in the periphery based on how they situate themselves. I am concerned that technology and knowledge transfer, in the case of women initiatives and technology hubs, are replicating a historical situation enforcing a gender dichotomy where there is little room for transformation.

I want to clarify my previous concern for a reproduction of woman-man dichotomy with little room for transformation. The reason I expressed concern for the reproduction of a gender dichotomy is that gender equality tends to be thought of in terms of representation rather than the gendering of science and technology, and although the women's tech initiatives are transforming material-discursive practices at the tech hubs, they are still a part of a larger infrastructure that may is formulated by another technoscientific narrative of how gender and technology should be addressed. The co-founders and the members of WITU and Girlgeek Kampala gave examples of how women and girls are being bullied and discouraged from participating in the arenas of technology and innovation. The co-founders and their members are challenging these misogynist threats through their activities.

The tension of gendered categories persists, and the gendered dimensions of science and technology are material-discursive practices omnipresent at the tech hubs. Bowker & Star (1999, p, 223) refers to it as a torque when "the twisting that occurs when a formal classification system is mismatched with an individual's biographical trajectory, memberships, or location". The twists and turns taking place with categorisations such as gender, is occurring in all kinds of contexts. It is crucial that we understand how the ideals of gender equality will be interpreted and approached differently; depending on your politics of location, and that an affirmative and adaptive approach is necessary so as not to fall back into a critical reflection of working within a singular knowledge

framework. When Nicholas Gane (2006, p. 137-138) interviewed Donna Haraway he asked her about gender as a category:

> *NG: So how do you think about gender in an increasingly transversal world?*
>
> *DH: In the way Susan Leigh Star and Geoff Bowker teach me to think: category work (see Bowker and Star, 1999). Don't deify the category. Don't make a criticism and think it just disappears because you've made a criticism. Just because you or your group got at how it works doesn't make it go away, and because you get that it is made doesn't mean to say it's made up. We're in a post-gender world in some ways, and in others we're in a ferociously gender-in-place world. But maybe the women-of-colour theorists got it right when they said we're in an intersectional world. That's what Leigh and Geoff meant when they came up with the category of torque. We live in a world where people are made to live several non-isomorphic categories simultaneously, all of which 'torque' them. So, in some ways post-gender is a meaningful notion, but I get really nervous about the ways in which it gets made into a utopian project.*

Gender matters.

Zones of transformation II

Knowledge which matters has to be knowledge which is open to its own historicity and spatiality, and open to alternative ontologies. In this age of renewed fundamentalisms of all stripes – religious and scientific – the crucial task for the University is to provide a playground. In classic liberal discourse, this is a neutral playground – free of ideology, will and power. In the nineteenth century, laissez faire economics was supported by Britain, the dominant imperial power, since a 'fair' economic arena with no government intervention would favor them every time. Similarly, 'fair' admission of all forms of knowledge to the playground constructed by Western science guarantees victory for the dominant ideology of science. I believe that our task now is to challenge the imperializing vision of the neutral playground governed by rational choice. We must create spaces in which the rules of the playground are visible and negotiable, and wherein myriad ways of seeing, reading and knowing can bloom.

(Bowker, n.d., p. 11)

To the reader

In this chapter I weave together stories from my research experiences in Sweden. I begin with the subsection A different media technology, which introduces the pedagogy for the undergraduate program media technology at Campus Karlshamn, Blekinge Institute of Technology. I then continue with the subsections A norm-critical game culture, Critical making and situated knowledge, and Design fiction and future-making practices.

Demographics of Sweden[1],[2]

Government type: parliamentary constitutional monarchy

Population: 9,960,487

Urban population: 87.4%

Median age: 41.2 years

Life expectancy: 82.1 years

Population growth rate: 0.81%

Unemployment, youth ages 15-24: 17.9%

Unemployment rate (total): 6.6%

GDP: $520.9 billion

Geography: Northern Europe, bordering the Baltic Sea, Gulf of Bothnia, Kattegat, and Skagerrak, between Finland and Norway.

Land use: agriculture 7.5%, forest 68.7%

Languages: Swedish (official), Finnish, Sami, Romani, Yiddish, and Meankieli are official minority languages.

Refugees (country of origin): 96,914 (Syria); 25,968 (Eritrea); 21,693 (Iraq); 22,548 (Somalia); 16,558 (Afghanistan) (2016)

Sweden's Telecommunications Sector (2017)[3]

Fixed lines subscription: 2,600,000

Mobile subscriptions: 14,400,000

Prepaid mobile subscribers: 24 % of mobile subscribers

Mobile subscription: 10,300,000
(voice and data)

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1 In the chapter *Zones of transformation III* I discuss my relation with this demographics box and the relationality of numbers.

2 The World Factbook, CIA https://www.cia.gov/library/publications/the-world-factbook/geos/sw.html and World Bank Data https://data.worldbank.org/country/uganda [Accessed 2018-10-26]

3 http://www.statistik.pts.se/media/1325/summary-of-the-swedish-telecommunications-market-for-2017.pdf [Accessed 2018-10-26]

A different media technology

The three research projects that will be presented later in this chapter took place at Campus Karlshamn, Blekinge Institute of Technology, together with undergraduate students in Media technology. I want to explain the context of this media technology program because the name says so little and presumes so much. In the dissertation 'Media Technology in Late Modern Time – Digital Technology, Aethethics and Expression', Peter Ekdahl (2005) explains the foundation of the educational approach at Campus Karlshamn. The transdisciplinary approach to the pedagogy of media technology has enabled discussions on the transformation of technology and what kind of implications these transformations will have on knowledge and learning.

Feminist technoscience has been the epistemological base from the beginning of the history of the campus, and provides an open and critical space for media technology students to formulate new research aims in digital technology. Donna Haraway's epistemological concept situated knowledge permeates the pedagogy of the educational space by creating a culture of transparency and responsibility. The media technology program was thus developed towards design-oriented activities including "the expression and the form (technically and aesthetically) one gives a knowledge content in order to, as strongly as possible, capture and maintain the interest of the intended recipient" (Ekdahl, 2005, p. 155). The concepts of knowledge, learning and people can interact in the context of media technology to encourage a transformation of the second order - where we are no longer thinking and acting with the same usual methods, but instead we are challenging the normativities of media technologies and learning and doing something quite different than before (Ekdahl, 2005).

The design-orientated activities in media technology education are based on the argument that technical and aesthetic expression is inseparable. The activities formulate a relationship between the development of a technical and an aesthetic skill, and how these skills in turn form a relationship with different ways of expression and communication. This approach has been, and still is, very challenging to enact. Decades of black-boxing technology as something abstract and separate from the self makes it very difficult for students and teachers to see technology as something relational. To challenge this constructed separability between technology and the self, the founders of media technology education formulated a pedagogy with an emphasis on processes of mentorship and reflective dialogue. The teacher challenges the student to critically explore different forms of expressions through the student's own experiences and through the development of professional media-related skills: "Design-orientated activities in a media technology education are not only about searching for forms of expression, but should be based on an approach to oneself and the outside world. It is a claim that has consequences for the relationship between a mechanistic interpretation of the concept of technology and media technology examination [sic] with what a digital technology concept can contribute with" (Ekdahl, 2015, p. 48). In my research practices within the media technology context, I have experimented with a reconfiguration of technology as relational – as part of the expression of the design process. This approach

has been met with confoundment and resistance. It has also provided possibilities for tinkering with norms and transgressing boundaries. The process of unboxing technology and reconfiguring not only the concept of media technology, but also learning practices, is a tricky transformation. My intention is not to critique media technology practices for the purpose of deconstruction. On the contrary, I want to collaborate, tinker, and experiment for the purpose of creating robust and constructive education.

> *The purpose of showing how things are constructed is not to dismantle things, nor undermine the reality of matters of fact with critical suspicion about the powerful (human) interests they might reflect and convey. Instead, to exhibit the concerns that attach and hold together matters of fact is to enrich and affirm their reality by adding further articulations.* (Puig de la Bellacasa, 2011, p. 89)

The quote above refers to how Puig de la Bellacasa is imagining a more constructive political approach in science and technology studies research. Thinking with care, I imagine the same for media technology. My exploration into critical design practices has helped me implode the boundaries of imagination and reality, and to better understand how we as humans can challenge injustice and generate alternative futures (Forlano, 2017). I use critical design practices in a similar manner as how the Design Justice network (Sasha, 2017) uses design:

> *We use design to dismantle structures that exploit nature and the human experience through systems of domination. Simultaneously, we use design to sustain, heal, and empower communities as we birth a sustainable future.*

A norm-critical game culture: exploring norms among media technology students

In this subsection, I explore my empirical data from the paper A norm-critical game culture: a participatory study (see PART D, pages 169-181) together with a blog-post from the project website and discuss the relationship between norm-criticality and norm-creativity.

A norm-critical game culture was a preliminary, Vinnova-funded study of how norms and power discriminate the innovation process in game development and in game culture. Underlying questions for the project were: Where in an innovation process does equality as a tool for change come in? How do we challenge and subvert the current power structures of the game industry? The aim of the project was to identify norms and attitudes among future game developers, increase knowledge of the norm-critical perspective in the gaming industry and experiment with the concept of games in partnership with the private and public sector.

We, the project consultant and myself, recruited ten undergraduate students in media technology interested in working with our research questions. We met the students during three workshops and a hackathon. The workshops focused on three different themes: education and research, business and industry and future uses. The hackathon was a one-day event where people from the private and public sectors were invited to create game concepts based on a norm-critical perspective. The study was done with a participant-driven model where all participants contributed their knowledge and dis-

cussed possible approaches for a more inclusive game culture. We, the project managers, chose not to build on existing companies, products or services or fixed definitions of concepts in our meetings. It was the participants' task to explain, define and develop concepts such as innovation, games and gender.

It is a widespread notion that gender equality concerns only, and is restricted to, equal representation of women and men. A feminist technoscientific framework expands this approach by investigating what feminism can do for science, and by focusing on how normativities have affected knowledge production (Trojer, 2018). A feminist critique of science reconfigures these normativities, and by doing so present alternative models for how knowledge can be acquired and applied. In the context of a norm-critical game culture, I foreground boundary-making practices taking place in technocultures, and ask questions such as:

- Whose bodies are allowed to take place?
- Whose knowledge is valued?
- What can normcreative innovations look like?

Voices from the game culture:

> *– I see myself as, and am perceived as a girl, which in the online gaming world very often means that I suffer from sexist comments. If things go well for me in the game, I am called a whore, bitch, and everything possible. If things go bad in the game, I am accused of not being able to play because of my gender. It's so damn tiring and lame.*
>
> *– I never say I am a woman when I play and I always use gender neutral nicks [nicknames]. My whole game experience is destroyed the moment someone believes that I am woman in real life. There is a steady stream of invitations, marriage proposals, sexual invites and when I win over them the aggravations and the detailed descriptions of rape know no limits.*

The quotes above originate from a report *"I don't exist in games" – A report on young LGBT people 's view of computer and video games and the culture surrounding it* (Wennlund, 2014).

A participatory framework

We entered the project without a ready-made list of preliminary outcomes, other than the opportunity to discuss and work collaboratively on the research objectives. Before the project began we made certain assumptions on where the focus of interest would be for the students. We thought we would be discussing how we could change the game culture and what kind of games we would like to play, but instead a lot of time was placed on discussing the concepts of gender, innovation and games. The concept of innovation proved to be the hardest one to discuss because it became difficult to know how one should, and could, relate to this phenomena. Several students entered the discussions with preconceptions on how one should perform a certain task, be it a game concept or formulating a hackathon, which posed interesting challenges. Together with the students we worked with exercises that would disrupt our lines of thought and look for other ways of engaging with the game culture as a phenomena. The following text is a blog post that I wrote after workshop number three.

Blogpost: Workshop nr. 3.

Date: April 8, 2015

A cold Thursday morning I came to Karlshamn. I, Linda, was the only one there. Elin was ill and had the flu. The clock struck nine and I was still by myself. I knew some students couldn't come due to illness and other priorities, but wouldn't anyone come?

After a few minutes, two faithful participants appear. A little while later, we became a few more.

The small group makes us personal. We become honest. We become straightforward in how much our own experiences influence how we want media to work, now and in the future. We are characterised by social censorship and self-censorship.

It is sometimes difficult to visualise norms in the game culture, but I notice in our conversation that when we challenge norms in another discourse it makes it easier to see norms in the game culture. But it's one thing to see them and another to develop strategies to change them. Of course, it's not all norms that should change, only those which are discriminatory.

Today's theme is future uses (of games). I start the workshop with a presentation on the topic of "What do we want our future tdo look like?" and discuss this topic from a feminist perspective. I have a slide with a quote by Judith Butler, "Gender is not something that one is, it's something one does, an act – a "doing" rather than a "being". The quote evokes discussion. Is this really true? Is gender just "a doing" or is it also "a being"?

We talk about intersectionality and how different power structures interact. What do we see in the game culture? I talk about moving beyond gender representation and discuss whose experiences and knowledge counts? Who is allowed to participate? I present another slide with a quote by the game researcher Mary Flanagan.

"Why does it matter who makes our games? Innovation comes from fresh voices and new ideas. [...] It matters to women who feel excluded from a livelihood. It matters to kids who can't grow up to be someone they want to be. It matters to all of us as we expand the role of games from entertainment to platforms on which classroom learning and everyday communication takes place".[4]

But it's hard to talk about the future. We are very here and now, in our everyday lives, in our undergraduate programs and in our jobs. So we start there. I introduce an exercise, which I call "What idiotic rules are in the way of having the game culture you want and how would you change or remove them?"

[Clarification: We made a list of all the rules we dislike and a wish list for what we would like to change. I have created two separate lists for easier reading. One that lists idiotic rules and one that addresses norm-creative suggestions for game culture.]

Idiotic rules:

- *A game must be as profitable as possible.*
- *A big game must be displayed on E3 and must be released within 9 months.*
- *Serious games/Teaching is a separate form of play.*
- *Each development of a game must have a crunch. (Crunch = A 'workpeak', when you have a higher gear and work all the time)*

Normcreative wishlist:

- *Stop using female characters as a prize for the male characters*
- *Feminine = / = weak [Feminine does not equal weak]*
- *Acceptance between groups*
- *Do not be afraid to show the feminine side of men*

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4 http://gamasutra.com/blogs/MaryFlanaganPhD/20140318/213356/By_2020_make_the_game_indus [Accessed 2018-11-28]

- *Stop bullying within the gaming community*
- *More challenging games and fewer games that take the "safe" way for the sake of money*
- *More games created for both men and women*
- *Stop trying to control what to buy depending on gender*
- *Anyone who likes games should be able to call themselves gamers without being questioned*
- *Criticism should be treated with attention, not hate*
- *Dare to include more non-binary characters and other sexualities*
- *Stop following old patterns with body shapes*
- *You should not be afraid to play if you are a girl*
- *More POC main characters [POC = people of colour]*
- *More realistic conditions [more realism in the games]*
- *Stop using mental illnesses to rationalise evil.*

Afterwards, we placed our Post-it notes that listed our wishes on an x-y axis system where the y-axis represented great effect - little effect, and the x-axis represented 'easy to implement' - 'difficult to implement'. All the Post-it notes ended up in the Great Effect box and Difficult to Implement.

This was an important practice to identify the barriers of a more inclusive gaming culture. It was easy to address idiotic rules, but more difficult to find solutions to change or remove them. Where should we focus our change strategies? We need to involve actors from all parts of the game culture in order to realise the wish list stated above. "Anyone who likes games should be able to call themselves gamers without being questioned". Yes, then more people in the gaming industry need to be involved for this wish to become a plausible future.

Everyone can be a gamer.

The exercise "What idiotic rules are in the way of having the game culture you want, and how would you change or remove them?" came with a lot of frustration. When we got to the part where all Post-it notes where placed in the Great Effect box and Difficult to Implement-box, we were left with a situation from which we didn't know how to proceed. The idiotic rules are many and cannot be solved overnight. What the exercise did accomplish was foreground taken-for-granted norms that create unequal relations and toxic game cultures, as well as negatively affecting innovation processes. We continued to work with the hackathon and to discuss how we could approach the event with normcreative methods.

When we conducted a hackathon together with the students, we collaborated with representatives from academia, industry and the public sector. The term norm-criticality is often used for the analysis of a specific context, whereas the term normcreativity refers to the practice or the application of the analysis. I maintain that our study did not have such a clear distinction. Our study involved an analysis of norms in game culture beforehand, but the analysis (and practice) continued together with the participants. When we designed the hackathon we deconstructed the normative processes of how a hackathon is usually conducted, and included an introduction concerning norms and values in the game culture. We encouraged the participants to play with norms. Some participants realised that they knew more about games and game design than they had initially thought. The participants who had a lot of experience with hackathons and

game jams [5]explained that the possibilities of brainstorming normcreatively strengthened the effects of the game prototypes. Norms matter.

Critical making and situated knowledge

I*n this subsection I introduce the framework of experimental design research in relation to the empirical data from the paper Exploring Situated Making in Media Technology Education (see PART D, pages 183-194). In the paper I explore critical making as a method and a pedagogy in bridging the gap between conceptual thinking and making, encouraging play to cultivate learning and understanding of one's relationship with the world. The key concepts of critical making, situated knowledge and interaction were implemented to encourage a learning process aimed at deepening knowledge on critical thinking and hands-on making. Critical making as a pedagogy has the potential to foster a practice of connecting critical thinking with physical making through iterative and self-driven learning. Capabilities, such as understanding the context and one's relationship to the world, and the co-construction of social life and technology is crucial for creating responsible, innovative design. I continue the subsection with a description of our initial ideas behind the course "Situated Making" and conclude with a discussion on the challenge of the second order.*

There is no "one way" of conducting design research. Johan Redström (2007) explains how design, in the broadest sense of the word, is a central part of any research method where we want to create the preconditions for studying a particular phenomenon. Design is not simply a method either, because a design process usually includes using several methods from different contexts and disciplines. Research experiments in technological disciplines are usually framed within a research tradition that presents a hypothesis where the experimentation lies in trying to solve the outline problem within the hypothesis. In Redström's (2007) definition, experimentation becomes something different. My work with critical design practices takes a similar approach to design as Redström's definition of experimental design research. The practices become experimental when design experiments become part of developing new theories and methods and investigating the relationships between design and research (Binder & Redström, 2006; Redström, 2007). All research has structural boundaries in terms of resources and goals, but the specifics of a design program is its focus on relationships. The design program defines the boundary that the experiments then try to express, challenge and cross.

In Spring 2016, I was involved in the development of a course for undergraduate media technology students in their second year of the undergraduate program in media technology. The course outlines the design program that we, the course coordinators, developed, together with the concepts of critical making and situated knowledge. Our aim with the course was to provide an understanding of how our knowledge affects the

5 A 'Game jam' is a hackathon where the participants plan, design and create video games during a fixed period of time.

objects we interact with, and how this in turn affects how media technology artefacts are designed.

Critical making, as introduced by Matt Ratto (2011), focuses on making things with the intent of exploring socio-technical relations. Situated knowledge is a concept that challenges traditional views of a value-free, positivist and universally translatable objectivity (Haraway, 1988). The concept redefines positivist objectivity in research by underscoring the locality and partiality of knowledge production. Situated knowledge together with critical making foregrounds the normativities in technocultural practices and situates the students' ethical responsibility (Corrius et al., 2016). The course was held during ten weeks between November 2016 and January 2017. During the first five weeks, modules with specific assignments were given, and the remaining five weeks were used for in-depth prototyping and reflection. Throughout the course the students filmed their assignments, which was then used for their final assessment. During the G16 conference in 2016[6], Annika Olofsdotter Bergström and I presented our initial ideas about the course and why we wanted to develop it. Annika began with an introduction of the faculty and the undergraduate program, and I continued with a presentation of our core concepts:

For this course we have worked with the concepts of situational knowledge from Donna Haraway and critical making by Matt Ratto and others.

- We use situated knowledge to provide an understanding of how the knowledge process (practice, culture, technology, material, language, time, politics, and economics) is something fluid, and also to position the students in a specific context.
- We focus on context and interactions so that students will highlight how they change through their objects and vice versa.
- Critical making is about critically reflecting your relationship with technology and society through tactile practice. In other words, through tactile practice new knowledge is generated.
- Another concept we include is 'evocative objects' from Sherry Turkle - objects which concern, evoke associations, and lead you into new directions.
- Situated knowledge in relation to critical making is about taking responsibility for the choices we make and the knowledge we produce. Technology is historical and cultural. We want to highlight the context in order to better understand who designs and for whom?
- The interaction between the concepts and the chosen object raises ideas and reflections on emotions, actions, the object's own actions and experiences.

Our vision

- We want to problematise and question normative rules and approaches in relation to technology.
- We want to focus on the process (the doing and thinking) rather than building a finished product.

6 G16 – Boundaries, Mobility, Mobilisation, Swedish Conference for Gender Research, Linköping November 23-25 2016

- We want to challenge the digital by highlighting analogue materials and their relations with human and non-human actors. Furthermore, we want to discuss what is digital. Here we also speak of dichotomies between the digital and the analogue.
- Affirmative criticism - where criticism is not a question of negation, "That was not good, it was worse than ..", but rather it is about constructive feedback where criticism opens up for 'I experienced this, what was your intention? What if you do this ...? It's about articulating and further developing ones' thoughts and creative processes; not correcting one's design process according to an existing norm.

With inspiration from the Rhode Island School of Design, Somerson and Hermano

- Raise critical questions through an iterative process
- Use embodied methods for problems
- Meet uncertainty with flexibility
- Generate ethical questions in relation to social needs

We want it to be playful.

Challenges of the second order

The Situated Making course posed a lot of challenges for both students and teachers. Several students were provoked by the analogue aspects of their object relations, and had trouble focusing on an open-ended, dynamic process rather than a design process that resulted in a product or service. We, the course developers, created content that we thought would be relevant for the students' skills and knowledge production as part of the media technology education. During and after the course, we realised that the content became too advanced and abstract in relation to the expectations of the students and their notion of what media technology is; especially in terms of their selected sub-discipline games, audio and images. The students are very digitally literate and are used to working in front of a screen, but when they had to work with physical objects, with micro-electronics where you physically connect things with cords, everything suddenly became very difficult and the students were unmotivated. In critical making the physical body is much more visible, and therefore much more troublesome.

What we experienced through this course was a transformation of the second order. Ahrenfelt (2001, p. 23) explains the difference between the first and second order:

> *At transformations of a first order you don't change mindsets or behaviours in the organisation. What is actually happening is a recombination of old patterns keeping the organisation within the old tradition. The system is still intact and unchanged. However, at transformations of a second order mindsets are changing both as interpretation of reality and in acting, which means the whole system has changed. We recognize reality in a new light and with a different understanding… Everything is altered and reality looks different.*

Ekdahl (2005) urges for the second order in the foundation of the media technology program as an incentive of breaking up old patterns of habit in the educational system and working towards new relations between the concepts of person, knowledge and learning in in the context of digital technology. Transformations of the second order cannot be predicted ahead of time as the values and relations within the system are

put into question during the transformation. The core elements of the course questioned normative processes in academia as well as in the media industry. We asked the students to focus on the design process; the doing and thinking rather than a finished product. We challenged the underlying value of a digital norm in media technology and addressed analogue material and their relations with human and non-human actors.

The normcreative practices in game culture and critical making in media technology education were our attempts of foregrounding the entanglement of norms and values in technology design and technocultures. I argue that this ambivalence needs to be addressed throughout any design process, and when norms create unjust relationships we should challenge these relationships and ask how we can design differently.

Design is never complete. Each and every design project is an iteration of larger processes of the historical present. For example, design thinking has become the go-to method for many different businesses and disciplines; usually set-up as a neat, linear step-by-step method that produces innovative results[7]. But as I explained with diffraction and postcolonial computing (see chapter *Zones of transformation I*), the design process is usually messier than what Design Thinking implies, and should be articulated and adapted to the context in which it resides. Returning to the cyborg figuration, I ask that we (pedagogues and students) engage with different design processes so as to learn how to navigate in 'zones of implosion' (Haraway, 1997) and design with care. Critical making matters.

Design fiction and future-making practices

In this subsection I introduce the concept of design fiction and relate the concept to the empirical data from the paper Design fiction as norm-critical practice (see PART D, pages 195-206). In the paper I explore how design fiction can be used as a method to address norm-criticality in media technology education. Design fiction is a hybrid practice that functions in the borderlands between actual and possible worlds. It is an approach for visualising and materialising alternative scenarios using design and storytelling, and is being used as a platform for questioning the status quo, invoking discussion on the social and ethical consequences of emerging technologies, and increasing political and civic engagement. Based on a week-long design fiction workshop with undergraduate students, three student projects are analysed in detail. The analysis suggests that design fiction can be used as a norm-critical practice to invoke discussions on values and beliefs within media design processes as well as established narratives of futuring.

What is design fiction?

> *Design fiction is a way of exploring different approaches to making things, probing the material conclusions of your imagination, removing the usual constraints when designing for massive market commercialization — the ones that people in blue shirts and yellow ties call "realistic." This is a*

7 http://www.cd-cf.org/articles/beyond-design-thinking/

> *different genre of design. Not realism, but a genre that is forward looking, beyond incremental and makes an effort to explore new kinds of social interaction rituals. As much as science fact tells you what is and is not possible, design fiction understands constraints differently. Design fiction is about creative provocation, raising questions, innovation, and exploration. (Bleecker, 2009, p. 7)*

I entered the world of design fiction from speculative and critical design (Auger, 2013; Dunne & Raby, 2013) and from a writing practice within feminist technoscience that works with speculative feminism (Haran & King, 2013; Haraway, 2013; Lindström & Ståhl, 2016; Neimanis, Hayes & Åsberg, 2015). Design fiction is often used as an approach, or a technique, for creating exploratory and discursive spaces between the actual and the possible (Franke, 2010; Morrison & Chisin, 2017). Sterling describes design fiction as "the deliberate use of diegetic prototypes to suspend disbelief about change" (Sterling, 2012). Lindley and Coulton (2015, p. 210) unpack Sterling's definition through the following criteria, "(1) something that creates a story world, (2) has something being prototyped within that story world, and (3) does so in order to create a discursive space." However, what this 'something' can be is far from easily defined. There have been many attempts to pin down a definition of this 'something', be it an artifact, prototype, poetry, system or world, but it lives on as an intricate, ambiguous device. Gonzatto and colleagues (2013) note that design fictions are not just innocent creative plays, they are always created with the intent of (re-)acting with present structures. Design fictions can have "both naïve and critical interpretations" (Gonzatto et al., 2013, p. 43). They become naïve when they are exclusive, deterministic and disregard stakeholders without power. Yet, when the design fiction projects are inclusive and open-ended and a multitude of perspectives and values are considered, it becomes critical-affirmative.

The design fiction workshop

Meta-manifesto
Design that is market-driven.
Design that slows us down.
Design that promotes efficient energy use.
Design that discourages use of technology.
Design that is technology-deterministic.
Design that makes us more wasteful.
Design that excludes.
Design that favors conflicts.
Design that promotes freedom of expression.
Design that maintains status quo.
Design that makes a difference.[8]

In my research, I entangled norm-criticality with design fiction in order to explore normative values and beliefs embedded in media technology and design. Jonsson and Lundmark (2014, p. 5) suggest that "norm-critical design can be understood as a sub-

8 This meta-manifesto was a play with the concept of design and was introduced to the students during the design fiction workshop.

field of critical design where the specific focus is on the relationship between design and social norms". According to Auger (2013, p. 11) the practices of design fiction, critical, and speculative design share certain premises where they "all remove the constraints from the commercial sector that define normative design processes; use models and prototypes at the heart of the enquiry; and use fiction to present alternative products, systems or worlds".

The student assignment for the design fiction workshop was as follows:

- Select a design manifest.
- Create an artefact that challenges, problematises or plays with the chosen manifest.
- The mandatory documentation at the end of the week included a link to the chosen manifest, a minimum of one illustration of the artefact, a description of the artefact and an explanation on the difference occurring between the chosen manifest and the created artefact.

The student projects were quite different in style and direction. Below is a list of a number of student projects that were created during the week-long workshop.

- A fictive advertising agency that was forced into creating absurd and provocative ads for a company.
- An illustration of a house on water where their discussion points concerned the future of architecture and housing solutions from an environmental perspective.
- A game concept where the player is rewarded by doing unethical actions.
- An oral speech presented by the first robot candidate for the world presidency.
- A design artefact called MaybePhone with the intention of making the relationship between the user and a mobile device less functional. The idea behind MaybePhone is that it may or may not work as you may expect it to. It can bounce away from you, become invisible or suddenly play loud music.
- A project that explored voluntary self-censorship by erasing certain objects, events or people. The prototype consisted of a set of glasses with different colour filters.
- A story world concept that follows and challenges a design manifest involving design ethics, sustainability and the anthropocene worldview. The student's concept and prototype is based on a long-term strategy of rebuilding nature.

Within an educational context, design fiction worked well as a creative critique of norms and values underlying design processes in media technology. Design fiction also has the potential of working as a normcreative and transformative agent for creating alternative scenarios and future-making practices in many different contexts in society. Design fiction has been used together with participatory design to unfold the black box in urban technology (Forlano & Mathew, 2014), for community engagement (Hanna & Ashby, 2016) and together with games as speculative design, so as to let players explore wicked, societal problems in different future scenarios (Coulton et al., 2017).

It is important that we remind ourselves that the future is made in everyday practices. It's not somehow out there, separated from the here and now. I can't predict the future.

No one can. We especially can't own the future even if we sometimes want to believe so. Le Guin (1989) mentions a quite common view of imperialism in the science fiction genre where space and future are considered alike, and just as we humans exploit, conquer, and colonise space we believe the future is ours to own and to do what we want with. This view holds no real ground since it would require that we already know and can see into the future. Future-making practices are connected to the places from where they are created: in design labs, at business meetings and in classrooms. The story becomes a trope to perform and stabilise particular futures, and when doing so other stories are left behind, and made absent (Watts, 2008). The stories performed in the design fiction workshop tinker with potential futures and a critical investigation into whose futures matter.

Fiction matters.

PART C

Zones of transformation III

How can we do justice to our different knowledge practices and at the same time share a common world?"

(van der Velden, 2009, p. 11)

To the reader

This chapter begins with a personal reflection of the study, and then continues with the subsection Trying transformations in Kampala and Karlshamn where I summarise and discuss my research findings. In the subsection Transforming technoscience, I discuss the relevance of feminist technoscience in science and technology and continue with discussions on ethical research practices in the subsections Making kin in cyborg worlds, A cat's cradle of viscous number, Response-able engagement, Matters of care and Caring imaginaries. In the concluding subsection I present an adaptive design manifesto.

A personal reflection

My love for technology has not faltered with this research, but it has definitely changed. If anything, it has become clear to me how technology is a material-discursive practice performed together with humans, but most often narrated as this black-boxed entity devoid of any moral decisions. I have learned that technology is relational, filled with norms and values. This means that how we choose to design technology has ethical implications in how technology is distributed, interpreted and used. My focus on society-in-science relations relate to several key concepts within the Sustainable Development Goals – resilient, equal, inclusive, safe, and sustainable. With this doctoral thesis, I show how the transformation of technocultures such as those in Kampala and Karlshamn lies in situated interventions, and how these interventions have the potential to transform technocultures to more resilient, inclusive and sustainable ones.

Norms and values are embedded in technology design, which have ethical implications regarding who is included and excluded in technocultures, such as the ICT community in Uganda, or the gaming community in Sweden. A feminist technoscientific framework provides an onto-epistemological base for exploring and understanding how these norms are made, and how they can be unmade. The importance of this making/unmaking process lies in the ethical and political dimension of creating just technocultures. I mentioned in my introductory chapter how science, technology and innovations (STI) are powerful drivers in the digital revolution, but their role in the contribution to sustainable development is ambivalent as they are both strengthening and jeopardising the action being undertaken to reach the Sustainable Development Goals. If we want to use STI as a means of reaching the SDGs, we need to consider how we can approach this ambivalence in society-in-science relations. I have approached this ambivalence by working diffractively and by foregrounding norms and values in technology design. This thesis is an example of an open-ended process of 'doing ethics' through situated interventions. In the following subsections I discuss these situated interventions and propose ways forward for ethical research practices.

Trying transformations in Kampala and Karlshamn

My research in the Ugandan context has shown how black-boxing technology creates unequal power relations, and that opening up technology as relational provides possibilities of transformation. Mobile phones are not inherently good or bad. As part of a larger infrastructure they can, in their interactions with humans, create confusion and opportunities, harm and fun. With the help of feminist figurations I have attempted to disrupt normative technoscientific storytelling by addressing the situated interventions taking place in the Ugandan ICT community

The situated interventions of technoscientific storytelling takes place when the young mobile entrepreneurs at the Open Space workshop, my research collaborators, discuss how their programming competence is devalued in comparison with programmers from other countries. One of the entrepreneurs further discusses how these norms are changing, and how the entrepreneurs are becoming a viable option for tech companies. Another example of transforming technoscientific storytelling are the women's tech initiatives WITU and GirlGeek Kampala. Their situated interventions with girls and women in the ICT community challenge the dominant narrative of technology as masculine, and transforms the narrative of the gender and technology discourse.

My research in the Swedish context has shown how critical design practices can help challenge dualisms such as theory and practice, thinking and making, digital and analogue, critiquing and transforming and evoke discussions on the social, cultural and ethical implications of media technologies. In the project A *norm-critical game culture* we worked with normcreative exercises to disrupt the normativities of game culture and held workshops concerning different ways of engaging with the game culture as a phenomenon. During the course "Situated Making" the students learned to situate themselves in relation to their chosen objects. Together, we learned how dominant certain narratives are in terms of how media technology productions can, and should be, designed. Reconfiguring design as a processual practice rather than a practice for creating finished products and services requires a shift not only in the academic context, but also in the industry. This reconfigurement is in itself a process that researchers and pedagogues need to continue working with. The design fiction workshop created situated interventions wherein the students' prototypes created discussions on what kind of world we want to live in, and how their practices relate to future-making practices.

Critical design practices provide a space for transforming media technologies towards a more relational and processual pedagogy. The space can invoke discussions on social, political and technical implications of technoscientific storytelling in present and future media technology education. Together, feminist technoscience and critical design foreground normativities of media technologies and discuss what kind of directionality we want for innovation. Are we looking towards innovation as a means of economic growth or as a means of fighting injustice? Must we choose between the two, and what are our other options? Do we want to create games that are disruptive, creative or political? Or can they be all of these things at the same time?

I am looking towards innovation as a means for political change and sustainable development, as well as a platform for creativity and serendipity. When we begin situating ourselves in time and space, and making our politics of location visible we can be transparent with the choices we make and why we make them. It matters what stories we, the students, teachers, designers and programmers, use when we design games, films and sound. It matters what methods we use when we conduct research because the results from those methods of choice will produce one kind of story. "[I]t matters what matters we use to think other matters with; it matters what stories we tell to tell other stories with; it matters what knots knot knots, what thoughts think thoughts, what descriptions describe descriptions; what ties tie ties. It matters what stories make worlds, what worlds make stories" (Haraway, 2016, p. 12).

Transforming technoscience

My choice of feminist technoscience as my onto-epistemological framework became vital in order for me to understand and transform misogynist norms in knowledge production. This framework entangles theory and method as relational, which transforms my results into a messy, partial figuration of technoscience. My use of a diffractive framework addresses how differences in technology design are made, and how technoscientific stories push concepts of development, innovation, gender and technology in certain directions, while others are pushed aside or ignored. I argue that these narratives are never only discursive. They are also material because they have material implications. The narratives of grand challenges, the 2030 Agenda, different legal systems and Google and Facebook algorithms have world-making (Haraway, 2017) implications which transform our everyday lives. How we choose to relate to these transformations makes all the difference. What I mean by this statement is how we learn to see the world affects the production of knowledge, which in turn affects how we relate to ourselves and others. We can choose to see the world through dualisms or we can choose to see the world differently. This is where situated knowledge comes in. When we acknowledge knowledge production as situated, partial and located we learn to listen for more stories than one.

Making kin in cyborg worlds

Early on in my research, I positioned myself and my practices in opposition of positivism. I critiqued the positivist research culture as a 'culture of no culture' (Traweek, 1988) and explained how the researcher becomes a 'modest witness' (Haraway, 1997), a disembodied, neutral placeholder of science whose norms and values don't affect scientific results.

I believe now that I needed to position myself in this somewhat polemic relationship as part of my transformative research process. I had to come to terms with how positivism has schooled me into categorising the world through dualisms. To do this I needed to distance myself from this upbringing in order to fully see it. In my previous research in

social sciences I have been categorizing and labelling people, things and methods with little consideration to how these categorizations have been made. From my critical-affirmative reasoning, my critique of this kind of knowledge production remains and the desire to make kin emerges. I want to relate constructively to the distance I have created between the philosophical frameworks of feminist technoscience and positivist research and open up for knowledge sharing practices.

In positivist research falsifiability and reproducibility are cornerstones, while in feminist technoscientific research situated knowledges, diffraction and intra-action are cornerstones. At first glance these cornerstones seem to be almost the opposite of each other and nearly impossible to co-evolve. However, I don't believe this to be the case. Do you remember Haraway's cyborg worlds? In one perspective the cyborg world becomes a sort of Star Wars apocalypse, where conformism, competitiveness, and opportunism leads to a masculinist orgy of war. In another perspective, the cyborg world becomes a world of kinship with animals and machines where messiness, contradiction and idiosyncracies are common place. It is the breaching of boundaries that makes the cyborg so intriguing; a fusing of the organic and the technological. The cyborg is a trickster figure, that resides both in the informatics of domination and as a figure of hope, blurring the boundaries integral to a Western worldview. I argue that both positivism and feminist technoscience, and many more epistemic communities, are needed as their different perspectives will provide us with risks and possibilities that are impossible to envision with only one story. We need to listen to more stories, develop more relations and learn to care for our kin.

I think of kin as this relational figure that we haven't quite been able to pin down, even though we try our hardest to. Can kin only be human, and must it always be organic? Or can kin be machines, or non-human animals? Humans are mammals. Are we then not already kin with many species? One of my aims with this doctoral thesis has been to reconfigure my epistemological framework towards situated knowledge. This reconfiguration has awoken a desire in me to make knots with many different research collaborators. Companions in text and through flesh. These entanglements are my way of becoming with kin. I did not go far beyond a domesticated version of kin in my research. I most often think of my research collaborators as human, although I try to dissolve this mind game and think of myself as part of a multispecies assemblage. These mind games, these anthropocentric narratives of economic growth, academic competitiveness and technoscientific domination, only seek to colonise our bodies and leaves us distraught, alone and afraid. In order to decolonise these mind games, I believe we need speculative fiction.

I began this doctoral thesis with a quote by Walidah Imarisha that in short expresses how "all organizing is science fiction".[1] Organisers and activists are constantly crea-

1 My focus in particular is on speculative storytelling as a methodological device for opening up different ways of imagining and futuring. I have therefore chosen to use science fiction and speculative fiction interchangeably for this context. I am aware of their different genealogies and meanings as well as the ongoing discussion among writers and critics of what can and should be included in each genre.

ting and envisioning other worlds. Speculative fiction is already happening everywhere around us yet we don't want to distinguish our actions as such. Policy-making is speculative. Innovation is anticipation. Research is uncertainty. Design fiction is "the no longer and not yet" (Gulbrandsen In Trojer, 2018, p. 205). Speculative fiction has the potential to point to the construction of scientific knowledge and technocultures, and therein to critique and re-imagine discourses including gender and technology, and postcolonialism and development (Merrick, 2009).

A cat's cradle of viscous numbers

I was initially uncomfortable writing the demographics numbers of Uganda and Sweden (see pages 63 and 89). Demographics are generally used to provide an overview of the development of a country in relation to certain international indicators such as GDP[2], and to compare countries and their 'success' rates in the overall development discourse. I was concerned that I would be reproducing the very practices of which I am critiquing. I then realised that this was not the case. I remembered that I actually really like numbers for their viscosity and transformative capacities, and that they could help me to point to the construction of norms and values in technocultures. I chose to include figures on population and the telecommunications sector so as to provide the reader with a brief introduction to the countries. When I tried locating a figure for the countries' populations, I found different figures. This is not so strange because people are being born and die every day. We can refer to the total population at a certain time, but the figure is not fixed; it is not a constant. I suggest that we think of numbers as part of this large cat's cradle, where we are relating numbers with farmers, farmers with mobile phones, mobile phones with programmers, programmers with design methods, design methods with researchers, and on it goes. I am intrigued with how numbers can propel our imaginations to create material-discursive stories for social change. But in these stories also lies the risk of harming Others. This is because within these stories lies our prejudices, norms and values which often separate us, definitely limit us, and violently negate the Other. While I have not worked explicitly with statistics in my research, it is certainly socially and culturally entangled with my research practices, my research collaborators and myself. The growing number of mobile tech hubs in the African region moved me in one direction, and the statistics of women in games moved me in another direction. Yet another influential directionality is the 2030 Agenda for Sustainable Development, which is deeply embedded and dependent upon the official statistics community.

The power of statistics is nothing new. Yet I believe that we sometimes forget the impact it has on us humans, and on the choices we make in our everyday practices. Just as technology is relational, so too are statistics. I ask:

- What are we imagining when reading figures and statistics, and why?

2 GDP stands for Gross Domestic Product and it is a measure of the market value of goods and services within a country. It is often used as an indicator for economic performance and used as a comparative measurement between countries.

- What are the ethical and physical implications when we share our imaginations with others?
- How can we imagine differently?

There are no safe and easy answers to these questions. In my research projects I have identified differences through the intra-acting patterns emerging. My diffractive methodology acknowledges that I become immersed with my data, and through my emergent interactions become transformed in indeterminate and different ways, rather than assuming a distance from the data in a neutral and objective manner. I try to take "responsibility to the entanglements of which we are a part" (Barad, Dolphijn & van der Tuin, 2012). When I created my zones of transformation I did so to explore, transgress, question, falter, play with, affect and transform worlds. I acknowledge that I included some technoscientific stories and excluded others in my zones. I acknowledge that my Eurocentric schooling and prejudices interfered with and affected my research practices. Instead of using a translator, I chose my research collaborators based upon their English language skills and their knowledge and experiences in the mobile ICT community. Therefore, I excluded other people who could have provided me with valuable knowledge concerning mobile phone development. I chose to work with critical design methods in a familiar media technology context, which excluded reaching potential research collaborators in similar communities of practice. My research choices are embedded with limitations and possibilities. I acknowledge this.

It is this acknowledgement I want to encompass, and which I believe can help us when transforming technocultures (and research cultures). Barad (2007) and Haraway (2016) call it response-ability.

Response-able engagement

The design of the scientific apparatus (instruments, software and methods) is integral to knowledge-making practices, and therefore integral to social, cultural, political and imaginary practices. Ethics cannot be limited to a cramped, codified practice that only appears when a researcher needs consent for working with human subjects in an experiment. Numbers, statistics, norms and values, matter and meaning, all make up the spaces where knowledge is being produced. "More than a clever play on words, response-ability, Donna Haraway argues, is not about aligning one's actions with a set of universal ethical principles. Instead, it requires cultivating practices of response. These practices are developed and carried out with others, both human and non-human, in a process of ongoing exchange" (Reardon et al., 2015, p. 12). Ethical research practices need response-able engagement. In other words, "one way of understanding response-ability is that it is what makes ethics do-able" (ibid, p. 13).

My research is trying to transform technocultural practices through situated interventions with the aim of creating more response-able research practices. I am inspired by the work on response-able ethics conducted at The Science and Justice Research Center at the University of California Santa Cruz. Reardon and colleagues, co-founders of the research center, mention how they created the centre "out of this desire to build

concrete institutional spaces where practices of response-ability could be cultivated" (Reardon et al., 2015, p. 14). They began working with justice, which can be quite uncompromising and static if one thinks of justice as a virtue one cannot be without. "Thus, the work of imagining and enacting justice is always open, and never finished" (ibid, p. 5-6). Justice became a conceptual bridge for opening up an ethical space for discussing questions about the principles of society and "to consider what new models of collectivity might better fit with the current zeitgeist and produce more responsive, robust knowledge" (ibid, p. 6). Their desire to build spaces of practices for response-able research resemble my own desires for response-able engagement in technocultures. However, my ambition of working towards building society-in-science relations diverges from their focus on the academic context. My zones of transformation are coherent with the new directionality of innovation and sustainable development[3], as well as the discussions of society-in-science relations[4] at The European Science Foundation (Felt et al., 2013).

Reardon and colleagues (2013, p. 12-13) express how "One condition for response-ability in the university is a better accounting of the conditions and consequences of knowledge production". In my research I respond to this condition by addressing dualisms in media technology. Dualisms in media technology, such as digital and analogue, or theory and practice, have created power relations where one category is valued above, or as being more correct, than the other. Together with my research collaborators, I've worked with critical making and design fiction to disrupt these dualisms through situated interventions. We've worked towards developing alternative learning processes concerning media technology wherein norms and values in technology design are foregrounded, challenged and transformed. In the design fiction workshop, the students worked with different design manifestos; each manifesto written for a specific time and context. In the workshop these manifestos were interpreted and used by the students for their future-making practices. I suggest that another condition for response-ability lies in the context of global development and a better accounting of the conditions and consequences of postcolonialism and technology transfer. With the help of my research collaborators, I have written stories of infrastructural inversion to foreground the challenges and possibilities of ICT development in the Ugandan context. I have written about the conditions and consequences of mobile application development at the tech hub Outbox. In my diffractive writing practices of the women's tech initiatives in Kampala, I have expressed the complexities of the gender and technology discourse and the importance of situated knowledges so as to make response-able choices.

Response-ability also lies in our imaginations. We need a better accounting of the conditions and consequences of anthropocentric, power-laden and colonial imaginaries. I have addressed these conditions through the cyborg figuration. The cyborg implodes boundaries of nature and culture, and in my case, technology and culture. In these implosions, in what I've chosen to call zones of transformation, I've tried to disrupt

3 Please see the introductory chapter for a discussion on innovation and sustainable development.
4 Please see the chapter *From Science and Society to science in society.*

some worlds and imagine others. My mind games have played tricks on my research practices, which have affected my scientific apparatus[5]. I am simultaneously humble and forceful when I write that my research relations are teaching me how to care so that we can survive and flourish on this planet called Earth.

Matters of care

In this subsection I discuss the matter of care and how care "could be generative of better survival, politics, and knowledge" (Martin, Myers & Viseu, 2015, p. 628). In the subsection Response-able engagement, I address response-ability and justice as important cornerstones for pursuing ethical research practices and now I integrate care into these discussions.

Care is a complex word which is hard to define. I choose to refer to Tronto and Fischers (1990, p. 40) definition of care in order to have at least a generic definition to refer to: care includes ""a species activity that includes everything that we do to maintain, continue and repair our 'world' so that we can live in it as well as possible. That would include our bodies, our selves, and our environment, all of which we seek to interweave in a complex, life-sustaining web.". Care is a valuable part of our relationships with, and alongside, other people and matter, and how we care, or choose not to care. Care affects "arrangements of power and privilege, and part of our goal here is to explore how these arrangements of care and power might be otherwise" (Martin, Myers & Viseu, 2015, p. 628). When studying power relations in infrastructures, Star (1990) posed the question 'cui bono' – for whom? For example, in my research I have studied how development, innovation and gender is embedded in technoscientific storytelling and how these narratives affect and intervene with the members of the ICT community in Kampala, particularly within the tech hubs (see PART B, pages 77-82).

Puig de la Bellacasa (2017) explores care as an ethical and political obligation for thinking with technoscientific practices and naturecultures (Haraway, 2003). Martin, Myers and Viseu (2015) explain how Star's question became an invitation for Puig de la Bellacasa to ask not only 'for whom' but also "Who cares?" "What for?" "Why do 'we' care?", and mostly "How to care?" (Puig de la Bellacasa, 2011, p. 96). The visionary work presented by the tech hubs, women's ICT initiatives and media technology students (see PART B) propose futures of elsewhere, which sparks discussions on how we care. When I state that technology is relational, I embed within that relationship the matter of care. In my research practices I have attempted to foreground norms in technoscientific storytelling, and how these norms are entangled with power and privilege in technology design. Just as norms shape behaviour and affect relationships, so do acts of care. How we design mobile apps, build infrastructures, and create video games, is a matter of care. There are many different ways of caring, and how we make ourselves response-able is a contextual act of caring. Sometimes it is by reacting and intervening and sometimes "'not casting one's lot' may be the most responsible action" (Martin, Myers & Viseu, 2015, p. 635).

5 Please see the chapter *A transformative research process.*

My overarching aim in writing this thesis is to contribute to transformations of normative practices in different technocultures through feminist technoscientific interventions.[6] I have accomplished this aim by examining how norms and values embedded in technoscientific storytelling affect, and are affected by, actors in different technocultures, and by exploring how norms sustaining unequal power relations can be transformed so as to foster more response-able and caring relationships. With the help of my research collaborators, I have attempted to imagine how technocultures can be 'otherwise' (Puig de la Bellacasa, 2011, p. 38).

Caring imaginaries

Drawing from speculative fiction, response-able ethics and matters of care, I propose that caring imaginaries can transform research towards more response-able research practices. Caring imaginaries works as an adaptive platform for learning to imagine technocultures collaboratively and differently. My research collaborators have helped me to imagine a different ICT development, another game culture, and a new kind of pedagogy. The relevance of caring imaginaries also lies in the SDGs. If we are to shift the world towards a sustainable path we need to be creative in how we create this shift. Drawing from my research experiences I suggest that researchers need to learn how to be more response-able by knowing when to intervene and not to intervene and learning to think and be-with societal actors. In my research I refer to visionary work on several occasions (SDGs, tech hubs, women's tech initiatives, game culture, design fiction). Within our visionary work we (humans) need to be humble in how we outline our visions and be transparent with the conditions in which they are being created. When I ask that we imagine with care it is because to imagine isn't enough. We need matters of care to decolonialise our minds and ask the hard questions: Who am I imagining for? And who is left out? What lives and what dies?

I want to relate caring imaginaries with responsible innovation by quoting Guston (2015, p. 2) who explains the need for responsibility:

> *If irresponsible innovation is the target of RI [Responsible Innovation], it might be that "responsible stagnation" (RS), in the final quadrant, is its competitor. RS might affirm something like the following: Given that innovation in part is what got us into this mess of pushing past planetary limits in an unsustainable fashion, and that the drive for growth and the satisfaction of the human needs and desires of a still increasing human population globally is what compels innovation, we need to consider how we can stop being dependent upon innovation and growth to get what we want. I think we have to take this position quite seriously, if only because one of its roots is absolutely correct in that innovation is not in itself a good thing (that is precisely why it needs to be modified by terms like "responsible"!) and that the means of grappling with our planetary challenges should not be limited to the technological ones that are so wrapped up in our concept of innovation (even if we give lip service to concepts like social innovation).*

In this era of new directionalities towards resilient, inclusive and sustainable societies we need to modify terms such as innovation, development and imaginaries with responsible, sustainable and caring so as to move beyond the technological and eco-

6 My research objectives are available on page 26.

nomical boundaries that incuse many global strategies and limits the possibilities for a necessary shift towards a more transgressive society-in-science relationship. Caring imaginaries provide, as do responsible innovation and sustainable development, the space for imagining and enacting with more than human futures response-ably.

An adaptive design manifesto

The historical present has created unjust relationships that are systematically power-laden and violent. We cannot ignore these relationships. When we choose to re-imagine science, technology and innovation as transformative with the possibility of subverting these violent relationships, we may achieve "a better world, a liveable world, a world based on the values of co-flourishing and mutuality" (Barad, 2011, p. 8). But in order to re-imagine science, technology and innovation, we need to radically re-imagine ourselves as human subjects and what we can become (Meissner, 2014). We are becoming-with[7] each other. To help us with this radical transformation, I have boldly yet respectfully made another list. While my first list involved key issues for contemporary feminist technoscience in the chapter *The wondrous worlds of feminist technoscience*, this list plugs into parts of my *Zones of transformation* chapters. The bullet points should not be read as a summary of my research. I think of lists as a material-discursive practice; moving, changing and adapting to the relations they enact. "The excruciating attraction of the list is its endlessness, for within this we are offered the ambivalent imaginary of the potential, turned inward in hegemonic forms of self-evaluation. The revolution of the list is not, therefore, an outward sign of change but change turned back upon ourselves" (Phillips, 2012, p. 108). I propose reading my list as a messy, adaptive[8], an open and speculative design manifesto of thinking-with[9], thinking-for[10], dissenting-within[11] and living-with hardcore technological development, ethics of care

7 Becoming-with emphasizes the connection of humans and nonhumans as a state of always being in motion.

8 I refer to adaptive design as van der Velden (2009, p. 15) suggests: "[t]his design principle changes the conception of the design process from a process that ends when the 'product' is finished, to an ongoing intra-active process, a design process as an ongoing dialogue between design, designers and users as designers".

9 I encourage to think-with people, beings and things (Puig de la Bellacasa, 2017).

10 I call upon Puig de la Bellacasa's (2017) term thinking-for as a critical self-reflection of how we choose to care when we care for Others, and Haraway's cautionary words when we think-for the Other: "how to see from below is a problem requiring at least as much skill with bodies and language, with the mediations of vision, as the "highest" techno-scientific visualisations" (Haraway, 1991, p. 191)

11 Puig de la Bellacasa (2017, p. 73) explains dissenting-within as "[d]issenting-within is openness to the effects we might produce with critiques to worlds we would rather not endorse". I am simultaneously critical towards some parts of the global technological infrastructuring while optimistic towards other parts. The ethics of care includes fostering efforts to care for each other across conflicts rather than just reinforcing breaks and splits".

and the big unknown.[12] I urge the reader to engage with the list through tinkering and disagreement, through joy and frustration, through love and desire. Let's play.

1. Situated knowledge is key.
2. Technology is relational.
3. Numbers become viscous.
4. Technoscience is political.
5. Figurations implode boundaries.
6. Design asks what if?
7. Make kin.
8. Engage response-ably.
9. Think with care.
10. Create justice for all matter.

12 In formulating the bullet points I have been inspired by my research collaborators and especially Donna Haraway and her essays (1991, 1997, 2017).

PART D

To the reader

Paper 1: A conversation on mobile phone practices and development - writings by a feminist postcolonial technoscientific scholar
This paper was originally a written assignment for a Ph.D. workshop named 'Writing imaginaries' in 2012. The style of the text was quite political and personal and I wrote it before I travelled to Uganda. When I submitted the text to different journals, I was advised to change the style and add my empirical material from Uganda. I did as suggested and the manuscript has been submitted with minor revision for publication.

Paper 2: Exploring the technological imagination among young entrepreneurs in Kampala: a feminist postcolonial technoscientific perspective
This paper was originally a conference presentation, named *Design-games and future-making – a technoscientific exploration among young mobile developers in Kampala,* which I held at the Mobile Telephony in the Developing World Conference, University of Jyväskylä, Finland in 2013. The manuscript has since then been rewritten and submitted (with minor revision).

Paper 3: Women's tech initiatives in Uganda - doing intersectionality and feminist technoscience
This text is a book chapter that will be in an anthology on gender, development and mobile technology.
Paxling, L. (forthcoming). Women's tech initiatives in Uganda: Doing intersectionality and feminist technoscience. In Gendered Power and Mobile Technology: Intersections in the Global South: Wamala-Larsson, C and L. Stark eds. (Forthcoming). Routledge advances in feminist studies and intersectionality. Routledge.

Paper 4: A norm-critical game culture: exploring norms among media technology student
This article is based on the pilot study *A norm-critical game culture* that took place at Campus Karlshamn in 2014-2015. The manuscript is submitted for publication.

Paper 5: Exploring Situated Making in Media Technology Education
This paper is a conference article published in the conference proceedings of the *Cumulus Kolding Conference* (2017).
Paxling, L. (2018). Exploring Situated Making in Media Technology Education. Cumulus REDO Conference Proceedings, 510-519.

Paper 6: Design fiction as norm-critical practice
This paper is a conference article published in the conference proceedings of the *International Conference on Design, Learning, and Innovation* (2017).
Paxling L. (2018). Design Fiction as Norm-Critical Practice. In: Brooks A., Brooks E., Vidakis N. (eds) Interactivity, Game Creation, Design, Learning, and Innovation. ArtsIT 2017, DLI 2017. Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering, vol 229. Springer, Cham.

Paper 1: A conversation on mobile phone practices and development – writings by a feminist postcolonial technoscientific scholar

Introduction

A major narrative in the discourse of world development has been the 'mobile revolution in Africa'. This kind of storytelling comes as no surprise as the number of mobile phone users in low income countries and lower-middle income countries has by far exceeded all expectations. According to GSMA report, The Mobile Economy: Sub-Saharan Africa 2017, Sub-Saharan Africa had 420 million mobile phone subscribers at the end of 2016 with an estimate of 535 million in 2020. Policy-makers, politicians, academics and journalists have excitedly been sharing their stories on how the mobile phone is used for public health information, monitoring elections and money transfer as part of improving livelihoods and socio-economic development (Chipidza and Leidner, 2017; Donner, 2008; Heeks, 2009). It has almost been considered a savior tool giving millions of people access to information and a great resource for wireless communication. The mobile sector has been influential within the larger informal economy with people selling phones and airtime, fixing and charging mobiles, and using them for money transfer (Etzo & Collender, 2010). For the currently 442 active tech hubs on the African continent mobile phones have been a central actor in terms of innovation and entrepreneurship. The mobile revolution narrative likes big data where numbers of access and connectivity present a decrease in the digital divide. However, the mobile is not merely a tool for socioeconomic development and productivity but also very much a relational actor for self-expression, empowerment and increased social connectivity. The transformative discourse is prominent in the context of ICTs and development and central to this research.

This article introduces a feminist postcolonial technoscientific framework to the conversation on mobile phones and development. The aim is to expand the narrative of the dominant development discourse by bringing forward new ways of seeing and relating with practices in ICTs and development. Similar to critical research in information systems, (De Vita et al., 2018) a feminist technoscientific approach aims to understand as well as transform the context and situation of ICT practices. Drawing upon feminist, postcolonial and design theories, I relate technology transfer to gendered, postcolonial practices where I discuss how social and cultural norms affect technological infrastructures. I then discuss how the social and cultural embeddedness of technology affects the production, design and use of mobile phones and applications. I situate design practices through the concept of postcolonial computing as formulated by Irani, Vertesi, Dourish, Philip and Grinter (2010). I explore the concept of transformation through material-discursive practices (Barad, 2007; Orlikowski & Scott 2008) where I focus on the relationality of humans and mobile technologies.

Feminist technoscience: a theoretical and methodological framework

Feminist technoscience is a transdisciplinary field that explores the social, cultural and material entanglements of knowledge-producing activities and formulate alternatives

to dominant epistemologies within science and technology (Trojer, 2018; Åsberg & Lykke, 2010). The term technoscience challenges the separation between the 'basic' and 'applied' science and emphasizes the obvious link between the two in that untouched 'basic' science is just as entangled with society and politics as 'applied' science is. [T]echnoscience, in partnership with global capitalism, generates major historical transformations, including new ways of conceptualizing what it means to be an embodied human subject in a globalized world (Åsberg & Lykke, 2010, p. 300).

In feminist technoscience a positivist research framework is challenged through situated knowledges that expresses how any (knowledge-producing) action is situated within a context. Situated knowledges is a response and an alternative to the disembodied objectivity incorporated by positivist knowledge production. A disembodied objectivity creates a god-trick perspective where the researcher is held ontologically separate from the study object (Haraway, 1988). One point of view within a context may at first glance appear more limited than the disembodied objectivity but it becomes richer in content because of how it considers and encourages knowledge-sharing within the context. Situated knowledges urge for a relational objectivity where we share and create knowledge collectively and become accountable for our actions (Haraway, 1988; Weber, 2006). Feminist technoscience acknowledges the researcher as a regenerative force whose actions defines and implicates the knowledge producing practices of who I am and what I become a part of. In other words, I'm not trying to position myself and have some sort of out-of-body experience where I travel to what's out there and study an object of interest; I am my research and what I do and produce have implications. The insider perspective of me as a technoscientific practitioner is characterized by my role as a PhD student at the Research division of Technoscience Studies at Blekinge Institute of Technology, my background as an interdisciplinary undergraduate student focusing on cultural studies and globalization in low-income countries and as a Manager of Web & New Media at an international medical company. I work with theories, methods, knowledge processes and practices within technoscience turning the issues of gender and sex in science and technology to the science question in feminism (Harding, 1986).

I, as a feminist technoscientific scholar, want to challenge the boundaries of development by, as Jutta Weber (2006, p. 407) suggests, "inventing powerful stories and different socio-material practices". I am walking between different academic disciplines and crossing the borders of academic contexts and society. Knowledge cannot be contained in compartmentalized disciplines shutting out each other. Knowledge needs to talk to each other (Giger, 2010). As part of my PhD research I traveled to Uganda and met with people from the mobile industry, ICT representatives from various NGOs, students, mobile developers, officials from the Uganda Communications Commission and co-founders of women's tech initiatives and tech hubs. The research provides technocultural explorations of mobile stories in a development context, knowledges of power discourses within mobile technology development and critical design processes. My explorations are performed as a conversation between different actors in society (academics, industry, government, NGOs etc.) and theoretical perspectives encouraging

openness and transparency in scientific knowledge (Novotny, 2006). Fortun (2006, p. 310) explains how "[t]echnoscience can be said to be at issue in any system if recognized as infrastructure that shapes what gets said and not said, done and left undone, produced and circulated". I am holding myself accountable for being an interfering, ever-changing, context-based practitioner pushing through space and time and encouraging multiple views and knowledges.

In my research I work with narrative, design and ethnographic methods. As such I want to highlight certain important shifts in ethnography as a research field that are relevant for my undertakings. Strathern (1991) questions the traditional concept of ethnography where the representation of a society or a culture based on a fieldworker's experiences and observations were enough for analysis and theory by introducing the opposing perspective of the term evocation. Evocation emphasizes that the ethnographic experiences can only be conceived as fragments of discourse and no longer as wholes. If representationalism was a stronghold for unity and objectivity then evocation in a technoscientific context underscores relationality and partiality. However, Strathern (1991, p. 27) is not quite satisfied with just flipping the coin and explores a third way for the personifying ethnographic experience where she asks herself: "What image would contain within itself the idea of a person capable of making connections while knowing that they are not completely subsumed within her or his experience of them? That of itself can then be neither one nor a particle in a multiplicity of ones, neither sum nor fragment?"

Strathern turns to the image of Haraway's cyborg as an explanatory figure for a personifying ethnographic experience and a road for stronger objectivity. Recognizing bodies and machines not as separate entities but as systems that are extensions of the other makes it easier to see the relevance of embodiment and the possibilities of making temporal connections in ethnography. At one point I'm in my body thinking about feminist discourse of mobile phone development and in the next minute I'm thinking about the life of a mobile phone and where it goes when the phone has filled its purpose, surpassing my own physical body and altering the common notion of one body and a single mind. By acknowledging the partiality and locality of knowledges and considering different perspectives, different rooms, different bodies, I will be several steps closer to objectivity. Objectivity through irony that is. In case you didn't know, we can't all be at one place at the same time. Haraway (1991, p. 149) explains that "irony is about contradictions that do not resolve into larger wholes, even dialectically, about the tension of holding incompatible things together because both or all are necessary and true. Irony is about humour and serious play".

The cyborg overrides the dichotomies that have been set up between nature/culture, body/mind and human/machine. The cyborg represents a different way of viewing and living things and once we've started thinking that way we can't just turn it off. If I recognize this new conviction that knowledge is partial and filled with contradiction I can embody the mobile phone as part of us. A connection between entities implies that the mobile phone and I mobilize each other, we create a relationship through interaction with each other, comparing this relation with "the relationship between a person and

his or her thoughts, or of one's thoughts and how one converses with others" (Strathern, 1991, p. 39) The extension in these relationships is not equal to the origins of each entity. A relationship isn't just mirroring an already existing relationship but should be considered a form of regeneration that builds new connections and irregularities of yet another set of connections. I am consequently already a regenerative agent of my own research - creating, interfering and extending relations with others - creating fractals in several worlds - and both seeing and not seeing the structures I want to challenge.

Following the theorizing of situated knowledges of Haraway and social methods as performative of Law, I argue that the method of writing differently, of storytelling, is political and embodied. Law and Urry (2004, p. 391) argue the productivity of social science methods in which "[t]hey do not simply describe the world as it is, but also enact it". Social sciences, are as any other discipline, part of the social order and when the world changes so do the disciplines. The research methods then used are performative in "that they have effects; they make differences; they enact realities; and they can help to bring into being what they also discover" (Law and Urry, 2004, p. 393). Reality is a relational effect. It is produced and stabilized in interaction that is simultaneously material and social. I am not merely observing a reality through ethnographic methods but enacting one reality through my choice of method. Using the terminology of Barad (2007), there is an ongoing intra-action occurring where relations are central to world-producing activities.

Gendered, postcolonial development practices

Mobile technology itself may be relatively new but Western dominated perspectives of knowledge and technology transfer are not (Pollock & Subramaniam, 2016). In her text on Postcolonial ICT - a continuum or a rupture? Rydhagen (2004) questions the summary from the report Gender and the Information Revolution in Africa from 2000 where it is suggested that the information given to rural women with the intention of improving their livelihoods needs to be carefully repackaged and locally adapted (i.e. local language) in order for the women to even comprehend ICT. Rydhagen's criticism lies in the fact that the summary, although probably not intentionally, gives a sense of a colonial one-sided thinking where rural women in a developing country are unable to improve their own lives through ICTs and instead should wait for a ready-made package provided by outside donors.

Chipidza and Leidner (2017) analyses information and communication technologies for development (ICT4D) research from a postcolonial perspective highlighting the devoicing of subaltern, resource dependency and resistance to IT. They argue that the devoicing of subaltern have implications on ICT4D project evaluations since it is often the donors and governments who decides which project is a success and which project is a failure. Another asymmetrical power relation concern the financial and technical resources that ICT4D projects rely upon. The resource dependency affects processes of independence as the mainstream providers in the West - or Global North- remain sole innovators of a project. The continued dependency of the subaltern affects their con-

tributions and possibilities of creating a sustainable and long-term independence in ICT and elsewhere. Although it is gradually changing, a top-down approach in development strategies for the Global South is still quite common (Heeks, 2014; Lund and Sutinen, 2010). Knowledge and technology production are treated as ready-made food packages to be sent down from airplanes in a state of emergency - a view disrespectful to people's self, needs and knowledges. So how can we change this one-sided approach and create a knowledge platform that is more inclusive and more lucrative for all involved actors? Studying how mobile phone users engage with their phones just isn't enough. It doesn't answer the question on how the absence of women in directorial positions such as funding, design and management affect the research and development of ICTs, ultimately affects the end-user's mobile phone adoption. Harding (2009, p. 401-421) writes:

> *[…] the gender relations of the societies sponsoring and conducting scientific and technological research in colonial and imperial contexts would shape the nature of the knowledge such inquiries produced. The absence of women in these kinds of directorial positions affected the selection of scientific problems, hypotheses to be tested, what constituted relevant data to be collected, how it was collected and interpreted, the dissemination and consequences of the results of research, and who was credited with scientific and technological work.*

In my research on women's tech initiatives in Uganda in 2012 I learned how the social and cultural embeddedness of technology effected the ICT environment in urban Uganda. Few women were active at the technology hubs in Kampala and few attended tech events such as hackathons. The co-founders of the women's tech initiatives Women in Technology Uganda and Girl Geek Kampala sought to change this exclusive environment by creating inclusive tech communities and relevant education. The initiatives provided programming courses and networking possibilities with the aim of subverting the status quo of a male-dominated ICT arena and on a larger scope changing cultural perceptions of gender and technology. Referring to Harding's discussion on gender relations the absence of women - although changing now - in the ICT community have consequences on how and for whom services and products are created. In their research on mobile phone practices among market women in Kampala, Svensson and Wamala (2016) suggest that mobile phone and empowerment should be studied as situated. In certain situations the women become empowered. For example when a woman was low on cash and could use mobile money to pay for her bus fare. In other situations mobile phone practices disempower the women where partners want to control their every move. At first glance it may seem that the women are empowered with their own businesses. However, Svensson and Wamala explain that the patriarchal structures of the Ugandan society force the women to work. Their household responsibilities of caring for their children economically pushes them toward the informal economy.

The women's tech initiatives and the case of market women illustrate how mobile phone practices are heterogeneous processes performed differently in different contexts. The participants at the tech hubs and the market women are all mobile phone users but their experiences and relations with them are quite different yet they share a story of asymmetrical power relations in their respective communities. These dif-

ferences and similarities need to be voiced and expressed in policy-making in order to transform the embedded power relations within development practices. Economic growth, cultural practices and patriarchal structures are part of the narrative of mobile phones and development and need to be understood and analyzed as such.

Situated design practices

Just as the power relations between stakeholders in international development are asymmetrical so too are relations between designers and users in design practices. In an attempt to foreground epistemological pluralism in the development context I urge for a similar approach in design practices. There is a great need for crossing boundaries between technology production and use so that mobile applications will have any chance of being useful for the context it is created for. The task is difficult because just as knowledge is being perceived as objective and neutral in 'basic' science so is knowledge in technology production and development. Situated knowledges - multiple and located perspectives - is necessary for a successful design approach. going from designing from nowhere to designing from somewhere means taking responsibility for your actions and acknowledging the situated knowledges that you are a part of and transform as well as acknowledging the designer's reality producing aspects (Suchman, 2002).

Traditional design processes often work with steps of ideation and iteration, user identification, analysis and formulation of activities and preferred design elements. These steps are embodied with certain values that affect how knowledge is shared and represented in different development situations. Looking through the lenses of Science and technology studies (STS) and postcolonial studies Irani and colleagues (2010) suggest an alternate formulation of design work which they call postcolonial computing and stresses the themes of engagement, articulation and translation. These themes provide a sensibility to "the translations, dependencies, conditions, and histories that shape perceptions of technology and its opportunities" (Irani et al., 2010, p. 1317).

Engagement addresses the connection with users and transcultural encounters in design. Participatory design (PD), for instance, originated as a design method in Scandinavia because of the long-term traditions of how the union organized at workplaces and which considers the cultures and practices of the location from which it evolved. Placing the PD method in a different location can have completely different outcomes than first intended or may not work at all (Irani et al., 2010). When I organized an Open Space workshop with the developers and entrepreneurs at a tech hub in Uganda user design methods were discussed. One of the developers mentioned that they made certain assumptions of who the user is - calling the user 'an elite guy'. Embedded values in technology can have consequences for how a mobile application is received and sustained among future users. Instead of looking for the 'right' methodology Harrison, Sengers & Tatar (2011) suggest that we should be conscious of the historical trajectories of methodologies and make methods meaningful for the context they will be used in.

Articulation concerns the ontological framing of a situation as designers. Interpreting imagined targets such as needs, wants or opportunities and reframing them so that they can function in a culturally specific design practice. The concept articulation considers situated knowledges, partial perspectives, in order to make proper ontological, political, and economic commitments for successful design processes. Irani and colleagues (2010, p. 1318) explain that "it is not a matter of finding the right ethnographic informant or the true way of articulating users' ontologies. It is a matter of grappling […] with how to design when the certainty of perfect intercultural translation is not possible". I interviewed a representative of the NGO Busoga Rural Open Source and Development Initiative (BROSDI) who gave an example of uncertainty in their farmers' project. The project is built upon indigenous knowledge of farming where BROSDI supports the farmers through networking, information and advice. The example of uncertainty was found in the representative's example of sending text messages:

When we first sent text messages to Butaleja (district in Southeast Uganda) we found it was a waste because there was no telecom network there. So the use of sms had to be confined to other districts. You have to study your population; age, academic situation, location. Do they have telecom companies there? Do they have electricity to charge the phone?

Through the example of BROSDI we understand technology as always in motion. There was no telecom network there yesterday but tomorrow there might be. The social and cultural embeddedness of technology is entangled with the ontologies of mobile phones as well as users. The work of BROSDI and the farmers is furthermore an example of civic science. The information provided by the farmers is validated by the National Agriculture Research Organization (NARO) before it is disseminated throughout the farmer's communities. The example thus show how technology as well as science and knowledge production is transformational.

Design methods and processes are partial yet global. They travel between different designers and locations in the world and are interpreted differently depending on context and situation. The third theme translation refer to both linguistics and geometry. Culturally situated translations occur between languages as well as the physical movement of a designer moving from one context to another. I met with design students from California, US, who were working with UNICEF Innovation lab in Kampala as part of their master's program design for social impact. Central to their design methods was creating conversations with different parties and designing with the local communities. During their stay the Californian design students virtually connected with graduate students at New York University. Both student groups had a similar aim of looking at opportunities around products and services in Uganda. However, in the case of the New York students they were not physically located in Uganda during their design work. The students from California, located in Kampala, shared their experiences with the students in New York through Skype-meetings. This kind of collaborative setup include several translations of languages and movement between the designers and their collaborative partners. Engagement, articulation and translation stress how

power relations are enacted in the development context and how important it is to assert cultural and social locality to design processes.

Exploring material-discursive practices

Actors – human and technological – create the conditions for transforming social, cultural and political situations, and within these situations mobile phone practices becomes entangled with social norms, cultural values and socio-economic expectations. Mobile phone use changes how we communicate with each other, effecting our relations to different actors and spaces - our self, humans and non-human entities (i.e. the mobile phone) and time/space. Donner (2008, p. 15) states, "for many researchers, mobiles are (like other technologies) best understood as co-constructed phenomena; there are interrelationships between what the technology is and how people choose to use it". When we recognize human bodies and mobile phones as part of a larger whole – an assemblage – we can disrupt the binary systems of representation that tend to freeze meanings of technology and its relations with other actors (e.g. humans). When we no longer create assumptions on the expected outcomes of development practices and instead turn toward "shaping and staging encounters between multiple parties. The essence of the process is the fact of different people coming together and meeting – holding a conversation rather than following a recipe" (Irani et al., 2010, p. 1317).

A sociomaterial perspective suggests that objects and subjects do not exist a priori. The entities – the mobile phones and human bodies we are familiar with – are performed (Barad, 2003) or enacted (Suchman, 2007) as relational ontology (Orlikowski & Scott, 2008; Bjorn & Osterlund, 2014). A relational approach in knowledge production is relevant for understanding how transformation occur. Rather than positing the mobile phone has certain characteristics that will transform a person in a specific, pre-determined way sociomateriality, and agential realism as formulated by Barad, suggest a more fluid, heterogenous and multiversal approach to meaning-making practices. My relationship with my smart phone have changed me in certain ways – certainly in how I communicate with others. I like how I can communicate with my friends and family, play a game, find the nearest restaurant, wake me up in the morning, pay my bills, and read the news. Our relation is performed through material-discursive practices we call work and play, which creates sociomaterial experiences whether I'm holding it in my hand or forget it at home. The phone enables experiences and transformation but it will only do so through me and our intra-actions. We cannot consider the mobile phone in itself as the solution for poverty reduction and socioeconomic development but we can position it as part of an assemblage that perform transformation in social, cultural and political situations. Below is a quote by Jasuben Malek, a member of the Self Employed Women's association (SEWA), Gujurat, India (GSMA, 2010):

> *I used to wonder about this machine called a mobile phone, but once I began to use it, I realised its many advantages. I can immediately call the wholesale market to inquire about prices and place direct orders. I have eliminated the middleman. I am now recognised as a businesswoman, growing and selling sesame seeds and not just as somebody's wife or sister.*

I use this quote to illustrate how Malek's relation with mobile phone transforms her body and self. The relation affects her social role in relation with other people and she is no longer only perceived 'as somebody's wife or sister'. She has become a business woman. Balsamo (1996) addresses how important it is to consider the body when exploring socio-material relations of power and domination from a feminist perspective. Taking into account the body of the mobile phone as a gendered and material embodiment temporarily located in history and time the example of the mobile phone user above show how the relation between mobile phones and humans reshape and challenge the human/machine binary. Returning to the cyborg figuration we recognize bodies and machines not as separate but as relational processes that build new connections and new relations. I suggest that the transformation from being someone's wife and sister to also becoming a business woman is an example of how the relationship between the mobile phone and a human is a regeneration of new connections.

Discussion and conclusion

This research has brought forward new ways of seeing and relating with practices in ICTs and development using an onto-epistemological framework of feminist, postcolonial and design theory. My intention was to illustrate how positivist objectivity tend to categorize science, technology and development as neutral place-holders for innovation and entrepreneurship making it difficult to question the narratives they partake in. When we acknowledge technologies as socially and materially entangled we can understand and transform technology practices to be more inclusive and heterogeneous. I challenge the epistemological infrastructure of today so that we together can create futures on more equal terms. I can't predict the future. No one can. We especially can't own the future even if we sometimes want to believe so. Le Guin (1989) mentions a quite common view of imperialism in the science fiction genre where space and future are considered alike and just as we exploit, conquer, and colonize space we believe the future is ours to own and do what we want with. This view holds no real ground since it would require that we can see into the future.

In my chapter on gendered, postcolonial development practices I exemplify how Western dominated practices of knowledge and technology transfer affect ICT4D projects and inflict upon tech communities and entrepreneurs in Kampala. Mobile technologies is embedded socially, culturally and politically and this is showcased through social norms of who is included and excluded in the management of ICT4D projects. It is further illustrated with cultural prejudices of who is more prone to use and create technology that affect women's participation in tech-related activities and examples of patriarchal structures that force women entrepreneurs to work in the informal economy.

Situating design practices through themes of articulation, engagement and translation can foreground asymmetrical relations in the mobile sector as well as the multiplicity of a user. Different design methods will always be implemented differently as context, time and space cannot be mirrored. Instead of creating step-by-step process

with pre-defined project outcomes designers can help shape and provide an arena for conversation with different parties. Where there is no mobile network today there will be tomorrow. Changing infrastructures and new mobile phone users create situations where researchers and designers need to learn the social and cultural context. The farmers' project by BROSDI shows how the mobile network between different regions in Uganda differ and so the NGO needs to consider these differences in their communication with the farmers. The project also illustrate how knowledge is shared by farmers with the larger farmer community in the country. This is an example of situated knowledges where the knowledge producers situate their knowledges for a growing corn for a certain environment. The knowledge is situated in a specific context and shared through the National Agriculture Research Organization.

The dynamics of change is one of the cornerstones of development. In an attempt to understand transformation in development I posit that a relational ontology should underscore all knowledge production. A relational ontology suggests a development narrative as a conversation rather than a singular, fixed directive to what constitutes socio-economic development. We as researchers are implicated in the narration of what development is and the embedded metrics of failure and success. These actions motion the narrative of technological development in one direction and by doing so closes the door to other story lines. A transformative approach towards knowledge production, as suggested by Trojer and Gulbrandsen (1996), underscore the process of transformation is itself the means and ends to research. I have, in my research practices, tried to challenge the dichotomies of technology, development and design while at the same time relating to them as categories temporarily fixed in time and space. When we acknowledge that categorizations as grand as technology and development are temporarily stabilized in one context only to be interpreted and embedded differently in another we can open up to conversation and a plurality of (epistemological) stories. We can include more voices, design sensibly and disrupt a development discourse partaken by an elite few.

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Paper 2: Exploring the technological imagination among young entrepreneurs in Kampala: a feminist postcolonial technoscientific perspective

Title

Exploring the technological imagination among young entrepreneurs in Kampala: a feminist postcolonial technoscientific perspective

Abstract

Drawing upon theories of feminist postcolonial technosciences my research objective is an exploration of how technoscientific stories such as the myth of digital universalism affect and are affected by power relations in mobile development. This article is based on conversations from an Open Space workshop that took place at a tech hub in Kampala in 2012. The theme of the workshop was "The mobile futures of Uganda: sharing visions and challenges for today and tomorrow". Drawing upon theories of feminist technoscience I work with figurations to address the relationality of mobile development and exemplify how norms and values are embedded in technology design. Through the theoretical and methodological lenses of Donna Haraway and Karen Barad I connect feminist technoscience with Irani and Philips concept of postcolonial computing to address the transformative capacities of technology design. ICT practices does not exist as an either/or phenomena where they can be measured as either a failure or a success. Instead they should be referred to as a hybrid design practice where differences in design, interpretation and use can be valued as productive and positive. Together with my empirical material I perform technoscientific stories that discuss challenges in entrepreneurship, software technology and user design practices. I argue that studying the social and political dimensions of technology design are vital for forming more inclusive and heterogeneous development strategies.

Key words

Feminist technoscience, mobile development, postcolonial computing, tech hub, technological imagination.

Introduction

Information and communication technologies is expanding as a universalizing project for increasing connectivity and economic growth and has become a catalyst for the SDGs as a means of transforming lives in a major way (ITU, 2017). However, the expansion of ICTs over the globe needs to be recognized in relation to the exclusionary practices of Eurocentric modernity. The European superiority over biology and culture exploited others during the colonial era and still lingers on as a catching-up approach within a dominant development discourse (Chan, 2014). Digital networks propose an alternative to Western universals and provides possibilities of new forms of connections that move beyond geopolitical classifications of center and periphery. Actors in digital networks are building alliances in many different sites and "[w]hat brings such partnerships together and seduces such disparate actors into alliance is not only the promise of increased access to technology, information, or other material resources but

also the promise of new forms of local and global connection—including the opportunity for diversely situated subjects to realize themselves as future-oriented, cross-nationally networked individuals freed from the oversight or intervention of established institutional and political actor" (p. 13-14). Examples of local and global connections in digital networks can be found in Burrell's (2012) research among urban youth in Ghana, Takhteyev's (2012) study of software practices in Brazil and Say Chan's (2014) work on digital cultures in Peru. Their studies provide accounts of the challenges and possibilities of working from the margins of a global network society and addresses the diversity and heterogeneity of digital, global connection as a move beyond the centre-periphery dualism. Digital networks take many different forms and shapes. One of them being a tech hub.

The tech hub[1] has become a transnational space for innovation that promises material and economic expansion as well as local and global connection (Irani, 2015; Kelly & Firestone, 2016). In sub-saharan Africa hundreds of tech hubs have sprung up to respond to the possibilities of mobile innovation and economic growth (Kelly & Firestone, 2016). The tech hubs are attracting a young, educated crowd with the promise of co-working spaces, internet access, networking and mentoring and have become a crucial part in the digital ecosystem. The tech hubs provide spaces for individuals to experiment and collaborate and provide business support. They often hold events such as hackathons, conferences and courses to help the entrepreneurs gain necessary ICT-related skills. The mobile phone is considered the primary platform for creating innovation solutions and many startups focus on mobile application development (Okeleke and Pedros, 2018). This article is based on conversations from an Open Space workshop that took place at the tech hub Outbox in Kampala in 2012. The theme of the workshop was "The mobile futures of Uganda: sharing visions and challenges for today and tomorrow" and the participants where entrepreneurs and developers in their early and mid-twenties. In 2012 tech hubs were still a new phenomena in Kampala, with only three or four active tech hubs. Outbox for instance had only been active for a few months before the workshop took place. Today, in 2018, Uganda has 16 active tech hubs (GSMA Ecosystem Accelerator, 2018). Tech hubs are part of a larger techno-scientific assemblage that create material-discursive[2] relations. These relations are embedded with norms and values of how science and technology can and should be produced. Feminist technoscience and science and technology studies (STS) have long studied the social and political dimensions of knowledge production in science and technology and provide methodological devices for situated intervention (Haraway, 1988; Philip, Irani, and Dourish, 2012; Traweek, 1988; van der Velden, 2009)

In this article I draw upon theories of feminist and postcolonial technoscience to address the relationality of mobile development and exemplify how norms and values are embedded in technology design. Through the theoretical and methodological lenses

1 A tech hub includes co-working spaces, incubators, fab labs, makerspaces and hackerspaces.

2 A material-discursive practice refers to the mutual entanglement of material and discourse. Material and discursive practices are not separate from each other but are always enacted together (Barad, 2003).

of Donna Haraway and Karen Barad I connect feminist technoscience with Irani and colleagues (2010) concept of postcolonial computing to address the transformative capacities of technology design. Technologies travel and with them social and cultural structures. Information and communication technologies are located at the center of international development and considered vital for the progress of the current sustainable development goals (UN, 2016). ICTs is embedded in cultural structures and social norms which is then transferred and used in different contexts. The relations between humans and technologies is co-constitutive and "[t]echnology is not neutral. We're inside of what we make, and it's inside of us. We're living in a world of connections – and it matters which ones get made and unmade" (Haraway cited in Kunzru, 1997). Feminist technoscience is a transdisciplinary field that studies how power relations impact on knowledge production in science and technology. The field challenges a positivist objectivity through an epistemology where categorizations of gender, ethnicity and class are entangled with socio-material practices in a globalized world. (Åsberg & Lykke, 2010; Law & Singleton, 2000) Together with postcolonial science and technology studies, feminist technoscience challenges "unidirectional "diffusion" models of science and modernity, where science, rationality, progress and enlightenment always rest in Europe or the West, to subsequently diffuse to non-Western nations." (Pollock and Subramaniam, 2016, p. 953). A postcolonial perspective helps trace how technosciences were (and are) an intricate part of colonialism and "show us how scientific and technological endeavours become sites for fabricating and linking local and global identities, as well as sites for disrupting and challenging the distinctions between global and local (Anderson, 2002, p. 644). For the development discourse this means that we need to shift the notion of technology as inherently deterministic and stable towards a technology, co-produced with different actors, human and non-human and embedded in a sociomaterial assemblage (Latour, 2005; Suchman, 2007; Trojer, 2018). Assemblage as suggested by Deleuze and Guattari (1987) is a different way of thinking and engaging with the social world. Instead of viewing the world as consisting of separate objects, an assemblage suggest a more fluid and heterogeneous approach to the world where social formations become relational not essential. I use assemblage to address the fluidity and heterogeneity of concepts such as development, technology, culture and design in my technoscientific stories. The technology hubs in Kampala perform an assemblage co-produced with different actors – entrepreneurs, investors, academics, politicians, researchers, computers, cellular networks, mobile phones, buildings, ICT policies and code.

A postcolonial framework questions the hierarchical and binary dichotomies of the West and the rest and should also be self-reflexive in how we choose to interpret and select 'data'. We as researchers need to be conscious in how we use 'writings' that were created with a colonial mindset (Prasad, 2009). Prasad (2009, p. 42) writes that "the intention has to be decolonization of our 'imagination' rather than yet another effort for sympathetic taking care of the 'other'". Postcolonial computing (as formulated by Irani et al., 2010 and Philip et al., 2012) is a concept for discerning how design practices are situated, culturally embedded and bound by power relations. Irani and colleagues (2010) use the concept to problematize and open up the conversation on

how colonial relationships still linger and affect contemporary design and technology practices. Design aesthetics, symbolic literacy and images differ from place to place and are not always easily transferable. Postcolonial computing according to Philip, Irani & Dourish focus on a hybrid knowledge practice that take into account not only failed practices of well-intended ICT4D projects but also "the productive possibilities of "difference" itself. The seams among differences are not simply a source of undesirable unevenness and aberration, but also sites of creativity and possibility" (2012, p. 7). I use postcolonial computing to exemplify how design practices traject with power relations and technology transfer.

Digital visions of Uganda

The development of ICTs in Uganda has transformed the digital ecosystem into a nation filled with millions of mobile phone users. The country has one of the world's youngest populations and a huge unemployment rate (Uganda Bureau of Statistics, 2017). It is also one of the most entrepreneurial countries in the world with 1.8 million informal businesses (GEM-Uganda, 2015).These factors have sociomaterial implications for the entrepreneurs located at tech hubs in Kampala. The focus on economic growth and sustainable development is visible in the tech hubs' missions and visions. Hive Colab "has a passion for solving Uganda's social and economic challenges using technology in partnership with the private sector, government and civil society"[3] and Outbox' mission "is to provide the entrepreneurship, innovation and technology infrastructure that supports African entrepreneurs through the growth of inclusive communities that foster talent and create value where we operate"[4]. Another space that focuses on the possibilities of digital innovation is the digital Uganda vision as formulated by the Ministry of ICT & National Guidance in Uganda. The digital Uganda vision "will empower its citizens, striving to achieve the goals of universal inclusion, sustainable development, economic progress and poverty eradication through digital innovation combining initiatives across multiple sectors. It will also electronically deliver a variety of government and private services in various fields like education, health, agriculture, social security, banking, justice, communication etc."[5]. Within these visions technologies play an important role in the development narrative and I here want to stress the relationality of technology design within this narrative. The myths of technology tend to compartmentalize technology as a black-boxed[6] entity wherein the social impact of technology is primarily focused on the users of technology rather than the designers and engineers of technology. In this context I focus on young Ugandan entrepreneurs who are both designers and users of mobile technologies and discuss how their narratives of mobile development in Uganda relate to differences constructed in the global development discourse.

3 https://hivecolab.org/about-us-2/ Accessed: 2018-11-07

4 https://outbox.co.ug/were-outbox Accessed: 2018-11-07

5 http://ict.go.ug/initiatives/digital-vision/ Accessed: 2018-11-07

6 "When a machine runs efficiently, when a matter of fact is settled, one need focus only on its inputs and outputs and not on its internal complexity" (Latour, 1999, p. 304).

The technological imagination

Balsamo (2011) formulated 'the technological imagination' as a "mindset and a creative practice of those who analyze, design, and develop technologies" with a specific focus on the categorization gender. Although I work with other categorizations in this article the gendering of the technological imagination is relevant as it provides a picture of how norms and values in knowledge production have created unjust power relations. Power relations that are entangled with the development of science and technology. "For any given technology, agency is manifested unevenly by the people who create the device, program it, engineer it, manufacture it, buy it, use it, abuse it and eventually dispose of it" (Balsamo, 2011, p. 33).

Gender has historically been attributed to women's work and bodies and men have been degendered. White men have thus become these degendered experts whose imaginations are without gender, race or class. Since women and marginalized communities have been systemically excluded from technological development they become nonexistent when designing and imagining technocultures. Woman does not equal gender and the work of women does not equal an essentialized feminine expression. The absence of women in positions of authority in science and technology has impacted the scientific premises in Western colonial contexts. This means "the gender relations of the societies sponsoring and conducting scientific and technological research in colonial and imperial contexts would shape the nature of the knowledge such inquiries produced" (Harding, 2009, p. 408). The technological imagination and all innovative projects have always already been gendered (Balsamo, 2011).The only difference now is that women and other marginalized groups are finally being recognized and to a larger extent included in contemporary knowledge production. The technological imagination transforms familiar habits to new possibilities and foregrounds the consequences of such a transformation from multiple perspectives. Taking gendering into consideration in the technological imagination means manifesting different values and perspectives. Yet, the transformation of the imagination can only be expressed in how it is enacted (Balsamo, 2011).

I work with Balsamo's 'technological imagination' as a figuration for exploring power relations in mobile technology development. In my discussions I expand the technological imagination towards categorizations of nationality and class and dualisms in development and design practices. I use the figuration to address prejudices and reimagine technoscientific stories, and together with the workshops participants provide alternative directions within the development discourse.

A relational and performative research method

I have selected extracts from workshop conversations that creates a situated, partial and local enactment that simultaneously tells and intervenes with norms and values in technoscientific storytelling as well as perform certain realities. Law and Singleton (2000, p. 767) suggest "that to tell technoscience stories is, in some measure or other,

to perform technoscience realities". I work with figurations with the intent of disrupting the dominant narrative of international development, foreground norms and values in technology design and propose alternative directions for how technoscience can be made.

Diffraction as a feminist figuration

Within feminist technoscience several theorists use figurations as methodological devices for studying and disrupting the discourses of science and technology (Braidotti, 1994; Haraway, 1991; Ståhl & Lindström, 2014). The figurations are used to help implode boundaries such as man/machine, culture/nature, centre/periphery and developed/developing (Haraway, 1997). The purpose of these implosions is producing knowledge on how differences such as dualisms are made and how they can be intervened so as to be able to see and relate with the world differently.

Diffraction is a feminist figuration presented as an alternative to reflection that originates from Haraway (1997) and is further elaborated by Barad (2003; 2007). Representationalism, or reflection, in research creates fixed entities such as gender, race, nation where the entities are continously compared and motioned towards the reproduction – a mirroring - of a true origin (Haraway, 2004). Haraway proposes diffraction as a move away from this reductive linguisticism and suggests diffraction as an approach of interfering with linear causalities. A diffractive reading entangles words, things and different disciplines to break through the dialectics that have been created between different theoretical schools (van der Tuin, 2011). Diffraction motions towards an affirmative framework of kinship and of difference. A diffractive practice critically engages how and which differences matter. Who are creating differences and for what purpose? (Alander, 2007; Barad 2003; Haraway 1998; Timeto, 2011). Sefyrin (2012) explains how diffraction can be understood as a metaphor for research:

"If diffraction is understood as a metaphor for research, the empirical material is the light, and the slits in a screen are research practices, such as the practice of formulating the purpose and research questions of a study, practices for gathering empirical material, the situatedness of the researcher, the choice of theories and the methods, and the format of the text. Hence if these are changed, so does the interference pattern that is the result of the diffraction. When diffraction is used as a research methodology the result may be that alternative patterns become visible." (p. 715)

Karen Barad (2007) uses performativity to explain how we are always a part of the world and how every action, every material-discursive practice, are continuously generating new practices. The researcher is always part of the knowledge production and every description of the world is an interference pattern that "either support or erode current technoscience agendas" (Law and Singleton, 2000, p. 767). I use diffraction to critically engage with my empirical material and my knowledge practices to enact different stories, interpretations and perspective.

This approach is not without its challenges. I've been trained academically and professionally to compartmentalize processes as isolated practices, to think and act within linear processes, to define actors, users and things as ontologically separate and to cement categories as objective and normative. If I start to interpret my empirical data, my transcriptions from the workshop, with familiar categories and themes I fall into the trap of trying to make sense of what the participants want to express (Jackson and Mazzei, 2012). I would then have positioned the human bodies as the subject of research creating a semiotic narrative where their stories re-inscribe to fit a universal narrative of anthropocentric dramaturgy.

Jackson and Mazzei (2012) have outlined a methodology-against-interpretivism where they suggest analyzing data as partial and incomplete and if data can be enacted differently so to can the analysis. Difference in representationalism depends upon an ontological separateness where for instance identities are positioned in a system of negation and division. Taguchi (2012) explains, through Deleuze's relational ontology, how difference as a positive concept becomes a continuum where the affects and effects within and between different bodies are always in a state of becoming. The pursuit of a feminist technoscience scholars such as myself is then "to avoid the interpretive question 'what does it mean?' when reading theory or analysing data, and instead ask: 'how does it work?' and 'what does this text or data produce?" (Taguchi, 2012, p. 268). The aim of a feminist technoscientific approach is thus not to classify and compare people and things but to understand and intervene with underlying norms and classifications in boundary-making practices such as dominant narratives of a linear technological development.

Open Space Workshop

I worked with an Open Space method for the workshop at the tech hub. The Open Space method is adaptable to size and can be used in meetings from five to thousands of people. In my case, the workshop had about 25 participants. The event process I followed is as follows:

Opening Circle (agenda co-creation process at the start, without the facilitator helping /synthesizing/suggesting/reducing topics)

Facilitator's explanation of principles and law (calling them guidelines, invitations, whatever)

Multiple conversations ideally happening around the same big space, ideally several discussion sessions across time (without the facilitator helping those groups)

Closing Circle (comment and reflection)[7]

The open space approach is open-ended as it begins with a topic but without a specific agenda. The workshop I held had the theme "The mobile futures of Uganda:

7 Please see Open Space Worlds's website for a detailed process outline: http://www.openspaceworld.org/files/tmnfiles/2pageos.htm Accessed: 2018-11-07

sharing visions and challenges for today and tomorrow." The specific characteristics of an Open Space format is the power of self-organisation (Owen, 2008). Together we set an agenda for the evening that included the following topics:

- Mobile apps crazy
- Simcard registration
- Future of Business sms
- Corruption and innovation/policy in the way of innovation?
- Developing for the local market
- Responsive design/local market/how relevant is it?
- Mobile app development - different platforms
- Go native or not
- Investors & Mobile apps
- Startup - mobile apps

Performing technoscientific stories

The topics during the workshop centered on technological and bureaucratic infrastructures and how they are affecting the entrepreneurs' personal and professional life. The topics ranged from mandatory simcard registration, what it means to develop for the local market, the complexity of working with different platforms and what kind of applications they should be producing. Analysing the conversations diffractively I suggest that the data produces a narrative of mobile application development that strengthens some practices and weakens others. Through my empirical data I have performed and analyzed technoscientific stories that focus on the challenges of entrepreneurship, software technology and user design practices.

The challenges of entrepreneurship

The entrepreneurs face major challenges due to corruption. The Social Watch Report (2014) indicated "[i]n 2005, the World Bank estimated Uganda loses to corruption at 510 billion shillings (USD 204 million), while the Global Integrity Report (2006) doubled the amount to one trillion shillings. The East African Bribery Index issued in August 2012 by Transparency International ranked Uganda first among the five countries of the region: 40.7% of the respondents said they encountered bribery incidents in the public sector". The implications of corruptions affects those who are planning to invest in their businesses as well as the entrepreneurs themselves. Below is a conversation between several workshop participants on the topic of setting up a business in Uganda.

- But Rwanda is moving so fast in tech.
- I mean, they will wake up when Rwanda has exploded.
-Seriously, in Rwanda it takes three days to register a business, in Uganda it takes 27 days.
- Actually, they changed it. It's no longer three days it's actually a couple of hours.
- Rwanda is practically ahead.
-They finished us.
-That whole initiative of one laptop per child means they encourage tech from the grassroots.
- I think they are really somewhere.
-And why do you think Uganda isn't there yet?
- Ugandans are thieves.
-I think corruption.
-Yes, that's what I think too.
-You can look at the status quo. The governments of Sweden, Ireland and those other Scandinavian countries they gave 10 million Euros…
-Yeah.
- …for the rehabilitation of Northern Uganda and someone diverted it to their private account.
- Yeah, I read about that. They had to freeze all funds.
- If you have such a corrupt economy and in Rwanda they don't tolerate corruption at all. Rwanda attracts investors, all kinds of investors. So actually I heard some funny thing "Good laws are made in Uganda, and they are implemented in Rwanda".

A constant negation of difference not only effects the relations between the Global North and Uganda but also the relations between neighbouring countries such as Rwanda and within the country ('Ugandans are thieves'). Through this negative differentiation the entrepreneurs re-creates a culture of 'the Other' which creates certain boundaries on how they can and should develop their applications. To position Uganda as a country filled with problems seems at first to comply with the dominant narrative of international development where Uganda is helplessly bound by aid. The conversation also expresses a difference in negation where Uganda, in comparison with Rwanda, lacks the necessary infrastructure to be ahead temporally. Because of time-consuming practices with business registration and corruption Uganda won't be able to reach the position Rwanda is currently at. The political agenda of ICTs and international development is embedded in an asymmetrical relation between countries and institutions (ie. World Bank, UN) where Uganda is almost always positioned as the Other, placed in the periphery of global science and technology. The country becomes a sociomaterial construct embedded within the infrastructures of socio-economic development, with figures and statistics showing a country filled with problems of conflict and corruption, bound by external donors and investors. Staying with this narrative risks reaffirming the dualism of failure and success in ICT-related practices in Uganda. In an attempt to move beyond this dualism I propose critically discussing what is implied in the narrative of the digital divide and how a linear

development as incited by a Eurocentric modernity might not be a universal solution. I suggest focusing on situated interventions wherein the entrepreneurs are resisting, adapting and tinkering with mobile technologies. One workshop participant turns the issue of national problems to an entrepreneurial advantage in mobile application development.

My main issue with the Kenyan tech scene is this, they have reached that point where the problem is they lack problems to solve. That is why I'm happy to be in Uganda cause we have so many problems. We have so many problems and that is the beauty of it.

This option shifts the focus on failure towards a space for creativity and possibility. Yet another shift is exemplified by a workshop participant who proposes a personal commitment to overcome the infrastructural problems of bureaucracy and funding.

For me, these days, we hear a lot of people pointing fingers and everyone blaming the government, blaming someone, but for me I think some of us, like you guys who are developers, some of you are lacking personal responsibility. So, you want to develop an app because you are sure that someone is going to find it and so people are not taking personal responsibility. And for me I think, taking it on yourself to fix problems is going to be the way out because if you wait for the government to help you it's not going to happen, if you wait for a donor who's going to bring terms and conditions nothing happens.

The workshop participant argues that there is a lack of responsibility among the developers and urges for a shift in work ethics. This shift involves a transformation from relying on government and donor support to working independently when setting up a business. Another workshop participants compares mobile application development with the game business.

> *Sometimes in tech we want to take it easy. We want to do something and then you run for funding. At least look at it from a traditional game business. Sometimes you don't really start with that much amount of money so I've been going back to that thing of 'let's start from zero'.*

This perspective follows the personal commitment of creating without initial support from the government or from donors. This example shows how the developers have multiple desires on what they want to accomplish with their products and services and their applications will reflect this multiplicity. The workshop discussions and my diffractive analysis perform stories of how national policy and regulation affect the developer's actions. In turn, as the developer is affected by the infrastructures the developer is affecting the infrastructures through an interference of ideas and desires and start-ups. The problems of the country become embedded in a positive difference where they are re-imagined as possibilities for innovative practices. This interference creates another narrative and a different reality.

Software technology

The stability (or instability) of data networks, internet access and access to relevant software affect who receives a job offer. Software is usually designed and created for a specific context but rarely remains there. It travels from one place to another, through fiber and telecom masts, being used in situations the software designer could not have been able to foresee. Yet the ethical implications of technology design remains when the software travels to different contexts. Below is a discussion between workshop participants on software development. The opinions differ in how local software is being developed and by whom.

-No, but I don't think software is being put so much into consideration.

- It's not put so much into consideration because, first of all, even the software that we use most of it is outsourced from other countries.

- Exactly.

- Really, like which one?

- Most of the software that is used.

- Like what?

- Look at AppGIS. It's an enterprise software. They brought it here, as in they buy the software from another country. Even just building a system, just a simple web system. They bring guys from out [outside of Uganda] to come and build something here.

- But I think that is changing, because if you check the RapidSMS groups[8] some local government bureau was looking for a RapidSMS developer and they preferred a Ugandan so they forwarded the thing to UNICEF and because UNICEF knows its people UNICEF forwarded [the job ad] to their [mail] groups so I think they are shifting focus but again that also depends.

- They wanted RapidSMS, RapidSMS is Python.[9] You know very well the Universities they don't teach those kind of languages so I it all zeroes down to how many other foreign companies are there and what kind of influence they have on whatever.

The AppGIS software mentioned in the discussion carry trajectories of negative difference. Because as the workshop participant mentions when simple software is imported Ugandan developers are excluded from ICT-related job opportunities. The scenario creates an unequal power relation wherein the actors – software and developer – are placed in opposition with Ugandan software development. The conversation address a disruption of this trajectory by mentioning how a local government bureau was looking for a RapidSMS developer, preferably Ugandan. The national identity becomes

8 RapidSMS is a free and open-source framework for rapidly building mobile services for scale. For more information see company website https://www.rapidsms.org/. Accessed September 27, 2013.

9 Python is a programming language commonly used for mobile application development..

entangled with the desires of application development and the possibilities of creating software situated for a specific context. The discussion further illustrates how a change is taking place where Ugandan software developers are now being taking into consideration for web development.

Access and knowledge to programming languages, such as Python, is part of a larger educational infrastructure that has material-discursive implications for the entrepreneurs. According to one of the workshop participants Python is not part of the University curriculum which means that you either need to be self-taught or receive your education outside of the University. This provides yet another challenge for the mobile app developers as they may be available for programming jobs but lack the necessary programming competence. This exclusion affects the developers temporally, spatially and geo-politically. It they want to receive job offers as mentioned above they need the necessary skills of Python. In order to gain these skills they need among other things a physical location, a computer and time. Furthermore they are affected by the boundaries of international education and as Universities in other countries may be more inclined to teach Python. This situated intervention resonates with the hybrid design practice Irani & Philip proposes with postcolonial computing. A technology transfer as in the case with the web software transforms into a situated design practice whereby Ugandan software developers are learning the skills to embed the software within their specific context. The tech hubs in Kampala provide not only a space for business support but also an important educational space by holding programming courses in relevant programming languages.

User design practices

The design process of mobile application development involves actors such as developers, computers, broadband, cellular networks, operating systems, cloud platform, mobile phones, software, workplace, conversations, websites, code. And users of course. How designers relate to users affects the design of a mobile application. Two workshop participants discuss user prejudices and exemplifies how different mobile application platforms are working with users.

- One thing about the way we build our platforms here is that we do not look at this thing, the end-user experience. When we build we assume that the guy who is going to use the application is an elite guy. For example the Farmer's application that was built by Grameen. [global non-profit organization]. Tell me how many farmers are using that application?
- The thing with Grameen, they go and interview the guys, I think I wouldn't front Grameen because these guys know what they are doing. They have experience dealing with the poor, so at least they go down to the grassroots and find out how we should do it and they train those guys.

Assumptions of who the end-user is affects how code is produced, how the application is designed and how the product is marketed. Philip, Irani and Dourish (2012) explain how methods such as user-centered design tend to follow the god-trick with a disembodied and neutral designer. The user-design method has been translated by

one of the participants as a normative method that they as developers should use but they don't. The participant mentions how the assumptions of "an elite guy" becomes the desired fictive user and continues to discuss how Grameen Foundation works with the method. Following a user-centered design approach creates a situation where the developers need to develop applications to a stable and easily understandable cultural sphere where users are ascribed familiar categories ('elite guy', 'the poor'). This kind of boundary-making practice separates people by creating a narrative of here and there (Philip, Irani and Dourish, 2012). The observer, in this case the developer and Grameen Foundation, holds power over who and what the presumptive users are. Just as technological infrastructures and objects are embedded with sociocultural norms, so too are design methods. Suchman challenges the conceptualization of the user and suggests that the user is much more than a relation to technology, in this case a mobile application. Instead of creating this linguistic redundancy of what a user is the user, or actor, needs to be incorporated in a sociomaterial assemblage (Suchman, 2007). Within an assemblage different relations within an actor emerge. In other words, an application can be designed for different actors for different purposes without cementing them as categories of rich or poor, elite or inferior. Furthermore, the developers need to acknowledge how their methods and relations with different actors affect the outcome of an application.

How can we account for hybridity and fluidity in design processes? How do we hold ourselves accountable for the designs we make? Philip, Irani and Dourish (2012) suggest Critical Technical Practice (CTP) as an alternative to solution-oriented technologies. Agre (1997) and Sengers (2009) explain CTP as a critical reflection on hidden assumptions and values underlying technology design and positions technocultural practices as situated, partial and ambiguous. If we subvert the categorization of the poor as a homogeneous collective identity we can start begin discussing what kind of values are prominent in a sociomaterial assemblage, such as mobile application development, and how they affect the actions and preferred methods of the actors involved.

Conclusion

A feminist postcolonial technoscientific perspective proposes a relational ontology where the social and the technological are inseparable. This perspective de-centers the human subject and recognizes the agency of different bodies, human and non-human, as a sociomaterial assemblage (Suchman, 2007). This means that together with the mobile technologies assemble certain meanings and practices together with the entrepreneurs and vice versa. The practices of the entrepreneurs are materialized, and stabilized, temporally through the workshop and then analyzed diffractively to address the fluidity and heterogeneity of concepts such as design, technology and development.

In the chapter Performing technoscientific stories above I have shown how technological storytelling can be subverted through critical engagement. Asymmetrical power relations such as those between the so-called Global North and the Global South and between developers and users are both re- constituted and re-imagined through my

stories. In the story The challenges of entrepreneurship a workshop participant challenged the agency of developers by suggesting that they increase their personal responsibility in the development of mobile applications. One workshop participant suggested that the problems of the country are fruitful for the Ugandan tech scene. Another workshop participant compare application development with the game business. In this example the developer suggests that scarce funding is not a barrier for development. In the story Software technology two workshop participants are discussing technology transfer by providing an example of software development. Postcolonial trajectories of technology transfer, social norms and culture are visible in this example as one workshop participant mentions how software development is built by developers outside of the country, non-Ugandans. Conceptualizations of the national identity (Ugandan), the software developer (non-Ugandan), well-known, international organization (UNICEF) and Python (programming language) are bound together in the discussion on job opportunities. The discussion illustrates a change taking place where Ugandan software developers are becoming a viable option for software companies. In the story User design practice the workshop participants assumes that user-centered design is a useful approach in application development. I discuss the normativities of the design method and urge for a more critical engagement of the roles designer and user. O I argue that the stories told are interference patterns that disrupt the dominant narrative of international development and provide a more heterogeneous approach to the conceptualizations of development, technology and design.

Gendering the technological imagination of the mobile applications recognizes who is managing, designing, buying and using the application. The participants, including myself all brought with us gendered, racial, and class-based assumptions to the workshop. Assumptions that we carry with us in each and every design process we enact. By acknowledging these differences between and within us we can disrupt and transform the norms that exclude and marginalize others. By disrupting the normative development story of Uganda as a country filled with corruption and bound by aid several workshop participants' proposed alternative directions for working with mobile applications creatively and responsibly. Acknowledging sociocultural patterns as embedded within the technological development becomes an important resource for innovative, and more inclusive, practices.

Working with different theoretical approaches - feminist technoscience, postcolonial computing and critical technical practices - helps to foreground the values that are embedded in technology development and design. Through these expositions I motion towards a difference of affinity where our differences are not and should not be held separately but performed as a continuum. I suggest that unequal power relations in technoscientific development creates dualistic narratives of categorizations such as nationality, developer, designer, and user. I argue that situated interventions can provide alternative ways of imagining and enacting mobile application development in Uganda and the technoscientific stories I have performed provide such a practice. I conclude that studying the social and political dimensions of technology design are vital for forming more inclusive and heterogeneous development strategies.

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Paper 3: Women's tech initiatives in Uganda – doing intersectionality and feminist technoscience

Introduction

Information and communication technologies, and mobile phones in particular, play an important role in the narrative of international development. Since the early 2000s the United Nations, the World Bank and other development organizations have worked extensively to bridge the gender digital divide with the intention of empowering women socio-economically.[1] However, ICT4D (Information and Communication Technologies for Development) projects have departed from a modernization paradigm in which technology is perceived to be an instrumental tool easily transferable between countries and cultures. Many ICT4D projects have been aimed at quick-fix solutions without considering context, local capacity or needs. Development was conceived not as a cultural process (culture was a residual variable, to disappear with the advance of modernization) but instead as a system of more or less universally applicable technical interventions intended to deliver "badly needed" goods to a "target" population.[2] This narrow approach has had dire consequences for how development strategies have been conveyed and implemented in developing countries, and has led to the failure of many projects in terms of intended outcomes for the target population.[3] It has also given rise to a narrative in which people in the global south are consumers of ICTs rather than participants and designers.[4] Policymakers have at times assumed that ICTs can easily empower women or somehow increase gender equality through access to technology. These assumptions are problematic as they neglect women's individual agency and their specific interests.[5]

The past decade has had an increase in technology hubs and business incubators on the African continent which have contributed to changing the discourse on technological development. ICT4D projects are moving away from a "blueprint" approach in which problem-solving is based on biased assumptions of individual and collective needs and narrowly intended outcomes, to a more processual approach involving participation and inclusion at an earlier stage, design-in-use, and building of local capacity.[6]

The ICT initiatives examined in Kampala present an alternative to the historically, culturally and materially embedded practices that have created a global society in which discourses such as science and technology are enacted as Western, masculine and elitist.[7] Entrepreneurs at technology hubs are developing mobile applications, working with investors and industry experts and attending hackathons with the intent to create solutions to geopolitical issues. Policy makers and researchers are interested in these

1 See UN, "Gender equality and Empowering Women through ICT", Women2000 and beyond; World Development Report 2016: Digital Dividends and World Bank: World Development Report 2012.
2 Escobar, *Encountering development*, 44.
3 Heeks, "The ICT4D 2.0 Manifesto," 1—33.
4 Rydhagen, "Postcolonial ICT."
5 Masika and Bailur, "Negotiating women's agency through ICTs", 65.
6 Heeks, "The ICT4D 2.0 Manifesto," 17.
7 Harding, "Science and Social Inequality."

initiatives because of their potential for local innovation and economic growth. The practices within tech hubs play an important role in the development context. In order to understand these practices better, researchers need to learn more about how they are distributed, valued and layered. These practices can include the economic impact of international funders; the design of technology and technology hubs; sociocultural inclusion (or rather exclusion) at hackathons; social constraints by parents, employers, teachers and IT entrepreneurs that limit access to technology; gender-essentialist thinking that suggests that women are prone to creating mobile applications for women; and reductionist thinking surrounding masculinity and development.

In this chapter I explore how the start-up of women's ICT initiatives in Kampala, Uganda uses structural adaptation and resistance through intersectionality and feminist technoscience. I propose a technological storytelling of doing intersectionality where processes of categorization (ie. gender, class, ethnicity) are not distinguished by being either disadvantaged or privileged[8] but are formulated as an assemblage.[9] This assemblage is performed as a process of action to detect boundary-making practices as well as sites of opportunities.[10] My empirical data consists of two interviews with the co-founders of Girl Geek Kampala and Women in Technology Uganda (WITU), observations at technology hubs, news articles concerning women in technology in Uganda in general, and the initiatives in particular, and the organizations' websites and Facebook pages.

Writing as a feminist technoscientific scholar, I argue that practices are situated and performative. They are political processes for creating realities. This means that how I choose to tell the stories of the initiatives are not merely descriptions but also an enactment of reality and that my descriptions are never innocent. The stories I tell make a difference in how they are performed and analyzed.[11]

Patriarchy and patriarchal structures are a recurring topic in this chapter and concern the gendered structures that discriminate and disadvantage women. Patriarchy is most commonly understood as a social system in which political, economic and legal power is predominantly held by men. In the private family domain, fathers or father-figures hold the authoritative role over women and children. In Uganda, patriarchal structures in ICTs are visible in terms of women having limited access to the internet, lacking relevant digital skills and online spaces being unsafe. Surveys made by the Uganda Communications Commission and the World Wide Web Foundation indicate that only 6% of women in Uganda are online. Kampala has the largest gender gap in Internet access when compared with eight other cities in the world and 45% of female Internet users in Uganda have encountered online threats.[12]

8 De Vita et al. "Re-thinking intersectionality," 503–524.
9 Puar, "I would Rather Be a Cyborg Than a Goddess," 49-66.
10 De Vita et al. "Re-thinking intersectionality," 503–524.
11 Law and Singleton, "Performing technology's stories," 765–775.
12 Wougnet, "Uganda's ICT Laws" and World Wide Web Foundation, "Women's Rights Online."

Feminist technoscience

Feminist technoscience is a transdisciplinary field that queries the epistemological foundations of science and technology through feminist concepts and methods.[13] Research in the field focuses on how the politics of gender and other trajectories such as class, race and ethnicity can disrupt and change technological and political processes.[14]A feminist perspective on technoscience challenges the dualisms of binary pairs such as subject and object, mind and body and observer and observed by positing that they are neither constants nor in a relative flux, "rather they are agents in a high-stakes game, a dynamic relationship as well as a product, constructed and taking part in, or even constructing discourses and practices".[15] One of the core elements in feminist technoscience is the concept of situated knowledges, which emphasizes the relation between the researcher and the so-called object of study.[16]

Haraway (1991) and Trojer (2002) expose the popular notion of the researcher as the knower, detached from the object of study, as an illusory 'god-trick', arguing for situated knowledges in which knowledge is partial, subjective and accountable.[17] The notion of situated knowledges critiques traditional assumptions of scientific objectivity in which the researcher acts as a singular, objective point for accumulating knowledge or where a measuring apparatus can replicate data independent of the context it works within and without taking into account the researcher's own experiences. This perspective neglects the researchers' social and cultural trajectories of knowledge production[18] The boundaries I make through my selection process of transcribed data, my choices of theory and method, and my emphasis on selected analytical categories will include some practices and exclude others. Knowledge is situated, and so is my perspective.

The relationship between gender and technology inheres tricky and disconcerting meanings and histories. Gender is often viewed in popular thought as composed of the fixed binary components of "male" and "female", and technology has been separated from the social and strongly associated with masculine norms and scientific 'truth'. The cultural notion of the phenomena of technology as something masculine, neutral and objective has been fundamental to modern science.[19] Just as gender and technology are culturally embedded concepts so too is the conceptualization of woman. Mohanty (1984) addresses the implications of unifying the category of 'women' in the context of analysis, and describes a political principle by which "a homogeneous notion of the

13 Haraway, "Simians, Cyborgs, and Women" and Hekman, "The Material of Knowledge."
14 Åsberg and Lykke, "Feminist technoscience studies."299–305.
15 Weber, "From Science and Technology to Feminist Technoscience," 402.
16 Haraway, "Simians, cyborgs, and women."
17 Haraway, "Simians, cyborgs, and women" and Trojer, "Gender Research within Technoscience."
18 For more on measuring apparatus and epistemology please see Traweek, "Beamtimes and lifetimes," Trojer, "Clean and Unclean Facts" and Barad, "Meeting the universe halfway".
19 For more on epistemology, feminism and science please see Keller, "Reflections on gender and science," Harding, "The science question in feminism," and Haraway, "Modest Witness."

oppression of women as a group is assumed, which, in turn, produces the image of an 'average third world woman'".[20]

The homogeneous narrative of the oppression of women is particularly important to emphasize when discussing gender and ICT initiatives internationally. It should never be assumed that women are a homogenous group with identical interests thereby disregarding politics of location and situated knowledges. The construction of the category 'black woman' as expressed in early intersectionality research becomes problematic when the category is understood solely as located in the context of white Western societies. Seeing as the majority of black women today live in majority-black societies, Yuval-Davies (2011) explains that intersectional analysis needs to consider the "'privileged positionings' within and between majority-black societies.[21] The women I have conversed with cannot be reduced to pre-determined categories in which they would be merely in a discriminated or non-privileged position. They are not confined to relations of either/or, but are in a state of becoming in which boundary-making practices are open-ended and in motion.[22]

Inside the tech hubs

A technology hub, or tech hub, is a physical space that fosters innovation for individuals and startup companies. It is also a community where people share ideas and knowledges, learn new skills and share offices. The tech hubs usually target young people with purpose of helping them thrive through networking and mentoring.[23] The best-known tech hub is probably Silicon Valley in the US, and many tech hubs take their inspiration from it. Several of the tech hubs in Kampala are located in the centre of town, or close to a university, and the offices are spacious and bright. Some of the tables are dedicated to startup companies and some are available as co-working spaces where the entrepreneurs change from day to day. The concept of a hub carries several connotations – communal, self-organizing, collaborative, grassroots-based, egalitarian, and characterized by heterogeneous knowledge and solidarity. Nicolas Friederici (2014) suggests that one key attribute in defining a hub is its adaptation to local context and at the same time its participation in the global ICT community.[24] The mentality and culture are important aspects of the tech hubs and the Kampala hubs I visited express a vibe of being focused, lively and determined to innovate for both local and global markets.

Hackathons and technology competitions are popular events among the entrepreneurs. A hackathon is an event where computer programmers and other professionals collaborate on software projects for a limited amount of time, usually a day or longer.

20 Mohanty, "Under Western Eyes," 337.
21 Yuval-Davis, "Beyond the Recognition and Re-distribution Dichotomy," 155–169.
22 Barad, "Posthuman performativity," 801-831 and Cassar, "Becoming."
23 For a list of active technology hubs in Uganda from 2017 se: http://digestafrica.com/6-active-tech-hubs-uganda/ Accessed 2018-02-20
24 Friederici, "What is a tech innovation hub anway?."

The events are often competitive, a panel of judges select the winning teams and monetary prizes are given. The hackathons are physical, one-time events that give the participants visibility and important skills. It also provides a space for networking and opens up possibilities for competing internationally.[25]

Only recently in urban Uganda the emerging ICT community and its technology hubs had very few women present and rarely engaged in activities such as hackathons and startups. Christine, co-founder of the tech initiative Girl Geek Kampala, expresses the normative values of a gendered technology in a news article: "[t]here's this vibe, this thing that happens where girls are pushed towards the arts and boys are pushed towards the sciences"[26] She gives an example of gender discrimination from her school years, when a teacher once told her that she shouldn't apply to a certain technical school because, as she remembered it, "you're a girl—you'll never get in." Participants in Ochwa-Echel's (2011, 280) study on the gender gap in computer science education in Uganda confirm that ICT is seen as masculine in the academic context. One male student explained that:

> *When you are at the primary and secondary levels, you just know from people that the boys are cut out for sciences. You know it is like that because most of the engineers you know are men, the electricians are also men. So as a boy you think that if I have to do something that is recognizable, then I have to go to sciences. Maybe that is why we have more boys than girls here doing computer science.*

In 2012, the initiatives Women in Technology Uganda (WITU) and Girl Geek Series – Uganda were formed in Kampala with the purpose of empowering women through technology. WITU offered various technology-related activities for different age groups and Girl Geek Kampala focused on programming courses and hackathon participation. Both initiatives provided courses in which young women were taught different programming languages, enabling them to create their own mobile applications, attend hackathons and enter or remain working in the ICT sector. Women's ICT initiatives are challenging sites of innovation, in this case the tech hubs and the hackathons, by creating physical arenas for inclusion and transformation.

> *We look forward to a time when WITU [Women in Technology Uganda] will not be needed by women in Uganda anymore, when they will be empowered as Business Leaders, Tech professionals, Community Leaders, Confident sisters, mothers and wives whose importance and contribution to a family is recognized and doesn't have to be demanded. When the men in our lives will support us as we support them. When we stop seeing ourselves as victims and rather take challenges by the horns and overcome them. That we will lead everywhere we go and create a generation of intelligent, inspiring, powerful young women who will influence generations to come.*
>
> *We do not believe that we have to empower women forever, for women catch up fast. Men need to support their women, daughters and sisters as we support them. Arise*
>
> *Women and girls in Uganda and Africa, Arise women and girls in the world, It's our time to create a generation of Women Leaders in everything.*[27]

The text above was written on Women in Technology Uganda's Facebook wall and illustrates the demand for gender equality within the urban ICT community.

25 Kyatuka, "Uganda hosts technology competition."

26 Miesen, "Geeking Out."

27 Women in Technology Uganda (WITU). Accessed: December 9, 2014. https://www.facebook.com/witug/.

Methodology

Intersectionality began in the 1970s[28]as a theoretical and methodological device to identify how social categories such as gender, class, race, function and sexual orientation are interwoven with each other. When these categories are applied to individuals and groups, they create overlapping power structures that discriminate and disadvantage.[29] Intersectionality has been criticized for taking categories for granted and using categories for adding to character significations that are interpreted as the more layers the more privileged or more oppressed one is.[30] This kind of social categorization places limits on transformative agency since are hierarchically organized and subjects and objects are positioned on a predefined map.[31] In order to address this critique, some intersectional research has addressed the processes of transformation and theorized "sociocultural categorizations as 'doings', that is, as effects of processes of interpersonal communication rather than as fixed identities that individuals 'have' or 'are'."[32] Nina Lykke (2010) suggests intersectionality as a "nodal point" or as, de Vita et al puts it, a "discursive site" for creating critical conversations with different feminist positions.[33] Helma Lutz (2014) introduced the concept "doing intersectionality" by proposing a shift from fixed categories of discrimination determining the practices of an individual to a process of negotiation where multiple identities converge and diverge in specific contexts, structures and relations. By *doing* intersectionality through feminist technoscience, practices become entangled and the actions and negotiations of the subjects of interest, in this case the co-founders of the women's ICT initiatives, are analyzed as processes where the social and the material are entangled.[34] We are all in different states of becoming and I propose that a focus on doing intersectionality shifts attention to new sites of possibilities and action.[35]

I use the approach of "doing intersectionality"[36] to explore how actors move between different situations and how these situations are enacted as assemblages. In an effort to move beyond a representational perspective in which words represent separate, pre-existing 'things', I move towards an approach in which matter and discourse are not separate but rather continuously enacted in relationships.[37] Matter – as in water, buildings, states, computers, sim cards – is not a fixed entity but a doing, part of larger assemblages. Jasbir Puar (2012) explains how assemblages do not value human bodies over

28 For more on the genealogy of intersectionality and black feminism please see Crenshaw, "Demarginalizing the intersection of race and sex," and Hill Collins, Black feminist thought.
29 Hancock, "Intersectionality as a Normative and Empirical Paradigm," 248–254.
30 Wamala, "Does IT count?" and Lutz, "Intersectionality's (Brilliant) Career," 1–21.
31 Geerts and van der Tuin, "From intersectionality to interference," 171–178.
32 Lykke, 51.
33 Lykke "Intersectional Analysis," and De Vita et al. "Re-thinking intersectionality", 505.
34 Haraway, "Modest Witness" and Barad "Meeting the Universe Halfway."
35 De Vita et al. "Re-thinking intersectionality" and Lutz, "Intersectionality's (Brilliant) Career," 1–21.
36 Lutz, "Intersectionality's (Brilliant) Career" and De Vita et al. "Re-thinking intersectionality."
37 Barad, "Posthuman performativity" and "Meeting the universe half-way."

animals or plants – matter is entangled with each other – and identities are multiple with different relations occurring in different contexts and between different bodies.[38] De Vita et. al. (2016) employ the notion of "doing intersectionality" to emphasize how science and technology are not just another set of categories of oppression but rather a site for material and discursive practices. In this chapter I wish to shift attention from categories of exclusion towards "sites of possibilities"[39] in which subjects move between socio-material contexts and engage with new kinds of actions and affinities.[40] Doing intersectionality, or becoming intersectional, through feminist technoscience involves entangled practices in which I discuss the stories of the co-founders of the tech initiatives and how I relate them with the themes adaptation, transformation and agency.[41]

This methodological framework emphasizes that individual experiences such as those of the interviewees are not reducible to singular context, role or category.[42] The two stories presented in this chapter provide modest perspectives on a larger story of women in business, and science and technology. Internationally, female entrepreneurs face a number of barriers – systemic, institutional, social and cultural– that affect their agency such as their participation and influence in governmental, academic and business ICT processes.[43] Instead of assuming that agency is foreseeable and controllable, as was the case with early ICT4D projects, we should recognize its relational quality and develop sensitivities that can support the design of, for instance, technology hubs.[44] The task is to then avoid creating strategies and solutions that outline certain formulations of problems based on a specific set of individuals with determined characteristics and an intended outcome.

Drawing upon De Vita, Sciannamblo and Viteritti's (2016) work on doing intersectionality through science and technology studies, I include their analytic categories of space and practice when formulating an assemblage of WITU and Girl Geek Kampala. In order to follow the movement of the subjects each category is made up of a pair.

Space is defined by immobility/mobility that looks at how interviewees "move or stand in their sites of action".[45] Iinterviewees discussed aspects of space both individually and collectively in terms of designated roles, hierarchies and power imbalances. *Practice* relates to the scope of reproduction/transformation. De Vita explains reproduction as following the rules within their contexts whereas transformation consider practices where rules and norms are challenged or transformed.

38 Puar, "I would Rather Be a Cyborg Than a Goddess," 49-66.
39 De Vita et al. "Re-thinking intersectionality," 507.
40 De Vita et al. "Re-thinking intersectionality," Haraway, "Simians, Cyborgs, and Women".
41 (Lutz, Puar, De Vita et al, Haraway and Barad.
42 (De Vita et al. "Re-thinking intersectionality", 509; Puar, "I would Rather Be a Cyborg Than a Goddess," and Lykke, "Feminist Studies".
43 UNCTAD, "Empowering Women Entrepreneurs."
44 Kocaballi et. al., " Embracing Relational Agency in Design Process," 100.
45 De Vita et al. "Re-thinking intersectionality", 508.

Barbara and WITU

Barbara has an academic background in Business Computing and a Master of Science (MsC), Information Systems Management. She is the director and co-founder of the technology hub Hive Colab and founder of WITU (Women in Technology Uganda). WITU seeks to engage with women who are new to the tech industry, and provides training in science, technology, engineering, and mathematics (STEM), entrepreneurship, leadership and life skills for women in underserved communities. WITU has introduced a holistic approach by providing courses on life skills and career support for girls who have dropped out of school. Its activities include career and leadership mentoring, internship programs, and a Tech Kids' program for boys and girls. The initiatives reside in the technology hubs Outbox and Hive CoLab. The number of female participants attending WITUs range from five to twenty people depending on type of activity. According to WITU's website, it has trained 622 young women since its start in 2012 until February 2018:[46]

> *Hive CoLab [the tech hub] has been open for about two years now and I think we have like three women who come and use the hub on a regular basis and others just pop in and out. [...] So I thought what's wrong, why aren't women embracing technology as much as men? [...] And actually in the universities we have women doing ICT or computer science and software development but when it comes to the actual field there are very few. Those that are there, there is no voice, there's no visibility for them. [...] Why don't we start something that would be just specifically for women in technology, in Uganda?*
>
> *[…] Recently we had a hackathon that was just for women. Hey, we ask that it's something just for us, you can start your own if you want. People fail to realize that for women, not that we are weaker or anything, but the way the world has put technology to women is that it's a hard thing yet it's actually not. Yes, it's not easy but women can do it just as well as men or sometimes even better. So we want to give them a platform where it's just us. Sometimes because of the mindset that has been put in many girls, they think: boys will do it better. So if I call for a hackathon, a general hackathon, very few women will show up. When you call for just women they will actually show up because, they know, I'm competing among women.*

Barbara herself is already mobile between different situations (tech hubs, hackathons and other related tech contexts) and she wants to create mobility for Ugandan women in technology through the network. According to Barbara, the physical space of the tech hub is not sufficient for women to engage with the ICT community. Together with friends, she saw a need for a space dedicated to women, a space where they can be given a voice and get help with challenges in the workplace. Women prefer not to attend if they know that men will be there also. The cultural perception of women in ICT is negative not among men but also among women themselves. Masculine norms of science and technology affect the action, or inaction, of the hackathon participants. Barbara's response to this immobility was to create a women-only hackathon:

> *We want to get girls who are really good and serious about their ICT careers and train them. We don't mind men teaching us as long as it gets us where we want. So get these girls, train them in application development, mobile apps, web apps. Get them to be really good and send them out to companies. We want to build a legacy - if you want quality a woman developer, a woman ICT personality – go to Women in Technology Uganda.*

46 http://witug.org/#about-us Accessed 2018-02-19

Barbara wants to change the perception of women and ICT through education. Her transformative practices involve moving beyond the standard curriculum of the university and the mindset of employees by creating her own team of women excelling in ICT-related fields. She mentions that she does not object to men as teachers if they are positive towards the transformative practices she is aiming for. The practices occurring at the tech hub, and for WITU in general, oscillate between reproduction of earlier tech hub models and transformation towards something new. The organization of the tech hub is similar to those of other tech hubs in the US, for instance, and the desires of WITU as a collective reflect many women's movements globally. The situatedness within each and every individual at the tech hub suggest a transformative practice that is bound by a geopolitical context where many of the applications being made target local audiences. In a news article from 2012, published at AFK Insider, Barbara describes a mobile application created as a result of WITU's women-only hackathons:

> *One notable application is a maternal and infant health application called Nakazade. Nakazade offers information for mothers and Traditional Birth Attendants (TBAs) on SIM cards that are embedded with information on basic pregnancy health care, infant health care, contraceptive use and immunization schedules. Due to poverty, lack of information and limited access to health centers, mothers resort to TBAs or homeopathic ways during pregnancy and infant care. With Nakazade, the women always have access to the best care advice, even if they don't have access to a mobile network […]. Barnes, "Q&A: Barbara Birungi."*

A women-only hackathon, as mentioned by Barbara, enacts a site of possibilities for mobile applications targeting women's issues. The developers of the application Nakazade have taken the lack of network access into consideration by offering SIM cards with the relevant information.

Maureen and Girl Geek Kampala

Maureen is 27 years old and one of the co-founders of Girl Geek Kampala. She has an academic background with a Bachelor's of Science in Information Technology and a Master's of Science in Information Systems. She has worked with several organizations in ICT4D, women and ICT, mobile phone development and social media. Girl Geek Kampala, with a core group of about six to eight people, focuses on the educated niche of the ICT community in terms of access to hubs, mentorships, hackathons and funding. Maureen was initially involved in the setup of WITU, but as the objective of the initiative changed from being niched towards girls already involved in technology to being more focused on basic ICT training, Maureen felt this was too similar to her previous work on Women of Uganda Network and she didn't want to repeat herself:

> *Sometimes I go for those hackathons. You enter the room, and you look around and in a group of fifty there are three girls and they are always the same girls. Because when we go for tech events you will find Christine, Emily and myself. You will find, yeah just the common faces. So that's a very huge challenge. There are very many girls out there who are so good but you know the confidence, the issues of being bullied. You can't blame them because it starts from home.*

Maureen's desire for having more women engaged in the hackathon remains unfulfilled, yet at the same time she mentions that there are women attending the hackathon, so

the desired transformation is occurring although not at the pace she desires. She briefly mentions confidence and relates it to the home setting. She herself is an example of the ability to transform hackathon events through participation and engagement, and at the same time she describe the collective immobility among young women due the culture of gender and technology. Maureen has moved from being stuck with an objective at WITU she did not wish to pursue (immobility) towards a desire to work with Girl Geek Kampala that focuses on programming courses and hackathons:

> *I wanted an advancement because while it's good to bring people back to the basics of technology, it won't easily help bridge that gap because when you go to universities you find that the percentage or the ratio of boys and girls in tech faculties, it's horrible. And you see while these girls they may be at universities doing the tech courses but when they come out they opt for something else. They never do anything tech-related for several reasons. There are so many reasons. It happens over and over again. So that's why maybe we should get some advice by ThoughtWorks [global technology company], I went for one of their meetings. I met one of their team members and she told me, why don't you have this Girl Geek Kampala chapter? So I asked, what's Girl Geek all about? So she explained you get girls who build apps, they compete. And that's what I really wanted. So I said, why not?*

Maureen is describing a situation in which girls' desires towards tech-related professions are diverted towards something else. Maureen urges for a transformation in practice where university-educated women can become entrepreneurs through mobile application development:

> *There are those startup weekends – where you get young people, university students, put them in one room for three days and tell them to come up with an application, and the whole idea is to have, the application has to add value, to someone's life, or it has to create positive social change, I mean you don't just come up with any application, that doesn't help anyone just because you think you like it or what. So they grade them based on their relevance and their applicability in real life.*

Maureen mentions that one cannot just come up with any application, hence the objective of the startup weekend pre-determines how the application can be created. Although the mobile application itself is not problematized, the directions for how it can be developed are reconfigured. Maureen explains how Girl Geek Kampala intentionally wants to be gender-biased, they want to encourage the members to develop apps that are women-friendly. Maureen's stories highlights an urgency of transformation where she wants more women to participate in the ICT community and engage in the hackathons and startup weekends. While she herself is quite mobile and moves between different ICT-related situations spatially, Maureen expresses a frustration over the immobility of other girls who are stuck in situations – university, workplace and home – from which they cannot move. Maureen and Barbara tell similar stories of how women study ICT-related courses at the university but when they graduate, they 'opt for something else'.

> *Barbara [co-founder of WITU]: It's not about how much education you have but how you sell yourself. Because we have so many women in ICT or girls that have studied ICT. They need a job right now to pay their bills, they will maybe go and apply for an ICT job and then during the interview the employer says she may not be able to handle this but I have a secretarial position available and she's offered that and, she's like, it's going to pay the bills, she will take it up but she's like, when I get the one I want that's in ICT I can take it up, but before she knows it, maybe the administration manager is leaving and they need someone to replace her and maybe they need a slightly higher edu-*

cation than that, maybe human resource [competence], she'll be like, ok if I study human resource I'll be able to become admin manager and that's more money. She's losing the vision of ICT. [...] So how to get those women before they actually divert to make sure they stay on this path?

Barbara explained how women become confined to certain job tasks. The administration manager in the story is female and the woman who has studied ICT will be inclined to choose a job as an administration manager, as this is more accepted due to her gender.

Discussion and conclusion

'Doing intersectionality' explores how actors are embedded in roles, categorizations and structures (gender role, masculine norms, organizational hierarchies, cultural perception) that create boundary-making practices. These boundaries form risks of exclusion but can also create sites of possibilities. Actors are oscillating between different categorizations and situations – place, practice and objects – and struggling to adapt as well as resist and transform. The stories by Barbara and Maureen form a process – an assemblage – of discrimination, resistance, adaptation and transformation moving in different directions. Barbara and Maureen strive to interfere with the social norms of gender and technology by changing the mindset of the actors in and out of the ICT community. The women's tech initiatives provide an alternative to the male dominance of the tech hubs and tech events. Interfering with social norms and providing an alternative can transform the agency of the female members of WITU and Girl Geek Kampala and have an impact on the broader ICT community.

Noticeable in both stories is the collective act of transforming women through education. Agency in relation to empowerment implies not only actively exercising choice, but also doing this in ways that challenge power relations. Because of the significance of beliefs and values in legitimating inequality, the process of empowerment often begins from within. It involves changes in how people see themselves (their sense of self-worth) and their capacity for action.[47] A cultural bias according to which women are somehow less prone to technology is, according to Barbara and Maureen, enacted in many of the member's views regarding themselves and ICT.

The masculine bias in technology affects the political agenda in Uganda, as less women may pursue ICT-related careers and they become marginalized in the national and global ICT community. Although both Barbara and Maureen are themselves agents in these ICT contexts, they both express loneliness and marginalization that they want to challenge. The immobility, invisibility, and low self-confidence of women in places of technology such as tech hubs and hackathons have urged Barbara and Maureen to challenge the status quo by creating WITU and Girl Geek Kampala. The complex nature of patriarchy that promotes male privilege means that access to technology and technological know-how within the ICT community may not just be handed down but must be actively appropriated by women as is the case with the initiatives. The

47 Kabeer, "Gender mainstreaming in poverty eradication," 172.

actions of WITU and Girl Geek Kampala both adapt to and transform the practices of the tech hubs. Since they are physically located within tech hubs, they abide by the rules and norms of the hubs and at the same time they challenge these norms by creating new rules within the same space. They create their own meetings, courses and hackathons to mobilize women to engage with ICTs. By engaging with technology as objects of knowledge and increasing the visibility of women in technology, new narratives and desires develop which in turn pushes the boundaries of gender and technology.

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Paper 4: A norm-critical game culture: exploring norms among media technology students

Abstract

For over a decade the video game culture has had its fair share of sexism, exclusion and marginalisation. This toxic gamer culture has led to an urgent call for change in education and the industry. This study shifts the focus from gender as representation towards gender (and other marginalised categorisations) as infrastructure. Based upon the empirical material from the project A norm-critical game culture, this paper details experiences from collaborative exercises that the students and project coordinators engaged in during three workshops and a hackathon. Working with a norm-critical perspective, the study foregrounds how norms affect our relationship with games and culture and how these norms in turn affect the narratives and infrastructures of video game culture.

Keywords: feminist game studies, feminist technoscience, norm-criticality, video game culture.

Background

Video game culture is usually referred to as the global subculture shaped by video games. During the late 1980s and 1990s video games turned into a niche product which created quite a homogenous audience (Kline, Dyer-Witheford, & De Peuter, 2003). "Like other forms of identity, being a gamer is defined in relation to dominant discourses about who plays games, the deployment of subcultural capital, the context in which players find themselves, and who are the subjects of game texts" (Shaw, 2013, p. 1). The narrow construction of gamers limited how especially women were portrayed and represented in games, which created a call for diversity from within the gaming community as well as among feminist game scholars (Cassell & Jenkins, 2000). The limitations of the homogenous gamer identity affect those who plays games, which has social as well as economic implications. The gaming industry is a multi-billion dollar enterprise which has grown extremely quickly in a relatively short time span.

In 2017, the global games market was worth $121.7 billion, and is expected to grow to more than $180 billion in 2021 (Newszoo, 2018). In Sweden, the games market grew by $1.6 billion in 2017 (Nylander ,2018). There are different types of devices used in gaming, where the biggest ones are personal computers, consoles, and mobile and tablet devices. The different styles of gaming between these devices have created hierarchies and opposing parties where the 'hardcore' gamers playing on computers and consoles 'look down' upon 'casual' gamers playing on mobile devices. The hardcore gamer is usually described as a person playing more complex games, and who identifies with gaming as a lifestyle, and sometimes takes part in electronic sports tournaments (Taylor, 2012). The divide between hardcore and casual gamers relates to a larger conflict that concern the gendering of the gaming community. Paaßen, Morgenroth and Stratemeyer (2017) describes a gaming community of white, young males that argue "video games are created by men for men" (Maddox 2013, 0:17).

The notion that women only represent a very small minority of gamers is disproven by major polls that over the past decade have shown how at least 40% of the people playing video games are female (Entertainment Software Association 2008, 2018; Interactive Software Federation of Europe 2012). This contradictory and misogynic narrative perpetuates gendered gamer stereotypes of women as casual gamers and men as true, hardcore gamers. The male biased narrative further limits women and other non-normative gamers in their relations with the game phenomena and forces non-normative gamers to constantly (re-)negotiate their position and gaming performance in the gaming community (Kaye & Pennington, 2016; Shaw, 2011). The norm of the male, hard-core gamer continues to live on because of a persistent reproduction of male and female gamer stereotyping within the gaming community, within news media, and by an industry who produces games based on the element of sameness - the same stories to the same 'ideal' players (Harvey & Fischer, 2013; Markendahl, 2017; Shaw, 2011; Styhre et al., 2016). When the lack of diversity among gamers goes unanswered the stereotype of a hardcore gamer persists, and the gaming industry continues to create for the same demographic group as always; white, middle class, heterosexual, males (Dymek, 2012; Kline et al., 2003; Lazzaro, 2008) Dymek (2012, p. 38) argues that "the hardcore gamer remains the most proclaimed important target group for the global video game industry". The biased narrative of a masculine gaming culture persists in many contexts and the Gamergate controversy in 2014 became a wakeup call that showed just how toxic the video game culture is (Mortensen, 2018). Gamergate developed into two separate, yet well connected, movements - one that was an organized harassment campaign and the other concerning ethics in games media. The harassment campaign targeted female and feminist game developers, scholars and journalists and involved rape and death threats (Chess & Shaw, 2015; Wingfield, 2014).

Women in games initiatives

The possibilities of creating a more inclusive video game culture is complex. Several initiatives have been formed throughout the years with the aim of increasing the numbers of female game developers or supporting existing ones. In the US several projects and initiatives referring to Women in Games (WIG) have worked towards "getting more women into the digital games industry" (Harvey & Fischer, 2015, p. 577). Albeit sharing a common goal the organization of the different projects differ where some initiatives are focusing on women working in the gaming industry and other smaller, incubator projects focus on supporting women in making a game. When Harvey and Fisher (2015) explored the post-feminist context of women professionally engaged in the North American digital game community the interviewed women expressed a fatigue with being socially and structurally constrained by being labelled a woman rather than a game developer in the gaming industry. "Women who are in any way publicly known have to negotiate a complex terrain. Those participating in WIG projects or conversations often dance between what is implicitly a feminist agenda and a context that is, by and large, deeply unfriendly to anything that is labelled or characterized as feminism" (Harvey and Fisher, 2015, p. 580).

The Swedish video game culture

In Sweden the EU-project SuperMarit spanned from 2004 to 2007 with the aim of getting more women into the game industry. The co-founders of the project were dissatisfied with only 8% women enrolled in the game education in the country. The co-founders of SuperMarit reasoned that the culture in the game industry needed to change, and more female role models were needed. When the project group met with representatives from game companies and game educations and asked why there were so few women in the industry, they had no answers, and no suggestions for change. The project group helped game companies with recruitment, talked marketing with the people behind the game education programs, and organized network meetings for female game students. When the project group from SuperMarit visited Dreamhack, Swedens biggest computer convention, in 2005 they presented SuperMarits manifest in front of five thousand people. The manifest was an exclamation against sexist stereotypes in video games and argued for a more inclusive game industry where games are produced for everyone. The audience, predominantly male, was very provoked by the manifest and booed at the project group. (Olofsdotter Bergström, 2009). Inspired by SuperMarit, the University of Skövde founded the project DONNA in 2011 with the aim of increasing the number of women in game education. In 2013 the non-profit organization Diversi was founded to promote equality and diversity in games and among gamers and game developers . One of the aims of the organization is to support female game developers and game journalists as a counter-movement to the Gamergate controversy.

The Swedish Gaming Federation (Sverok) is a nationwide non-profit association and Sweden's largest youth organization with more than 90 000 members in clubs all over the country. Together with RFSL Ungdom , Sverok published a report on young HBT-QIA-peoples' views on computer games and game culture in Sweden. The majority of the interviewed people had negative experiences of gaming in relation to their sexual orientation or gender and a majority missed positive experiences from the same perspective (Wennlund, 2014). A quote by one of the interviewed people explains the issues of being a female gamer: "I never tell anyone that I'm a woman when I play and I always use gender- neutral nicks [nickname]. My entire gaming experience is destroyed the moment somebody may say that I am a girl irl [In Real Life]. There is a heavy stream of invites, proposals, sexual invites and when I win over them, the insult and detailed descriptions of rape know no limits" [my translation]. In the report summary Wennlund (2014) mentions that the young people have both negative and positive experiences of the gamer culture. The online gaming environment can be negative and discriminating but it can also be a social place for gaining new friends.

Games and culture

The Women in games initiatives in the US and the Swedish initiatives such as SuperMarit and Diversi paints a picture of solutions that focuses mainly on women's

behavioural change and gender as representation. Less focus is placed on how the normative, exclusive and misogynic infrastructures of video game culture should change. A recurring aim in gender equality work is the need to balance the workplace with an equal number of men and women. While this is an important approach, in many contexts becoming a number - a statistic in numerous gender equality reports - doesn't change the culture. "Defining gaming culture as something distinct and separate from a constructed mainstream culture encourages us to only study those who identify as gamers, rather than more dispersed gaming" (Shaw, 2013, p. 416). Video games are part of mobile technologies, family and friend interactions, work places, education and industry and are played by people of all genders, sexualities, races, ages, and nationalities (Shaw, 2013). Many of these players may not define themselves as gamers or as part of a gaming community. In this study I shift focus from gender as representation towards gender (and other marginalized categorizations) as infrastructure. I focus on how norms affect our relation with games and culture and how these relationships in turn affect the narratives and infrastructures of video game culture.

Feminist technoscience and feminist game studies

The transdisciplinary research field of feminist technoscience challenges power relationships in science and technology by questioning the binary categorical systems –man/woman, nature/culture– that positivist epistemology is built upon (Haraway, 1991). The need to categorise and avoid any change in categorisation often limits any possibilities for change. Also, when categories are beneficial for certain, leading groups (white men) and classes (middle-class) in society, it becomes even more important to uphold them (Harding, 2008). A feminist technoscientific approach to technocultures, and in this case gamer culture, implodes these boundaries and categories, and suggests a different way of thinking and engaging with the world. Instead of trying to enforce the people who have been 'Othered' (i.e. deviating from the dominant norm) through the misogynist game culture into a narrow label of a pre-constructed gamer identity, I move beyond the constructed audience (Shaw, 2013) and focus on the relationships being formulated between different actors in video game culture.

The gender and technology discourse has primarily been framed as a political discourse with issues of diversity, representation and equity, framed within a modernist epistemology with a very specific relationship to technology, culture and nature (Vigdor, 2014). The gender-technology discourse needs to address how politics, economics, educational and technological access and social norms structure the contexts for how digital games become available to individuals. Nooney (2013, p. 1) explains how the history of videogames is permeated with a paternal lineage of "'founding fathers', 'hacker heroes', and 'game gods'". In one sense this is accurate as the vast majority of jobs in the gaming industry are taken by males. However, the notion of the video game culture as a 'boy's domain' has emerged from how the culture has been framed and documented in video game history. The narratives of game culture are continuously being (re-)produced in how we tell the story of games (Nooney, 2013).

The practice of creating a gender balance in game culture by focusing exclusively on getting more women involved in games fails to account for the "the ways gender is an infrastructure that profoundly affects who has access to what kinds of historical possibilities at a specific moment in time and space" (Nooney, 2013, p. 1) We need to be asking different questions in order to shift the focus on gender equality as a means of representation towards a focus on infrastructures and power relations. Nooney (2013, p. 1) suggests a shift from "Where are women in game history?" to "Why are they there in the way that they are?" Moving beyond the modernist boundaries of technology practices, this study departs within a feminist technoscientific framework that focuses on how differences are made (such as gender) and how these differences affect social norms and values in video game culture (Ehnberger, 2017; Nooney, 2013; Trojer, 2018).

Normcriticality

Norms shapes human behaviour in a group and in a society. Norms refer to what is considered normal and abnormal behaviour, and includes everything from technology design and economic growth to traffic rules and how we eat. Social norms govern human behaviour by building in expectations of, for example, how an individual should behave, dress, and relate to other people etc. An individual who follows the norm of a certain group is approved by the other members of the group, whereas an individual who diverts from the norm risks being punished, stereotyped or discriminated against by the other group members (Bicchieri, 2017; Ehrnberger, 2017). Norm-critical perspectives often challenge normative practices, but they can also address the transformations and making of new norms. "By asking 'who benefits from this social order?' it is possible to discover how norms are reflected in specific activities, actions, and situations" (Jonsson & Lundmark, 2014, p. 4). A norm-critical perspective recognises those deviating from the norm, the marginalised, and foregrounds those benefiting from the constructed norm, the privileged. In the project A norm-critical game culture, we addressed normativities in the video game culture by recognising those who benefit from the constructed audience as formulated by the existing gaming community and by examining our own positions and privileges.

A participatory action research method

We, the project coordinators, used a participatory action research (PAR) method for the project. Action research works with an agenda for social change whereby knowledge is shared to address and solve a problem (Greenwood & Levin, 1998). "PAR is considered an alternative approach to traditional social or scientific research, as it moves social inquiry from a linear cause and effect perspective, to a participatory framework that considers the contexts of people's lives" (MacDonald, 2012, p. 36). We wanted to create a participatory framework where students and project coordinators contribute with their knowledge and discuss possible approaches to a norm-critical game culture. Participatory action research stands for active participation by both researchers and participants, which underlines the need for a discussion on the researcher's role in

commencing a study. The traditional position of the researcher is that of an observer: in PAR this position is active and undoubtedly brings the researcher's own experiences and prejudices into the arena (Haraway, 1997).

In order for the workshop participants to be comfortable and open with each other during the workshops, we set-up a few guidelines that encouraged the creation of a caring space for discussion and interaction. Among other things, the guidelines expressed how we should show humility for each other's differences. We tried to avoid having any ready-made definitions of concepts, such as digital games or gender, so as to be able to discuss how we within the group and in relation to the video game culture, relate to the concepts.

Three workshops and a hackathon

This chapter presents the documentation and analysis of the project A norm-critical game culture in relation to the following aims:

- identify norms and attitudes with potential game developers
- increase the knowledge of a norm-critical perspective in the game industry
- experiment with the game concept together with businesses and the public sector

The subsection 'The invitation', provides information on the invitation sent out to the students and the academic context in which it was made. The subsection 'Three workshops' introduces the themes related to each workshop and provides two examples of community-building exercises. The final subsection 'Hackathon' discusses the hackathon event which was held together with those students who participated in the workshops and with representatives from the municipality and the University.

The invitation

We sent out a digital invitation to all students at Blekinge Institute of Technology. The invitation explained that it was not necessary for a participant to be studying any subject related to digital games, or to be a dedicated gamer, or to be identified with the gaming community. We were looking for a group of participants with a background as diverse as possible. The invitation explained how the participants registering for the study were to be committed to attending three workshops and a hackathon. We chose to hold the workshops during the day, and in order to avoid clashing with the students' schedules we limited the number of workshops to three. The hackathon was held separately at a later date. Interested students then got in touch with us in advance, and we registered them as participants for the study. The University composes of two campuses and the project was based at Campus Karlshamn. This created the situation where the majority of students engaged in the study where from Campus Karlshamn. Furthermore, there is only one undergraduate program in Karlshamn, namely media technology. The undergraduate students in media technology major in one of the four following subjects: digital games, digital audio, digital images, or web production. We had ten registered participants for the project.

The three workshops

Each 3-hour workshop related to a theme: Education and Research, Business and Industry, and Future Uses. The students shared insights on how they perceive today's game industry, both regarding education and the labour market, as well as which gaming features are perceived as problematic, and how the participants envision the future. For each workshop, different exercises where used to shed light on norms and privileges among the participants, and two of the exercises will be described below.

Brainstorming a game concept

The aim of the brainstorming exercise was to invoke discussions on the students' norms in relation to game design and development. The students were asked to read two pages from the book 'Boys' by Jessica Schiefauer (2014). The book is a coming of age story, telling how a group of teen girls deal with everyday life and a magical transformation. They are given the opportunity to physically change gender. The pages presented for the exercise are those when the girls transform for the first time. The project coordinator then asked the students and the participating coordinator questions such as: If this was a video game, who would it be for? Would it be sell-able? Where? To which demographic? The questions were first discussed in pairs, then together with all of the participants. These discussions focused more on how games can be designed, rather than how the proposed game could be marketed. One of the comments was that the transformation had too few game mechanics. No one believed that the game could reach outside of the indie game market.

Which idiotic rules stand in the way of the game culture you desire?

One exercise focused on which rules or norms limit how the workshop participants can engage with the video game culture. The workshop participants were asked to write down which rules they feel stand in the way of the game culture they desire, and what are their suggestions for a more norm-creative game culture. During the exercise we made a list that included both the rules we dislike, and a wish list for what we would like to change. For this context I have created two separate lists for easier reading. One list presents the idiotic rules, and the other list addresses norm-creative proposals for the individuals involved in the video game culture, including the gaming industry.

Idiotic rules

- A game must be as profitable as possible.
- A big game must be displayed on E3 and must be released within 9 months.
- Serious games/Teaching is a separate form of play.
- Each development of a game must have a crunch. (Crunch = A workpeak, when you have a higher gear and work all the time)

Normcreative wishlist

- Stop using female characters as a prize for the male characters
- Feminine = / = weak (Feminine does not equal weak)

- Acceptance between groups
- Do not be afraid to show feminine sides of men
- Stop bullying within the gaming community
- More challenging games and fewer games that take the 'safe' way for the sake of money
- More games created for both men and women
- Stop trying to control what people buy depending on their gender
- Anyone who likes games should be able to call themselves gamers without being questioned
- Criticism should be treated with attention not hate
- Dare to include more non-binary characters and other sexualities
- Stop following old patterns with body shapes
- You should not be afraid to play if you are a girl
- More POC main characters (POC = people of colour)
- More realistic conditions (more realism in the games)
- Stop using mental illnesses to rationalise evil.

Afterwards, we placed our Post-it notes that listed our wishes on an x-y axis system where the y-axis represented great effect - little effect, and the x-axis represented 'easy to implement' - 'difficult to implement'. All Post-it pieces were placed in the Great Effect box and Difficult to Implement. The exercise foregrounds norms in video game culture, and how they affect and, to a certain extent, limit the workshop participants from engaging with the culture in the way they desire. After the exercise we discussed the problems with the video game culture, and that it was quite difficult to find solutions to change norms that exclude and discriminate.

Hackathon

A hackathon is a timed event where software developers and others are engaged in software development. The word hackathon is connected to the words 'hack' and 'marathon', where hack is referred to as experimental programming. The hackathon concept began among software developers in the late 1990s and has since become a widespread concept branching out in fields beyond computer software. There is no formal structure to a hackathon, but they do have a few common characteristics. The hackathon event is usually centred around a theme:– developing apps, working on an open-source project or game development. It often begins with some presentations and then the participants are organised into groups and are encouraged to start coding/making. We chose the hackathon concept as a useful method for experimenting with the game concept, together with representatives from the municipality and the local industry.

When we planned for the hackathon we experienced strong opinions among the workshop participants concerning what a hackathon is and what it is not. Where we making a game jam instead? How could we design a successful hackathon? The advice from the workshop participants concerned how we could produce an event that would attract sponsors, create products that would soon reach the market, and how to create

hype around the hackathon. We then asked the questions: Did this approach promote an innovation process? And did it support a norm-critical perspective of the game culture? We, together with the students, decided that the hackathon would be a meeting place to discuss norms in games and experiment with game concepts. We outlined a few guidelines for the hackathon:

- The participant doesn't have to be a student in digital games, or a dedicated gamer or identify with a game culture.
- Everyone in the room automatically becomes the game developers of the future (in this project we don't have experts)
- We firmly believe that interactions with others are vital for change.
- We are aware that transforming norms is a slow process that will involve many actors and initiatives.

The 13 hackathon participants were students from the project, representatives from the municipality's cultural and library services, the municipality's business sector and university staff. Many of the participants positioned themselves as having little or no experience of games or gender issues, but they were curious as to what a norm-critical game could involve. They were also interested in learning more about gender and games, and gender and IT in general, so as to share their knowledge with their respective workplaces.

The hackathon began with an introduction to the project, and then followed with two presentations on diversity and gender issues in game development. The participants were then divided into groups. The aim was to experiment with the concept of games, innovation and gender. This meant working with a concept or method, rather than product prototypes. We used the same open process which we used during the workshops with the students. The participants were given seven hours to work with their conceptual prototypes. At the end of the day, all participants gathered to present their ideas and solutions to each other. One concept revolved around moral issues concerning 'which choice is moral justice in a war?' and how this could be expressed in a game. Another concept concerned game mechanics and 'what happens if the author who creates a story is constantly replaced for each level of the game?'

Conclusion

Norm-critical perspectives and participatory frameworks provide possibilities for discussing norms in video game culture. A norm-critical perspective recognises how existing norms, in addition to the existing norms of the workshop participants, affect the video game culture. When brainstorming a game concept, several workshop participants where inclined to follow a dual approach of positioning the game either in a mainstream or indie market. The idiotic rules-exercise acknowledged many problems with the video game culture, and it was difficult to easily create solutions to the problems since many of them where quite complex and involved structural change in the gaming industry. The persistent gamer stereotyping affects people negatively, and leads people

to question their role and engagement with the video game culture. This study refocused categorisations, for example gender, from being a fixed category towards being a part of an infrastructure. This re-focus helps to move beyond a constructed gamer identity, and discusses individuals engaged with games regardless of a preferred gamer identity. The hackathon was an opportunity to bring together people with diverse backgrounds and discuss their relationships with the gaming culture and create game concepts norm-critically and norm-creatively.

The term norm-criticality is often used for the analysis of a specific context, whereas the term normcreativity is referred to as the practice or the application of the analysis. In our study, we did not have this clear distinction in our activities. Our study involved an initial analysis, but also an ongoing analysis that was formulated together with the students. When we designed the hackathon we deconstructed the normative processes of how a hackathon is usually conducted, and began the hackathon with a presentation on norms in the video game culture. Some of the hackathon participants realised that they knew more about games and game design than they had initially thought, and were positive towards playing with norms when brainstorming game concepts. The participants with a lot of experience of hackathons and game jams explained that the possibilities of brainstorming normcreatively strengthened the effects of game prototyping.

The study A norm-critical game culture complements initiatives such as Women in Games in the US and the Swedish project SuperMarit by focusing on the underlying norms among media technology students and by exploring how participatory methods can provide a platform for intervening with norms that are discriminatory and misogynic.

Moving forward

In this study we focus on the academic context. Moving forward, norm-critical and normcreative perspectives can provide a much-needed platform for behavioural change in the gaming industry, in online communities and in the media. Moving beyond gender as a means of representation towards gender as part of an infrastructure, we can recognise the structural changes needed in terms of education on equality and ethics in video games. We need to involve actors from all parts of the game culture in order to realise the wish list proposed by the workshop participants - “Anyone who likes games should be able to call themselves gamers without being questioned”. Yes, then more people in the gaming industry need to be involved in the structural changes needed for this vision to become a plausible future.

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Paper 5: Exploring Situated Making in Media Technology Education

Linda Paxling*
*Technoscience Studies, Blekinge Institute of Technology, Sweden
linda.paxling@gmail.com

Abstract: Critical making has the potential to foster a practice of connecting critical thinking with physical making through iterative and self-driven learning. This paper explores critical making as a method and a pedagogy in bridging the gap between conceptual thinking and making, encouraging play to cultivate learning and understanding one's relation to the world. Situated making is an undergraduate course for second-year students in media technology at department of Technology and Aesthetics, Blekinge Institute of Technology. The key concepts critical making, situated knowledges and interaction were implemented to encourage a learning process aiming at deepening knowledges on critical thinking and hands-on making. We found that augmenting the perception of digital media is necessary moving forward. Acknowledging the hybridity of nature and culture as ever present in critical making practices needs to be taken seriously if we are to create situated educational interventions fostering responsible futures.

Keywords: critical making, situated knowledges, media technology

1. Introduction

How we interact and engage with materiality is changing; our relations and experiences of the world are becoming increasingly virtual and abstract and our learning environments are becoming more and more digital. How we design digital prototypes, characters, artifacts and infrastructures have consequences independent of any label we assign the world. Learning by interacting with and remaking everyday objects is a stepping stone for using critical making as a method for integrating social, political, ecological and intellectual ideas with embodied knowledges. Linking digital relations with material engagements are vital for social intervention. Schwartz (2016) explores the potential of critical making as a pedagogy among architecture students and suggest that

> *"[…] instead of creating a virtual model in the computer composed of lines and volumes which are detached from many realities - including gravity, mass, and weight, assembly sequence, texture, and material properties – a student can be asked to generate project ideas by fabricating a series of conceptual constructions out of concrete, wood or steel". (Schwartz, 2016, p. 230)*

In media technologies the political, corporate and social agendas set the standards for how a production should be designed. How do universal standards of game design inflict on the individual experience of learning? What are the conventions of film-making and who do they exclude? What are the underlying political interests of standardization of digital infrastructures? Understanding the consequences of digital activities is crucial for questioning and redefining normative values in media technologies. As Schwartz explains, "the practical knowledge of knowing how to do something is always tied to the individual experience of the person who is learning. This latter form of learning must be attained through embodied interaction with reality" (2016, p. 228).

The ultimate goal of critical making experiences is not the evocative or pedagogical object intended to be experienced by others, but rather the creation of novel understandings by the makers themselves (Ratto, 2011b). Working with critical thinking and critical making, Dunnigan (2013) introduces the term "thingking" as a symbiosis between object and idea and "as situated in contemporary and historical frames of reference" (p. 95). Dunnigan further explains "thingking" as a union of critical thinking and critical making and how the iterative process of critical making encourages a reflection of how and why certain materials are used in the prototyping phase, and how technology, culture and identity are connected.

The immersive practice of thinking and reflecting while making features the intentions and consequences of the work process and a phenomena-in-the-making. Making as a practice of tinkering, messing around, knitting, 3D printing, rapid prototyping and digital fabrication goes beyond the scholar context. The maker movement has gained a lot of momentum where every other major city in several countries provide makerspaces, fabrication labs or technology hubs for the public. The agency behind the maker culture is diverse. In "Conversations in Critical making", Hertz (2015) interviews academics who raise concern that parts of the maker movement lacks social critique and are confined to a corporate imagination where the makers only use ready-made building blocks such as Lego or Arduino. Jeremijenko (2015) suggests that, "[…] the work needs to be about change, social innovation, and political innovation—just as much as it is about technological innovation. Social change has been excised from the discussion around making due to political views, and it's a tremendous, tremendous problem" (p. 26). In response to this critique, it is important to note that the collaborative culture, which is seen at makerspaces, are also a flora of creativity, openness and innovation. Nascimento and Pólvora (2016) studied the maker culture in relation to technological action and explain that the relations being formed between maker and technology are more complex than a generic notion of freedom and creativity. The values and practices enacted by the makers are still formed according to social, economic, and cultural conditions, and social change is mostly visible in projects with agendas on gender equality, sustainability or open source.

Lindtner (2014) has studied the maker culture in China where makers believe physical places such as hackerspaces aid technological innovation, social change and individual empowerment. When discussing the relationship between the makers and the state, Lindtner suggests that "maker culture is better understood as a parasitic culture rather than a counterculture, altering the system from within, contributing to our understanding of the relationship between technology use, production, society, activism and the state" (2014, p. 145).

Working with critical making as part of a curriculum in higher education with predetermined course goals and learning objectives in the disciplinary context of media technologies is a layered, messy practice. Alongside grand visions of learning diversity, accountability and transparency of motivation, resistance, confusion and serendipity reside (Law, 2004). This paper explores using critical making as a method and a peda-

gogy in bridging the gap between conceptual thinking and making, encouraging play to cultivate learning and understanding one's relation to the world.

2. Critical and situated making

> *So this is the source of the cognitive dissonance that one feels where hearing the phrase "critical making"—critical we see as conceptual, and making is seen as not conceptual—there is a kind of lacuna between those two terms. But that's obviously quite strange if you're at all a maker, of course, because making is a deeply conceptual activity, and deeply reflexive . . . though not necessarily in the same way as critical thinking.* (Matt Ratto as cited in Hertz, 2015, p. 37)

Critical making as introduced by Ratto (2011) focuses on making things with the intent of exploring socio-technical relations. The concept "signals a desire to theoretically and pragmatically connect two modes of engagement with the world that are often held separate—critical thinking, typically understood as conceptually and linguistically based, and physical "making," goal-based material work" (2011, p. 253). There are similarities between critical making and critical design. Critical design, as created by Dunne and Raby (2013), confronts conventions and social norms specifically within industrial design, where product design is almost always optimized and efficient and reinforcing more of the same. Critical design practices question these conventions by creating provoking design prototypes that questions design itself. Still, critical making differs from critical design in a number of ways. Critical making is focused on an iterative making process primarily in an academic context whereas critical design works with critique in the realm of industrial design. Furthermore, the material prototypes made during the creative process are not the topic of discussion – the process is.

Kurti et al (2014) suggest educational makerspaces to build on the philosophy of constructionism as developed by Papert (1998). The aims of this ideology is a focus on self-directed learning where students are required to initiate their own hands-on learning processes by creating and interacting with physical objects. Ratto (2011) explains his intentions with critical making as similar to Papert's ideas on constructionism, in that it should embody theoretical concepts through making but with the difference of the exercises proposed in critical making to focus more on social sciences and its concepts than the constructivist tradition of mainly residing within the fields of science, technology and mathematics. We chose to introduce situated knowledges as a means of addressing these disciplinary boundaries alongside critical making.

> *How to see? Where to see from? What limits to vision? What to see for? Whom to see with? Who gets to have more than one point of view? Who gets blinded? Who wears blinders? Who interprets the visual field?* (Haraway, 1988, p. 587)

Situated knowledges is a concept that challenges traditional views of a value-free, positivist and universally translatable objectivity (Haraway, 1988). The concept redefines objectivity in research as local and partial perspectives where an objective vision in singular is impossible. Situated knowledges together with critical making foregrounds the agency of the students and their ethical responsibility (Corrius, 2016). Thomas and Brown (2011) suggest that changing a knowledge system based on facts, and a continual referral to the question "what is the information", means a reframing of know

ledge where context becomes more important and a question of "where is the information" is foregrounded. This reframing is similar to the concept of situated knowledges and Haraway's reformation of objectivity. By understanding the context of a physical object, knowing the objects' historicity and how its meaning has travelled over time through places, cultures, people and other objects we can provide a thicker description of its meaning. Also, as Haraway (1988) proposes, we need to include ourselves in this knowledge production. The traditional fact-based objectivity suggests accruing facts from a place of nowhere, a strong held position in the academia and elsewhere which has created a hierarchy of knowledge systems and an exclusion of the many.

2. The course

2.1 A description of the course

Media technology at Blekinge Institute of Technology is the umbrella discipline for four undergraduate programs - digital games, digital visual production, digital audio production and digital infrastructures. The undergraduate program is placed within the department of Technology and Aesthetics at the Faculty of Computing. A conscious effort has been made by the teaching department to include design practices and technoscientific studies for the purposes of strengthening the relations of theory and practice and preparing the students for a paradigm marked by continual change, a wealth of knowledge resources, and new social structures with ubiquitous connectivity. In 2016 a new course for second-year undergraduate students was developed with the aim of using critical making as a pedagogy. Critical making was introduced in union with situated knowledges and the course name Situated Making was formulated. The course was held during ten weeks between November 2016 and January 2017. During the first five weeks modules with specific assignments were given. The remaining five weeks were used for in-depth prototyping and reflection and creating a video as the final assessment. The number of students attending was 110. The focus of the method is the reflective process of making and construction. The physical prototypes made in the process are of interest specifically for the purpose of visualizing critique and reflection. Ratto (2011a) suggests three different stages for a critical making project involving literature review and creating material prototypes, collaboratively design, building technical prototypes and reconfiguration and reflection. The course content diverged from these stages in that the students worked individually with a physical object of their choice throughout the course. A list of the course modules is presented in table 1 below.

Table 1.

Week 1 – Situating your object. Selecting and situating an object (Situate the object historically and culturally, place of origin, common uses, material, changed over time etc.)
Week 2 – Critical making. What is critical making and how has it been used and how can you use it in your creative process. Daily workshops on microelectronics and Arduino.
Week 3 – Situated knowledges. Interpret, reflect and problematize the concept of situated knowledges. How does critical making relate to situated knowledges? Daily workshops on microelectronics and Arduino.
Week 4 - Prototyping with new materials. How has the object changed in the prototyping process? Do you interpret the object differently and does it have new areas of use?
Week 5 – Interaction. What is interaction? How do you interact with your object? How can you interact with it differently? How can you change the affordance of your object? Create prototypes where you explore where an interaction begins and ends.
Weeks 6-9 - In-depth work with further prototyping.
Week 10 Final assessment film. Compilation of video documentation from course modules.

2.2 Analysis of final assessment films

The empirical material consists of 86 student films. The student assignment consisted of compiling a film based on the video documentation they had conducted during the course. This made the chronological structure and content of the films fairly similar. They were asked at the start of the course to document their process and upload the videos to YouTube each Friday. The Friday uploads were not mandatory which led to many students recording their processes at the last few weeks of the course.

A majority of students chose to recreate their objects in different materials, such as plastics, cardboard, paper, fabric, yarn, aluminum foil, wood. Those who worked with microelectronics used it as an extension or as a complement to their objects. Examples are attaching led-lamps on shoes, creating a compass with led-lamps on cardboard with the intention of adding it to a pair of shoes, turning a dish brush into a torch, connecting Arduino and aluminum foil to a belt for the purpose of creating heat, adding a led-lamp inside the cap of a perfume bottle, attaching a led-lamp on jacket, adding a vibrator to a snuffbox. Other examples showcase students altering or damaging the object for the purpose of using the broken pieces in their prototyping, for instance breaking a cup and using the pieces for aesthetic purposes when making a hook. Two students worked with changing the dimensions of their objects. One went from a three-dimensional stuffed animal to creating two-dimensional string art. The other worked with mirrors and created a 3d glass box creating an endless mirroring of led-lamps.

For the module on interaction several tried using their objects for new purposes, changing a plastic cup into speakers and a night lamp, plastic plant turned into a hat hanger, duster and a makeup brush and a glove turned into a holder for candle lights. In the final assessment films a lot of emphasis was placed on explaining key course concepts (critical making, situated knowledges and interaction), presenting their prototypes and how they had worked with different materials. Reflections on their individual making tended to be placed after the prototypes were made rather than during the process

2.3 A detailed analysis of three student projects

Victoria's mirror

When situating the mirror historically and materially the student Victoria mentions reflection, movement and notions of self, self-improvement and closeness to truth. Her object is a small, pocket-sized mirror with surrounding soft fabric. She brainstorms on the kaleidoscope and deconstructs the underlying meanings behind the word - Kalos – "beautiful/beauty", eidos – "that which is seen: form, shape" and skope - "to look to, to examine". When she situates her object and her own pre-conditions in the present time and place the following thoughts occur:

- Double standards - cosmetic companies profit on people that are uncomfortable with their appearances.
- Why are women more marketable? - One basic archetype of attractive / men vary wildly. The following questions arise before starting to prototype: as why is this material better? Do I exclude anyone when I design it this way? Who uses this object, and why?

The prototype was created with plaster, mirrors, fabric and glue (figure 1). With the popularity of social media Victoria reflected on the importance of validation and how others perceive you visually and started experimenting with different filters for her prototype (figure 2). She then created a comical commercial presenting the prototype as an essential accessory.

Figure 1.

Figure 2.

Juri's attaché case

Juri's personal views on the case involves notions of a status symbol as it is connected with business and economy, an expensive artifact, male-dominated, cold colors, representing a cold surface, responsibility, company, profit, education, elegant, strict,

women and men and bureaucracy (figure 3). He chooses to focus on gender differences in the style of the attaché case and makes a short comparison on how the case is marketed differently between the two target groups' men and women. Cases marketed towards men – material made of leather or fabric, color brown, black, dark blue or beige, exterior – large, heavy. Cases marketed towards women – Color – beige, black, light brown, white, and silver, patterned. Exterior – small, purse-like, slim, soft edges. Material - fabric or leather.

Recognizing these differences Juri chooses to focus on gender norms for his prototype. He begins working with Adafruit flora but then decides to move away from microelectronics and finds an interest working with wood (figure 4). He makes three conscious choices before starting to work with his prototype:

1) A personal desire to create gender-neutral design

2) Change standards for the business world by creating a case with material that doesn't connote luxury.

3) Ridicule the case as a symbol of stature by creating a case that could be connoted as a cheap one.

Figure 3.

Figure 4.

Jonna's keys

Jonna picks keys because they are one of the objects she uses daily and she wants to explore her relation with them as they take a lot of space and are difficult to keep track on. She continues to situate them historically and materially, introducing different kinds of keys and where they are used. In her mind map on critical making she lists some issues and possible solutions.

- Keys look the same --> difficult to find the right key -- use sound, blinking lights, patterns.
- Easy to lose --> connect to mobile phone or an electronic key finder.
- Take a lot of space ---> alternative keys --> code, alarm, finger print
- Difficult to find keyhole for visually impaired --> add sound to key, cardkey.
- Use mobile as key --> safe

Jonna reflects on the practicality of the key finder product and if you still need to know where the badge is. Would it be better to connect it to the mobile phone? She further

reflects on how future keys will be developed and whether lock systems will use codes instead of physical keys and how secure these systems are. As part of the module in creating a prototype in new material students are encouraged to browse through the Swedish magazine Crafts ("Hemslöjd"). Jonna is inspired by a method where you work with imperfection. For instance when knitting you shouldn't stop to correct the pattern if you have made an error, just continue to knit. Jonna wants to use this method in her prototyping by producing an object without reflecting on what it would look like beforehand or look into correct production techniques. She decides to create a key in fabric. The prototype is soft and bendy, difficult to use in any existing keyholes and breaks easily. She experiments with new uses for her prototype and tries it as a door stop, umbrella hanger, window holder and mobile stand (figure 5). Her prototypes with microelectronics differentiates the keys by changing color depending on which key you press and by creating unique sounds to each key (figure 6).

Figure 5.

Figure 6.

3. Discussion

3.1 From "maker" to "critical maker"

> *For me through the whole time of the making I was focused on the functionality side, is it going to work? I asked myself, is it safe? I asked myself is it, is it, is it...so many questions were coming to my mind but I was bound by something. I didn't understand what it was ---was it my limits of making or my limits of critical thinking?"* (Quote from one of the final assessment films)

The student projects shown above present examples of critical makers. They have worked with their everyday objects by asking questions such as: why is this material better than anything else? Do I exclude someone when I design the object in this way? How can I challenge social norms through my design? In all three cases they are working with ideas and prototypes where the critique is visible in their processes and they are positively inclined to playing with different materials and interaction.

The idea of focusing more on the process than a ready-made object was new to many students and it proved difficult to work with prototypes with no pre-determined end-goal. This resulted in several students remaining more in a maker role rather than actively critiquing their own process throughout the course. Several student projects present prototypes of attaching a led-lamp to the chosen object without explaining why this was done. One of the biggest challenges was encouraging students to move

from being a "maker" to being a "critical maker". Embodying critical thinking with their tacit prototyping phase was sometimes lacking in their final exam films, although the concepts of critical making and situated knowledges were presented and discussed among the students during the course. Other forms of examinations with oral and hands-on presentations and critique sessions could overcome this obstacle.

3.2. Self-driven learning

Working with a method such as critical making requires a very active role of the student and this approach diverged from many of the other courses in undergraduate programs. The students are accustomed to more of a teacher-driven pedagogy both from previous courses and especially from the school system from younger years. Encouraging the students to use their curiosity and working iteratively with their objects helped them reframe their understanding of knowledge as something more fluid, and understanding the importance of context. Furthermore, a student group of 110 is far from ideal for creating an atmosphere of collaboration and sharing, which led to an environment of many smaller maker groups and individual work.

3.3. Analogue objects and micro electronics

The perception of media technology as being something wholly digital, working with physical, analogue objects and introducing a difficult element such as microelectronics further alienated students from course content. The majority of students were new to microelectronics and learning Arduino became quite time-consuming, which in turn affected their activities with designing prototypes. Still, many students who continued to work with Arduino embodied the analogue and digital relationship between objects, which led to a playful and reflective practice.

4. Conclusion and further recommendations

Critical making as a pedagogy has the potential to foster a practice of connecting critical thinking with physical making through iterative and self-driven learning. Considering the educational paradigm where learning is taking place in a world of capabilities such as understanding context, one's relation to the world, sharing imaginations and embodying the co-construction of social life and technology is crucial for creating responsible, innovative design. Using critical making and drawing upon the philosophy of makerspaces in an academic environment with set boundaries of course content and learning outcomes posed several challenges in the course Situated Making.

Critical making as a pedagogy is in a phase of development, and a key issue that needs to be further explored in our learning environment, and which Ratto mentions on the future of critical making, is "the balancing act that must occur between technical and social scholarly expertise" (Ratto, 2011a, p. 258). The students' preconceptions of social scholarly expertise and what this expertise can entail, became somewhat of an obstacle in their course assignments. Although collaborative work was encouraged from start the task of choosing an analogue object and working

with it individually discouraged many students from working collaboratively and ultimately created many smaller makerspaces rather than a few larger ones. For future courses with a similar pedagogy we would suggest using production methods the students are familiar with and concentrate on creating smaller communities of collaboration and sharing. Additionally, student to student critiquing sessions would be beneficial for the students in comprehending the 'critical' aspect of critical making. The analysis of the student projects was primarily done on their final assessment films. The discussion of the course therefore lacks an extensive insight into the individual processes of the students throughout the course and it is recommended that further research would include ethnographic and action-oriented research methods to gain a more comprehensive picture of the on-going making practices. Moving forward we need to work with the perception of digital media and how it can no longer be perceived as something exclusively digital. As Ratto and Ree (2012) explain in their study on 3D printing and social change, digital information (virtual; electronic; 'bits') is becoming increasingly porous with physical representation (material; tactile; 'atoms'). The hybridity of nature and culture is ever present in critical making practices and it needs to be taken seriously if we are to create situated educational interventions that foster responsible futures.

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About the Author:
Linda Paxling is PhD Student in Technoscience Studies. Her research intersects feminist technoscience, development and design and includes ethnographic work in Kampala, design methods development in Karlshamn and practices of making and activism in Malmö.

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Paper 6: Design fiction as norm-critical practice

Linda Paxling

Technoscience Studies
Blekinge Institute of Technology,
Sweden

linda.paxing@bth.se

Abstract. The transdisciplinary fields of design and feminist technoscience share a common interest in focusing on the world in a state of always becoming, always changing. Within feminist technoscience, norm-critical perspectives are implemented to shed light on unequal sociotechnical infrastructures. Within design research, generative methods of critical design and design fiction encourage processes of fictional prototyping and storytelling that infuse discussions on what kind of world we want to live in.

The purpose of this paper is to illustrate how design fiction can be used as a method to address norm-criticality in media technology education. Based on a week-long design fiction workshop with undergraduate students, three student projects are analysed in detail. The analysis suggests design fiction can be used as a norm-critical practice to invoke discussions on values and beliefs within media design processes as well as established narratives of futuring.

Keywords: design fiction, norm-criticality, media technology, education.

1. Introduction and aim

Design fiction is a hybrid practice that functions in the borderlands between actual and possible worlds. It is an approach for visualizing and materializing alternative scenarios using design and storytelling and is being used as a platform for questioning status quo, invoking discussion on social and ethical consequences of emerging technologies and increasing political and civic engagement [1, 26, 27]. Vermeulen & Van Looy [2] show in their study on stereotypes in game culture how discriminating norms can affect playing frequency as well as motivation among female players. Racial, gender and cultural stereotypes have been quite persistent in the film industry, where marginalized groups are depicted in a negative manner or often not at all [3]. While portrayals are gradually changing for the better it is important to shed light on these issues so as to encourage positive change in the future media landscape.

Similar to intersectional feminism, norm-critical practices in media education can provide fruitful critiques on how and for whom digital games and films are produced and distributed. The practices highlight question such as; which stories are we telling? How and which characters are portrayed? How does this effect differences within and between cultures? How do dominant technologies, information systems and software affect our perceptions of the future?

The purpose of this paper is to illustrate how design fiction can be used as a method to address norm-critical perspectives in media technology education. Norm-critical perspectives stem from research fields such as feminist research and education [4], and while the terminology has not yet gained ground within design research, the emphasis on questioning norms and values in design, technology and information systems is well established in the areas of human-computer interaction and critical and speculative design [5].

Norms signify the 'normal' and address behaviours acceptable in a social setting. Lifestyle choices, clothes, greetings, table manners, public and personal behaviour – we are inscribed with many social norms in our daily lives - norms that are implicit and functional. The intention of a norm-critical perspective is not to create a society without norms and social rules of behaviour, but rather to place attention to certain dominant norms excluding and discriminating people and ultimately creating unequal cultures. Heterosexuality, ableism and whiteness are for instance critiqued as norms that can exclude and discriminate people, who do not follow the socially accepted behaviours within these discourses [6, 7]. Other norms of interest embedded and embodied in media design processes concern the relation between media designer and the presumptive users, technologies of choice, digital infrastructures and how stories of futures are framed.

2. Feminist technoscience

Feminist technoscience is a transdisciplinary research field, which stem from decades of feminist critique within science and technology [8]. It is, similar to posthumanism, an epistemological knowledge production that challenges the anthropomorphical assumption of humans being at the center of the world [9]. The research field further critiques a positivist approach as being too limited and negligible towards knowledge production because of how it ontologically tends to separate researcher, objects and users. The theoretical framework of feminist technoscience suggests that we should view the world in a constant becoming where researcher, objects and users are much more inter-dependent and the relations between actors temporally and spatially change [4]. The fields of science and technology are entangled with sociotechnical networks and the relations (human and non-human) occurring between them need to be made ethically and politically accountable. Reshaping humanist concepts such as body, identity and gender through technoscientific practices can create more equal worldings [10]. Haran & King writes how the "'now' is not necessarily a shared experience, as we are materially embodied on different continents. We are subject to different local political economies, however transnational we might imagine our shared projects to be" [11:2] Science fiction, speculative fabulation, design fiction, critical design or even story-telling are all different genres, discourses and methods that can deconstruct and reframe our different temporal and spatial experiences of social norms and values [25].

3. Norm-criticality

Criticality is rooted in a design tradition of questioning the ideas, exposing structures and creating a space for discussion of power, inequality, capitalism, industry and technology that underpins conceptions of design [7, 12]. Jonsson & Lundmark provide a framework for making the invisible values in design visible through norm-critical design analysis. They suggest "norm-critical design can be understood as a sub-field of critical design where the specific focus is on the relationship between design and social norms" [7:5]. They introduce four perspectives - cultural representations, technology, interactivity and context of use - in their framework of norm-critical design analysis for interactive systems. The different perspectives illustrate identity markers such as gender, race, ethnicity and social groupings, interactions, or lack thereof, between people and artefacts and technologies can strengthen certain values and diminish others, for instance photo manipulation. The perspective of context reflects the diffractive approach of understanding how norms are manifested in everyday life and how this can differ temporally, spatially and geographically [4]. These perspectives focus on interactive systems and constitute an analytical framework relevant for similar mediations i.e. games, film and sound design.

4. Critical practice in design

I contextualize design fiction within design research by making use of Malpass' umbrella term critical practice in design [14]. Malpass' differentiates the practice with the subcategories associative design, speculative design and critical design. Associative design focuses primarily on confronting dominant traditions in product design and while this approach can certainly be useful in design fiction scenarios, speculative and critical design are closer at hand when situating design fiction. Speculative design creates a discursive space between science and technology and material culture. The designers work closely with materials and concepts which are often related to scientific practices and "the process of doing science itself figures as the design process" [14:339]. Speculative design places the attention on how our present development in science and technology is directed towards certain futures and advocates a dialogue on whether these are the futures we desire. In for instance Auger-Loizeau's speculative design project 'Afterlife' the debate concerns the ethics of human death. The design concept consisted of intervening with the usual decomposition process by connecting the body with a fuel cell that can produce electricity from organic matter. The electricity is then enclosed within a regular dry cell battery that can be used by friends and family of the deceased [15].

Dunne and Raby define the concept critical design as using "speculative design proposals to challenge narrow assumptions, preconceptions and givens about the role products play in everyday life. It is more of an attitude than anything else, a position rather than a method. […] Its opposite is affirmative design: design that reinforces the status quo" [16]. Practitioners in critical design offer alternatives to existing design objects and practices thereby providing a commentary on social, cultural and ethical matters.

In Dunne & Raby's project *Robots* [13] normative values of how humans perceive existing and future relations with robots are highlighted. The robot bodies further challenge the popular cultural notions of robots in science fiction film and literature and suggest alternatives to what kind of material and form can be used.

Ambiguity in research is a risky thing and design artefacts can certainly become meaningless and confusing and lack the intended outcome of the design researcher, especially with artefacts having an intended audience. Gaver, Beaver and Benford explain how an ambiguity of information, context and relationships moves us toward a 'relational ambiguity', where we need to interpret incomplete information, implement references seemingly incompatible and consider subjective individual experiences and attitudes onto new situations [17]. However, working with research through design and design fiction in an educational context ambiguity can become a useful design method for asking questions of how and why we use certain techniques, concepts, tools and methods and how these choices affect our futuring. Just as critical and speculative design are intentionally non-rational, so too are design fictions. The intent is to compel the audiences to simultaneously relate and question the design artefact thereby (re-)considering one's beliefs, values and behaviours [14]. According to Auger, the practices of design fictions, critical and speculative design share certain premises, where they "all remove the constraints from the commercial sector that define normative design processes; use models and prototypes at the heart of the enquiry; and use fiction to present alternative products, systems or worlds" [15:11].

5. Design fiction

Design fiction is often used as an approach, or a technique, for creating exploratory and discursive spaces between the actual and the possible [18, 19, 20]. Sterling describes "the deliberate use of diegetic prototypes to suspend disbelief about change" [21]. Lindley and Coulton unpack Sterling's definition through the following criteria

1. something that creates a story world,
2. has something being prototyped within that story world
3. does so in order to create a discursive space" [22:210]

However, what this 'something' can be is far from easily defined. There have been many attempts to pin down a definition of this 'something', be it artefact, prototype, poetry, system or world, but it persists an intricate, fickle path [22, 23]. Gonzatto, van Amstel, Merkle and Hartmann proclaim that design fictions are not innocent creative plays [24]. The fictions are always created by someone, who has a specific intent of (re-)acting with present structures and Gonzatto et al. suggest that design fictions can have "both naïve and critical interpretations" [24:43]. Design fictions become naïve when they are exclusive, deterministic and disregard stakeholders without power. Yet, when the projects are inclusive, open-ended and a multitude of perspectives and values are considered, they become critical.

6. The design fiction workshop

The workshop was part of a method course for third-year students at an undergraduate program in media technology. The students represent four different orientations within media technology – digital games, digital visual production, digital audio production and digital infrastructure. The aim of the week-long design fiction workshop was to introduce design fiction as a concept and method for undergraduate students to explore their roles as media designers and critically reflect on the normative narratives of design by engaging with different design manifests. The students could either choose a manifest from a list of design manifests on the Social Design Notes website [28] or they could locate one on their own. I provided the students with a few directives on what the manifests should entail. It should hold a statement with aim and method, focus on design practices and preferably include some ethical considerations. What these ethical considerations entailed were later discussed when the students started experimenting with the manifests. This ultimately led to the selected design manifests differing greatly in genre, style, aim and age.

On the first day of the workshop the students were given a lecture on design fiction, allocated reading of Bleecker's essay *Design Fiction: a short essay on design, science, fact and fiction* [29], and a brainstorming workshop on the relation of design fiction and media technology. The students were then introduced to the assignment, which was conducted in smaller groups of 2 to 5 persons throughout the week. A few students chose to work with the assignment individually. The assignment was as follows:

1. Select a design manifest.
2. Create an artefact that challenges, problematizes or plays with the chosen manifest.
3. The mandatory documentation at the end of the week included a link to the chosen manifest, a minimum of one illustration of the artefact, a description of the artefact and an explanation on the difference occurring between the chosen manifest and the created artefact.

The student projects were about 30 in total and quite diverse in style and outline. One student group, for instance, created a narrative of a fictive advertising agency that was forced to create these absurd and confrontational images for a company. Another group sketched a house on water were their discussion points concerned the future of architecture and housing solutions from an environmental perspective. One student created a game concept where the player was rewarded doing actions that he or she normally would have been punished for. Malpass explains how designers work closely with materials and concepts often related to scientific practices and "the process of doing science itself figures as the design process" [14:339]. This mindset resembles the work done by several undergraduate students in how they worked with future scenarios on how the relation between humans and technology will manifest in a possible future. The three student projects described in more detail below were chosen based on the students' distinct discussions and prototypes in relation to the chosen design manifest.

6.1 Project MaybePhone

The selected design manifest *The Ten Principles of Good Design* [30] by Dieter Rams makes use of concepts such as innovative, unobtrusive, long-lasting and aesthetic to define what good design is. The students wanted to challenge the conformity of Ram's design principles by creating a design artefact that challenged the perception of how a communication tool should behave. They chose to illustrate a design artefact called MaybePhone with the intention of making the relationship between the user and communication tool less functional. The idea behind MaybePhone is it may or may not work like you expect it to. It can bounce away from you, become invisible or suddenly play loud music. The students worked with questions such as what will personal communication tools look like in the future and how will the changing boundaries between body and tool change our communication?

6.2 Project Through coloured lenses

The selected design manifest *The Karimanifesto* [31] by Karim Rashid focuses on the work ethics of a designer. The project *Through coloured lenses* is an experiment with colours and lenses to explore how colours can work with and against each other. The students began their exploration by working with different digital colour schematics and then proceeded to create a prototype consisting of a set of glasses with different colour filters. The students also outlined a concept where the glasses can be used as voluntary self-censorship to erase certain objects, events or people.

6.3 Project HumTec

The selected design manifest is *1000 Words: A Manifesto for Sustainability in Design* [32] by Allan Chocinov relates design to ethics, sustainability and the anthropocene worldview. The project HumTec consists of a story world concept and illustrations of an artificial intelligence which in part follows the guidelines of the manifest. The critique of the manifest is visible, when the student discusses the prototype in relation to sustainability and technological access. The story concept is as follows; through human development and an increased consumption nature has turned into roads, housing and merchandise. Fertile soil has been covered with asphalt and forests are destroyed to make room for factories and buildings. Eco-friendly cities have sprung out of this development and HumTec is one of the companies working with the plant biospheres. HumTec's prototype is an artificial intelligence based on studies of the hummingbird. The students describe how the prototype will eventually work with pollinating and planting seeds based on the long-term strategy of rebuilding nature.

7. Discussion

In this paper design fiction is positioned through various branches of critical practices in design and further entangled with norm-critical perspectives. The situatedness and interests of the students as well as how the chosen manifests differed in style and aims was reflected in the diversity of the design fiction prototypes.

7. 1 Analysis of MaybePhone

This project challenged the chosen manifest outlining what 'good' design is by distorting the functionality of a smart phone. The students made the phone unpredictable and difficult to use with the purpose of challenging the normative values and purposes of design and when discussing the future of communication and the fluid boundaries between humans and technology. MaybePhone is similar to associative design as it subverts an everyday object, the smartphone, and plays with its functionality and the relationship between humans and technology. The project also contains speculative and critical design perspectives, where they contextualize their artefact with discourses of communication and values of 'good' design.

The project holds critical interpretations of the chosen manifest when the students worked with creating a set of opposing principles. The students' discussions revolved around future communication and how the MaybePhone implore new kinds of relations between the user and the phone when it doesn't work over distance. The norm-critical perspectives of the project are narrated in the ambiguity of the design attributes and helps designers question and re-evaluate what we are expecting of future communication tools. We are designing technology that should suit the user's behaviours but can the user also benefit from changing its behaviours for the sake of technology?

7.2 Analysis of Through coloured lenses

The students behind the project chose a manifest on how a designer should work, which led to a design artefact and a work process that conversed on censorship and the practices of a designer. The prototype itself holds both naïve and critical interpretations when it was initially created as a playful activity for experimenting with colour and material and then proceeded to become more critical as a practice of self-censorship. The students mentioned lenses can be used for avoiding certain objects, events or people, creating hidden messages or for subtitling films.

The Karimanifesto focuses on expected norms of designers, which turned the students in the direction of focusing more on how they perceive their own work ethics in relation to Rashid's principles. In this case the norm-critical perspectives is visible in relation to the students work process and the outcomes of their design artefact. Rashid doesn't value reflection or the past as meaningful and the students are very critical of this perspective. They consider their backgrounds as valuable for creating the design artefact and their learning outcomes has taught them things on how to design differently in the future. This project illustrates how one's own boundaries demarks the outlines of a design fiction project, which creates further responsibilities for the designer, or in this case, the students. The ethical aspects of their prototype should be further explored in terms of what is rendered invisible when using the lenses, who is excluded from using them or how can the lenses be beneficial in media outlets?

7.3 Analysis of HumTec

The student created an artefact and a story world that discusses the work practices of an engineer and implicitly a designer. The student differentiates its prototype with the manifest through two examples. One is the manifest suggesting it is important people understand how artefacts works, while the student discusses the challenges of creating technological artefacts that are understandable for everyone. The second example concerns material choice and longevity. The student prefers to create a product that is sustainable and has longevity rather than creating products that can't be recycled as the manifest suggests. However, this seems to be a misunderstanding from the student as the author of the manifest compares designers' tendency to work with inorganic materials rather than organic and how these materials are far from sustainable or recyclable.

The design fiction prototype creates a future-making narrative when it suggests a plausible future of less nature and more urban environments. Furthermore it creates critical focal points on the changing relations and inter-dependency of human and non-human actors (the humming bird). The student illustrates norm-criticality when creating fictive solutions to a changing future environment and also when discussing what is preferable when creating technological artefacts for specific users.

8. Conclusion

The multi-dimensional structuring of design fictions pose interesting challenges when attempting to shed light on norms and belief systems in media technology. The selected student projects bring forward norm-critical discussions on the intended role of a media designer and future relations between humans, animals and (communication) technologies. How we narrate our future-making practices in the present holds real-world consequences for our socio-material futures. Within an educational context design fiction works well as a critical, ambiguous and deconstructive form of meta-design and it also has the potential of encouraging students to act as change agents for creating alternative future-making socio-material practices.

Combining the processes of making (games, websites, graphic and sound design) with design fiction works well to disrupt the established narratives of the digital media in and out of the academy. Based on the student prototypes presented in this paper I consider design fiction a promising method for creating discursive spaces in learning situations so as to stimulate vital discussions on social, cultural, technological and ethical implications of the past, present and future.

Future work with design fiction, together with norm-critical and feminist technoscience perspectives, can include invisible infrastructuring in technological systems, cultural representation, diversity, interactivity, context, manipulation, the list goes on and on. Acknowledging these different socio-political discourses as well as the individual and collective situatedness of knowledges students and media designers embody, we can work to deconstruct and reframe the media landscape to be more inclusive and diverse.

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