Chapter 17
When Research Challenges Gender Stereotypes: Exploring Narratives of Girls' Educational Choices

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What Kind of a Girl Chooses Science?

Women's roles in Norway have changed greatly over the last few decades and women have made significant gains in many fields. Despite these gains, much attention has been focused on the limited participation of girls and young women in STEM[1] (Science, Technology, Engineering and Mathematics). It is not easy to interpret and make sense of the limited participation of girls[2] in STEM. Feminist analyses have linked socio-cultural[3] ideas of feminine ideals and gender to the historical under-representation of girls in STEM, arguing that the professional qualities most valued in science are not consistent with the acceptable social behaviors prescribed for girls (Schiebinger 1999). However, *how* social-cultural ideals shape educational choices is still a relatively open question.

The research and recommendations given to stakeholders, politicians, media and the public often contribute to and correspond with what I refer to in this chapter as the "meta-narrative" about girls and/in science. A meta-narrative in this context, is a story about stories, or how to tell a story. In this case, the meta-narrative is used as an analytical tool to clarify the dominant public discourses about girls, which in different ways can affect girls' choices through normative practice and gendered

[1] For a historical review of girls and science, see for example Brotman and Moore (2008).

[2] I will mainly use the term "girl" throughout the text. The category ranges from early childhood to young women in higher education and young women generally in society, the latter constituting the context for this chapter.

[3] See discussion of the concept "socio-cultural" in James Wertsch's book, *Voices of the Mind: A sociocultural Approach to Mediated Action* (1991), where he also includes the historical dimension in socio-cultural.

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E.K. Henriksen et al. (eds.), *Understanding Student Participation and Choice in Science and Technology Education*, DOI 10.1007/978-94-007-7793-4_17

expectations. Norms exist in the form of tacit knowledge, stereotypes and cultural barriers, in research communities, in the world of academia, in the world of work and in society-at-large. Such discourses can be reproduced without resistance, because we take knowledge for granted. Providing a meta-narrative is an attempt to synthesize the results of multiple studies that support and reproduce dominant discourse of girls and/in science, tacit knowledge and common gendered perceptions,[4] to describe the current understandings of girls and/in science. The concept of a meta-narrative is here positioned as a dominant public discourse, which includes: (1) culturally dominant discourses of *girls in general*, (2) perceptions about girls' attitudes and aspirations to science and a scientific careers – *girls and science*, and (3) discourses and perceptions about girls who have chosen an education in natural sciences, and/or a career within natural science – *girls in science*.

The meta-narrative as a dominant public story, or dominant discourse, is consistent with what Nancy Brickhouse and her colleagues describe as: "... a story that was constructed by the comparison of boys and girls; studies which focused on the differences between the two groups" (Brickhouse et al. 2000, p. 442). In the same article Nancy Brickhouse and colleagues describe this story as follows:

> Girls are alienated by science. Science is masculine, competitive, objective, impersonal – all qualities that are at odds with our images of what girls are. The more masculine the branch of science (e.g., physics), the less likely it is that girls will like it or do well... [...]...Girls are disadvantaged in science before they even get to school because they are encouraged to play with dolls rather than blocks. They rarely accompany their fathers while they fix items around the house. Parents rarely purchase chemistry sets or microscopes for their girls, nor do they take them camping. As adolescents, girls become interested in being attractive to boys, they take on more feminine roles that often exclude science. Girls become women who cannot and do not engage in science. (p. 442)

Brickhouse and colleagues (2000) say that this is the story we tend to hear about girls, and that these claims are well known and supported by research. Girls' underrepresentation in STEM has been a key feature in science education over the last four decades, and research has documented that girls: are more collaborative than boys, are less competitive (Chetcuti 2009), are more concerned about context (Stadler et al. 2000), wish to know why things happen in science rather than what happened (Osborne and Collins 2001), have a more theoretical approach to science (Staberg 1994), are more people oriented (Miller et al. 2006) and think it is important to have a job where they can help others (Holter et al. 2009), have lower self-efficacy in science (Kjærnsli et al. 2007; Boe et al. 2011), have fewer relevant science experiences from their early childhood (Sjøberg 2000b) and are alienated by science (Brickhouse et al. 2000). These stories have been important in terms of creating gender awareness in science classrooms among other things, and often illustrate that "inequity is a social problem that can be fixed" (ibid., p. 442).

[4] Such tacit or implicit knowledge can be seen in relation to what Svein Sjøberg (2000a), calls the "body-language" of science, which is a metaphor to "describe the often hidden and implicit messages about the nature of science (as well as scientists as persons), aspects relating to the perceived values, norms and ideologies of science".

However, these stories also represent a gender-stereotyped and homogenized image of girls, which may limit individual choice. The complexity of gendered meanings and diversity can, therefore, be ignored if this picture is not more nuanced.

To what extent are we in danger of reproducing broad generalizations and, thus, creating or cementing barriers? I will argue that the meta-narrative supported by much research gives a stereotyped and oversimplified picture of *girls in general*, of *girls and science* and of *girls in science*, that do not help us to understand the diversity between girls. As research also shows, there are greater differences within each gender category than between in many areas (Hattie 2009; Fine 2010). Many of these studies also show that gender constitutes an important part of identity, but not the only part and, therefore, highlights the importance of exploring diversity within gender groupings, in order to work against cementing stereotypes and essentialist binary oppositions between boys and girls as unitary groups (Brotman and Moore 2008). This is consistent with post-structural feminist theories and the idea that gender is one of many factors contributing to a person's identity project (Brickhouse 1998, 2001).[5] Work inspired by post-structural and post-constructivist theories acknowledges the diversity that exists among boys and girls, arguing that many girls engage with science in positive ways, but as Brickhouse et al. (2000) argue, we need to "know more than that they are girls," we need to know "what kind of girls they are" (p. 457). I, therefore, also question the consequences of research that distinguishes girls in comparison to boys, without any reference to gender as a cultural discourse, and thus assuming a naturalized conception of difference. It should be clear by now that I in this study, in tune with perspectives inspired by postmodern feminist theories, conceive of gender as socially constructed.[6]

In this chapter, I will argue that communicating broad generalizations based on sex/gender differences, stands the risk of losing important nuances that again might lead to the cementation of gender stereotypes.[7] To illustrate this, I give examples from an empirical analysis of female students' written narratives collected through the "Write your choice" project.

After a brief description of my methodological approach, I will, examine three issues that became apparent during the narrative analysis, namely; (1) negotiating identity and participation, (2) the significance of role-models and (3) questioning feminine appropriate values. Addressing these issues I will finally discuss: whether gender generalizations based on differences might reproduce stereotyped images of girls, and thus act as a self-fulfilling prophesy; and how discussing narratives about

[5] See Chap. 4 in this book, for a more detailed conceptualization of gender in third wave feminism.

[6] But I also sympathize with theories which move beyond postmodernism and post-structuralism in the sense that they theorize gender as historical-socio-cultural and / or semiotic-discursively constructed, while also emphasizing agency of materiality (artifacts, technology, body, clothes, time, text, etc.) See for example Lykke (2012) and Barad (2007).

[7] Norms exist in the form stereotypical perceptions about girls' educational choices, cultural barriers at school, in research communities, in the world of academia, in the world of work and in 'society-at-large'. Such discourses can be reproduced without resistance, if we take knowledge for granted.

girls in science can give a more nuanced picture of females in science and challenge and refine dominating discourses – thus reducing barriers and obstacles to allow more girls to see attractive possibilities within the broad spectrum of the sciences.

The Study "Write Your Choice": A Narrative Approach Through a Gender-Critical Lens

To obtain valid data on people's lived experience is not easy. One way of doing this is to engage in narratives (see Chap. 3). A narrative approach emphasises the individual's understanding and perception of her place in relation to her surroundings, and attaches importance to historical, structural and socio-cultural factors and embodiment in relation to the social and physical world (Daiute and Lightfoot 2004). Thus the narrative "is constructed on a background of memories and thoughts about what happened in real life on this journey of transformation" (Horsdal 2012, p. 88). According to Denzin (1989) "stories then, like the lives they tell about, are always open-ended, inclusive and ambiguous, subject to multiple interpretations" (ibid., p. 81). Like my informants' written stories, narratives are always situated interpretations of lived experience. My methodological approach is mainly hermeneutic and inspired by literary narrative analysis.

The female informants in "Write your choice"[8] were recruited among first- and second-year college and university students in Norway who had chosen studies where women are underrepresented; technology, engineering, mathematics or physics. Female students in subjects such as biology, dentistry etc. are not a part of my study. The 17 narratives were collected in the autumn of 2009 and through two follow-up email-interviews conducted in the spring of 2011 and the spring of 2012. The informants were partly recruited from the same population as the Norwegian IRIS respondents, but were at an earlier phase of their studies. The point was to invite girls to share their story with me, as a researcher. The girls themselves chose to write their stories, and, thereby, constitute a group that cannot immediately be said to represent all girls who choose sciences. The sample consists of girls aged 18–22, who became science students in a subject with a low percentage of female students. They are in a minority and some are the only girl in their class.

The invitation to participate was launched through a website in the autumn of 2009 and the texts were immediately entered into the software NVivo, to help me achieve order early in the analytical process. The website provided some guidelines to encourage the authors to focus on experiences of importance for their educational choices. At the same time, the informants were urged to emphasise what they themselves wanted to emphasise. The method was somewhere between the open

[8] For more information about the project, see: naturfagsenteret.no (in English). http://www.naturfagsenteret.no/c1515605/prosjekt/vis.html?tid=1519446

qualitative interview with a semi-structured interview guide and dialogue as the ideal on the one hand, and the biographical reporting that maintains something akin to a storytelling style in a diary or a chronicle on the other. In the method literature, my choice of methods can be recognised as solicited stories (Hammersley and Atkinson 1996). The written narratives are research-generated personal documents that have to be read against the background of the context in which they were written. The approach is also characterised by the belief that people's choice of words can be of great importance; "The 'local vocabulary' may provide useful information about how members of a specific culture organise their opinions of the world, and, thus, participate in the social construction of reality" (Hammersley and Atkinson 1996, p. 210). Of course, this study's limited sample is not statistically representative, but its strength is to give a more in-depth and broader qualitative view, applying a critical gender lens on educational choices.

Analysing educational choice through a critical gender lens means investigating how gender is constructed in relation to complex social institutions through lived experience and through intra-acting with the material world. The focus has shifted over time but much feminist research is committed to forms of "situated knowledge" (Haraway 1989). Especially since the early 1970s after Gayle Rubin's formulation of the distinction between sex and gender (see Chap. 4), the idea that biological differences could not provide a universal basis for social definition emerged as an established orthodoxy (Rubin 1975). Current feminist analyses often focus on the recognition of the specifics of historical and cultural contexts, and most particularly on the intersections between gender and other forms of difference. The consequence of this is the attention given to the diversity of women's experience, the differences within each woman (Braidotti 1994),[9] situations, powers and resources, rather than simply documenting cultural variability. The major outcome of this work was to position gender as an analytic category; not as a fixed category, but as the performance of a set of regulatory practices.

My focus on girls' stories is consistent with Haraway's discussion of the "Inappropriate others", which she has borrowed from the US-Vietnamese theorist Trinh Minh-ha (Haraway 1992). The discussion of women's stories in science can also be traced back to Harding (1986) and her discussion of how "The Woman Question in Science" turned into to "The Science Question in Feminism", which is about feminist inspired transformation of the epistemological basis for all scientific knowledge production (see Chap. 4). The girls in the study are part of this knowledge production, as agents within and outside of science, but also in-between (science and everyday life).

Baker and Leary (1995) argue that quantitative methods seldom reflect females' opinions because they are decontextualized, therefore, we need qualitative methods

[9] This is consistent with postmodern philosophy that does not believe there exists an entity that provides a stable inner core. But we are, according to a postmodern mindset popularly said, different people at different times and in different situations, what Gilles Deluze calls a nomadic subject – a term Braidotti (1994) borrows from Deluze.

to provide a deeper understanding of girls' experiences. My point of departure is lived experiences transformed by my informants into written stories in an attempt to achieve a deeper understanding, or meaning-making of choices. The focus is not primarily on the individual person, how she "really" is beyond the surface, but how she tries to make sense of her educational choice through her story-telling. What can the young women's own reports teach us? "Us" refers to researchers in the field, but also to teachers and school administrators, politicians, industry, and the media. To understand more about educational choice as a phenomenon, I have approached the material with an open mind.

A narrative approach attaches importance to how the informants express themselves and what this expression, through interpretations, can say about a phenomenon (see for example Chap. 3, Johansson 2005; Daiute and Lightfoot 2004). The narrative approach has thus been chosen to understand, describe and explain girls' choice of science, on the basis of an understanding that a construction of text is a construction of meaning. By going deeper into the stories of girls making "atypical" choices, I unravel diverse narratives about girls choosing an education in technology, engineering, mathematics and physics. These girls' breach of conventions can shed new light on dominant discourses and gender stereotypes. Stories are created *by* and *in* social life – and they help to create social life. In other words, my own stories and those of my informants are part of life itself. Telling a story can be understood as a desire to project identities and self-images by telling about one's self. I understand a narrative "self" in the same non-essentialist way that social anthropologist Marianne Gullestad describes the concept in her book *Everyday philosophers*: "As a perpetual process to bring together an individual's many experiences and adventures" (1996, p. 25).

There is no shortage in explanations of why education continues to be gender segregated. The explanations range from lack of confidence to lack of aspiration, from lack of guidance and lack of knowledge of opportunities to socialization by gender, peer influence and lack of role models among others. Stereotypic understandings of science and scientists, and ideas about appropriate behavior for men and women have also been put forward as explanations for this phenomenon. Recognition that students are not passively situated in educational discourse, but agents who actively negotiate subject positions within discursive constraints, points towards new ways of understanding the complexity of gender issues in science, which do not rely on universalized gender categories and stereotypes.

"Until now, stories about the diverse roles and paths girls take have not been told. We want to tell those stories" wrote Brickhouse and her colleagues in 2000. Twelve years later I want to tell these stories, illustrated by excerpts from 6 (out of the 17 submitted) stories in the study "Write your choice". The stories belong to Vanja who studies technology, Maria and Tina who are both students in computer science, Kate who studies marine technology, Sandra who is a cybernetic student and Stella who studies chemical processing. They are all underrepresented in their field of studies. In common with all the girls in my data, they have different experiences with STEM, and different expectations and dreams for the future. But they still represent some phenomena, or patterns, that I will focus on in the

following analysis. There is no room for further detailed profiles of the six Norwegian girls here, but excerpts from their written narratives were strategically selected to shed light on the question raised in the chapter: whether more diverse stories can challenge the meta-narrative of girls in/and science. I could have chosen others to represent the findings, but found these excerpts/stories well suited to illustrate some of the tendencies I will examine.

I will now go on to show how findings from my study challenge conventional discourse about girls and/in science – an established discourse with which young women are confronted through the processes which lead them to their educational choices.

Destabilization of Dominant Discourses

"I am like most girls. I spend too much time in the shower. I'm a bad driver. I use impractical clothing in winter. I use every opportunity to dress up a little bit extra, even when I am at the lab." This is how Stella begins her story in a gender-stereotypical way. The participants in "Write your choice" all question the stereotypical pictures painted of girls and/in science, while they also write themselves into such an understanding of their own life-world. And they all use different strategies to meet the socio-cultural expectations of them as "girls against the current" – their own and others' expectations. They are "the others" because of their choices, but they still describe themselves as similar to their female peers. This ambiguity appears in different ways in the data. Stella begins her story by describing herself as a "typical woman" with feminine abilities and values, and hereby positions herself as being like "most girls". In the end of the story, after reflecting upon her educational choices, she describes her "science identity" by saying that "science students are characterized as featureless, nerdy, antisocial and bad dancers. So what? We may not be the hippest, most pretentious students. It is often an all-weather jacket and rubber boots that counts. Nerdy, yes we are to a pretty high degree. So what?" This awareness of her situation as someone "within" and someone "outside" at the same time, can also be interpreted as rhetoric one should master to be both an appropriate girl *and* an appropriate science student.

I will now focus on three themes derived from findings in the narrative analysis; negotiating identity and participation, the significance of role models and questioning "feminine appropriate values", before I go on discussing the results in the light of theoretical perspectives and the overall aim of the chapter.

Negotiating Identity and Participation

A lot of research indicates that girls feel alienated by science, and that boys to a greater extent that girls express an intention to study or work in science (see for

example Schreiner and Sjøberg 2007), but there is also research which to some extent challenges this view, such as the Australian study "Choosing Science" (Lyons and Quinn 2010).[10]

The majority of my informants express a positive image of science in general, although ambiguities are prevalent in the data. Sandra is one of the girls who appears as sporty, active and ambitious. After she participated at a gründer-camp[11] she decided to study something more "practical" (than mathematics): "Until then, I was convinced I was going to study maths, since I loved maths and because it was very easy for me". With a positive attitude towards science she considered studying nanotechnology: "Me and my friend from the physics class began to play with the idea to study nanotechnology, primarily because of the high entrance requirements and because we thought it was for the elite. And we liked the idea of being in the elite." One could argue that it is not surprising that Sandra and other girls in these fields of science do not find themselves fitting into a stereotyped description of girls, since they themselves have chosen to study science. They have made different choices, but still view themselves as like "most girls", as Stella expresses in her story. What is certain is that girls in general are not a homogeneous group, neither are girls who choose to study a science where they constitute a minority group. Several of my informants state that they wish to be viewed as unique *and* invisible at the same time. Stella writes, "I wanted to take an education that made me unique.", and Maria writes this about being visible as a representative of a minority in her field: "Boys have the advantage that they can easily fit into the surroundings of male science students (. . .) In a way it would be nice to be invisible. I like to distinguish myself through clothing, interests and general behavior, but I hate to stand out negatively. On the other hand, it gives me the opportunity to distinguish myself positively, which I should embrace with open arms." This is one kind of ambiguity that runs through the written narratives. The informants are aware that they are visible by virtue of being in a minority, and that this provides opportunities. At the same time they state that they do not want to be labelled as different or stereotypic, and certainly not as victims or someone who needs special treatment because they are girls. Vanja represents this view by saying that she is looking forward to the day we "can all be individuals and not gender/sex".

Vanja is only one of my informants who expresses that she feels alienated by the descriptions of "typical girls", and thus the meta-narrative. As she so clearly puts it, "Maybe I am a boy-girl, although I am also a girl-girl (. . .) I generally enjoy being with people who are not so keen to categorize the characteristics of people according to their sex (. . .) people are first and foremost individuals. Most people are not stereotypical, but have a mix of typical girl and boy qualities (. . .) it is stupid

[10] See Quinn and Lyons (2011) for a critical look at students' perceptions of school science and science careers, which is most relevant for the discussion in this chapter.

[11] May be translated as "innovation camp" or "entrepreneurship camp".

when people try to explain my behavior based on what sex I am. I get the impression that I react more quickly to being gender-labelled in this way than others might. I'm not quite sure why, but I obviously feel more unfairly treated than others. I can imagine that those who feel offended by being reduced to a "number" have similar feelings as me when I'm reduced to what gender I am. I really do not know if I feel it is useful to react to this, wish I did not have to, really. Maybe I see too few opportunities in being a woman. Perhaps it is simply that I do not identify with any particular stereotype of women." Vanja also refers to the issue of gendered attitudes as resistant and is surprised by readers' reactions to articles in the media which "present a positive attitude to girls", and how people (males in particular) have "quite peculiar views as to what are the right and wrong things for girls to do." Vanja emphasize her own ambivalence to gendered matter by saying that she is "a little confused as to how I relate to my own sex".

The uncertainty Vanja describes in relation to her own gender identity can be related to the discussion in Anna Danielsson's dissertation (2009), about how female physics students balance the norms of femininity and the standards of what a good physicist is. One strategy is to reject the traditional female image, thereby positioning herself into the male-dominated culture of physics (ibid). An excerpt from a physics student from my own data, who previously studied nursing, illustrates a similar position: "As a former nursing student, I know what it is like to be overrepresented as a girl. To be quite honest, it was hard to find like-minded people there. I did not thrive in the big "women's club" as it was. As a physics student, however, it is different (...) I'm glad, that the atmosphere in the class is a little bit more masculine." Her way of dealing with the transition from a nursing identity to a physicist student, is to reject the nurse identity and to portray herself as different from women in the so-called "women's club". (See also Chaps. 18 and 19 in this book for further discussion on available identities to females and males in STEM).

Everyday language usage often reaffirms how well-established stereotypical opinions of gender are. This is why the choice of education is far more than a choice based on interest and subject-related motivation. It is about the cultural discourse in which the subjects are located, about others' expectations and prejudices. This means that educational choices also are about "doing identity". Identity in this context is understood as what is formed when an individual creates stories about herself (Solsvik 2004). According to Shanahan (2008) "identities are constructions, inextricable from both the individuals and their surroundings and relationships" (p. 44). (Gender) identity can be regarded as a process, as something we *do*, rather than something we *are* or *have*, thus similar to the concept of "doing gender", which refers to how gender is constituted and in a constantly renewed negotiation of meaning (Lykke 2012; Butler 1990). This process refers to previous experiences in the girls' lives, seen in the light of new experiences, and understood on the basis of what they think about the future; about imminent education and future jobs – and, thus, how stereotypes act as forceful "organizers" of practices, choices, identities, negotiations and participation.

The Significance of Role Models

The meta-narrative suggests that girls lack significant role models in science. This fact is hard to deny. To achieve a sustainable society based on diversity and equal status, and to make girls less alienated by science, we might focus on a variety of girls that other girls can relate to and identify with. However, good role models alone are not enough to recruit more girls to science. Maria refers to women from the business community who make company presentations and illustrates how role models can represent a kind of ambiguity in being inspiring but also threatening: "The student association often organizes company presentations. Now and then I meet women who hold that very special position that I myself would like to have in the future. They are sociable, professional and clever. They do their jobs well and enjoy the daily challenges they meet. Every time I think to myself that I really have to shape up to have the slightest chance of ever becoming like them. In a way they are my role models, but they are also a kind of ghost. They haunt me when I have time to think, stirring up my fear. Sometimes I want to give up." Such "heroines" can also have a negative effect; they can give young girls the impression that these women are unattainable and alienating.

One of the recommendations in the Norwegian "Lily"[12] report is that one must show that STEM subjects are consistent with a feminine identity and therefore women need feminine role models:

> This means that the conscious use of role models may be a relevant measure to strengthen the recruitment of young people in general and girls in particular. We think then, of course, of social, athletic, talented, competent female role models and representatives of science. (Schreiner et al. 2010, p. 92)

This recommendation implies some assumptions about gendered values, norms and expected or socially appropriate behavior (Sinnes and Løken 2012). Such "normality" can be understood as an expression of social order, or what "at a given time in a given society is perceived as a prudent and good way of life" (Solvang 2006, p. 168). Hazari and colleagues found in their study that female role models such as scientists and guest speakers had no significant effect on girls' identity formation as scientists (Hazari et al. 2010). However, as Quinn and Lyons argue (2011): "These are not arguments against using role models, but underline the need for additional strategies to foster girls' enjoyment of science and science-related self-concepts and identities" (ibid p. 233).

In her story, Kate writes about women from the business community who make company presentations: "From time to time we meet female representatives from different companies, for example giving a business presentation for marine students on campus, I have noticed that they distinguish themselves not only as women but as more committed, more inspiring and simply happier." It is not necessarily any contradiction between being "social, athletic, talented, competent" and being

[12] The Norwegian research project Lily has served as a pilot to the IRIS project. See Sinnes & Løken (2012) for a more detailed analysis of gendered assumptions in the Lily report.

"committed, inspiring and happy", but my informant's description can be interpreted as a less gender stereotypical description, which emphasize personal engagement rather than abilities and appearance. Nevertheless, it shows that there is a need to rethink and to refine the image of what a "good" female role model is, or what "proper" female values are, and to conceptualize gender identity more broadly. How female students form and negotiate their identities as "becoming" scientists is a key issue. These are processes that Aikenhead (1996) refers to as "cultural border crossings".

An excerpt from one of the girls can illustrate how she becomes what culture conventionally supports as a "proper participant in science": "Something happens when you enter the science community. I did not know I was a nerd before I started here [at the University]. But during the first year I had already seen all six Star Wars films for the first time, solved Rubik's cube, and gotten glasses, and had developed a kind of dry humour." This strategy can be understood as a form of assimilation, where she adopts the dominant codes to be a proper physicist while she marks the distance from girls she describes as "chatty", "I just cannot stand assumptions and opinion and empty talk that do not introduce anything." Thus she refers to the meta-narrative and a dichotomous understanding of girls as "chatty" and men as active or "vigorous" – emotion versus action.

Parents are also role models, providing girls and boys with different experiences and messages (Eccles 1994). A majority of my informants describe the influence of their parents. In particular, they emphasize the father's role as a source of inspiration, even in families where the mother or other close relations have a scientific background. Vanja writes that "my father has been an inspiration through his own studies and his master's degree. My mother is also interested in technology and works as an engineer with an ICT company, but she is mainly a self-made woman. In my family, several people, aunts and uncles and a grandfather, have higher education. I strongly feel that my interest in science is a part of my identity. But it is hard to say how much my family has influenced me. People say that the children of parents with higher education also choose higher education. To me this seems right. Nevertheless, I think I have identified more with my father, sharing my interest in science with him. My mother was different, she was the one who told us to work hard and be good at school, but she was not present in the same way as my father was." Fathers as significant others concerning girls' choice of science-related studies is broadly documented by research (Sjaastad 2011; Meece et al. 2006), but why do girls who choose to study STEM refer to their fathers as a source of inspiration – and not their mothers to the same extent? Is it because the majority of the fathers themselves possess a science degree, or because they generally show a greater interest in science and technology? Or is it because it is most natural to refer to fathers because the subjects they have chosen are already associated with masculine values and norms, and therefore, associated with men and fathers more than women and mothers? It also shows a "possible violation" of a general understanding that it is fathers who inspire their daughters to study science. Such assumptions, documented by research or not, should be regularly challenged and not left as taken-for-granted "truths". The picture might be more complex. For example, one study found that the more mothers believed in their children's science

and mathematics skills in grade 7, the more likely those students were to pursue science careers at age 24 (Bleeker and Jacobs 2004). Whether young people report that they are influenced by the recognition and support they received from their parents, or not, such social influences might be troubling, because parents (like peers and teachers) often have gender stereotypical views of children's interests, aspirations and abilities in science and mathematics (see for example Eccles et al. 1983).

Questioning "Feminine Appropriate Values"

Statements such as 'girls prefer to work with people' or 'girls are more idealistic', construct social gender categories that are inscribed in the original biological categories (Johnston and Dunne 1996). One way around this is to move towards a deeper understanding of women's motivation for studying STEM, and to question traditional female roles as "caregivers". Stella has no plans to use her education to work with people: "I am interested in health, but I will not work with people. (It may sound selfish or cynical, but I certainly have enough insight to recognize my weaknesses.)". What she does here can be interpreted as an excuse for not being an "appropriate" girl, because she does not want to work with people being well aware that this is a culturally gendered expectation. Vanya also shows such implicit contradictions between subjectivity as a female science student and socio-cultural discourses of femininity. She writes that she would not consider "typical women's work because the term female work is somehow understood as something bad. Working with children, the sick or the elderly is not quite me, anyway." Vanya is not comfortable with the label "men's work" either: "Speaking of women's and men's careers, I am probably not very motivated by the term male work either. I do not like things that are gender labelled". This statement confirms an overall pattern in the analysis, as stated previously; the girls state that they want to be treated as individuals, not according to their gender/sex, despite ambiguities in their stories.

Furthermore, the stories reveal how problematic it can be to connect symbolically gendered constructions with the gendered preferences and identities of human subjects. Is it the case that girls who choose atypical educational routes "are undoing gender"? Choosing traditional masculine educational routes should not imply that women "lose" their femininity. Nevertheless, a large body of research has shown that girls respond to a greater extent than boys that they would like to work with people. Such findings are often understood as an expression of personal interests and aspirations, but the picture might be more nuanced. Girls might respond more positively to questions related to care and empathy, because they reflect the *socio-cultural expectations* of femininity and female behavior.[13]

[13] See also Chap. 18 which describes how traditional male STEM students, more than females, tend to "rely on pre-established roles, which in the case of science and technology are easily available and provide them with reassurance."

This chapter aims to take the gender and science education literature a step further by exploring the available discourses and practices of girls' educational choices, but the excerpts from the narratives demonstrate that the process toward a choice is ambiguous and complex. The girls' stories challenge the stereotypes of girls, and through their "atypical" choices and practice, they also challenge the image of what it means to do science. But they also challenge various attempts of specially designed initiatives, based on so-called female- or feminine values. Stella is one of several girls in the study who indirectly challenge a more "girl-friendly" approach by distancing herself from what she sees as "typically girlie". She is critical of "pink blogs" as a phenomenon, and writes: "In the past few years the so-called pink blogs have become popular, where young girls blog about clothing, makeup, hair and various "female topics". While these blogs are only meant as entertainment, they seem to make girls stupid. I hope young girls now know that there are more important things in the world than conditioning treatments, and that they will do more than be concerned about how they look." Stella is well aware of her opportunities as a scientist and has no intention to use her knowledge in the cosmetic industry: "I read somewhere that a chemist's number one dream employer was the cosmetic brand L'Oreal. I hope it is because of ignorance of other employers. I am certainly not one of those who aim to use my education to develop body lotion." Other girls express a similar attitude. They will use their education in various fields, and not on what "others" might think is appropriate for girls.

The informants in the "Write your choice" – study do share some values, interests and attitudes to STEM, but they also differ in various ways, even though they all have an "untraditional" choice of education in common. They tell different stories about their choices, although there are overlaps. In other words 'girls who choose STEM' are not a homogeneous category. Therefore, they will, in different ways, influence the discourse of female educational choices through diverse participation *in,* and approaches *to*, STEM. Thus, their differing participation in science might influence stereotyped images – both of what it means to be a girl, of what it means to be a female scientist, and of the image of scientists and science in general.

So far I have tried to show how telling local stories can open up a more plural representation of girls in/and science. I will now go on to discuss some of the implications of this.

Discussing Gender Stereotypes

Firstly, I will discuss whether communicating stereotyped images of girls might act as self-fulfilling prophecies, and secondly how challenging narratives about girls in/and science can give a more nuanced picture of the kind of girls actually choose to study science.

The point is not to show whether the meta-narrative, to some extent supported by research, is "false" or not, but to show that reality and everyday experiences are more nuanced than the dominant stories we tend to hear about girls and/in science.

Repeated Citations and Self-Fulfilling Prophecies

Words can lead to action. Words can trigger actions as impacts of the spoken word. This is in line with post-structuralist perspectives and in particular with Judith Butler's theorization of gender as performative (Butler 1990). In line with Butler's theory of performativity, educational choices might be seen as an effect of repeated citations – or actions. By repeating the meta-narrative of girls and/in science, norms about gender, aspirations and interests, behavior, and of educational choices, are "naturalized":

> Gender is the repeated stylization of the body, a set of repeated acts within a highly rigid regulatory frame that congeal over time to produce the appearance of substance, of a natural sort of being. (Butler 1990, p. 33)

This performative practice is consistent with the idea of gender as something we are *doing*; not something we *are* or *have*, but rather is a repetition and a ritual, understood, in part, as culturally sustained over time. A key point is that performativity is not necessarily a willing act of the subject, but rather is the reiteration of various gendered norms that tell us how to act, dress and think in terms of gender identity (Butler 1990). Using performativity as a lens for analysing girls' educational choices shows how such choices are gendered, and a part of the process of "doing" and "becoming" a female scientist. By repeating the meta-narrative without emphasizing the nuances, we can contribute to self-fulfilling prophesies:

> A self-fulfilling prophesy refers to a type of circumstances that take place when social participants believe that something is going to happen, and act accordingly, then it happens. In other words: The prophesy fulfils itself, so to speak, in that those who make the prophesy also act in a way that brings it about. Initially, the prophesy is based on a mistaken assessment of the state of things, but through the course of action elicited by the prophesy, it ultimately works, then the prophesy is fulfilled, as though it had been based on a correct assessment. (Østerberg 2003, p. 62)

Such repetitive practice includes an element of power, because it reproduces a normativity which people relate to and "define" themselves in relation to. Researchers' repeated stories about how girls "are", what kind of aspirations they share as a group, and about the grounds on which they choose, are absorbed into language and cognition as "common sense".

We base our choices on our perceptions of the world, like Tina. She has chosen to study computer engineering, but she feels she does not fit the subject's public "image": "Many have really been surprised when I tell them that I have started studying computer engineering. Are you one of *them*, they ask me? Well, I guess I can be, I reply with a hesitant voice and a half smile, because I am still very uncertain. Am I really the right girl for this?" Tina wonders whether she really wants to be a computer nerd, which underlines the conflict between her academic interests and motivation on the one hand, and society's expectations, myths and prejudices on the other. She is not alienated from the ICT profession, but society's scepticism and gendered perceptions make her feel alienated from the potential

opportunity to become a computer programmer. Such paradoxes open the door to several interesting interpretations of the data, which must be situated in a historical and socio-cultural context. The choices my informants make, are a part of themselves. They are what they choose – and if they choose outside the box, they stand out from their peers and outside of the public view on gendered behavior, values and norms. Girls are "free" to choose whatever career they would like in countries such as Norway, but are also limited by the meta-narrative, and therefore have to negotiate their choices and participation in science, because of their sex.

Generalizations might contribute to negative and limiting stereotypes, which in turn shape our perceptions of normality and variance. Research does not occur in a vacuum but is part of a set of mutually constitutive intra-active[14] processes. As studies of gender stereotypes among adults reveal, gender polarization is resistant and does not necessarily wane as people grow older. Perhaps as a result of these tendencies, researchers often expect to find sex differences. Even researchers are not immune to popular essentialist beliefs about gender, and we should therefore address the ethical dimensions of generalizing findings. As the physicist and feminist Karen Barad (2007) argues, politics and ethical issues are always part of scientific work, but specific historical circumstances encourage people to fail to see those connections.

As history inside and outside the field of science shows, dominant discourses of science are open to reformulation, reinterpretation and destabilization, offering possibilities for widening the range of scientist subjectivities available, for those in, and for those often excluded from science. A key question in the process of becoming a scientist may still be "who we think we must be to engage in science" (Barton 1998, p. 379). A relevant follow-up question might be; *why do girls think that way, and what is there to do about it?*

A More Nuanced Picture Towards Diversity and Sensitivity

On the one hand, gender inequity is a problem within technology, engineering, mathematics and physics, and stakeholders want clear answers as to how the problem can be solved. On the other hand, in the process of making broad generalizations based on differences due to sex we stand the risk of losing important nuances that again might lead to the creation and cementation of stereotypes. As Cathrine Hasse puts it: "When we look for gender differences we might overlook differences that are not simply sharply defined and cannot be distributed in two groups defined by the categories male and female" (Hasse 2002, p. 253). I wish to emphasize the importance of more detailed knowledge of the variation between women who choose science, to avoid categorizing women who choose science as a

[14] See Karen Barad (2007) for a discussion of the concept of intra-activity.

homogeneous group. They do share some interests, aspirations and values, but the way I interpret my data, they also describe and justify their choices differently.

Challenging the meta-narrative of girls and/in science implies a consideration and consciousness of the language in use, including what type of language we use as researchers, teachers and parents. The French feminist thinker, Luce Irigaray, says that researchers must innovate and reformulate the age-old socio-cultural values and concepts on which the understanding of gender rests (Irigaray 2004). Is there a need to create a new language with more room for women in the natural sciences? Some would claim that inventing new words to describe "old content" is the same as "the emperor's new clothes"; the content will remain the same. An ambition can be to elevate girls' own descriptions and experiences, which I have tried to do in this chapter, to create more room for more choices available to girls (and boys) enrolling in higher education or embarking on their career.

Theories about normality and non-conformity are related to ideas about what is perceived as "pure" and "impure" in a society; or what the social anthropologist Mary Douglas (1966) theorizes as "matter out of place". Anything impure is "matter out of place", meaning things (or persons) that do not fit in. Is it the case that the absence of girls in the sciences is ascribable, among other things, to girls being perceived (and perceiving themselves) as "impure" in a research tradition and discipline where the norm includes values such as: neutral, objective and value-neutral research? This is, perhaps, not putting too fine a point on it, and it is certainly a provocative assertion; but language is power, and power can be symbolic. Symbolic power is, according to Bourdieu (1996), the power to construct reality. The researcher as a producer of knowledge, and the teacher as a communicator both have the power to define a part of reality through their choice of words. Therefore the researcher has a significant responsibility to avoid one-sided and oversimplified language and a repetitive practice which might help to confirm negative stereotyped perceptions.

According to feminist scholars such as the biologist Donna Haraway (1991) and physicist Karen Barad (2007), scientific research produces realities and worlds that are never without consequences. Therefore, researchers cannot evade moral responsibility for the consequences of their research. The researcher is always located in, and part of, the reality he or she explores (ibid). Research on educational choices is no exception. We are all socialised into gender-specific values and norms that tell participants in a society what counts as valuable research, what being a girl implies and what being a boy implies – and how we are expected to choose educations and professions based on sex.

More nuanced stories about girls and/in science may provide us with a better understanding of the variety of ways girls engage in science, and how this engagement is shaped by their experiences and views of what kind of girls "they" are. Like Haraway, I argue that although not all stories about the world are equally valuable, several stories are better than one (Haraway 1989). My interpretation of this statement – and an implication of it, is that several stories of girls' educational choices are better than one. This means both telling more stories, and refining the stories we tell about girls and/in science.

In the article *Gendered education in a gendered world: Looking beyond cosmetic solutions to the gender gap in science*, Sinnes and Løken (2012) suggest looking at research and recruitment initiatives from a perspective developed by feminist critics of science, to reveal the implicit gendered assumptions that can be found within projects focusing on gender issues in science (see also Brickhouse 2001; Harding 2001; Sinnes 2006, for reviews of the historical development of feminist perspectives on science education). Use of feminist theory to elicit the view of gender reflected in interpretations of IRIS findings can be useful (see also discussion of different feminist theoretical approaches in Chap. 4 in this book).

It is beyond the scope of this chapter to go deeper into the study of girls' diverse lived experience in a more qualitative way. I have argued that there needs to be increased attention to the level of local stories; without it we will not obtain a nuanced picture of what kind of a girl does science. Failing to attend to these issues might, as argued, lead to a cementation of negative stereotypes and thus limit diversity and plurality in science. To focus more on diversity and plurality within the gender groups may be a step towards a more (gender) sensitive (science) education, which could avoid contributing to enhancing stereotypical images that young people of both sexes feel alienated towards.

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