"Engineering is a men's business!" - Identities of Women in Engineering

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(1) Introduction

"Engineering is a men's business!" this initial quotation belongs to a Russian woman engineer working in research. Looking at actual statistical data her observation seems to be true for most of the European countries: according to the numbers in the current She Figures 21,3 % of researchers in the academic engineering and technology field in Europe are women and 22,3 % is the proportion in governmental sector (European Commission 2006)[1]. Which impact has men's dominance in technological fields on women opting for a career in engineering? Researchers grapple with this question since the last 30 years underlying theoretical approaches and having different angles for analysing the situation. For getting a short overview Wendy Faulkner's classification seems to be helpful:

Concerning Faulkner (2002, p. 18ff) four theoretical feminist streams dealing science and technology can be identified:
1) women *in* science and technology
2) women *and* science/technology
3) *gender* and science/technology
4) *men/masculinities* and science/technology.

First point deals with popular question 'why there are so few women in science and technology', which is today still regularly introduced by government or industry stakeholders who can't explain why women are not attracted by engineering (p. 19). Managers, stakeholders and other relevant groups still tend to transmit the responsibility for the low number of women in engineering to the women themselves. Company internal factors for under representation or external societal embedded reasons for stumbling blocks that hinder women's career progression (Thaler 2005, p. 93) or even women's interest in engineering and technology are often neglected.

The women *and* science/technology stream (p. 19) sees women as users and ultimate consumers of technological developments while they are mostly uninvolved in designing and creating processes in science and technology. Technical attainments are deeply embedded in everyday life and be particular relevant for everybody and not only for white, heterosexual middleclass men. This stream also deals with women's trust and mistrust in technologies e.g. pre- and postnatal medicine and it sees women partly as victims of capitalistic and patriarchal technical developments (reproduction research).

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[1] There is no comparable data for the business sector available because statistics for this sector are differentiated by economic activity (NACE code), but it's presumed that the numbers are even lower than in academic and governmental research..

Third theoretical line drifts from focussing on women as main issue towards gender as influencing factor. That implies understanding the relation of men *and* women in the frame of technology and therefore also engineering, and also their attributive gender differences. This approach looks with a constructivist understanding of gender *and* of science / technology on emerging connections, which are above this presumed as mutually shaped (p. 20).

Closely related to this constructivist thoughts the *men/masculinities* and science and technology line understands their approach. Looking on men and different masculine characteristics which are culturally embedded, endured and perpetuated in society, they want to analyse its impact in relation to masculinity and technology. Many findings in this concept can be transmitted to the matters of point one, women *in* science and technology as cultural settings can be seen as high influencing factor towards attraction, retention and progression on women in science and technology (p. 20). Above this, male hegemony is continuously stabilized and renewed by technological relations and contributed towards modern society patriarchy (Cockburn 1999, p. 129).

(2) Methods and Sampling

Base of this paper are quotations of women engineers out of semi-structured interviews and focus group discussions with women engineers which were conducted in the frame of PROMETEA project[2]. Research instruments were developed in cooperation with responsible project partners and aiming on investigating relevant aspects of work packages and project intents[3]. Therefore career furthering and hindering factors of women engineers working in industrial and academic research should be detected and lead towards recommendations for relevant stakeholder groups.

Delimitated to the project objectives, clearly focussing on career influencing factors, may they be organisational or individual, I try to highlight in this paper how identities of women engineers are co-constructed in a masculine dominated work field, to which behavioural dilemmas the 'special' status of women in a male domain can lead like coping with a high visibility and how women are per gender excluded from informal networks.

(3) Gendered Organisational Culture

For looking at identity conceptions of women in engineering it is indespensible to consider their working environment, the culture within their job situation. Organisational culture can be – without a gendered perspective – defined as a "pattern of basic assumptions - invented, discovered or developed by a given group as it learns to cope with its problems of external adaptation and internal integration – that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think and feel in relation to those problems" (Schein 1995, p. 25).

Gender is deeply embedded in structures of organisations, due to practices how work is organised, how processes of recruitment and selection are realized, brief what counts for a successful career

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[2] I would like to thank our project partners in the participating countries for the great input they provided. This article is based on their results and analysis. In alphabetical order: in Austria: Birgit Hofstätter, Anita Thaler and Christine Waechter, in Chile: Dámaris Fernández Donoso, Claudia Paz and Sonia Yáñez, in Finland: Liisa Husu and Paula Koskinen, in France: André Béraud, Anne-Sophie Godfroy-Genin, Cloé Pinault, Yvonne Pourrat, Emilie Saunier, Jean Soubrier and Hélène Stevens, in Germany: Gaby Hoeborn and Felizitas Sagebiel, in Greece: Nikitas Nikitakos and Maria Lambrou, in Lithuania: Ala Kovieriene, Diana Saparniene and Virginija Sidlauskiene, in Russia: Elena Myasina and Vera Uvarova, in Serbia: Jovan Dudukovic, Jelena Jovanovic and Sanja Vranes, in Slovakia: Oto Hudec and Nataša Urbančíková, in Spain: Carme Alemany, in Sweden: Helen Peterson and Minna Salminen-Karlsson, in UK: Wendy Faulkner, Lisa Lee and James Stewart, at Schlumberger: Pierre Bismuth.
[3] See contribution of Godfroy-Genin is this publication.

progression is defined on a male working model (Halford and Leonard 2001). Above this, two patterns of gendering in organisations stay very obstinate according to Holtgrewe (2007):

organisations attributions towards individuals where gender is regularly made relevant in shifting relations like for instance achievements and qualifications, and second underlying organisational norms of total and all time availability while other (private) commitments or relationships have to be neglected. "Both factors seem to be central for re/production of gender inequality, also in new, flexible and project shaped organisations." (Holtgrewe 2007, p. 10).

Parkin and Maddock showed that even in organisations concerned about their employees' needs, through offering family friendly structures like part time work, flexible hours or childcare, the prevalent culture may women define as 'mothers only'. Six categories, a *gender typology of organisational culture*, arose from their study in the public sector: lasting from "the gentlemen's club, with its paternalist overprotection *[of women]*; the barrack yard, with its bullying hierarchy; the locker room, excluding women, using sexuality; the gender blind, pretending differences between men and women do not exists; the feminist pretenders, men assuming the mantle of feminism" and finally "the smart macho, where profit is all that matters" (Parkin and Maddock 1995, p. 72). This typology pictures the broad variety of possible masculine organisational cultures, shifting within the existing types may be found too.

As organisations can be found on a sociological meso level of society, building an intermediate stage between the macro societal level and the micro individual's level, it's interesting to look how organisational cultures are affected by gender constructions in the society. The culture on the meso level cannot be seen detached from society's impact, as individuals working in an organisation are characterized by interactions and implications in their daily life. Gender relations within and without the organisation are connected.

Hofstede once argued that cultures of organisations are directly affected by national cultures, and that in institutions societies' masculinity or femininity is reflected. Means workplaces settled in countries with high masculinity are more likely to mirror values connected to it, for instance clearly distinct gender roles, assertiveness, toughness or being focussed on material prosperity. Whereas in cultures with a high femininity gender roles overlap, they are not clearly distinctable, individuals are supposed to behave more modest and tender, focussing on the quality of life (Hofstede, 1998). This concept implies very homogenous national cultures and seems therefore to be limited, but nevertheless it illustrates the connection of gendered national cultures and organisational cultures.

(4) Identity concepts

Sociologist understanding of *identity* focuses on individuals belonging to a social group or entity as part of a social identity. Established cultural settings with in an existing community influence identity development processes of its members or members-to-be.

(4.1) Identity formation

Cockburn and Ormond (1997) talk about dual identity concepts: subjective identity which is individually experienced and culturally produced identity. Within both concepts identity develops fluently and continuously, so it's something which is not fixed. Different environments can lead towards different identity construction of individuals because specific experiences contribute towards a construction of identity through social practices (Henwood 1996). Identity development is closely linked with affiliation to a community and identity itself is seen as stable a base for individuality. "With whom people identify depends mainly on values, they share or want to share with others" (Weeks 1990, p. 88 cited by Cockburn and Ormond 1997, p. 24). Gender is one aspect of identity which is never seen detached from other aspects; it's never a single position on one or the other side.

(4.2) Identity formation in engineering

After entering a degree course where the majority of students and faculty members are male, many young women face problems which they possibly never have thought about before. So it can happen that "for the first time in their lives, white women suddenly experience what it is like to be a minority, negatively viewed by the majority" (Etzkowitz 2000, p. 60). In this environment, were engineering competencies and practices are developed, a strong association of masculine image closely linked with the male gender role is still prevailing (Cockburn 1999, Du 2006, Dahmen 2006, Sagebiel and Dahmen 2006). This engineering image can lead towards a conflict for the young women, as their understanding of femininity does not fit into this masculine picture. Female and male students starting degree courses with different gendered identity formations and opinions about what "appropriate" masculine and feminine behaviour means to them; strongly influenced from their social surrounding like family and peers, but also from media .

This fact can also be mentioned as one factor deterring young women picking up an engineering degree course, because their gender role embedded self-conception of femininity has to be matched with the 'male' technique, even if it is partly only an image which is kept alive (Dahmen 2006, Wolffram 2000). During their study time (female) students in engineering have to pass through different levels of association, each providing its own related rules, structures and expectations (Du 2006). Identity formation implies a common sense of cultural knowledge which signalises individuals' positions within the community including appropriate behaviour. Aspects of *degendering* can be observed by female students adopting ascribed masculine attributes for fitting into the engineering world while male students reject in taking on feminine ones (Walker 2001). 'Becoming on of the boys' was also one reaction observed by McLean et al. (1997), on how female students respond to the masculine culture in engineering degree courses for being accepted. Above this they identified two more ways: first emphasizing traditional femininity, often linked to a special dress code, and second taking over the feminist position, facing the most dismissively responses from their fellows because they are "going against the flow" (McLean et al., p. 14).

Later on the developed 'engineering identity' has to be transmitted successfully to professional life. Women and men in organisations learn to do different professions and become different professionalists. Bourdieu called it a *profession related habit*, developed in an environment, which is for the engineering example initially male shaped. Development of habit is based on individual and collective experiences, which lead to common perceptions, thoughts and action schemes. Here a linkage to the understanding of organisational culture and identity formation becomes more obvious, both concepts talk about shared values, norms and collective experiences within a group. The creation of a system conform habit would be the result of the process, if individuals are willing to adopt those underlying principles.

(5) Results

Following four aspects about what it means to be a woman in an engineering organizational culture will be presented. *First* influences of the masculine domination on work processes and work environment, also on individual's sides will be discussed. *Second* it will be pointed out in which behavioural dilemma women engineers can find themselves because of their gender and how this can lead to ambivalences in individuals self-performing and self-expression. The *third* focuses on hyper-visibility of women engineers within the institution; which consequences has this heightened attention in developing a professional job identity? And the fourth and last point which will be discussed deals with women's exclusion from male dominated networks.

As an illustration each of the following aspects is opened by a statement of a woman engineer. All following statements were expressed by interviewees or focus group participants during the investigations.

(5.1) Engineering organisational culture

What makes a culture within engineering differing from those in other disciplines? First it can be determined that every disciplinary culture has its own traditions or practices which are shared among its members. Connected to this traditions or practices is a certain kind of knowledge transmission in the frame of shared norms, morals and meanings (see also point 3). Above this "to be admitted to membership of a particular sector of the academic profession involves not only a sufficient level of a technical proficiency in one's intellectual trade but also a proper measure of loyalty to one's collegial group and of adherence to its norms" (Becher and Trowler 2001, p. 47). Also for the field of engineering there are equally shared traditions which lead to a specific disciplinary culture, in this case established in a surrounding which is dominated by one group – men. It happens that societal and organisational structures correspond with dominating values and norms, which then again correspond with a certain form of masculinity (Connell 1999).

> *"Our society is based on masculine criterions. Those who can adapt themselves can go into those fields. Some women want to go, others don't want to. ... The general taint of the work values stays masculine!"[4]*

Engineering is a masculine dominated world, which was shaped more or less without female contribution. Therefore engineering can be described as homo-social world. Possibilities for changing processes initiated by women are seldom and long-winded, success is not immediately visible. Women are compelled to adopt strategies to take part in masculine world, being in the "belly of the beast" how Kvande (1999, cited by Pinault 2005, p. 84) called it, because men are seen as different from the men, not men from women. Men are the norm.

> *"You get used to working with men. You learn from the start that this is another world. It is a tough world but it is also a world where it is easy to learn the rules of the game because it has a thousand year old tradition. You soon learn that you have to be professional to one hundred per cent. You can't say 'I don't know', 'I can't'. Go, try and understand and come back with an answer. It is very clear and plain if you fit in or not."[5]*

Most women engineers describe that they like the working environment and feel to work in a friendly community. Interviewees seem to be quite conscious about their male dominated work environment, even if some interviewees did not question influence of masculine domination on work organisation in general. Also effects on individual occupational progression are tending to be neglected. Ignoring such effects could be interpreted as kind of a strategy for coping with their minority situation.

(5.2) Behavioural ambivalences

> *"In my team, relationships are mostly cooperative. In fact, sometimes I get to play mother hen to them. If they squabble, I mediate and get them to make up. That's a role I get to play."[6]*

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[4] French women engineer, governmental sector.
[5] Swedish woman engineer, academic sector.
[6] Chilean woman engineer, academic sector.

A variety of behavioural ambivalences which women engineers can face in their everyday work life can be found in the qualitative material. Nearly all interviews and discussion participants could at least tell one example for conflicts within gender and/or job identity. This conflict can lead towards a dilemma as their professional identity, as competent engineer, is not seen detached from the "gender factor". Even women who studied successfully a technical major, together with men, can face gender stereotypes about female's relation to technique:

"It is common to believe that men understand mechanics much better than women, thus women have to prove that they are also professionals."[7]

Women who try to adopt (attributive) masculine behaviour shown by their male colleagues are sometimes not taken seriously from their male dominant surrounding. This behavioural adoption can be interpreted as an "irruption into their prestige system, especially for women who compete successfully with men" (Etzkowitz 2000, p. 55).

"I've always been like a tomboy, I'm into sports, football and cars and everything so I don't know, I kind of fit into the environment I find."[8]

This woman thinks she is fitting well in this masculine surrounding because she has always been "one of the boys" concerning her interests. For assimilating herself within her environment, attributive masculine behaviour respectively interests helped her, no problems of integration occurred.

The phenomenon of *undoing gender* (Heintz and Nadai 1997) can explain this behavioural dilemma, if gender is generated actively it must be also possible to do this not. Women are not only personating gender but also try making it unimportant or taking back the own gender. Women in professional life, especially those who are successful in overcoming barriers in their career progress face partly a permanent balancing act between doing and undoing gender. Trials to become an *insider* through adaptation of male culture and identification with it, is a process where gender is hidden behind professional role. If women present themselves as exception among other women some kind of professionalism is conceded but on the other hand perpetuation of male defined prejudices about women is supported (Berg-Peer, 1981 cited by Fetzner et al 1999, p. 6). What follows can be interpreted as some kind of tabooing of gender differences (Sagebiel 2006).

"I wonder what not being a minority is like. I just can't imagine. We've always been in the minority and have always had to act accordingly, so I just can't picture it."[9]

The whole dilemma could be explained by Goffmans (1997) concept of context specific performances and stages, a social actress (here woman engineer) performs on. For each stage certain rules are valid, these rules are mainly not defined. If the *front stage* is the professional one, the actress has to perform undoing gender for gaining recognition and acceptance. If she succeeds in creating a habit conform to the hegemonic system, chances for a successful professional progression will be enhanced, in comparison to persons who show discrepancies between personality and role (Ihsen 2005).

(5.3) In/Visibility

"Maybe it helps a bit to be a woman because then I'm the one who's remembered.[10]"

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[7] Russian woman engineer, academic sector.
[8] British women engineer, business sector.
[9] Chilean woman engineer, academic sector.
[10] Finnish woman engineer, business sector.

To attract attention is a process most women in the sample were confronted with latest during study time in a technical major. This does not only continue when entering professional sphere, the gender ratio in companies is even worse compared to universities. Women find themselves in a minority situation, which was not expected and they partly do not feel comfortable with it.

Persons in minority situations, so called tokens, are more easily stereotyped because of lacking group affiliation. They are seen as outsiders while the dominant majority, for these example male engineers, stress their group homogeneity. As a result polarisation of differences (minority versus majority) follows (Kanter 1979). For the women engineers this means that they are considered as something *strange* or *unfamiliar* because of their low number, in this rather homo-social environment.

Tokenism was divided by Kanter into three categories: first *hypervisibility*, second *boundary heightening* and third *role entrapment*. In a predominant male environment like in engineering visibility means sticking out of the dominant masses because of obvious categorized differences – here the gender. Higher visibility can not lead only to disadvantages because of higher recognition, or like a woman from Finland, who explained that she feels to get more liberty of her superiors because of her minority situation:

"I haven't really faced different expectations because I'm a woman or anything like that. I think that it might be an advantage for me that there are so few women in the field. That leads to a situation where each of us is considered a special case and you are allowed to do a lot of things that the men may not be allowed to do."[11]

Women's behaviour is not observed individually, but as representatives of their (gender) group, their behaviour is always judged in combination with gender stereotypes (Kanter 1979). Minorities are in the centre of attention (*hypervisibility*); their activities and behavioural patterns are observed and commented. Sometimes this can lead to a higher performance pressure in comparison to their male colleagues. For some women this means trying to evade this visibility and avoid attracting attention.

"And men probably see there more common characteristics among themselves. Are women defined as the 'others'?"[12]

Boundary heightening is a process which is triggered by tokens that irrupt in a group or environment which was before more or less homogenous or homo-social. From this moment the dominant mass becomes conscious about similarity and alliances; boundaries will be emphasised even if it was not necessary before. Men show higher *doing gender processes* if their former homogenous field is entered by women. Occupation and a successful career progress are no more seen as an evidence of masculinity because women can do it equally (Heintz and Nadai 1997).

Tokens are never seen as individuals, always as member of their group / category. All attributions which are respected as typical female or typical male will be emphasised and highlighted. This process can be interpreted as doing gender. The dominant group (men) are actively in performing gender, while the token group is forced to take over their attributions.

Role entrapment means adaptation of expectations towards the tokens. The dominant group stereotypes the tokens. Tokens should not perform better than the dominants on one hand, but on the other hand have to over perform to be deemed as equal. Women have to perform better for getting rid of the femininity stigma:

"Women have to work twice more and harder in order to prove their competence."[13]

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[11] Finnish woman engineer, business sector.
[12] German woman engineer, business sector.
[13] Woman engineer from Lithuania working in academic sector.

Paradoxically women engineers don't have to cope only with a higher visibility they also can face some kind of invisibility. This easily can become true for women working part time or at home due to family commitments. The less time they spend at the work place the less present they become. What can remain is the 'mother' colleague who only works half of the time. But distribution of work can as well lead to invisibility. Like the example of some Spanish engineers who describe themselves as 'ants' because they do the necessary stuff "behind the scenes" which assures that procedures work out well. The work of 'ants':

"…because it is not visible but it is indispensable for everything to work smoothly."[14]

Visible as woman who is good in doing organisational work, like making sure that a meeting takes place in a productive environment and way - but not as a qualified engineer. So again women become visible as representatives of their gender and ascribed gender attributes (like being good in caring, organising etc.), but invisible concerning their professional qualification, which does not meet traditional gender attributes.

(5.4) Networks

"It's hard for women becoming a part of a men's network."

Finding a definition of 'networks' one is swamped with information technology related definitions, of course not aiming on explaining social networks within a organisation. But on the second glance those definitions are not so far away from describing functions of social networks either: "…a network is a series of points or nodes *[here individuals]* interconnected by communication paths. Networks can be interconnected with other networks and contain sub networks.[15]" Above this, social networks can be on a local level like organisational internal or on an external level.

Bourdieu sees networks as „social capital" which is a result of previous investment strategies and will lead sooner or later to benefits (1982). But what if those investment strategies do not lead to success and benefits are not forthcoming, in this case "joining the game"? Barriers for joining the group are mostly not obvious, factors for successfully becoming a network member are written on a hidden agenda, imparted only between the members and possible members-to-be. Initiation for entering networks is mostly done by higher management levels, appropriate people will be initiated, and inappropriate people will be excluded. Rules for initiation are the same for men and women, but in fact women and marginalized men will be different initiated in comparison to those people who meet the hegemonic expectations and norms (Doppler 2005).

"Men are maybe afraid to damage their reputation with a woman as a network partner."[16]

Women stay outside from social and professional networks Kanter (1979) succinct wrote. What really counts for becoming a member is mostly not obvious; men's group homogeneity facilitates inclusion of new male members, especially in a work environment predominantly occupied by men, but leads to an exclusion of women or 'inappropriate' men. Both latter ones are defined as the others, even if network members would deny any exclusion mechanisms per se. In contrary to the previous statement one finds a common opinion of women engineers and also of men engineers in the interview material, that becoming a network member is gender independent. If barriers for access exist, they are personality or competencies related:

"It's more a personality history than a sex one."[17]

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[14] Spanish women engineers, business sector.
[15] Definition from http://searchnetworking.techtarget.com/sDefinition/0,,sid7_gci212644,00.html [8.10.2007]
[16] German woman engineer, business sector.

Individual attributes like sympathy or personality, are superficially not restricted to a certain gender, but missing group affiliation of women in combination with some kind of masculine solidarity compound access possibilities of persons not belonging to the majority. One explanation for women neglecting gender differences in accessing networks is probably a kind of un-reflected view in this topic combined with being excluded without knowing. Using or not using networks is a self-decided aspect, even if most of the women are aware of network's essential influences, not everybody wants to play and join this game. Maybe also because it's a relation of *giving and taking* and interdependencies, not everyone wants to coalesce with.

"I do not want to play male game. I am tired of this game in everyday life."[18]

Even if informal networks aren't a conscious way for exclusion mechanisms by men they lead apparently to discrimination, because not only networks and information channels are male dominated also the management level is (Wimbauer 1999). This homo sociality is characteristically for informal networks, which also goes along with leading positions mainly occupied by men. They have great impact in personnel decisions, for career progress they are essentially (Ohlendieck 2003). Career relevant aspects, also called *tacit knowledge*, is faster on men's disposal because they are integrated in relevant networks where this knowledge is transferred. Women need more time to get in touch with this information (Wimbauer 1999, 138); sometimes this can be the essential competitive edge for the men. Tacit knowledge was defined by Schein (1995) as one level of organisational culture. This knowledge contains elements of interactions which aren't obvious identifiable but communicated between members or special member groups within the organisation. Unspoken rules aren't officially discussed and transferred, understanding it works out by time, experiences and affiliation. Missing networks can lead to isolation and lacking confidence in own abilities. Women mainly don't belong to networks which could be called 'powerful', related to influencing internal organisational processes and they can't oppose 'mighty' women's networks for compensating the exclusion from men's networks.

(6) Resume

For this paper statements of women engineers out of individual interviews and discussion groups were extracted for representing some of the manifold experiences women in minority situations can face in their work life. It was not my aim to identify generalised forms of doing or un-doing gender processes, as this attribution would easily lead to stereotypes on *how* women in engineering or technical work fields *should behave* or not for feeling convenient or being successful in career progression.

I tried to highlight some of the behavioural ambivalences women engineers *can* experience in their daily work life, which is characterized by doing and un-doing gender processes. The women themselves are a part of these processes and even contribute towards its manifestation, because they partly are captured in the framework of gender construction too. Cultural changes should lead towards a more broaden horizon were diverse masculinities and femininities can exist side by side without being devaluated. Gender can not be regarded as a unitary category; it's not a homogenous group.

Another circumstance which arises is the fact that the illustrated process of taking back (own) female gender for gaining recognition is applicable to many occupational areas where women want to reach a certain career level, indifferent if these are so called *male* or *female domains*. It should not be forgotten that men, who do not fit in the male, archaic, tinkering picture of an engineer can face

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[17] French woman engineer working in governmental sector.
[18] Slovak woman engineer, academic sector.

similar problems of affiliation and inclusion like women do. So also one respondent concluded that not meeting heteronormative expectations as a man can be even worse than being a woman:

"It is perhaps an even more inferior position, if you are a feminine man."[19]

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