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'The Hard Hat Problem': Women Traveling the World of Computing

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Gender and feminist STS studies have shown the benefits of using gender as an analytical category in order to problematize not only formal discriminations of women in technoscientific fields, but also gender biases encoded in technical knowledge and professional cultures. According to this view, gender and technoscience are mutually shaped, so that just as gendered beliefs and practices affect the construction of scientific knowledge, so too technoscientific organizations shape the relations between men and women. In the field of computing these processes have been scrutinized by recent studies that put under scrutiny those 'unspoken ideas' on gender that have shaped computing. Against this backdrop, this paper problematizes the experience of Italian women who travel the world of computing as practitioners and academics. The analysis is based on a set of in–depth interviews which aim at addressing the gender gap in computing by questioning the gender assumptions that shape the construction of disciplines, practices, and knowledge surrounding computer technologies. Therefore, rather than emphasizing those mechanisms that keep women outside or at the margins of computing, the paper examines the experience of those women who inhabit the computer world in order to question the alleged gender neutrality of the field.

***Keywords**: Gender; women; computing; feminist STS*

Introduction

During the last three decades, feminist theory in Science and Technology Studies (STS) has largely explored the relation between gender, science, and technology. If early STS remind us that scientific and technical worlds are the outcome of collective and material processes (Latour and Woolgar, 1986;

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Pinch and Bijker, 1984), feminist STS problematize such processes by uncovering power differentials, marginal and invisible positions, multiplicities and layers of silence that technoscientific phenomena inevitably produce (Haraway, 1997; Star, 1991). Far from being a homogeneous body of knowledge, the feminist critique of technology has come to terms with the various approaches and issues raised by feminist critical theory. In this respect, we recognize three streams of research by which feminist analysis has articulated its reflections about the gendered character of technology (Cozza, 2008; Faulkner, 2001). A first research path can be phrased as 'women in technology', and addresses the key question 'why are there so few women in technical fields? This approach shapes many institutional and corporate campaigns that aim to recruit women in technical paths.

A second analytical perspective examines the relationship between 'women and technology' by focusing on specific technologies with which women interact, for example, in domestic and work places. This stream develops a reflection on the experience of women as users of technology. As Faulkner (2001) points out, this line of thought tends to hold a dichotomous understanding of technology, seen either as a masculine instrument of control or as an opportunity for the emancipation of women. Both these approaches view technological artifacts as black boxes, disregarding their inner articulation and ambivalence.

In contrast to the perspectives described so far, feminist contributions to STS have framed their analysis in terms of 'gender and technology' (Cockburn and Omrod, 1993; Wajcman, 1991), questioning the mutual shaping of gender relations and technical practices. A key tenet of this approach is the relevant critical stance towards the nature of technology, its use, users, and design processes, which challenges both technological determinism and any assumption about the neutrality of technology.

Against this backdrop, recent studies have come to employ feminist critiques in science and technology in order to investigate the relationship between gender and computer technologies (Abbate, 2012; Balka and Smith, 2000; Misa, 2010). This is a body of research that, starting with the acknowledgment of the gender divide in computing, has developed an interesting set of historical, sociological, and cultural analyses about the interplay between computing and gender in different countries (Corneliussen, 2014; Hicks, 2010; Lagesen, 2007, 2008). The assessment of the imbalance between men and women in computing is the first step required to develop reflections that go beyond the mere assessment of

numbers. As a matter of fact, the scant presence of women in computer science training programs and jobs is a phenomenon that has been well–documented over the last years (Hill, Corbett and Rose, 2010; She Figures, 2015). Besides monitoring the gender equity in technoscientific studies and careers, this line of research suggests the claim that computing is regarded as male territory and, by the same token, that girls show disinterest and disaffection towards computer science. Margolis and Fisher (2002) point out that such feelings are neither genetic nor accidental, but rely upon multiple external factors such as the encounter with a technical culture that women perceive as distant from them, and a variety of discouraging experiences with teachers, peers and school programs.

Following this line of inquiry, this paper problematizes the experience of Italian women who travel the world of computing as practitioners and academics. More specifically, the study has involved women who participate in Italian and international networks, initiatives, and campaigns that confront the problem of the gender divide in computing. The analysis is based on a set of in–depth interviews which aim at questioning the gender assumptions that shape the construction of disciplines, practices, and knowledge surrounding computer technologies. Therefore, rather than emphasizing the mechanisms that keep women outside or at the margins of computing (glass ceiling, leaky pipeline), the paper examines the experience of those women who inhabit the world of computing in order to question the alleged gender neutrality of the field.

The research

This paper provides the results of my doctoral research in which I interviewed Italian women within the field of computing as students, professionals, and academics between the ages of 23 and 71, and involved in networks and initiatives committed to promoting greater female presence and gender awareness in computing. I have conducted nineteen semi–structured interviews and carried out direct observations of six events dedicated to attracting young female students to computer science and IT professions. In doing so, I have tried to detect arguments and rhetoric deployed when recruiting young female students to computer science and computer engineering academic departments, the discursive practices around gender issues in computing and the relationship between women and computing.

Six networks were involved in the study:

- Girls Geek Dinners
- Project NERD? – Sapienza University
- Microsoft Pink Cloud
- Ubuntu Women
- Girls in Tech
- Wister – Women for Intelligent and Smart TERritories

These networks can be defined as such inasmuch over the course of my research I verified that several women involved in the interviews belong to more than one organization, that some of them participate in activities promoted by other groups, therefore most of them know one another. Accordingly, besides promoting networking events to foster the relationships between women and the IT industry, they themselves practice networking (Cozza, 2011) in order to promote and reinforce their goals.

However, despite being connected to one another, these networks present differences in the practices, targets, and goals characterizing their approach. For example, some of them belong to corporate initiatives (Microsoft Pink Cloud), others are developed by open source communities (Ubuntu Women). Some of them are distinctively national initiatives (the Project NERD? at Sapienza University, Wister) while others are international organizations with local branches (Girls in Tech and Girls Geek Dinners).

The interviews I conducted were structured according to three macro–themes: educational paths, gender issues in computing, viewpoints on and experience in informatics. These themes revolve around two main research questions I wish to investigate:

- What is the relationship between women IT professionals and IT technologies?
- How do women problematize gender issues in their technical field?

In addressing these inquiries, the excerpts of interviews presented in the following sections problematize the popular rhetoric that describes computing as an unwelcoming place for women, thus challenging the assumption by which computer science is inherently a masculine domain. According to Keith Grint and Rosalind Gill, the association between technology and masculinity is a cultural and ideological one, but it also seems to be an academic assumption as some writings on the gender–technology relation start their reflections with the understanding that technology is inherently masculine (Grint and Gill, 1995). As a matter of fact, several studies have remarked that women are not alienated from technology as they invented early computing technologies (Light, 1999;

Sciannamblo, 2016) and they continue to have relations with technology which are marked by pleasure and enjoyment (Corneliussen, 2014). Along these lines, women students and professionals I met throughout my research find computing as an empowering, interesting and funny world while, at the same time, they do not disregard the gender issues in the field. In the following sections, I thematize three main issues that emerged from the interviews: the importance of numbers, the dynamic of pinkwashing, and gender troubles women experience in traveling the sociotechnical world of computing. The analysis of the narrative collected has shaped these three analytic dimensions that allow us to see how women travel through and problematize a technical territory that is marked out as predominantly male (Gherardi, 1996). Moreover, the engagement with computer technologies will show how women fashion themselves as critical subjects *of* and *in* male gendered technical culture (Dorrestijn, 2012).

'We are very few': numbers matter

Although computing has been greatly populated by women in the early days of digital computing (Light, 1999; Sciannamblo, 2016), nowadays it represents a typical example of a technoscience that has excluded women (Lagesen, 2007). Indeed, since the early 1980s, various narratives have focused on the exclusion of women, developing an understanding that describes computer fields as technical worlds 'where women and femininity appear as matter out of place' (Sørensen, Faulkner and Rommes, 2011, p. 45). The acknowledgement of the low number of female students in computer science and engineering is also one of the first issues that has come up during interviews with women of different ages. Here is the reflection of Maria, who started studying electronic engineering in 1984:

> 'When I started engineering at university, there were 10 girls out of 250 students. My group of female students attended throughout the 5 years, so everyday was like this. Then I accompanied my brother to the law department, I took a look around in Crociera Room at University of Milan and I said 'oh, this is a different world'. I studied electronic engineering, actually it was computer science but back then it was all electronic. We were counted according to our surname and the percentage of women was of 4%. But today it has not changed.' (Maria, engineer, member of Girls Geek Dinner)

As Maria points out, the number of female students when she studied electronic engineering at Politecnico in Milan was rather low. Such disparity

was more evident when she got the opportunity to visit the law department where her brother studied, an entirely 'different world' in her words, looking at the differences between the number of men and women.

The scant presence of women in computing is not just an issue affecting educational paths as it becomes more evident in volunteering activities such as those required by open source communities. Here is the reflection of Eva, who recalls the time she has joined the Ubuntu Women community:

> 'When I arrived, there were very few women. There were no women on the board, no women among the moderators of the forum, there were very few women. It was just a fact of presence, there was no presence, there were very few.' (Eva, communication manager, co–founder of Ubuntu Women Italy)

Here Eva remarks on the first issue that emerges when it comes to the discussion about gender issues in science and technology, namely the actual absence of women. This is not a matter of (in)visibility, namely to make visible the contribution or the presence of women that has been concealed by historical records as Rossiter points out (1993), but it has to do with the very lack of women in this field. While recognizing the shortage of women in computer science can appear an obvious issue, this is anything but trivial insofar as no further inquiries – such as the supposed symbolic and material construction of computing as a masculine realm – would have been posed without the acknowledgement of the absence of women. As several studies have pointed out (Lagesen, 2007; Margolis and Fisher, 2002), the analysis of numbers is crucial in order to even think about gender issues in computing and, then, to explore further readings and approaches to the problem. Additionally, the recognition of a neat disparity in the number of men and women is important inasmuch as it is the basis for the emergence of the women's networks I have examined as well as the first concern that motivates female professionals in computing to join and create these networks in order to promote the presence of women in the field.

Pinkwashing: problematizing the access of women to computing

The fundamental goal driving campaigns toward the promotion of women in computing is to reduce the distance between men and women. In this regard, the women students and professionals I interviewed tended to dispute not only the alleged gender neutrality of the field, but also two commonplaces at the heart of recruitment campaigns and discourses

surrounding computing: that women are particularly good with people and at developing communication skills (Corneliussen, 2014; Lagesen, 2007; Lagesen and Sørensen, 2009), and, by the same token, that they do not particularly like technical and scientific subjects which are often depicted as adverse masculine mastery. However, if the majority of the women I met attributes the choice made to undertake a career in computer science to passion and interest in mathematics and technical tinkering, there also are slightly different experiences, as in the case of Viola, who recounts the time before applying to the computer engineering program as below:

> 'It's a dumb thing, but it went by exclusion. You know, at the beginning I wanted to study communication. I liked the idea of communication, I saw the computer and computer science as a means of communication, able to connect people in order to communicate. However, the educational offer did not convince me because I wondered 'what can I do next?'. I wanted something more technical, more... I do not know how to say, I liked studying, but it [communication] seemed to me little concrete actually, I liked writing but I also liked scientific subjects. Therefore, I eventually landed up in computer engineering because the aspect of communication related to information technology as a computer system, as a way to connect people stood, and it was engineering on the other hand, which had the scientific part I was interested in.' (Viola, engineer, member of Ubuntu Women Italy)

Viola did not consider studying computer engineering as her first choice, but rather it seemed to be a good link between her primary interests (communication) and the need to envision a clear path after university which, in her words, 'something more technical and concrete' like a degree in engineering could offer. In Viola's words, computer engineering as educational path emerges as a crossroad where different motivations converge.

This experience is somewhat at odds with the rhetoric that aims at recruiting women in IT by outlining a supposed model of femininity that sees women as more inclined to communication and social skills. The so–called representation dilemma (SSL Nagbot, 2016), which aims precisely at recognizing the lack of diversity in technoscience along with attempting to push the boundaries of the heteronormative masculine culture of computing, is problematized by Neda, a computer scientist working in the public administration and committed to promoting open source software:

> 'This issue [shortage of women in computing] is becoming popular to the point that, I dare to say, I have had enough of those initiatives that are also commercially exploited and that always associate the term 'pink' with technologies, which is a really absurd way of trying to fight a stereotype using another stereotype that is pink. This is deadly annoying because the fact of associating the pink to technology gives a wrong message to girls, that is that technology is the candy, the cute thing, it is a simplification of technology that women themselves actually do not hold. So, I don't understand the reason why they are told, like babies, 'do get closer to technologies because they are cute, they are pink'. Rather, we have to explain the real benefits of technology, because there are. Moreover, I am a computer scientist so I speak from personal experience, when women get access to informatics they don't do that superficially, I think the worst nerds that I know are women, so we are not necessarily fascinated by the pink aspect if we want to use the pink term in this way. We are often fascinated by what is behind, the challenge that lies behind informatics, not at all because it is an easy job. They pass on an absolutely distorted message and it's a shame, it is really a shame.' (Neda, computer scientist, open source advocate)

Here Neda exemplifies some crucial issues that define the complexity of the gender–technology relation. Wendy Faulkner considers such relation as lying in the symmetry by which 'just as one cannot understand technology without reference to gender, so one cannot understand gender without reference to technology' (Faulkner, 2001, p. 90). Neda's words problematize precisely this assumption by challenging two opposite material–semiotic associations that regard technology as a traditional masculine domain on the one hand, and the opposite construction of female, thus pink–colored, technologies.

Additionally, in challenging the dichotomous terms whereby technology is gendered, Neda also points to the heteronormative assumptions behind such dualistic understanding of informatics insofar as heteronormativity refers to the relationship between gendered opposites – a male and a female. On the contrary, the claim 'the worst nerds that I know are women' shows how stereotyped gender identities constructed through a likewise stereotyped image of technology come undone in practice.

'The hard hat problem': women traveling through the world of computing

As figures and numbers certify, educational paths and careers in the world of computers are domains quantitatively dominated by men. Nevertheless, there is no lack of women mentors and historical inspiring examples – such as Ada Lovelace to Anita Borg, and Grace Hopper – which are popularized to a great extent by networks aimed at bridging the gender gap in computing. Such availability of references is an important aspect to be taken into account especially when it comes to addressing the age of women involved in the field. This issue has emerged from the field research when I met Frida. She is full professor in Artificial Intelligence (AI). She received her degree in mathematics in 1968, after which she started researching Informatics with a permanent contract in an Italian public research center. When she started working in computer science, there were neither academic programs in informatics in Italy nor the recognition of computer science as an academic subject area.

To borrow a poignant expression from Silvia Gherardi, Frida can be regarded as a woman who has traveled in a male world throughout her career (Gherardi, 1996). Frida is a pioneer, namely someone who paved the way for AI in Italy, a woman in a world totally populated by men. In recalling her career, she claims that she has experienced an overall fair environment in terms of gender dynamics, aside from one particular case, when she moved from introductory courses to the 'real engineering':

> 'When the graduate program in computer engineering set out, I moved to the course of AI. Previously, I taught in a course of the biennium, that is an introductory course, then I moved to a course in the triennium, namely an advanced engineering course: I felt some hostility in the faculty. Because back then a woman teaching in a course of biennium...why not? There are several women that teach mathematics and physics in the biennium, but in the triennium of engineering… engineers are male, a and woman is perceived, or was perceived in 1990…' (Frida, full professor in computer engineering)

Here Frida outlines a division of subjects areas – introductory courses and advanced courses – which are informed by gender asymmetries and presumptions. According to her experience, introductory courses such as mathematics and physics are likely to be taught by women, but when it comes to advanced engineering courses, like AI, a woman is perceived as an intruder (Gherardi, 1996). Therefore, I asked Frida what is it that makes

introductory courses a likely female domain, whereas advanced courses look like a male clubhouse:

> 'Because in the triennium you have advanced engineering subjects like civil engineering. So in the first two years you learn the tools of the trade, right?! Mathematical tools, physic tools and so on. Then you learn the proper techniques of your engineering, these are what I call engineers with capital 'i'. So I felt some mistrust among faculty colleagues when I had the courage to leave the world of service subjects and enter the world of actual engineers. There are few women who are actual engineers.'

This excerpt shows the extent to which Frida has experienced the gendered division of knowledge within the engineering field. In her view, the more it comes to specialized and technical subjects the more the field is male–dominated. A gendered division of sub–fields emerges, with 'service subjects' taught by more women in the biennium and advanced engineering subjects which were configured as a male domain.

When I asked Frida to explain this supposed distinction between 'harder' and 'softer' engineering, she claimed:

> 'Well, also in engineering there is the engineer who goes with his hard hat to construction sites and the engineer who goes to offices and sits at the table. […] In the field of information, the graduate program that attracts more women is management engineering because it is without the hard hat.'

The figure of the 'hard hat' is a powerful one, therefore I asked Frida what this object represents for her:

> 'It means hard life, life you live on construction sites, life in an environment where there are only men, in which you have to lead or control a group of men, so you have to be accepted as chief by a group of men, so it is a working condition not that easy, honestly. Let's say, to be a forerunner or be alone in certain positions, without models for you and for others around you, without previous examples for those around you, this is not easy.'

The hard hat is both a symbolic reference and a material artifact through which Frida describes the prevalent masculine environment that construction sites embody. These are environments commonly associated with manual work, physical strength, risk, danger, noise, dust, elements

that, in turn, are usually associated with a gender identity that corresponds to the heterosexual, able, working–class male. It is this gendered field with the 'hard hat' that Frida describes as hostile in seeing a woman teaching advanced engineering subjects rather than 'service subjects'.

Conclusion

The interplay between gender and technology can be analyzed under a variety of approaches (Cozza, 2008; Faulkner 2011). In this paper I put these approaches to work in order to explore the field of computing, a relatively young technoscientific area that registers one of the lowest percentages of women (She Figures, 2015).

However, notwithstanding the gender imbalance in terms of number that female computer professionals themselves recognize as a pivotal issue, the narratives of women who travel through a technical territory that is marked out as male problematize precisely the alleged neutral character of computing as well as those initiatives that call for 'more women in tech' by reproducing those very gender stereotypes they are supposed to fight. From this point of view, a critical reflexive approach emerges with respect to rhetoric and marketing campaigns aimed at recruiting young women to computer science. In this respect, the term 'pinkwashing' has been employed to describe the exploitation of social and political causes – such as the struggle against breast cancer – by companies to appeal to consumers and sell their products (Lubitow and Davis, 2011). In the case of the interviews presented here, this critique has been moved by women who operate within open source communities towards corporate initiatives that use the color pink – and metaphor – to mark out the company's commitment to promoting more women and gender awareness in technology. This is an important issue inasmuch as it points to the heteronormative, binary character with which the image of computing is associated. Indeed, the marketing strategy of linking computer technology with the color pink reflects the traditional gendered division of labor by which women take up care duties such as housework and childcare, while men play the role of breadwinners focused on career and professional advancement (Rubin, 1975). The critical stance of several women practitioners towards pinkwashing interestingly resonates with Christina Dunbar–Hester's analysis of gendered selfhoods within American radio activists (Dunbar–Hester, 2014). Her account of the good intentions of many radio activists committed to contrasting a hierarchy of technical

participation based on gender roles unveils the reluctance of some women to overcome a traditional feminine domain marked by domestic duties. In her view, such 'reinscription of neotraditional gender roles' operated by female members of radio communities emphasized the complex and nuanced relationships between gendered selfhoods and technical practice, and the thorny challenge of decoupling the hegemonic masculine identity from technical mastery.

Finally, the case of women pioneers who enter male worlds as in the accounts of Frida brings into play elements of reflexivity that deserve attention. Indeed, Frida's experience unveils the contribution of women to the construction of computer science as a new technical field and scientific discipline in Italy. In this regard, 'the hard hat problem' points precisely to the gendered character of technoscientific knowledge inasmuch it is possible to detect a hierarchical order of disciplines such that introductory subjects (mathematics, physics) to the field of computer science are regarded as a female domain, whereas advanced engineering subjects are to be considered as a male domain. This remark calls into question the mutual shaping of political orders and the construction of science (Shapin and Schaffer, 1985), but it mainly identifies the invisible or marginal role of women, thus an asymmetrical order of gender relations behind the advancement of Western knowledge (Haraway, 1997).

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