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Re-thinking intersectionality through Science and Technology Studies: trajectories of women in technoscientific fields

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1. *Introduction*

Intersectionality is an important analytical device whereby to interrogate the processes of social categorization. The concept has gone through multiple foundations (Lutz 2014) throughout its use, to become an inclusive conceptualization with different understandings. It has contributed to make accountable the plurality of discrimination suffered by black women (Crenshaw 1989); it has become a theoretical tool to denounce forms of discrimination (Collins 2000); it has been discussed with the purpose to unveil social agency (Lykke 2011). From being a category that identifies fixed positions, it has turned into an engaging analytical lens to explore the process of becoming of crucial social categorizations continuously reworked by the agency of subjects. As Colombo and Rebughini (2015) argue, intersectionality can be conceived of as a method, as a theory, and as an epistemological inquiry able to speak to different disciplines and perspectives.

In this paper, we aim to connect the debate about intersectionality with Science and Technology Studies (STS). The central idea is that of interpreting intersectionality as a process always in action, instead of a crossroad of categories. In this regard, the analytical toolbox provided by STS allows us to scrutinize the intersections of female trajectories and scientific systems in a way that attempts to go beyond an «additive approach» to discriminations as it is in the original formulation of the concept (Crenshaw 1989). We argue that science and technology are regulated, controlled and legitimized by gender asymmetries (Rossiter 1993), thus they have also been investigated with the lens of intersectionality. However, we argue that intersectional-

ity should not be understood as an addition of conditions that determine *either* disadvantages *or* privileges, but rather as an assemblage (Castiello 2012; Puar 2012) of social and material locations. Against this backdrop, we advance an explorative perspective to show how different assemblages of sociomaterial practices, in which actors are embedded, may open autonomous positionings and trajectories.

The aim of this paper is twofold. On the one hand we want to extend the discussion on intersectionality to the fields of science and technology; on the other we propose to move the theoretical debate on intersectionality beyond its original boundaries and to put the concept in conversation with the rich literature of STS. In this paper we present three exemplary biographies of Italian women working in scientific fields. These stories have been selected from a sample of narrative biographies collected as part of a broader research project[1]. We have examined how women *do* science and technology by oscillating between adaption and resistance to structural features of society, but also through the articulation of agency in terms of reconfiguration and enactment of new practices and networks among contexts and disciplines that are not taken for granted. These issues can be phrased through the following questions: What kind of space, knowledge, practices and objects maintain forms of subordination? What are those interconnections that foster and enlighten experiences of social agency and individual enactment? The three stories are exemplary cases because they show how the analysis of different social, cultural and material arrangements that characterize female trajectories allow us to go beyond the traditional understanding of intersectionality as matrix of domination (Crenshaw 1989), suggesting different ways of confronting risks of discrimination through resistance, reconfiguration and processes of enactment.

2. *Thinking intersectionality through Science and Technology Studies*

Intersectionality has its theoretical roots within the gender studies, anti-racist and post-colonial debates of the 1970s. In this section, we hint at the origins of the concept by underlining its dynamic trajectories and insert it into the conversation with further theoretical frameworks and empirical fields. We would like to expand the theoretical understanding and empirical employment of the concept through a dialogue with Science and Technology Studies (STS) (Haraway 1985; Latour 2005; Wacjman 1991)[2]. In this contribution, STS is to be understood as our analytic sensibility to look at the processes of construction of the social, the material, gender and its interconnections. With feminist STS scholar Nina Lykke (2011), we consider the notion of intersectionality as a «nodal point», that is not a concept with a fixed definition, but rather a «discursive site» where different feminist positions are in critical dialogue with one other. In our treatment of intersectionality, we aspire to a productive conversation between postcolonial, intersectional feminist theory, postrepresentational and posthuman debates. In this respect, the concept becomes a thinking device to detect the multiplicity of ways in which categorizations bring about forms of marginalization, power differentials and agency.

Although the fields of science and technology are often considered as problematic realms in terms of gender equality, and sometimes hostile to women, their empirical investigation through a dynamic understanding of intersectionality allows us to see them as interesting spaces where the processes of categorization are often negotiated, contested, and reworked in practice. While contemporary forms of female discrimination and subordination, described by popular metaphors such as the «glass ceiling», «leaky pipeline» and «sticky floor», emphasize fixed positions and hierarchies, intersectionality has been recently employed as an analytic lens (Charleston *et al.* 2014; O'Brien 2015; Rodriguez *et al.* 2016) to detect scientific disciplines as further axes of discrimination besides race, ethnicity, sexual orientation and ableism.

However, if these studies provide a clear impulse toward the promotion of policies, practices and interventions which can

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[2] To get an insight into the rich debate between feminist and mainstream positions within STS, see Lykke, Markussen, and Olesen (2008).

fill the gender gap in STEM (science, technology, engineering, mathematics), we observe an overall tendency to assume science and technology as fixed realms and their internal articulation taken for granted[3]. By employing the concept of «doing intersectionality» (Lutz 2014), science and technology are understood not only as further categories of discrimination, but also as a discursive and practical site of sociomaterial construction. In line with those authors who have discussed intersectionality by underlining the mobile character of experiences defining each subjectivity (Castiello 2012; Puar 2012), we also suggest to read science and technology as heterogeneous and sociomaterial fields (Orlikowski 2007).

Intersectionality has brought about greater complexity in the social analysis of difference by stretching the scope of the field of gender studies (De Vita 2014). However, we regard such concept not as a label to describe *the matrix of domination* of race or class and gender (Crenshaw 1989; Davis 1981), but mainly as an analytical and empirical open device to explore the articulation of differences that characterize individual experience as «irreducible and dialogic» (Anthias 2013, 335).

Recent re-formulations (Hancock 2007; McCall 2005) have advanced a dynamic understanding of intersections, which sees the dimensions of inequality translated in practice, so that boundaries among actors, categories, practices, and contexts become blurred, variable and contested. Following these considerations, we seek to uncover the potential of intersectional analysis to generate novel questions and perspectives (Matsuda 1991) by employing the analytical framework of STS, with particular reference to the feminist thinking in this field (Castiello 2012; Lykke 2011; 2010). As a discursive site, we aim to combine two reformulations of the notion of intersectionality, which draw on recent studies on intersectionality and on feminist STS – «doing intersectionality» (Lutz 2014), and «assemblage» (Puar 2012), respectively. If both of them look at the dynamic character of the concept, the former focuses on the agency of the subject, whereas the latter allows

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[3] «Gender mainstreaming» is one of the most popular strategies developed to achieve gender equality within policy actions, legislation, research programmes and resource allocations. As far as scientific research is concerned, gender mainstreaming has been included as a cross-cutting issue with the EU framework programme for research and innovation, Horizon (2020).

us to detect processes of mobility in sociomaterial terms through the categories of spaces, knowledge, practices and objects.

The argument of «doing intersectionality» invites an exploration of how individuals creatively, and often surprisingly, draw upon various aspects of their multiple experiences to gain control over their lives. Additionally, following suggestions from STS and practice-based studies, we examine how «doing intersectionality» is situated in practice (Suchman 2007) within specific contexts, objects and networks. Just as these approaches have showed that science and technology are continuously translated in practices, we also understand «doing intersectionality» as an ongoing sociomaterial process which calls into question the boundaries between the material and the social, agency and structure, fixed categories and mobile trajectories. To sum up, we advance a theoretical leap from intersectionality to «doing intersectionality», that is understanding how intersectionality is accomplished in practice (Gherardi 2006; 2009; 2012). Therefore, as STS suggests, we look ecologically at how actors are assembled in specific sociomaterial contexts and networks shaped by their own organizational practices, disciplines, technoscientific objects, values and cultural beliefs. The central idea of this contribution is that of interpreting intersectionality as an assemblage, a process always in action, instead of a gridlock of categories as in the original formulation (Crenshaw 1989).

3. *Methodology and research fields*

By drawing on the argument of «doing intersectionality» (Lutz 2014), we seek to shift attention from risks of exclusion to sites of possibilities. We argue, indeed, that subjects are not pigeonholed into fixed categories of discrimination, but rather they move across social situations that open up new spaces for action.

We empirically discuss such a way of understanding intersectionality by examining the fields of science and technology, which have been broadly investigated as terrains of gender discrimination (Etzkowitz, Kemelgor and Uzzi 2000; She figures 2015). The literature generally confirms that being a woman with different places of origin, social and economic capital and educational trajectories in scientific fields constitutes a potential

source of marginalization. Alongside these aspects, already widely investigated, we want to put forth other insights by drawing on STS, so as to empirically detect not only oscillations between discriminations and opportunities, but also sociomaterial relations that draw the patterns of such movements. Following STS scholarship, by which nothing is natural and ascribed but everything is an ongoing social and material site of construction, we have identified some analytical dimensions that enable us to empirically trace the trajectories of subjects not only in terms of «doing intersectionality», but also in terms of «assemblages», that is to say how subjects move across different social settings intersecting contexts, disciplines, practices and objects. Therefore, seeing «doing intersectionality» through STS means seeing actors as entangled in networks of practices and translational processes (Callon 1984), experimenting with forms of adaptation, marginalization, enactment and agency.

Therefore, by combining these suggestions from STS with recent reformulations of intersectionality through assemblages (Puar 2012), we introduce four analytic categories to enrich the intersectional framework. The categories are: space, knowledge, practice and objects. These STS-informed categories serve as crucial heuristic tools whereby we have challenged the divide between the social and the material that sustain the original understanding of intersectionality, in order to focus on processes of sociomaterial assemblage that characterize the female trajectories. These issues are still a neglected aspect of intersectional analysis. In this framework, the category of «gender», which has strongly informed the traditional intersectional analysis, becomes a set of changing practices to perform in relation with different situations and actors rather than a detrimental trait of female experience in science and technology. As we suggest in the conclusion, this theoretical leap brings the debate on intersectionality *beyond* a *human-centered* view towards a *post-humanist* perspective.

Each category presents two dimensions that, in our view, allow us to trace the movement of doing intersectionality. The first category, made up by the pair *immobility/mobility*, looks at the *space*, that is how our interviewees move or stand in their sites of action. In this case we expect that the spatial *mobility* of our respondents, in their crossing of different contexts and networks, or rather in the *immobility* within the same contexts, unveil different patterns of doing intersectionality. The places involving our

subjects present different arrangements of roles, power asymmetries, hierarchies, agency and constraints, which are experienced in different ways in terms of discrimination and opportunities. The second pair of dimensions is *disciplinarity/interdisciplinarity*, which concern the category of *knowledge*. In this respect, we aim to see how interviewees move beyond different disciplinary areas, assuming that these dynamics are also related to different ways of «doing intersectionality» between consolidated and emerging knowledge. The third category is *practice*, which is probed through dimensions of *reproduction/transformation*. Here we look at the extent to which our respondents reproduce labor practices by following rules belonging to their contexts or, rather, they perform in a transformative way work practices by stretching routines and standards prescribed by their settings. The fourth category aims to reflect on the role of *objects*, and it relies on dimensions of *black-box/tinkering.* In this regard, we seek to unfold how the women we have interviewed construct relationships with their objects of knowledge, that is whether they relate to them as black-boxes ready to use, rather than as open artifacts that are problematized, disassembled, and reconfigured. This methodological framework nurtures an idea of individual experience as not reducible to one point (a context, a role, a discipline), but rather as a plural and mobile trajectory; by the same token, we consider the individual background (education, family, culture) not as a Bourdieusian *habitus* that affects destinies, but as a resource that can be used reflexively towards different directions. In our research, we have chosen to foreground a non-individualistic idea of action as the subject is constantly immersed in practices whose meanings are always under construction (even during the interview). Empirically, we scrutinize educational and professional biographies of Italian women working in scientific fields and organizational contexts within science and technology: universities, private research institutions, high tech companies, and startups committed to technological innovation. These are sites in which the lens of intersectionality allows us to detect how gender discriminations take place according to various dynamics. The three stories offer a micro-perspective of a much broader story of women in educational and professional paths in science and technology, where discrimination, inequalities and gender gap persist. More specifically, we have selected three exemplary cases from a broader sample constructed as a part of a research project on women's careers in scientific fields.

The three biographies presented belong to Italian women between 29 and 45 years old. In the light of the «narrative turn» in social sciences (Poggio 2004), we conducted semi-structured interviews (Bertaux and Bichi 2003) which allowed us to adopt a proximal view so as to trace how women's trajectories unfold through processes of mobilities, active construction, and pitfalls among spaces, knowledge, practices and objects. In our settings we spurred a vivid dialogue with our interlocutors, so as to evoke and discuss their personal and scientific trajectories situated in practice. In this regard, the interview becomes a *performative research method* (Law 2009) able to generate reflexive knowledge (Melucci 1998) in the course of its production, and trace the actors' agency and constraints. The interpretation of the three stories, collected and analyzed according to our four categories, will allow us to observe how the experiences narrated unfold the interconnections of such categories. The stories of Lucia, Elena and Alessia bring us into the scientific fields of biotechnology, physics and computer science, and show how educational and professional biographies move across space, knowledge, practices and objects. These movements describe intersectionality as a dynamic site constructed in practice as well as in the tension between risks of discrimination and construction of opportunities.

4. *Trajectories of Italian women in technoscientific fields: three exemplary cases*

4.1. «*I feel stuck*»: *intersectionality between discriminations and opportunities*

Lucia is 35 years old and she is a post-doc in biotechnology. She moved from Sicily to Northern Italy to undertake her academic studies. She currently works at Istituto Superiore di Sanità (ISS) in Rome, a public national research institute. During high school, she became interested in biology, then she moved to Bologna to study biotechnology at university. Later she decided to undertake an internship in a pharmaceutical company in Siena, after which she went back to Bologna where she started an unfunded PhD. Thanks to her personal networks, she decided to move to Rome where she got a scholarship. The ISS group where Lucia works became smaller over the years, which is a

typical process in research organizations that employ people with non-fixed employment contracts (PhD candidates, research fellows and post-docs). Today Lucia lives in a world where leaders are men, whereas her peers are mostly women. Lucia has worked in the same organizational space for some years. She feels constrained, but for several reasons she does not move. Everyday she experiences the rules of a hierarchical organization, she is part of a scientific field designed and managed by others (mostly men), and she feels she experiences discrimination. In this respect, she raises several concerns:

> We manage different projects, but the work is based on hierarchies. There is the senior researcher, who is a German guy in my case, who is in charge of one or more projects and has people working under him. The network of relationships in my group is large, we have partners in London and Germany, but often we cannot manage them by ourselves, basically there is also a hierarchical way to manange external contacts. Over the years several people have moved to other cities, to work in other contexts, so I feel very stuck. On the one hand I want to take a look around, on the other I want to conclude, I do not want to give what has been done to someone else! Now I am in this phase… I want more autonomy…

Here we see an articulated context, which presents space of action and international networks on the one hand, and typical patterns of public bureaucracies on the other. As a matter of fact, roles and responsibilities are structured by gender and hierarchical rules: usually women carry out the most operative tasks, whereas men are in charge. Lucia is not happy but cannot find a way out. She oscillates between a desire of *mobility* and professional *immobility*. While she describes the context where she works as being discriminatory, hierarchical and characterized by gender disparities, it is not easy for her to leave.

As far as the role of objects is concerned, Lucia's scientific work focuses on the identification of monoclonal antibodies for colon cancer. In the following excerpt, we see how she uses these objects as *black-boxes*, namely unproblematized objects that she handles just for technical purposes and repetitive tasks. The monoclonal antibodies are effective tools used in biochemistry, biology, diagnostics, and cancer research. Lucia has focused her efforts on the use and test of these biotechnological tools and her daily work consists exclusively in the production and validation of them.

It's been 3-4 years, so let's say the whole period of my post-doc, since I am working in a project that deals exclusively with the identification of monoclonal antibodies for diagnostic, prognostic and therapeutic use against colon cancer stem cells. I do like very much what I do, but I realize that I cannot do it for a lifetime, and if I do not move I could go on like this for life, because seven years are gone and I know that it may take just as many.

Lucia has long worked with the same object, immersed in work practices characterized by repetition. As to the category of knowledge, we see her moving across narrow disciplinary fields. Indeed, although she comes from a curriculum in pharmacy in the field of biotechnology, the scientific knowledge in which she is currently involved concerns the rather narrow discipline of molecular biology. Lucia is in an impasse. She is experiencing troubles that do not allow her to find simple solutions or an immediate way out. She *feels stuck*. Such immobility also reflects her daily unchanging tasks. In the following extract, we see her urgent need to finalize in material terms, with a scientific publication, the work done in these years. In order to see her job accomplished, she would be willing to publish in a smaller journal.

I would like to ask my professor if he's going to keep me here, and how, because it is not so obvious, it depends on funding…you realize that doing research is fascinating but frustrating at the same time, the results take a lot of time to come. I hope to start to write about my research and send the work of antibodies to a journal as soon as possible. For me, the problem now is getting an article published and the hierarchical organization does not help. This is a very stressful moment. It's been a year since we are trying to publish this work on glioblastoma, we have already sent the article, we aim to publish in top journals like Nature, but it's tough. We are going through some troubles, we have sent it to a journal but it rejected it, we are amending it, we have been suggested to make more experiments, so we are trying to collect more data. I hope that my supervisor will decide to publish in a smaller journal, so now we are at the beginning of the work, again, but he does not involve us in his choices. Here is the problem. Talking about the future, I would actually like to remain in cancer therapy and also antibody, but in a company. Recently I sent my CV to a company in Cambridge, which makes monoclonal antibodies for therapy, so I may move towards industrial research. I really do not have many expectations, I do not expect big changes, but I champ at the bit, yes.

Lucia's story is ambivalent. Risks of discrimination and attempts of agency seem to coexist. Lucia's trajectory appears at a crossroad, in a space of intersection where pressures and

resistances coexist. She does not have space of action and believes that someone else (her professor, her supervisor) should give her autonomy. Lucia is restless and *champ at the bit*. Her agency lies in her discontent, in the desire to emerge and in the awareness of the risk of getting caught in the events.

4.2. «*I feel a hybrid*»: moving across spaces and knowledge

Elena is an electronic engineer working as researcher at CNR. She is 41 years old and she was born in Pisa. After winning a Fulbright Best which allowed her to spend six months in the Silicon Valley, she returned to Italy and founded a biomedical company with other two researchers. The company is a spin off from CNR and develops non-invasive devices for the prevention of cardiovascular disease. Looking at the story of Elena with the category of space, the dimension of mobility is the one that distinguishes her trajectory. Elena moves across contexts of academic research and contexts of business applications – universities, research centres, Silicon Valley, a spinoff from CNR. In this dynamic she has intensified and extended her professional networks. As for the category of knowledge, Elena moves across a rather interdisciplinary field – from engineering to medicine and biology. Such a combination of locations, disciplines and transformative practices are materially translated into an innovative, open object: the biomedical software.

With regard to the heterogeneous and changing experience across multiple spaces, she claims she feels «a hybrid»:

> I feel quite a hybrid. I am a researcher from CNR, but at the same time I got the chance to apply what we develop for research to business, and make it accessible to people. This is something I'm interested in as researcher. I'm interested in this process of combining research with industry, something that has become a natural need for me. The Fulbright has represented a chance to develop knowledge in this regard.

The interdisciplinary mobile trajectory is Elena's way of building an autonomous path where the personal interest in hybridizing disciplines, already present during her academic studies, combines with a re-articulation of the traditional working practices of the CNR, with the ultimate goal to create a biomedical object that improve people's lives.

I have taken this thing to hybridize from my university studies as I chose to take exams like biomedical materials and biomedical electronics within an electrical engineering program. At the time, there was not any course in bio-medical engineering. I have begun to cultivate such interests by taking some exams, and then I realized I liked it, so I decided to pursue it later, when I started at CNR. I then also started a course of study in entrepreneurship and technology, I participated to the Competition of Mind the Bridge, which is an environment designed for entrepreneurs but also for profiles, like mine, who come from research. During my experience in the Silicon Valley, I saw that this combination of business and research I have in my curriculum is something natural. I do not know yet, my approach is this one now. So, let's say this is my job, that of linking reaserch to industry. I am not saying this is the norm today, but at least there are concepts that have become commonly used. Today it makes sense that a technical path is open to other aspects.

It is precisely in the mobility across multiple spaces, in the tension between theory and practice, research and application, that she finds the possibility to articultate her personal trajectory. Moreover the crossing of different spaces, while it allows us to grasp how, in different environments, the fact of being a woman, scientist, researcher or entrepreneur has a different impact, on the other hand it promotes a redefinition of their own choices and trajectories, opening up new courses of action. Therefore, conditions of marginalization are not the same in any context, but, as pointed out by the interpretation of intersectionality as assemblage, it is precisely the mobility across contexts that promote individual agency. Being in a predominantly male world increases a sense of alienation and isolation. In this case, however, taking the central role that intersectionality assigns to marginal positions, that of Elena, albeit deviant, is a successful trajectory. It is precisely in a niche that the concatenation of biographical, scientific and positional elements produces a positive reconfiguration.

Speaking of men and women, I would say I have never experienced discriminatory attitudes neither in university nor in the workplace. I think it depends on your disposition, on what you care about. I am always looking for personal satisfaction, curiosity, interests, places where I can do what I like the most. Today I am the only woman in my workplace, it is still a male-dominated world, although I have to say I have met many women in biomedical fields recently. I am not alone, I am not the only woman, many others have done this before me.

In this male world, it is clear the need to search for other similar female stories. These stories, like in Elena's case, should

be read not with the categories of segregation but as an active construction of interdisciplinary fields. Thus, intersectionality is useful not to create new categories of discrimination as «women entrepreneurs» or «women scientists», but it is useful for looking at the relationships of inequality and the process of changing configurations of inequalities themselves.

4.3. «*I have always been used to pull things apart in order to figure them out*»: tinkering with space, knowledge, practices and objects

Alessia is 29-years-old PhD candidate in computer science at Sapienza University. She was born in L'Aquila, where her mother took her degree in biology and works as a teacher in elementary school, whereas her father is an entrepreneur. Since her childhood, Alessia has shown interest in technical and literary subjects. In the high school, she became passionate about physics, so she decided to enroll in the physics program at University of L'Aquila. In the second year of her bachelor program, she turned to computer science. During this time, she went on Erasmus to Amsterdam, then she moved to Rome to attend a master program in computer science at Sapienza University. After her graduation, she founded a startup with two partners, but in 2013 decided to quit her business to apply for a PhD in computational graphics.

> I have always been used to pull things apart in order to figure them out, things like my brother's music box or the TV remote in my house, nothing survived. And I have always been on the borderline between natural sciences and humanities. Then I met this physics teacher in my high school, a tough woman but with a golden heart. She let us open the caskets of experiments, full of dusty and strange objects… I fell in love when this teacher asked us to make an experiment and present it in front of the class.

This first excerpt shows two main patterns of Alessia's story, namely her disposition to *tinkering* with objects along with a passion for both literary and scientific disciplines. Since she was young, Alessia is used to treat objects not as black-boxes to undertake repetitive tasks, but as artifacts to tinker with and reconfigure. As for the category of knowledge, it is clear she is

able to combine different disciplines – the natural sciences and the humanities – in a transformative way.

Inspired by the positive role of her physics teacher in the high school, Alessia decided to apply for physics at the university. However, she experienced a stressful environment and troubling relationships with professors in the physics department and, after having undergone a tough crisis, she decides to drop out.

> At that time I had a boyfriend who studied informatics, and, after about six months since I did not get out of the house, he told me: «That's enough! Come to class with me!». So I start to follow him and I discover that I like informatics, I felt at ease! That's exciting, crazy, it's like studying Dante [Alighieri] without studying Dante! So, I enrolled in computer science, I started taking exams of programming and they go pretty well. At the end of the first year, I decide to go on Erasmus, that was a moment of cut in my life… So I went to the Netherlands to visit the place where Dijkstra was born. Then I finally came back to L'Aquila because of the earthquake, so I quit my Erasmus in 24 hours. I worked for four months in a warehouse that delivered essential items and I realized I was good at logistics.

This extract shows a flavor of Alessia's creative gaze on knowledge. Indeed, she is able to approach a technical discipline such as computer science through her passion for humanities, and Dante Alighieri in particular, with the ultimate outcome to create personal disciplinary worlds.

The new educational path in computer science also speaks to the category of space insofar as we see Alessia moving easily across different locations: she goes to Amsterdam where she has the opportunity to study in the same university where one of the most influential computer scientists (Edsger W. Dijkstra) worked. However, after being informed about the earthquake, she suddenly moved back to L'Aquila and quit her Erasmus «in 24 hours» in order to help her family and her town. Here we can see the great sense of mobility that Alessia unfolds along with the ability to transform a practice undertaken during an adverse event into a resource of self-awareness. Indeed, in Alessia's case a detrimental occurrence became a source of agency rather than a factor of disempowerment. The voluntary work in the warehouse allowed her to discover she was good at business, something that she undertook after her graduation by founding a startup with two female partners thanks to a project sponsored by Sapienza University, where she moved to after L'Aquila:

I spent a year working for this startup without being paid, and you have to know that I am economically independent from my parents and I did not change my mind on that. In 2013, two friends of mine from my master program started their PhD in computational graphics. They told me that their professor was looking for another student for his team, but I was a bit skeptical as I did not even take that exam during my master. So I talked with this professor, he told me he was gonna pick me up to work with him if I got the scholarship. I was like «No way, that's impossible!». But the idea kept tantalizing me. So I applied, I got the scholarship, and I started my PhD.

Here, again, we see Alessia overcoming difficult conditions such as economic troubles and skepticism by moving across different spaces (a private company and the university), practices (working in a startup and doing research in university), disciplines (from her previous interest in intensive computing to the current PhD in computational graphics). The transformative approach she has towards her current experience emerges from how she describes her research field:

Another thing of my field that I love very much is that it is a good field, it does not have military or dangerous purposes, so I think it's a good choice for me. I am doing simulations for things like dinosaurs, the new «Jurassic Park» movie, but also other stuff like biomedical tissue, bones, or 3D printing. If I show you our work, you would wonder: «is that real or digital?». You don't know that. It's really cool!

Considering intersectionality as an analytical device to trace patterns of movement rather than fixed positions allows us to unveil the nomadic and rhizomatic character of Alessia's story (Braidotti 2011). Indeed, if we had read this story through the original formulation of the intersectional theory, we would have emphasized the *gridlock* of categories that define Alessia's identity and experience in scientific domains as negatively affected by a system of discrimination. Rather, by focusing on her crossing among different networks as well as on her ability to creatively re-articulate the boundaries among spaces, knowledge, practices and objects, we have tried to shed light on motion rather than on the gridlock.

5. *Discussion and conclusion*

Intersectionality examines how subjects are embedded in social categorizations and structures (gender roles, scientific dis-

ciplines, organizations, professional positions, hierarchies) that define boundaries and risks of discrimination; at the same time, it invites us to consider how actors always struggle to maintain margins of autonomy and agency (Colombo and Rebughini 2015), underlining the fact that individual life cannot be reduced to definite categories and conditions.

In this regard, the stories we have presented are exemplary precisely because they do not confirm common understandings of the condition of women in science and technology, but rather they suggest different articulations trough forms of discrimination, resistance, reconfiguration and processes of enactment.

In the first story, we see Lucia who is *stuck* between hierarchies and organizational structures, but at the same time she looks for spaces of recognition. Here the concept of intersectionality confirms its potential as an analytic tool to highlight risks of subordination. Lucia has long worked in the same place, she is immersed in practices largely characterized by repetitive tasks, she moves across bounded disciplinary fields, she inhabits hierarchized and gendered contexts, dealing with epistemic objects that she considers as black boxes. However, having adopted an interpretation of intersectionality based not so much on discriminations and individual agency, but rather on processes of re-alignment along spaces, knowledge, practices and objects, we notice that Lucia considers her condition not as a *matter of fact*, but as a *matter of concern* (Latour 2005). Despite the constraints, it is possible to detect some traces of her agency to escape from the risks of intersectionality.

Elena and Alessia's stories show a more evident interrelation of personal reconfiguration and mobility. The story of Elena seems to be in line with our attempt of interpreting intersectionality as an assemblage (Puar 2012), namely a process always in action instead of a *gridlock* of categories. Therefore intersectionality is here an analytic device not to map positions and identities, but patterns of movement that emerge in diverse processes of differentiation. We detect a need to reach and build new networks along with an intention to break hierarchies of knowledge between what is regarded as science and what is not. In her experience she develops new instances of knowledge that produce new *texture of practice* (Gherardi 2006). Elena's trajectory is lively, it presents unexpected features, forms of resistance and agency to break boundaries among knowledge and also gender roles. In Elena's

story, the intersection of gender and scientific research, far from engendering a barrier to her professional career as the popular methaphor of the «leaky pipeline» recalls, describes a re-articulation actively constructed through the crossings of spaces and disciplines. The experience of Elena is going beyond intersectionality in its traditional understanding, since space, knowledge, practices and objects are not axes of cumulative discrimination. In Elena's trajectory, we notice a way of personal action that does not try to enter the network by simulating male behaviours as she herself claims, but rather by creating shared knowledge as a result of a common negotiations. If Elena claims she feels a hybrid who combines different disciplines with research and business, she stays within the boundaries of her interdisciplinary field (bioengineering). On the other hand, Alessia is able not just to combine, but to actively transform the disciplinary realms in which she travels. Alessia's story suggests a critical evaluation of the idea of intersectionality in its traditional understanding as analytic tool to detect forms of subordination and oppression. We have employed an *ecological gaze* in order to detect patterns of relations, rather than single accidents, causes or categories. In this regard, re-thinking intersectionality through assemblage theory invites to focus on *motion* rather than of fixed positions, and to search for forces and processes that are prior to, around and *beyond* what gets established (Puar 2012, 63). In the transition from the first to the third story we move from the more fixed to the more mobile term of dimensions used for the analysis. Lucia, Alessia and Elena unfold different trajectories as they are entangled in different sociomaterial assemblages. Subjects, objects and social forces produce different outcomes in terms of «doing intersectionality».

In this paper, intersectionality has been regarded as a *discursive site* (Lykke 2011) as well as a *porous metaphor* (Puar 2012) able to gather different theoretical perspectives together. We have joined this conversation by advancing further analytical insights and empirical sites. More specifically, we have looked at STS both as an analytic toolbox and empirical terrain as we have presented three exemplary stories of Italian women inhabiting the fields of science and technology. These theoretical references have allowed us to problematize some crucial dimensions that are often taken for granted in the literature on intersectionality. For addressing scientific and technical knowledge, and any social phenomena

more in general, as processes always under construction and open to different outcomes, STS provides an important suggestion in order to go *beyond* the essentialist character of the original formulation of intersectionality. Additionally, the recent formulation of the notion in terms of «doing intersectionality» (Lutz 2014) has invited us to search for insightful links with feminist STS as in the case of Nina Lykke (2011) when she suggests to consider intersectionality as a «nodal point» and «discursive site», and Jasbir Puar (2012), who reinterprets intersectionality in the light of the concept of «assemblage».

Theoretically, we have sought to put these macro-perspectives into conversation. From such a dialogue, we have developed some analytic categories (space, knowledge, practice, objects) whereby we have read the three stories. These categories have allowed us to problematize the *human-centered* character of intersectionality, which persists also in the recent formulations of the concept. Indeed, the four categories and the related dimensions unveil aspects of the material construction of the world that enrich the empirical analysis of intersectionality, going beyond the axes of discriminations. In this respect, constructionist and sociomaterial perspectives have allowed us to see *space* through the movement between mobility and immobility (Urry 2007), *knowledge* between disciplinarity and interdisciplinarity (Barry and Born 2013), *practices* as transformative and reproductive (Schatzki, Knorr Cetina and von Savigny 2001), *objects* as epistemic artifacts through the dimensions black-box/tinkering (Knorr Cetina 1997). Against this backdrop, we suggest that a similar analysis brings the debate on intersectionality beyond a *human-centered* view towards a *post-humanist* perspective (Barad 2003; Braidotti 2013).

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Re-thinking intersectionality through Science and Technology Studies: trajectories of women in technoscientific fields

This paper seeks to explore the concept of «intersectionality» through suggestions taken from the interdisciplinary field of Science and Technology Studies. We explore three exemplary stories of Italian women engaged in science and technology through the categories of «space», «knowledge», «practice», and «objects». In doing so, we introduce a connection between STS and recent contributions within the debate on intersectionality in order to shed light on sociomaterial issues which have been a neglected aspect of intersectional analysis. We suggest that a similar analysis brings the debate on intersectionality *beyond* a *human-centered* view towards a *post-humanist* perspective.

Keywords: Intersectionality, science and technology studies, feminist studies, women, science, technology.

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