Chapter 20
Italian Students' Ideas About *Gender* and *Science* in Late-Modern Societies: Interpretations from a Feminist Perspective

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Introduction

This chapter draws on a selection of qualitative findings from the Italian IRIS survey, which allow us to explore different aspects shaping the representation of gender and science among young women and men enrolled in different scientific courses: biology, biotechnology, physics, chemistry, mathematics and statistics, computer sciences, mechanical engineering, electronic engineering, chemical engineering. The relevance of this issue within feminist approaches to STEM educational choices is specified in Chap. 4, where it is described how science might be viewed as part of a gender discourse, invested with gendered attributes that can impact on the choice process in science.

Several data from the Italian IRIS survey, both qualitative and quantitative, are relevant to this issue, in particular the answers to three open questions: (1) Do you attend a course where one gender is over-represented? If so, why do you think this is the case?; (2) Do you see any reason why the situation described above should change – and if so, what do you think could be done to change it?; (3) Describe how you came to choose this course. These questions are part of a larger questionnaire which was distributed to students attending their first year in 45 Italian universities, with 2,667 valid cases collected in spring 2010. 2,203 students answered the first question, 1,506 answered the second question and 2,135 answered the third one (see Appendix).

Although the overall qualitative data obtained through these three questions offered evidence to formulate hypotheses about students' representation of gender and science, in this chapter I mainly focus on the answers to the first question, which was specifically formulated to study students' perceptions and ideas about

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the gender dimension of the scientific course attended at university. To sum up, the analysis of the responses to this question provided:

- An understanding of Italian male and female students' perceptions about the gender dimension of the scientific course attended;
- An understanding of the way Italian male and female students symbolically represent gender as a concept, and the way they conceive it both in relation to science and to the different scientific subjects;
- A description of some emerging features in the gender and science imagery of Italian males and females in a late-modern society.

Research Methods

Data were first analysed by means of *content analysis*, an inductive process which starts from the texts, and then assigns to every answer one or more proper codes. Through a selection and assessment activity carried out by a research team, student responses were coded into categories, in order to build up a more restricted body of data available for syntheses and comparisons (Krippendorf 2007). Atlas ti v.5 software was used in order to select and study the written texts which were initially structured as single parts, then assigned to several codes and further interpretative dimensions.[1]

Three interpretative dimensions have been formulated on the basis of key concepts employed in feminist theories: *culture/nature; male hard sciences/female soft sciences; equality/difference*. These binary concepts are complex and open to different interpretations, and their meanings are intertwined. In the Italian IRIS survey they structured a feminist interpretative framework, philosophically and historically oriented, which helped to understand the way gender and science are represented within the imagery of the respondents. To be more precise, these polarisations have been employed as test categories, thus helping to enquire whether this imagery presents continuity or discontinuity aspects with reference to a traditional gendered discourse.

A brief clarification of the way these concepts have been specifically understood and employed in the Italian IRIS survey is further necessary here. A more detailed explanation of them can be found in Chap. 4.

The polarisation *culture/nature* lies at the root of the way the gender relationship has been figured out throughout the history of Western thought. In classical times, it started to be essentially conceived as a female subordination to the male being. The

[1] Giuseppe Pellegrini and Chiara Segafredo outlined this preliminary content analysis, discussing it with Alessandra Allegrini who analysed and interpreted the collected data from a feminist perspective. Besides the feminist interpretative dimensions described in this chapter, Eccles' model categories have been employed for analysing qualitative outcomes about students' motivations towards scientific subjects (Chap. 18).

naturally given female difference has been negatively seen as lacking compared to male sameness and uniqueness – neutral, abstract and universal (Irigaray 1974, 1977; Cavarero 1987, 1990; Fraisse 1991, 1996). In the modern age, this symbolic order also had a social meaning and value, having an impact on what is commonly known as "the gender (or sexual) division of social roles". In the shift to modern society, it started to be the organizational principle at the bottom of the long-lasting division between the "public/productive male" sphere and the "private/reproductive female" sphere, also known as the "male breadwinner/female caregiver" model in the Anglo-Saxon literature (Ferber and Nelson 2003; Picchio 2003).

The binary concept *male hard sciences/female soft sciences* might be considered a specific derivation of this gendered discourse, with a double-edged significance: a symbolic one (gender and science representations) and a material one (gender heterogeneity in science course choice). The material dimension of this polarity is largely documented in national and international research on the gender gap in STEM studies and educational choices: the number of women enrolling in life and health sciences has been increasing, while women are still a minority in technologically-orientated sciences, such as engineering and computer science, but also in physics and mathematics. In the Italian IRIS survey, the sample composition confirms this trend: male students form the large majority in engineering, computer science and, to a lesser extent, in physics and mathematics, while females are in the majority in biology and biotechnology.

Women have repeatedly attempted to overcome this dichotomous and oppositional order of discourse, a process manifested throughout the three waves of feminism. From the First-wave to the Second-wave, and until nowadays, *equality/difference* have been the two conceptual terms in which they located their subjectivity. On the one hand, women need to be equal to men – as far as free opportunities in thought, word and action are concerned. On the other hand, they want to be free to be different, assuming that this difference is not a negative and subaltern, rather a positive and exceeding concept (Offen 1988; Scott 1988; Groppi 1993; Saraceno 2008).

Before presenting and interpreting results from IRIS, it is worth addressing the structural limits of the research method adopted here, that is a qualitative analysis based on written texts. Differently from oral narratives, written texts are not collected within a face-to-face relationship between the interviewer and the interviewed, so that they do not really allow to deeply figure out the inner subjective notions and views behind the terminologies employed by each respondent. This is why the interpretations of the overall results that I will offer in this chapter must be regarded with particular care, especially since they emphasize a strong stereotypical imagery of gender and science. The question wording in itself might even have called forth such an imagery, which the respondents may not personally hold. At the same time, these interpretations are based on a very high number of responses, which enables observing and registering the most recurrent and specific types of representations held by the respondents. This is an undeniable advantage that any oral research method would hardly provide. Moreover, even if the emerging imagery might have been influenced by the questions, so that it tends to reflect

the responses students believe they were expected to give, this is in itself an indication of the kind of perceptions about gender and science that are prevalent in the present society and continue to shape students' choices in STEM.

Male Hard Sciences/Female Soft Sciences

This gendered polarisation is highly relevant for interpreting the Italian IRIS findings. Besides sorting students' STEM choices materially, thus outlining the gender gap underpinning them, it deeply shapes students' gendered representation of the scientific subjects they study, and more widely the representation of gender and science. Indeed, it has been observed to be a rather recurrent tendency to sharply distinguish between "male sciences" and "female sciences", and more specifically among "what is male" and "what is female" in the interests, attitudes and abilities required to learn scientific subjects, as well as in students' conceived future work scenarios after university. The gendered distinction male hard sciences/female soft sciences therefore keeps a significant symbolic value in the imagery of the respondents, confirming that the gender gap in STEM course choices has a significant counterpart also in the gender and science representations.

Not surprisingly, on the one hand, life and health sciences, along with humanistic subjects, are frequently connected to care-giving attitudes or ideals, which are considered typically female.

> There are many male students because it is hard that a woman likes these things, compared to law or medicine, where she can express in the best way her will to help others (Male, Mechanical Engineering)

> Unfortunately there is a high prevalence of females, because women are more sensible towards humanitarian problems (Female, Biology).

As it is underlined in Chap. 18, also the analysis of the responses to the above mentioned question "describe how you came to choose this course" pointed to the same association between life and health sciences, and female care-giving aspirations, which has been recurrently observed behind students' motivations for choosing their university course. Female students often explain their choice by a sensitivity to helping other people and dealing with health problems.

> I have chosen this course because of my desire is to help the others, and research seems to me the most proper field to realise my passions (Female, Biology)

> I have chosen this course because I feel the necessity to give my own contribute to society, my personal contribution to "improve life conditions in the world" (Female, Chemistry).

On the other hand, technical subjects are most of time connected to male prerogatives, interests and abilities, both by male and female students, and especially among those enrolled in physics, mechanical engineering and electronic engineering courses.

> The course is very homogeneous, although I thought informatics was more oriented to a male public (Male, Computer Science)

> The participation in the course is predominantly male, because there is a common belief that studying informatics means studying "the way to adjust a PC" (Male, Computer Science)

> In my course there is a male prevalence, probably because of the shared conviction that mechanical engineering is a study course for males. Actually in this course we don't only make machines (Female, Mechanical Engineering);

> Male prevalence. Male sex is more willed to follow this study course because he has a major contact with material (e.g. video-games), but also because of some stereotypes. (Male, Computer Science)

The practical dimensions of a subject are often perceived as interconnected with technical aspects, once again frequently associated with men. On the contrary, theoretical interests and attitudes are more often seen as female prerogatives, especially the theoretical dimension of mathematics.

> Mathematics is more theoretical and less practical than for instance physics, this is why it attracts more girls. (Female, Mathematics)

> There is a female prevalence, because mathematics is the scientific subject most suitable for girls' attitudes, since it is the less technical subject. (Female, Mathematics)

At first sight, ascribing the theoretical features of mathematics to women's interests and inclinations could be evaluated as a non-traditional aspect, that challenges the historical association of science with masculinity attached to the traditional distinction male hard sciences/female soft sciences. Actually, this is not the case if we consider other traditional features that draw this association. First, to a larger extent theoretical aspects are not uniquely attributed to mathematics but also to research and study, as evidenced by students enrolled in biology and biotechnology as reasons for the female prevalence in these courses.

> There is a female prevalence; the reason is that nowadays girls are the most motivated to continue to study, much more than boys (Male, Biotechnology)

As I will clarify in the next paragraph, students often remark a natural female tendency to methodical study, meant as a compensatory effort to the lack of male innate abilities in learning scientific subjects. A second aspect to consider is that a high number of students report that women decide to study mathematics because they wish to enter school teaching, which can undoubtedly be seen as a typically female job, traditionally connected with care-giving ideals.

> There's a female prevalence in my course. I do not know why, but doing "the mathematics teacher" is a quite common female ideal (Male, Mathematics)

> Female prevalence, because of the main opportunity in future teaching jobs, which attract more women (Female, Mathematics)

Overall, the findings presented here clearly pinpoint a rather traditional trend in the students' gendered imagery of science, since they point out a reiterated association of the "hard sciences" with men, and the "soft sciences" with women.

Among these findings, the most important and emerging one is the highly frequent association between technical subjects, technology, technical aspects and men, while these aspects are never connected with women. This finding suggests the primacy of the male-gendered connotation of techno-science over science in the students' imagery. On the one hand, physics or mathematics are not among the subjects mostly perceived as "male hard sciences", compared to engineering and computer science, that – compared to physics and mathematics – also have the highest number of male students enrolled. On the other hand, besides biology, health sciences and humanistic disciplines, biotechnology tends to fit in the same trend: next to the other traditional "female soft sciences", also biotechnology is symbolically associated with typical female aspects, so that it tends to be represented as a "female soft science".

As already underlined in Chap. 18, the case of biotechnology is indeed rather emblematic. Students perceive a strong association between biotechnology and engineering, in so far as they frequently compare one with the other, more precisely describing them as gender connoted opposite fields.

> There is a female prevalence, probably because males prefer engineering or informatics (Female, Biotechnology)

> The female component is more consistent, because there is a high percentage of males enrolled in engineering or polytechnics (Male, Biotechnology)

Although engineering and biotechnology are often perceived as related disciplines, it is remarkable that technology – which is supposed to be a central feature of biotechnology – is not considered a distinguishing aspect of this field of study, while on the contrary, biology, medicine, laboratory activities and the typically female inclinations ascribed such as care-giving and helping others are perceived to characterise this field. As many students attending biotechnology assert:

> I attend a course where there is a female prevalence: women are more patient in laboratory (Female, Biotechnology)

> There is a slight female prevalence, because they are more willing to engage in laboratory activity (Male, Biotechnology)

> Female prevalence. Maybe because this scientific subject, useful to help others or contribute to society and people, attracts more a female sensibility (Female, Biotechnology)

> There is a female prevalence, maybe because women are more fascinated by the biological or animal field than males (Male, Biotechnology)

The association of technology with men is also found in several responses stressing a major female proximity to scientific disciplines, which implies a sharp distinction between scientific disciplines – associated with women – and technological disciplines – associated with men.

> There is a female prevalence. In my opinion the reason is that humanistic-scientific disciplines are considered nearer to a female personality than a male one (Female, Biology)

> This course is more attended by females, maybe because biology attracts more girls, since we have a major predisposition towards scientific subjects (Female, Biology).

By means of seeing the terms 'scientific-humanistic' and 'theoretical' as alternative and opposite concepts to 'technical' and 'practical', these responses can moreover be interpreted in the light of the considerations offered above about the connections of theoretical aspects of scientific subjects, mathematics in particular, to female prerogatives.

The primacy of the male-gendered connotation of techno-science over science finds further evidence in other Italian inquiries into the gender and science representations in secondary school educational contexts, indicating that the gendered polarisation male hard sciences/female soft sciences still plays a central role in the students' imagery, although partly reworked into major techno-scientific meaning (Allegrini 2009).

Culture/Nature

Students cite a wide range of factors as the main reasons for the gender composition of the course they attend. These factors can be interpreted in the light of the culture/nature polarisation. Different social, cultural and historical elements, both internal and external to the educational system, are explicitly offered as cultural reasons for the gender imbalance observed, or for the prevalence of one gender over the other. Moreover, they unveil a historical-cultural idea of gender as a concept. Other factors, internal and external to the educational system, are suggested as natural reasons for the gender composition of the courses attended, especially for the gender imbalance perceived in several disciplines. As I will further clarify in the next paragraph, they explicitly or implicitly assume a deterministic and essentialist view of sexual difference, both from a biological and psychological point of view.

Although natural aspects are detected in the responses of students of both genders, the analysis of the overall outcomes show that male respondents, more than female, remark this type of features as reasons for being dominant in the course they attend. Students enrolled in male-dominated courses, or, more precisely, the courses where they perceive to be the majority – namely engineering, computer science and, to some extent, physics – especially share this naturalised conception of sexual difference, as a naturally given difference among males and females, as far as skills, abilities, capacities and cleverness are concerned.

> I suppose that in my course there is a prevalence of male students because these subjects fit more with male abilities and capacities (Male, Mechanical Engineering)

> There is a male prevalence because women are afraid of the word 'mathematics' (Male, Mechanical Engineering)

> Male students, because I still have to find a really clever girl. (Male, Computer Science)

Attitudes, interests, abilities in technical subjects, most of all computer science, are especially evaluated as male attributes, often by virtue of a natural reason.

> There is definitely a male prevalence, due to a way of thinking and reasoning, which is closer to the one of a machine (Male, Computer Science)

> My course is male dominated because it is a purely technical-working study course, which is unsuitable for females. (Male, Mechanical Engineering)

Besides the technical dimension of a study subject, its practical relevance, and the overall concrete dimension of a study course, are often male-connoted on the basis of an essentialist difference among sexes, most of all among students in engineering and computer science courses.

> Engineering is a very practical subject (. . .), that is a male characteristic, more than female (Male, Computer science)

> The prevalence is male because this is a very practical study course (Male, Computer Science)

In male-dominated courses, engineering and computer science in particular, women give a larger spectrum of cultural reasons to explain the gender imbalance. Different elements describing the sociocultural background and structuring cultural beliefs, such as gender stereotypes and prejudices, or historical factors such as the history of the gender relationship in the past, are mostly named by these female students, whose remarks often turn into forms of denunciation and social critique.

> Male students are prevalent, because we live in a male chauvinist society, where there is the conviction that women are unsuitable for these things (Female, Computer Science)

> There is a prevalence of male students. It is a cultural inheritance, because men more than women have always undertaken scientific studies (Female, Physics)

> I believe to attend a course with a male prevalence because, according to the current stereotypes, my interests are those of boys (Female, Mechanical Engineering)

> There are many male students because there are still prejudices against women, who are not considered to do much better than men. (Female, Mechanical Engineering)

Women enrolled in engineering also underline gender stereotypes attached to the engineer as a male professional figure.

> In my course there is a prevalence of male students. I suppose this is the case because in our society the engineer is a purely male figure (Female, Electronic Engineering)

It is worth noticing that the tendency to represent gender and science in a stereotypical and essentialist way also appears in the responses to other open questions, in particular the question "do you see any reason why the situation described above should change – and if so, what do you think could be done to change it?". The analysis of the students' responses to this question highlighted that this trend is once again largely shared among male students enrolled in engineering and computer science. They represent the majority of all the respondents who do not consider a change in the gender composition of their study course to be feasible. They justify this belief on the basis of naturally deterministic reasons, often employed to defend a status quo, thus to reaffirm a strong association between masculinity and technological hard sciences.

> No, this situation will not change. Females are like they are, because of their nature (Male, Mechanical Engineering)

> If this situation has not changed yet, it will never change. While mathematics is getting better, informatics will stay like it is now. Although there have been some, I cannot imagine women contributing to innovation in this field. (Male, Computer Science)

The tendency to offer naturalised reasons, which is prevalent among male students attending male-dominated courses, is also frequent among female students attending female-dominated courses. Nevertheless, in both cases, men more than women are those who report a wider range of naturalised factors. While in male-dominated disciplines the majority of male students justify this situation by remarking their own ability and innate attitude towards science, specific scientific subjects – especially technical subjects – in this case, the innate aspects attributed to women are mainly behavioural inclinations towards care-giving and human relationships. As already mentioned in the previous paragraph, these female qualities are mainly associated with humanistic subjects, life and health sciences, including biotechnology. Women enrolled in biology and biotechnology particularly underline these aspects.

> It is a course prevalently attended by female students, because women have an innate attitude to be interested in all the problems connected to our planet. (Female, Biology)

In disciplines such as mathematics, statistics, physics and chemistry, where more women are enrolled and the perception of the scientific field is more gender balanced, and in several cases even female-dominated, the idea of a typically female care-giving prerogative disappears, leaving instead space to the belief of an innate female capacity for studying and learning. More specifically, methodical study, often described as a natural inclination to make efforts, is the most cited female capacity in these disciplines.

> There is a female prevalence, because girls are more inclined towards studying and effort (Female, Physics)

> There is a female prevalence because, in my opinion, female sex is more inclined towards and constant in studying (Female, Mathematics)

> There is a slightly female prevalence, probably because women are more willing to make sacrifices. (Female, Biology)

Sometimes, this typically female predisposition for effort is also related to laboratory activities, most of all in biotechnology courses.

> I attend a course with a female prevalence, because I believe women are more patient within laboratories (Female, Biotechnology)

It should be noticed that these are not really innate abilities or capacities towards scientific subjects, rather innate behaviours in the learning style adopted in the study process. In Italy, several qualitative enquires on didactic-pedagogical issues from a gender perspective have shown that this characterisation of a typically female learning style begin already in secondary school (Mapelli 2004; Tamanini 2007a, b; Padoan and Sangiuliano 2008). Teachers play a major role in reinforcing this characterisation, negatively evaluating the methodical female learning style as

a compensatory effort to the lack of male innate abilities and cleverness in learning scientific subjects (Allegrini 2009, 2012).

Equality/Difference

The interpretative dimension equality/difference highlights other significant elements which structure students' imagery of gender and science, more specifically how the gender relationship is configured in relation to science and the different scientific disciplines.

The great majority of respondents conceptualise the gender relationship as women's equality with men, in regard to interests, capacities, abilities and inclinations towards science and specific scientific subjects. This idea of equality is mainly meant as absence of difference, whereas difference is synonymous of gender stereotypes, prejudices, discriminations affecting women and not men in science, in culture and society. Difference is thus conceived as a negative concept in opposition to equality. This idea of equality is explicitly underlined by students who observe a gender balance in their study course.

> There is no difference in my opinion: this course is attended only by who has interest in the subjects to be studied (Male, Electronic Engineering)

Among the respondents, women are those who especially support a gender balance, compared to the large majority of men who perceive to be dominant in their study course. They particularly assert a gender balance by underlining the absence of gender stereotypes and prejudices in their study course. In their words, difference means discriminations and prejudices against women, no longer affecting present society and science studies.

> We are balanced; nowadays there is not any more so much difference or prejudices (Female, Chemistry)

Also women perceiving a male prevalence in male-dominated courses, most of all engineering, assume the same idea of difference as a negative concept: an idea of equality of women with men in the sense of absence of differences meant as discriminations. As already underlined, these young women are the most critical towards gender stereotypes and willing to denounce them.

Most of the students perceiving gender balance address equality with a slightly different meaning: as in-difference or gender neutrality, that is considered a distinguishing feature of the interest in science.

> There is no difference in my opinion: this course is joined only by who is interested in the subjects to be studied (Male, Electronic Engineering)

> I do not think there is a female or male prevalence, because the choice to study a subject does not depend on sex, rather on interests (Female, Biology)

> No gender prevails on the other, and this is because scientific subjects are a shared interest common to everyone (Female, Biotechnology)

> There is not a prevalence of male or female students; the course is heterogeneous. I think this is because the study subject is interesting regardless of a student's sex (Male, Chemistry)

Nevertheless, I would suggest that the same idea of difference as a negative concept, opposite to equality, is assumed also in these cases, since gender neutrality is conceptually and historically linked to this way of conceiving difference. Further details concerning this issue can be found in Chap. 4.

In some other cases, it is science itself, or a particular scientific subject, that is considered neutral, not influenced by external elements such as gender.

> The percentage of males and females is the same. Probably because mathematics is a hybrid subject (Female, Mathematics)

Science is not only considered neutral from the point of view of the subjects who study and practice science; it is rather neutral as far as its own methods, categories and approaches are concerned. As it is pointed out in Chap. 4, this can be considered a sign of a historical heritage coming from a positivist idea of science: a pure science, that is free from external elements influencing it. From this perspective, equality among men and women – meant as gender neutrality – is linked to an idea of scientific objectivity as neutrality. Over the last 40 years, feminist theories on science have contested this idea of neutrality, trying to undermine the internalist conception of science and its objectivity that, in short, represents the original male association with science behind the ideal of neutral objectivity (Bordo 1987; Keller 1983, 1985; Harding 1991, 1993; Haraway 1988; Longino 1990, 1996).

Apart from being understood as gender equality, or gender in-difference, the gender relationship is often elaborated in an essentialist way, as a naturally given difference. As it as been already described in the previous paragraph, a large proportion of respondents indeed share a widespread tendency to naturalise difference among women and men, especially men in male-dominated disciplines, who recurrently consider this natural difference a reason for justifying to be the majority in their course. In line with what is described in Chap. 4 about gender identity as a performative practice (Butler 1990, 1993), it is possible to suggest that both young men and women need to ascribe their belonging to a certain gender, reinforcing their gender identity as a personal and social role through a reiterated practice. However, while the former perform their gender by over-stressing gender difference, the latter often perform their gender by denying their difference. If that is the case, difference is meant as discrimination, and urges girls' need to be equal to boys, most of all in male-dominated sciences. An analogous interpretation is offered in Chap. 19, where it is described the way female students enrolled in male-dominated university courses, such as computer science, physics and nanotechnology, perform their gender by trying to be "more masculine" than other women, and assimilating with the majority gender group. On the other hand, male students in the female-dominated course of molecular biomedicine tend to denote themselves as different from the majority gender, therefore not trying to become as them. By employing another key concept introduced in Chap. 4, "hegemonic masculinity" (Connell 1987; Connell and Messerschmidt 2005),

I would also suggest that both women and men who differ from "hegemonic masculinity" might perceive to be devalued.

Recently, other Italian surveys have attested this double tendency in the imagery of the gender relationship: the alternation between an essentialist conception of sexual difference and a conception that denotes in-difference or gender neutrality (Contarello et al. 2008, 2009; Allegrini 2009, 2012). Although further analysis should be required, from a feminist perspective it is possible to argue that this is not really a conceptual alternative, but rather the same way of seeing the gender relationship: as equality among maleness and femaleness, among men and women. Indeed, as it is clarified in Chap. 4, both these ideas might be traced back to a historical-conceptual perspective that traditionally conceives sexual difference as a female lack by virtue of a naturally given difference, as something negative to remove in favour of an ideal of equality, often meant as homogenization of embodied differences to a neutral-male universal representation.

Italian Students' Ideas About Gender and Science in Late-modern Societies: Continuity or Discontinuity with the Past?

This chapter has explored different symbolic aspects outlining the representation of gender and science within the imagery of Italian students who are enrolled in different scientific courses in their first year of university. Three historical-conceptual dimensions, based on key notions particularly relevant in feminist theories, have been employed for this purpose: culture/nature, male hard sciences/female soft sciences, equality/difference.

More precisely, these interpretative categories have specifically allowed us to explore the relationship between traditional and non-traditional features characterising students' representation of gender and science and different sciences. Among the traditional aspects, the most significant one is the recurrent inclination to stereotype in a naturalised and essentialist way "what is male" and "what is female" in the different scientific disciplines, in the interests, attitudes and abilities required to study these subjects, and in the job opportunities after university. Although a number of students, especially women in male-dominated study courses, appear to be oriented to a cultural approach to gender, this being behind their motivation to be a minority in the male-dominated course they attend, the largest proportion of respondents mainly share an idea of sexual difference meant as a naturally and essentially given difference among sexes. This reiterated assessment of male and female traits reproduces gender polarities to be properly framed in the binary concept male hard sciences/female soft sciences that in students' imagery still has a powerful symbolic meaning, in that it appears to orient their choices in science studies.

It is especially in the light of this last interpretative dimension that non-traditional aspects have been remarked, mainly the primacy of the male-gendered connotation of techno-science over science. As it has been noticed, technically-oriented disciplines, such as engineering and computer science – that have the highest number of male students enrolled – are the fields mostly represented as "male hard sciences". On the contrary, biotechnology, although perceived as related to engineering, is largely represented as a "female soft science", since technology is not considered a distinguishing aspect of this field of study. I have underlined that biology, medicine, and specific inclinations ascribed to women, such as care-giving and helping others, are instead considered the distinctive features of biotechnology.

How can we further interpret these main findings, here briefly summarised, within the socio-historical context of late-modern societies?

Modern age, or first modernity, is defined through several peculiar features which shaped a patrimony of ideas that, despite originating far back in time, visibly materialised within industrial Europe, after the Second World War. Among these features, we should mention the national-state organisation of economies in each single country; the class hierarchies between the bourgeoisie and proletariat, experts and profanes, on the basis of knowledge monopolies that were professionally produced and controlled; the "natural" territorial bond between production, cooperation and enterprise (Harvey 1993; Bologna and Fumagalli 1997; Marazzi 2001). Also the long-lasting "natural" principle that has ruled and controlled the exclusion of women from the public sphere has been a central feature. The latter expressed itself through the division among "productive male labour" and "reproductive female labour", which defined nuclear families as reproduction contexts for male salary workforce, by using biomedical knowledge in order to maintain male and female "natural" foundational principles, and translating them into a social, political, economical order (Allegrini 2004). This is in short the reason why gender roles, defining a gender or sexual division of labour, fundamentally characterised the socio-cultural order of Western societies during the first modernity.

In the transition to the so-called second-modern or late-modern societies, different social, cultural and economical changes have occurred through a number of events and processes in the last 15–20 years (Giddens 1991; Beck et al. 1994; Beck 1999; Castells 2000; Bauman 2001; Beck and Beck-Gernsheim 2002). In the IRIS project specific attention is paid to understanding youth identity-building dynamics in late-modern societies (Boe et al. 2011; Chaps. 2 and 3).

As mentioned in Chap. 4, Second and Third-wave feminism, along with the increasing feminisation of the public/productive sphere in the last decades, have played a major role in the de-traditionalisation process which has characterised late-modern societies. Late-modernity, or rather post-modernity, might indeed be considered an important step for feminism, in that it offers a way out from modernity and its values, which are inextricably linked to a traditional gender order. Feminist scholars belonging to the Third-wave feminism have conceived feminism itself as a theoretical-political instance aimed at transforming social reality and symbolic orders, as a powerful weapon disaggregating the foundational categories shaped

in the modernity age (Braidotti 1992, 1994). In this transition phase, principles considered for a long time as "natural laws", and the social conditions defined as universally and naturally given, have finally lost their relevance. The rigid crystallisation of gender roles has turned into opening up opportunities not only for women but also for men.

Nevertheless, traditional features, traces of modernity, can be still noticed today. Gender roles have not completely disappeared: although they are no longer social and work roles, they still act as stereotypes, conventions, constraints that have a normative but invisible power, so that specific behaviours, expectations, competences, emotions, abilities are still conventionally ascribed to women and men. Some thinkers believe that these traditional aspects, or continuity factors with the first modernity, are now back again, with an even stronger impact on younger generations. "Re-genderisation trends", that is a tendency to come back to traditional gender roles, together with a tendency to re-actualize a naturalization of sexual difference, can be detected (Lipperini 2007). Living in a crisis situation characterised by a lack of reference points as well as widespread economical, cultural and existential precariousness, these generations tend to restructure traditional social and cultural models.

This socio-cultural trend has also been noticed in the context of scientific and technical education, within a larger pedagogical-educational frame that, visibly in Italy, tends to maintain a very traditional asset, rather distant from the complex reception and governance of changes that are affecting our present, also within the field of science (Allegrini 2009). According to some scholars, there is a "substantial stability of educational and cultural models" that "has an inevitable impact on intergenerational transmission, perpetuating – from parents to sons, and from teachers to pupils – characters, specificities, but also social expectations in regard to male and female roles" (Zajczyk 2007, p. 159).

Returning to the Italian IRIS findings, I would suggest that the traditional aspects describing the students' representation of gender and science can be further understood with reference to these sociological issues. The recurrent tendency to reproduce gender polarities among "male sciences" and "female sciences", frequently grounded on an essentialist view of sexual difference, can be effectively seen as a result of re-genderisation trends re-emerging in the young generations of late-modern societies and particularly enforced by the traditional asset of the educational system.

What about the non-traditional aspects, more specifically the primacy of the male-gendered connotation of techno-science over science?

An understanding of this factor might be provided by drawing attention to other features characterising late-modern societies, such as the widespread diffusion of technology and technological objects in daily life, which, as a matter of fact, undoubtedly has a significant influence on the imagery of the late-modern societies' young generations.

Actually, the relevance of techno-science is not only a distinguishing feature of late-modern society. It is also at the core of the transformation process that has occurred in science itself over the last 15–20 years. In this process of change,

science becomes more tightly connected with technological research. More precisely, science's transformations are mainly oriented towards and informed by new technologies, which overall reconfigure science from several perspectives. The international literature on this issue is so diverse that it is rather difficult to offer a brief summery here. However, the well-known book *Real Science: What It Is and What It Means* (Ziman 2000) can surely be mentioned as a shared reference. In this book, physicist and sociologist John Ziman describes the way contemporary scientific research is increasingly mediated by communicative processes carried out by information and communication technologies, which strongly modify scientific features and epistemic categories which were earlier considered unchangeable through the passage of time.

Some specific aspects underpinning science transformations have recently been discussed by Italian philosopher Elena Gagliasso and biologist Flavia Zucco, such as for instance the difficulty to sharply distinguish between science and technology, the former increasingly depending on virtual simulation practice in several scientific research fields. Considering the large amount of data computers are able to provide for formulating hypotheses, in many cases this process has been able to change the parameters of the hypothetical-deductive and experimental approach implied in the scientific method (Gagliasso and Zucco 2007, p. 7).

In the Italian IRIS survey, not only the primacy of techno-science over science has been largely observed to be deeply represented by the students, rather it is the gender connotation of this process that has been noticed to be clearly represented, especially by looking at the type of disciplines the students repeatedly polarise into male hard sciences/female soft sciences, along with the typical gendered attributes ascribed to them. In so far as this gendered polarisation still plays a pivotal role in the Italian students' imagery on gender and science, I would finally suggest that the historical association of science with masculinity is not overcome in the context of late-modern society, rather it is reconfigured in a new techno-scientific dimension.

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