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Gender bias in STEM disciplines: Exploring differences and similarities among early career researchers

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Gender bias in STEM disciplines: Exploring differences and similarities among early career researchers

Federica Cagnoli

Abstract: Despite increasing attention to gender disparities in Science, Technology, Engineering, and Mathematics (STEM) disciplines, early career researchers (ECRs) remain under-explored, especially in national contexts such as Italy. Using an online questionnaire, this study investigates perceptions of gender bias, work-life balance and career aspirations, among 160 ECRs at an Italian university. Drawing on Fricker's theory of epistemic injustice, the findings reveal significant gender differences in perceived experiences and opportunities in STEM. Female respondents reported greater awareness of structural limitations and bias, while male respondents tended to perceive the academic environment as more equitable, highlighting testimonial injustice and gendered patterns of recognition. It should be noted that no significant gender differences emerged in work-life balance or future career plans, suggesting generational changes or limited exposure to academic systemic barriers by ECRs. From this perspective, this paper highlights the need to address the structural and epistemic dimensions of inequality, where institutional contexts can disadvantage women and obscure their contributions. By focusing on ECRs, the paper provides information on how gendered academic environments shape aspirations and belonging at a formative stage. It contributes to the literature by combining quantitative analysis with a critical theoretical lens and calls for more inclusive and longitudinal research.

Keywords: Early Career Researchers, Gender Bias, STEM Field, Epistemic Injustice

Introduction

Despite significant investments by countries in Science, Technology, Engineering, and Mathematics (STEM) disciplines, the composition of the STEM workforce continues to be a source of concern. Many have referred to this as the 'leaky pipeline' (that is, the proportion of students choosing STEM disciplines gradually decreases as the level of education increases) (Blickenstaff, 2005). Policy makers and researchers have tried to find solutions to these leaks (Fisher et al., 2020). Although progress has been made over the years, gender equality has not been achieved in STEM disciplines. More action is needed not only to address this lack of diversity in STEM disciplines but also for the broader development of science and technology. Indeed, women, as well as other minorities who go beyond the scope of this paper, can provide different insights and perspectives that can increase innovation and limit potential skewness in research results and knowledge (Intemann, 2009).

Although there are numerous studies on gender bias in STEM disciplines, relatively few of these focus on Italy and early-career researchers (ECRs). For example, Filandri and Pasqua (2021) investigated the effect of gender in the career advancement of professors in Italian universities. To do so, they used secondary data at the national level. They found that gender alone does not explain the lower rate of career advancement among female researchers. Di Tullio (2019) explored the effects of gender awareness on self-efficacy (which is the perception regarding the ability to perform tasks) among female researchers in STEM disciplines. Focusing on the Italian National Research Council and using a qualitative approach, the author identified a strong association between gender-based discrimination against women and the perception of their self-efficacy. Women tend to react to discrimination in different ways based on their awareness of the gender. In conclusion, Carriero and Naldini (2022) focused on the already mentioned 'leaky pipeline', structural and cultural factors, among female researchers in the early stages of their career. Using secondary data at the national level, they analysed access to academic research. They found almost no gender gap in post-doc positions, which, however, grows as career advances, especially in STEM disciplines.

The fairly small gap in studies covering ECRs and Italy is an important aspect to be addressed. On the one hand, by investigating perceptions and experiences of gender bias, it is possible to further research and support mechanisms that can improve gender equity in STEM in academia. On the other one, ECRs usually represent a significant portion of the academic workforce, and their experience can reflect the broad organisation and culture of the academic system (Christian et al., 2021). In addition, they represent a transition

phase towards more senior positions. Recalling the metaphor of the 'leaky pipeline', focusing on such an early stage can provide interesting results that can then be advanced while considering the long-term advancement of researchers.

In light of the main objective of this paper, that is, investigating perceptions of gender bias in STEM disciplines, an online questionnaire was developed and submitted to ECRs in STEM from an Italian university. Specific aspects were investigated: perception of gender bias, the issue of work-life balance, and career plans. Thus, the following three research questions were addressed:

1. How do ECRs perceive gender disparities in STEM disciplines?
2. To what extent do perceptions of work-life balance differ between male and female ECRs in STEM disciplines?
3. Are there differences in future career plans between male and female ECRs in STEM?

The results have significant implications to address gender disparity in STEM disciplines. Indeed, if the perceptions of gender bias confirm the current state of the art (e.g., Carriero & Naldini, 2022; Fisher et al., 2020), the results on career plans and work-life balance shed light on new aspects. The sample of respondents share similar ideas and concerns about these two aspects, unlike what other studies have found so far (for example, Gagnon et al., 2019; Lv et al., 2022). Although this may suggest that younger researchers share a similar understanding of private and work life, their recent academic position has not yet shown potential barriers and paths to their future choices. More research is needed to grasp these complex dynamics in order to be able to harness the full potential of future senior researchers. In this sense, given the limited scope of this paper, which focuses on a small sample of the entire population of ECRs, it has to be considered as a pilot study, which will be developed to expand its sample and investigate the results presented here.

The literature review

Gender gaps in STEM disciplines have a long history in research and have been investigated in various fields. For example, in education, scholars have analysed the performance of male and female students. Looking at academia, previous studies have focused on the 'gendered experience' in the STEM university course (Fisher et al., 2020). Many of these pieces of research are based in the US (Cheryan et al., 2017), Australia (Christian et al., 2021), and Asia, such as China (Lv et al., 2022). They have found that female students tend to have lower levels of science self-efficacy, which is how someone perceives their ability to perform tasks, and belonging (Fisher et al., 2020; Tellhed et al., 2017). Although they may have limited generalisability

in Italy due to differences in social, cultural, and educational systems, they provide a framework to work on in order to delve into the Italian context. In light of this, since much has been discussed on this topic, this literature review will focus mainly on three main areas of research, keeping in mind the role played by ECRs: gender stereotypes in STEM disciplines, work-family balance, and career aspirations. In conclusion, a brief overview of the Italian case will be provided. In this sense, in this paper, the focus is on ECRs because, being in a transition stage between PhD and senior academic positions, their well-being can provide insights into the health of the general academic industry (Christian et al., 2021).

Starting with gender stereotypes, they are “judgments about the abilities or attributes of individuals based on their membership in a social group” (Wang & Degol, 2013, p. 320). Based on this, they can support or hinder individuals, in this case, ECRs, from making decisions that do not conform to certain expectations. Research on gender disparity in science education was pioneered by Field and Cropley (1969), who focused on Australia and the United Kingdom in terms of cognitive style and achievement.

The masculine culture surrounding STEM disciplines has contributed to gendered experiences of female ECRs, where the latter feel lower levels of belonging and lack female role models (Cheryan et al., 2017). These aspects affect them, for example, in a piece of research on computer science, it was found that female students discontinue their studies because they believed that they did not fit the ‘geeky’ stereotype (Michell et al., 2017). Gender stereotypes can be transmitted implicitly or explicitly through peers, teachers, parents, media, and others (Lv et al., 2022) and can be significant contributors to gender imbalances (Gagnon et al., 2019). What students and ECRs perceive from others forces them to conform to certain behaviour expectations and shapes their beliefs concerning STEM disciplines based on the role played by gender (Lv et al., 2022). If masculine stereotypes are reinforced in a given environment, in this case academia, women’s self-efficacy can be negatively impacted (Gagnon et al., 2019). Furthermore, this can erode their identification with STEM fields, considering that even when female students decide to study maths-intensive university degrees, they can have difficulty self-identifying with their discipline (Wang & Degol, 2013).

The views of STEM disciplines as male-dominated, socially isolated, and technology-focused can have a strong impact. Because of this, on the one hand, female ECRs having certain qualities make them aggressive; then, on the other one, women may feel a conflict between the woman and the scientist identity, which pushes them to balance research and the idea of ‘good wife’ (Lv et al., 2022; Settles et al., 2009). However, at the same time, such views of STEM disciplines may also explain why some female ECRs are more

interested in specific fields, such as biology and medicine, than others (Wang & Degol, 2013).

The stereotype threat occurs when a person is concerned with the idea of confirming a negative stereotype (Gagnon et al., 2019). In this case, female ECRs may be more subjected to it because they are aware of being part of a minority. Research has suggested that when a stereotyped individual feels stressed during a testing context, physiological responses lead to increased cortisol production, which can undermine intellectual performance (Wang & Degol, 2013). Thus, after experiencing several failures in such a context, a process of disidentification can take place (Schmader et al., 2004). From this perspective, discrimination has often rooted in negative stereotypes (Wang & Degol, 2013).

These aspects are related to other significant factors. In particular, work-family balance, which has already been indirectly mentioned in these paragraphs, has been described as a 'collision course' (Ceci & Williams, 2010). In other words, the decision of a woman to have a family is detrimental to her career in STEM. Women may be deemed more prone to make occupational sacrifices for their families and to prefer home-cantered lifestyle (Wang & Degol, 2013). In any case, women researchers who take care for their family and work in STEM disciplines tend to attain lower levels of productivity compared to their male counterparts (Wang & Degol, 2013). Although women can freely choose their private life, these aspects play a profound role, in particular, in light of cultural norms that consider women responsible for their families, while men for finances. The increasing possibilities that women have obtained over the last decades strides with these norms, becoming a challenge for many women. Therefore, these findings may help explain gender imbalances among ECRs in STEM disciplines.

In terms of career aspirations, it is widely known that female workers tend to have inferior statutes, earn lower salaries, and fewer chances of promotion compared to their male counterparts (Gagnon et al., 2019; Lv et al., 2022). This fact is linked to the idea that science is still associated with 'masculinity', forcing young women to balance their aspirations with the model of the 'good wife' (Archer et al., 2012). The already mentioned gender stereotypes play a crucial role in lowering expectations among girls and young women (Lv et al., 2022). Although not directly related to the focus of this paper on ECRs, some studies have found that high school occupational aspirations are predictive of university degrees; from this viewpoint, gender differences in such occupational preferences are significant predictors of the under-representation of women in STEM careers (Ferriman et al., 2009; Morgan et al., 2013). Thus, trying to trace the choices of these researchers can be significant in gaining a better understanding of gender differences in STEM. More recently, work on occupational choices has begun to include self-effi-

cacy, interest, values, and identity processes as key factors (Ceci & Williams, 2010; Wang & Degol, 2013). However, it should be noted that few studies have dealt with different occupational choices within STEM, such as physical or biological sciences (Wang & Degol, 2013). In this sense, it is interesting to note the motivation to pursue these studies. Many have investigated this adding contribution to the gendered experience of university STEM students. They have identified various factors, such as mathematical achievement or personal values (Eccles & Wang, 2015). Additionally, some have found that women may decide to enrol because STEM courses are mandatory (Ogunde et al., 2017), although they may still be interested in these disciplines (Fisher et al., 2020). These elements clearly play a role in career ambitions. However, in addition to occupational preferences, there is another aspect to consider when referring to women's career decisions, which is work-family balance. Returning to what has already been discussed, ideas connected to their caregiving responsibilities make it more difficult for women to balance these two facets of their life. In this sense, although some young women may love science, they do not consider science as their future career because it is seen as 'smart' and 'masculine' (Archer et al., 2012). Since career choices are made at the individual level, further research is necessary on the social and psychological processes that lead to such decisions.

In conclusion, concerning the Italian case, data may be difficult to obtain as they depend on how and when Italian institutions, such as ISTAT (the national institute of statistics) or the Ministry of University and Research, collect them. However, one can draw some conclusions. Women are under-represented in STEM disciplines, especially in fields such as engineering; at the same time, as already highlighted in the literature review, they are more present in disciplines such as biology or chemistry (Di Tullio, 2018). This under-representation is even more evident when looking at senior positions, where the gender gap grows in more permanent positions. For example, data from 2011 show a decrease in the female component as the career role covered increases, which is 5.5% at the full professor level against 21.3% of men (Di Tullio, 2018).

The theoretical framework

In order to study gender bias in STEM disciplines, this paper draws on epistemic injustice by Fricker (2007). This framework focuses on unfair treatments of individuals as knowers and contributors to shared knowledge. In particular, the attention is on contexts where their credibility and perspectives are systematically diminished. According to her (2007), there are two main forms of epistemic injustice: testimonial injustice and hermeneutical injustice.

Testimonial injustice occurs when prejudice entails the assignment of less credibility to someone's statements, based on aspects of the social identity of the person. In STEM disciplines, female ECRs may experience testimonial injustice when their ideas are met with scepticism or undervalued, merely because they do not fit the stereotypical image of a scientist. This dynamic is common in settings where male voices dominate, such as academic conferences, where the contributions of women may be undermined or silenced (Dotson, 2011). For women ECRs, the cumulative effect of testimonial injustice can lead to decreased self-confidence, limiting their professional development, and reducing their contributions to the field. Instead, hermeneutical injustice occurs when one can find a gap in collective understanding that prevents certain experiences from being fully understood or articulated, in particular by marginalised groups. In STEM disciplines, this form of injustice can occur when the unique challenges and experiences of female researchers, such as gender-based discrimination, are not widely recognised or understood. For example, terms like 'imposter syndrome' have only recently been acknowledged in academic settings, and their impact on women in STEM is often underestimated by colleagues and supervisors. The lack of shared language or recognition for these experiences isolates female ECRs, unable to convey or address the obstacles they face, which in turn, limits their professional support and advocacy.

In this framework, other elements can be identified. For example, one can look at how epistemic injustice can lead to epistemic objectification, where individuals are seen not as knowers but merely as vessels of information, stripping them of intellectual agency. This fact can reinforce power imbalances, as women in STEM disciplines are often positioned as passive recipients of knowledge rather than active contributors, affecting their sense of belonging and credibility (Doan, 2018). From this point of view, epistemic injustice can extend beyond individual experiences, thus affecting the context as a whole. When under-represented groups, such as women, are systematically excluded from meaningful research or their insights are undervalued, the diversity of perspectives within STEM disciplines is diminished, potentially skewing research outcomes and limiting innovation (Intemann, 2009). For example, women researchers can provide unique insights into areas such as health and technology, but epistemic injustice can prevent these insights from gaining recognition within the academic community, thus narrowing the scope of STEM knowledge.

By focusing on the epistemic elements that marginalise the knowledge and contributions of ECRs, this framework can provide a new lens for investigating forms of discrimination that women ECRs face in STEM disciplines. Doing so highlights the need for equitable epistemic practices, where researchers are valued as knowers and contributors.

In conclusion, epistemic injustice offers a theoretical framework for investigating gender bias in STEM disciplines. Fricker focuses on the impact of gender on credibility and knowledge of individuals. In the case of STEM disciplines, this framework suggests that gender disparities are deeply embedded in epistemic practices. By using this framework, it is possible to investigate how gender bias develops at the interpersonal levels.

Based on what has been presented, this paper aims to shed light on gender bias among ECRs in STEM disciplines. To do so, it focuses on the following research questions (RQs):

1. How do ECRs perceive gender disparities in STEM disciplines?
2. To what extent do perceptions of work-life balance differ between male and female ECRs in STEM disciplines?
3. Are there differences in future career plans between male and female ECRs in STEM?

From this perspective, the following hypotheses (HPs) align with the theoretical framework and results on gender disparities in STEM disciplines:

1. Female ECRs are more likely to report higher perceived gender disparities than their male counterparts (Wang & Degol, 2013).
2. Female ECRs are more likely to report lower satisfaction with work-life balance compared to male ECRs (Gagnon et al., 2019).
3. Female ECRs are more likely than male researchers to plan lower academic or research positions or to leave STEM careers in academia (Lv et al., 2022).

The research design

Participants in this study were ECRs in STEM disciplines from the University of Genoa, Italy. According to the Italian academic system (Ministero dell'Università e della Ricerca, 2024), ECRs are those who are in the initial stages of their academic careers. This group comprises PhD researchers, postdoctoral researchers (*assegnisti di ricerca*) and Type A Fixed-Term Researchers (*Ricercatori a Tempo Determinato di tipo A*). They are often employed on fixed-term contracts, which usually provide them with funding and limited teaching responsibilities to allow them to focus on research. ECRs are not yet established in permanent academic positions.

As already presented in the section on the literature review, one main reason was considered to select those participants: they are at a critical stage where perceptions of gender bias can significantly impact their career decisions.

Thanks to the support of the Equal Opportunities Committee of the university, ethical approval was not required. The survey was administered on-

line to the respondents in February 2024. This decision was based on cost efficiency and ease of data collection, considering that this particular group is interested in the use of electronic devices to conduct their work (Christian et al., 2021). The questionnaire and its items were mostly adapted from the literature already presented in the relevant section of this paper, ensuring conceptual consistency with established research in the field. Although a full validation procedure was beyond the scope of this paper, a pre-test helped ensure clarity, internal consistency, and face validity of the items. Before briefly presenting the survey, a few aspects are considered to underline the rationale that guided its implementation (Marradi, 2019). This questionnaire was built to limit states of fatigue and facilitate the compilation thanks to short and clear questions with exhaustive closing plans and thanks to a few questions limited to what is necessary to collect data useful for the analysis. Most questions were closed-ended and mandatory; however, to reach a deeper analysis, a few questions, which were non-mandatory, were open-ended to enable respondents to present their thoughts on the case under scrutiny. In any case, if participants believed they were in a state of fatigue, they could interrupt the compilation and possibly decide to resume it later. Regarding anonymity, the nature of the study did not require information that allowed the identification of the participants. In addition, sensitive questions, such as religion or political orientation, were omitted.

Before sending the questionnaire to the respondents, a pre-test was conducted among the research group to ensure that it worked properly. All respondents received an email from the Equal Opportunities Committee of the university; thus their email addresses were not needed. The respondents were informed of the objective of the study, the format of the questionnaire, how long it took to fill in, and what was expected from them, including the hyperlink to fill in the questionnaire. The study presentation informed participants that their responses were anonymous and that the outcome of the study was only for research purposes. Finally, email addresses of the research group were provided in case respondents needed clarification of the study. After two weeks, another email was sent to remind them to fill in the questionnaire. In total, data collection lasted four weeks.

Responses from 510 ECRs were collected. However, after a brief inspection, only 160 cases were completed and included in the analysis, resulting in a response rate of approximately 31.4%. Although this rate is comparable to similar online surveys, thus allowing the research group to answer the research questions, it raises potential concerns regarding response bias, where individuals with stronger opinions or greater awareness of gender-related issues were more likely to complete the survey. After having conducted the descriptive analysis, which will be presented in Section 4, it was decided not to include respondents who defined themselves in non-binary terms. Al-

though this may seem in contrast with the scope of this paper, these respondents represented a small percentage of the research that would not allow statistically meaningful comparisons. Including them in the analysis would have risked producing unreliable or non-interpretable results.

Starting with RQ1 (How do ECRs perceive gender disparities in STEM disciplines?), an exploratory factor analysis (EFA) was carried out to identify latent factors useful for the analysis. EFA can be used to identify, for example, limitations, advantages or disadvantages in terms of gender bias perceived by ECRs in STEM disciplines. The factors were extracted using the principal components method. This was done by considering three selection criteria (Pituch & Stevens, 2015):

- Kaiser criterion: All extracted factors that have an eigenvalue greater than one are taken into account because lower values refer to factors that can explain less than a single variable can explain.
- Explained variance criterion: In this case, the basis for selection is the cumulative explained variance. A level of explained variance of 65% - 70% is considered significant.
- Scree test: This technique (Cattell, 1966) aims to provide a graphical representation of the factors to be taken into account. The eigenvalues are represented as points connected by a line. According to the Cattell method, the choice of factors should be limited to the point where a levelling of the slope of the line occurs.

As shown in Table 1, the EFA results suggest a two-dimensional structure for the factors related to perception of gender disparities among respondents. These components will then be used to answer the research question.

First, based on these results, to identify whether the two groups had statistically significant differences, the author evaluated whether the two factorial variables, that is, 'motivation for choosing STEM' and 'STEM Perceptions and Experiences', had a normal distribution. Since they did not, the Mann-Whitney U test was performed. This test is a non-parametric technique often used in sociology for analysing categorical and ordinal data. The Mann-Whitney U test compares differences in ranks between two independent groups, thus making it suitable for analysing, for example, Likert scale responses when normality assumptions are not met, as is common in survey data (Field, 2024). In conclusion, a chi-square test was performed¹ on two categorical variables on opportunities and limitations in STEM, respectively. This evaluates associations between categorical variables by comparing observed and expected frequencies, allowing researchers to test hypotheses about relationships, such as those between gender and perception of gender

¹ Pieces of research using the chi-square test in similar research designs are, for example, Khazaal et al. (2014), Saavedra-Acuna and Quezada-Espinoza (2021), and Kargal and Ranganathan (2024).

bias (Agresti, 2018). As will also be done in RQ3, this test was considered appropriate for non-parametric nominal-level data. In addition, it met the assumption of minimum expected cell frequencies, ensuring the validity of the results. For this RQ, the effect size (Cramér's *V*) was reported to assess the magnitude of the associations.

Table 1. EFA, output from SPSS

Rotated Component Matrix		
	Component	
	1	2
Q10_scelta_STEM_F	,840	
Q10_scelta_STEM_D	,821	
Q12_STEM_opinione_B		,722
Q12_STEM_opinione_A		,633
Q12_STEM_opinione_C		,600

Component 1 primarily captured Q10_scelta_STEM_F (interest in STEM) and Q10_scelta_STEM_D (pre-disposition to STEM). This factor likely represents the 'motivation for choosing STEM', since both variables relate to the reasons to choose STEM disciplines. Component 2 captured Q12_STEM_opinione_B, Q12_STEM_opinione_A, and Q12_STEM_opinione_C, which involve experiences and perceptions within STEM, such as underestimation, predisposition, and ease of working in STEM fields. This factor was named 'STEM Perceptions and Experiences'.

With respect to the other two research questions, a similar approach was taken. In RQ2 (How do perceptions of work-life balance differ between male and female ECRs in STEM disciplines?) a rather normal distribution was found for work-life balance, which allowed the researchers to conduct the T-test. On the other hand, RQ3 (Are there differences in future career plans between male and female ECRs in STEM, and what are the underlying reasons?), the relevant variable on the reasons for choosing STEM disciplines lacked normal distributions. Thus, the Mann-Whitney U test was again performed. Then, for the last research question, a chi-square test was performed to investigate the variables on future job occupations in STEM disciplines.

As will be described in the next section, this study presents some limitations that had to be considered when discussing the results. First, the relatively small sample size (N=160) and its focus on a single Italian university could limit the generalisability of the findings. It may reflect specific organisational cultures, policies and gender dynamics that are not representative of other contexts and influence the perceptions of respondents. Second, the exclusion of non-binary respondents, due to their low number, prevented

a more inclusive and comprehensive understanding of gender diversity in STEM. This decision was methodological rather than conceptual, future research should ensure adequate representation for meaningful comparative analysis. Third, the self-selection nature of online surveys might introduce bias, as those with stronger views and greater awareness of gender issues might be more likely to participate, thus potentially influencing the results and requiring greater attention when interpreting the findings. Furthermore, while the chi-square test was appropriate for analysing associations between categorical variables, the lack of formal sampling strategy and the potential self-selection of respondents limit the generalisability of the results to the broader population of early career researchers. Finally, the cross-sectional design captured perceptions at a specific point in time and might not reflect how views evolve throughout academic careers. Future studies could expand the sample, include more institutions, and adopt longitudinal approaches to better understand the long-term impact of gender bias in STEM.

Results and discussion

This section presents and discusses the results that emerged from data analysis, bearing in mind the aim of investigating gender bias among ECRs from an Italian university. Each question will be addressed individually, presenting results followed by a discussion to contextualise what has emerged. However, above all, the demographics of the respondents is illustrated. Of the 160 respondents, 84 people defined themselves as female, which corresponds to 52.5% of the total, while 72 as male, which corresponds to 45%. The remaining percentage corresponds to those who prefer not to answer. With respect to age, most people were born between 1991 and 1999, so they were between 32 and 24 years old at the time of data collection. Regarding their role, 109 people are PhD researchers, representing the highest percentage (68.1%); then, there are 28 Type A Fixed-Term Researchers (17.5%) and 23 postdoctoral researchers (14.1%). Concerning the area of research, the majority of respondents are from engineering disciplines, with 70 individuals representing 43.8% of the total. They are followed by chemistry (22.5%), physics (14.4%) and informatics (6.3%). The rest is distinguished between geoscience, mathematics, environmental science, and life science. Referring to more private aspects of their life, it is noteworthy that 21 respondents are married (13.1%), while three decided not to answer. The rest of the respondents are not married. Similarly, almost all respondents have no children (146 people, representing 91.3% of the total).

In addition to this wide panoramic view, crosstabs present interesting elements. Starting with gender and academic role, female respondents are mostly present as PhD researchers (52.3%) and as postdoctoral researchers

(72.7%). However, among Type A Fixed-Term Researchers, which is a higher level than the other two, male respondents represent 53.8% of the total. Concerning gender and disciplines, females represent the majority in physics (60.9%), geoscience (66.7%), mathematics (100%), environmental sciences (83.3%) and life sciences (85.7%). Although interesting, it is necessary to look at how many people research these subjects. Doing so can help to have the right perspective. Indeed, for example, only three people said that they study mathematics and all of them identified themselves as women. In this sense, when we look at engineering, which has the highest absolute number, 47.8% of respondents are women. In terms of marital status, 13 men are married compared to 7 women. As a result, most women (56%) are not married. Similarly, when looking at the number of children, only three women declared that they had two children, while eight men declared that they had between one and three children. Therefore, most women (55.2%) do not have children.

RQ1: How do ECRs perceive gender disparities in STEM disciplines?

The analysis of gender disparities among ECRs in STEM disciplines reveal significant findings. Based on the two latent factors of the EFA (‘motivation for choosing STEM’ and ‘STEM Perceptions and Experiences’), the Mann-Whitney U test was performed. Looking at Table 2, it shows no statistically significant difference by gender for Factor 1, that is, the motivation (p=0.220), but a statistically significant difference was observed for Factor 2, perceptions and experiences (p < 0.001), indicating distinct perceptions across genders.

In terms of this aspect, the results of the chi-square test show some differences. The first test on perceived opportunities in STEM reveals a statistically significant association (p=0.021), with males more likely to report equal opportunities (70.8% versus 48.8% of female respondents).

Table 2. Mann-Whitney U test, output from SPSS

Hypothesis Summary Test				
	Null Hypothesis	Test	Sign.	Decision
1	The distribution of FAC1_1 is the same across the categories of Q4_gender.	Independent-samples Mann-Whitney U test	,220	Retain the null hypothesis
2	The distribution of FAC2_1 is the same across the categories of Q4_gender.	Independent-samples Mann-Whitney U test	,000	Reject the null hypothesis

In this sense, it is worth noting that 47.6% of female respondents say that men have more opportunities, while 23.6% of male respondents say that men

have opportunities. For the limitations in STEM, the second chi-square test again yields statistical significance ($p=0.016$), suggesting that women perceive limitations more frequently (58.3% of them). Looking instead at male respondents, none of them report that men face limitations, while 31.9% declare that women face limitations. However, 34.7% believe that men and women have the same limitations (against 20.2% of female respondents). This highlights gendered perspectives on opportunities and barriers in STEM fields. With respect to Cramér's V , taking into account its threshold (small=0.10, medium=0.30, large=0.50) the analysis revealed a moderate association between gender and perceived opportunities in STEM (Cramér's $V=0.282$), while the association was notably stronger when examining perceived limitations (Cramér's $V=0.449$), suggesting that gender differences are more pronounced when respondents reflect on barriers rather than opportunities. These results somehow recall what was illustrated in previous sections, confirming HP1 (female ECRs are more likely to report higher perceived gender disparities than their male counterparts). When referring to experiences and perceptions of differences, including limitations and opportunities among male and female ECRs, these results confirm that female respondents live a gendered experience (e.g., Di Tullio, 2018). In particular, it is interesting to note that male respondents tend to declare that both groups experience similar limitations and opportunities.

This institutional bias may reflect a form of testimonial injustice (Fricke, 2007): women's perspectives and reports of unequal treatment are undervalued or dismissed, especially by male colleagues who may perceive the system as equitable. This disparity can also be related to the so-called stereotype threat, a concept presented in the literature review, which explains how negative stereotypes about women in STEM undermine the confidence and professional position of female researchers (Lv et al., 2022; Schmader et al., 2004). The persistence of such stereotypes can lead to a cycle in which women's experiences of limitations further diminish their sense of belonging and self-efficacy in STEM disciplines (Tellhed et al., 2017; Wang & Degol, 2013). A lack of shared understanding about the experiences of women may make this challenge less visible in institutional discourses.

RQ2: To what extent do perceptions of work-life balance differ between male and female ECRs in STEM disciplines?

With respect to work-life balance, the t-test results do not show statistically significant differences between male and female respondents (Table 3). Levene's test indicates that the assumption of homogeneity of variances is met ($p > 0.05$).

Table 3. T-Test, output from SPSS

	Group	N	Mean	SD	T	df	p.
Q17_equilibrio_lavoro_privato	Male	69	3,29	1,07	-,290	149	,772
	Female	82	3,34	1,10			

These findings indicate the absence of statistically significant gender differences in perceptions of work-life balance, leading to the rejection of HP2 (female ECRs are more likely to report lower satisfaction with work-life balance compared to male ECRs). This finding may suggest comparable perceptions across genders, challenging the common assumption that work-life balance is predominantly a female concern in academia.

Although the literature frequently cites work-life balance as a gender-sensitive issue, these results may indicate that younger generations of male researchers are also beginning to recognise and value work-life balance, potentially influenced by shifting societal expectations (Ceci & Williams, 2010). However, the literature suggests that work-family conflicts continue to affect female researchers disproportionately in the long run, especially as they progress in their careers and face greater demands from family responsibilities (Wang & Degol, 2013). Women in STEM disciplines are often expected to navigate caregiving responsibilities along with intense career demands, which can impact their productivity and advancement (Wang & Degol, 2013). This tension can be understood as a gap where academic cultures do not recognise the gendered dimension of work-life balance. From this viewpoint, the absence of significant gender differences in work-life balance perceptions might reflect the predominantly younger demographic of respondents in this paper, many of whom are still PhD students, who may not yet experience the full scope of work-family pressures. In addition, it may reflect a period in which expectations around work-life balance are shifting for both men and women, which are not yet matched by structural reforms.

RQ3: Are there differences in future career plans between male and female ECRs in STEM?

In conclusion, the last analysis refers once more to the Mann-Whitney U and chi-square tests. With respect to the first one on choosing STEM disciplines for high academic prospects, there are no statistically significant differences by gender ($p = 0.68$), as shown in Table 4. When considering this matter, the chi-square test on future careers in the next five years again shows no statistically significant differences ($p = 0.965$). For example, male and female respondents mainly declare that they see themselves in academia

(40.3% and 39.3%, respectively) or in private companies (37.5% and 40.5%, respectively).

Table 4. Mann-Whitney U test, output from SPSS

Hypothesis Summary Test				
	Null Hypothesis	Test	Sign.	Decision
1	The distribution of Q10_scelta_STEM_A is the same across the categories of Q4_gender.	Independent-samples Mann-Whitney U test	,687	Retain the null hypothesis

The study did not find significant gender differences regarding future career plans, with male and female respondents showing similar inclinations toward careers in academia or private industry, which rejects HP3 (female ECRs are more likely than male researchers to plan lower academic or research positions or to leave STEM careers in academia). This lack of distinction may reflect similar aspirations between genders, potentially due to a shared educational background, professional training, and the specific demands of the STEM field. However, the literature suggests that as researchers progress in their careers, women may encounter more barriers to advancement, leading to differences in career choices over time (Lv et al., 2022; Wang & Degol, 2013). This phenomenon is closely related to the concept of the 'leaky pipeline' (Blickenstaff, 2005), where women disproportionately exit STEM careers at higher career stages due to factors such as gender bias, work-life conflicts, and limited advancement opportunities. Although intentions in the early career stage may be similar across genders, systemic inequities, which are often invisible to those not affected, can erode these aspirations over time. Recognising this requires not only longitudinal monitoring but also a change in how institutional success and credibility are defined, assessed, and supported.

This paper has investigated gender disparities between early ECRs in STEM disciplines from the University of Genoa, focusing on their perceptions of gender bias, work-life balance, and future career plans. Using an online survey, the paper has explored patterns across genders. Drawing on Fricker's (2007) theory of epistemic injustice, the analysis has presented a deeper understanding of how gender shapes experiences and expectations among respondents to the survey.

Although these results cannot be generalised to ECRs as a whole, they provide an interesting picture to be addressed. The disparities in perceived opportunities and experiences among ECRs suggest that gender biases are not only socially constructed, but also institutionalised, impacting ECRs in different ways depending on their gender. The results that males are more

likely to perceive STEM as equitable align with the idea of testimonial injustice (Fricker, 2007), where male perspectives are often privileged and female perspectives undervalued or dismissed. As a result, male researchers may lack awareness of the obstacles their female counterparts face. The sense of belonging of women can be reduced, perpetuating the difficulty of acknowledging gendered disadvantage. However, the results on work-life balance and future career plans suggest a more complex picture. Indeed, both women and male ECRs have reported similar perceptions of work-life balance and career aspirations. Focusing on work-life balance, these results may reflect two aspects, which may nonetheless overlap. On the one hand, this finding may indicate the emergence of generational shifts, where younger cohorts of researchers - regardless of gender - place similar value on balancing professional and personal life. On the other hand, it may also reflect a temporal effect linked to career stage: many respondents, particularly PhD students, may not yet have encountered the structural constraints that tend to intensify work-family conflicts later in academic careers. In this sense, the apparent similarity in perceptions should not be interpreted as evidence of equality, but rather as a potentially transient condition that precedes the emergence of gendered inequalities. This interpretation aligns with the literature suggesting that disparities often become more pronounced at later career stages. Similarly, the lack of gender differences in career aspirations may reflect an initial alignment of expectations that is progressively shaped by structural barriers over time. At early career stages, male and female researchers may share similar ambitions; however, institutional constraints, evaluation systems, and implicit biases may gradually influence career trajectories in gendered ways. This suggests that aspirations alone are not sufficient indicators of future outcomes and highlights the importance of examining how structural conditions interact with individual expectations over time.

By focusing on ECRs, this paper has highlighted a critical aspect in academic settings, where perceptions and ambitions are still forming, but already shaped by gendered environments. Considered a pilot study to be further developed, it contributes to the sociology of education and gender studies in several ways. It provides empirical evidence on early career researchers in STEM within the Italian context, which remains underexplored in the literature. Then, it integrates quantitative analysis with the theoretical lens of epistemic injustice, offering a novel perspective on how gender bias operates beyond structural levels by including the epistemic ones. In conclusion, by focusing on perceptions at an early career stage, the pilot study highlights how inequalities may begin to take shape before becoming fully visible in career outcomes. Future research should deepen this investigation both at institutional and theoretical levels. From an institutional perspective, these findings suggest the need for universities to go beyond formal equality

measures and address the subtle and often invisible mechanisms through which gender bias operates. This includes fostering awareness of epistemic injustice and creating spaces where diverse perspectives are recognised and valued. From a theoretical standpoint, studies should reinforce the relevance of epistemic injustice as a framework for understanding gender inequalities in academia. This approach would complement more traditional structural analyses and opens new avenues for research on knowledge production and power dynamics in higher education. To advance meaningful changes, universities must not only track gender disparities quantitatively but also recognise the epistemic dimensions of biases, ensuring that all researchers are heard, valued, and included.

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Reference

- Agresti, A. (2018). *Statistical methods for the social sciences*. Harlow: Pearson
- Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2012). “Balancing acts”: Elementary school girls’ negotiations of femininity, achievement, and science. *Science Education*, 96(6), 967–989. Retrieved from: <https://doi.org/10.1002/sce.21031>
- Blickenstaff, J. C. (2005). Women and science careers: Leaky pipeline or gender filter? *Gender and Education*, 17(4), 369–386. Retrieved from: <https://doi.org/10.1080/09540250500145072>
- Carriero, R., & Naldini, M. (2022). Gender Disparity in Access to Academia in Italy. Are there barriers to women’s early career stages? *Polis, Ricerche e Studi Su Società e Politica*, 1/2022, 5–32. Retrieved from: <https://doi.org/10.1424/103557>
- Cattell, R. B. (1966). The Scree Test For The Number Of Factors. *Multivariate Behavioral Research*, 1(2), 245–276. Retrieved from: https://doi.org/10.1207/s15327906mbr0102_10
- Ceci, S. J., & Williams, W. M. (2010). Sex Differences in Math-Intensive Fields. *Current Directions in Psychological Science*, 19(5), 275–279. Retrieved from: <https://doi.org/10.1177/0963721410383241>
- Cheryan, S., Ziegler, S. A., Montoya, A. K., & Jiang, L. (2017). Why are some STEM fields more gender balanced than others? *Psychological Bulletin*, 143(1), 1–35. Retrieved from: <https://doi.org/10.1037/bul0000052>
- Christian, K., Johnstone, C., Larkins, J., Wright, W., & Doran, M. R. (2021). A survey of early-career researchers in Australia. *eLife*, 10, e60613. Retrieved from: <https://doi.org/10.7554/eLife.60613>
- Di Tullio, I. (2018). Gender equality in STEM: Uno studio di caso sulle ricercatrici del Consiglio Nazionale delle Ricerche [Master Thesis, Sapienza Università di Roma].

- Di Tullio, I. (2019). Gender Equality in STEM: Exploring Self-Efficacy Through Gender Awareness. *Italian Journal of Sociology of Education*, 11(3), 226–245. Retrieved from: <https://ijse.padovauniversitypress.it/2019/3/13>
- Doan, M. (2018). Resisting Structural Epistemic Injustice. *Feminist Philosophy Quarterly*, 4(4), Article 4. Retrieved from: <https://doi.org/10.5206/fpq/2018.4.6230>
- Dotson, K. (2011). Tracking Epistemic Violence, Tracking Practices of Silencing. *Hypatia*, 26(2), 236–257. Retrieved from: <https://doi.org/10.1111/j.1527-2001.2011.01177.x>
- Eccles, J. S., & Wang, M.-T. (2015). What motivates females and males to pursue careers in mathematics and science? *International Journal of Behavioral Development*, 40(2), 100–106. Retrieved from: <https://doi.org/10.1177/0165025415616201>
- Ferriman, K., Lubinski, D., & Benbow, C. P. (2009). Work preferences, life values, and personal views of top math/science graduate students and the profoundly gifted: Developmental changes and gender differences during emerging adulthood and parenthood. *Journal of Personality and Social Psychology*, 97(3), 517–532. Retrieved from: <https://doi.org/10.1037/a0016030>
- Field, A. (2024). *Discovering Statistics Using IBM SPSS Statistics*. SAGE Publications.
- Field, T. W., & Cropley, A. J. (1969). Cognitive style and science achievement. *Journal of Research in Science Teaching*, 6(1), 2–10. Retrieved from: <https://doi.org/10.1002/tea.3660060103>
- Filandri, M., & Pasqua, S. (2021). ‘Being good isn’t good enough’: Gender discrimination in Italian academia. *Studies in Higher Education*, 8, 1533–1551.
- Fisher, C. R., Thompson, C. D., & Brookes, R. H. (2020). Gender differences in the Australian undergraduate STEM student experience: A systematic review. *Higher Education Research & Development*, 39(6), 1155–1168.
- Fricker, M. (2007). *Epistemic Injustice: Power and the Ethics of Knowing*. Oxford, UK: Oxford University Press.
- Gagnon, R. L. Q., Heath, D. S., Koh, K., Lindeman, C., McIvor, A. K., Porthukaran, A. I., & Nicoladis, E. (2019). Exploring Gender Imbalance in Computing Science. *Journal of Interpersonal Relations, Intergroup Relations and Identity*, 12(Winter), 35-45.
- Intemann, K. (2009). Why Diversity Matters: Understanding and Applying the Diversity Component of the National Science Foundation’s Broader Impacts Criterion. *Social Epistemology*, 23(3-4), 249-266. Retrieved from: <https://doi.org/10.1080/02691720903364134>
- Kargal, R. G., & Ranganathan, S. (2023). Impact of Digital Advertising on Consumer Sentiments in the Indian Footwear Market. *MS Ramaiah Management Review*, 14(02), Article 02. Retrieved from: <https://doi.org/10.52184/msrmr.v14i02.154>
- Khazaal, Y., Singer, M. van, Chatton, A., Achab, S., Zullino, D., Rothen, S., Khan, R., Billieux, J., & Thorens, G. (2014). Does Self-Selection Affect Samples’ Representativeness in Online Surveys? An Investigation in Online Video Game Research. *Journal of Medical Internet Research*, 16(7), e2759. Retrieved from: <https://doi.org/10.2196/jmir.2759>
- Lv, B., Wang, J., Zheng, Y., Peng, X., & Ping, X. (2022). Gender differences in high school students’ STEM career expectations: An analysis based on multi-group structural equation model. *Journal of Research in Science Teaching*, 59(10), 1739-1764. Retrieved from: <https://doi.org/10.1002/tea.21772>
- Marradi, A. (2019). *Tutti redigono questionari: Ma è davvero così facile?* Milano: FrancoAngeli.
- Michell, D., Szorenyi, A., Falkner, K., & Szabo, C. (2017). Broadening participation not border protection: How universities can support women in computer science. *Journal of Higher Education Policy and Management*, 39(4), 406–422.

- Ministero dell'Università e della Ricerca. (2024). *Reclutamento delle Università | Ministero dell'Università e della Ricerca*. Ministero Dell'Università e Della Ricerca. Retrieved from: <https://www.mur.gov.it/aree-tematiche/universita/carriera-accademica/reclutamento-delle-universita>
- Morgan, S. L., Gelbgiser, D., & Weeden, K. A. (2013). Feeding the pipeline: Gender, occupational plans, and college major selection. *Social Science Research*, 42(4), 989–1005. Retrieved from: <https://doi.org/10.1016/j.ssresearch.2013.03.008>
- Ogunde, J. C., Overton, T. L., Thompson, C. D., Mewis, R., & Boniface, S. (2017). Beyond graduation: Motivations and career aspirations of undergraduate chemistry students. *Chemistry Education Research and Practice*, 18(3), 457–471. Retrieved from: <https://doi.org/10.1039/C6RP00248J>
- Pituch, K. A., & Stevens, J. P. (2015). *Applied multivariate statistics for the social sciences: Analyses with SAS and IBM's SPSS*. New York, NY: Routledge.
- Saavedra-Acuña, C., & Quezada-Espinoza, M. (2021). A study of gender differences in career choice in STEM disciplines: The case of Chilean students. In *Proceedings of the ASEE Virtual Annual Conference*. Retrieved from: <https://peer.asee.org/36615>
- Schmader, T., Johns, M., & Barquissau, M. (2004). The costs of accepting gender differences: The role of stereotype endorsement in women's experience in the math domain. *Sex Roles*, 50(11–12), 835–850. Retrieved from: <https://doi.org/10.1023/b:sers.0000029101.74557.a0>
- Settles, I. H., Jellison, W. A., & Pratt-Hyatt, J. S. (2009). Identification with multiple social groups: The moderating role of identity change over time among women-scientists. *Journal of Research in Personality*, 43(5), 856–867. Retrieved from: <https://doi.org/10.1016/j.jrp.2009.04.005>
- Tellhed, U., Bäckström, M., & Björklund, F. (2017). Will I Fit in and Do Well? The Importance of Social Belongingness and Self-Efficacy for Explaining Gender Differences in Interest in STEM and HEED Majors. *Sex Roles*, 77(1), 86–96. Retrieved from: <https://doi.org/10.1007/s11199-016-0694-y>
- Wang, M.-T., & Degol, J. (2013). Motivational pathways to STEM career choices: Using expectancy–value perspective to understand individual and gender differences in STEM fields. *Developmental Review*, 33(4), 304–340. Retrieved from: <https://doi.org/10.1016/j.dr.2013.08.001>