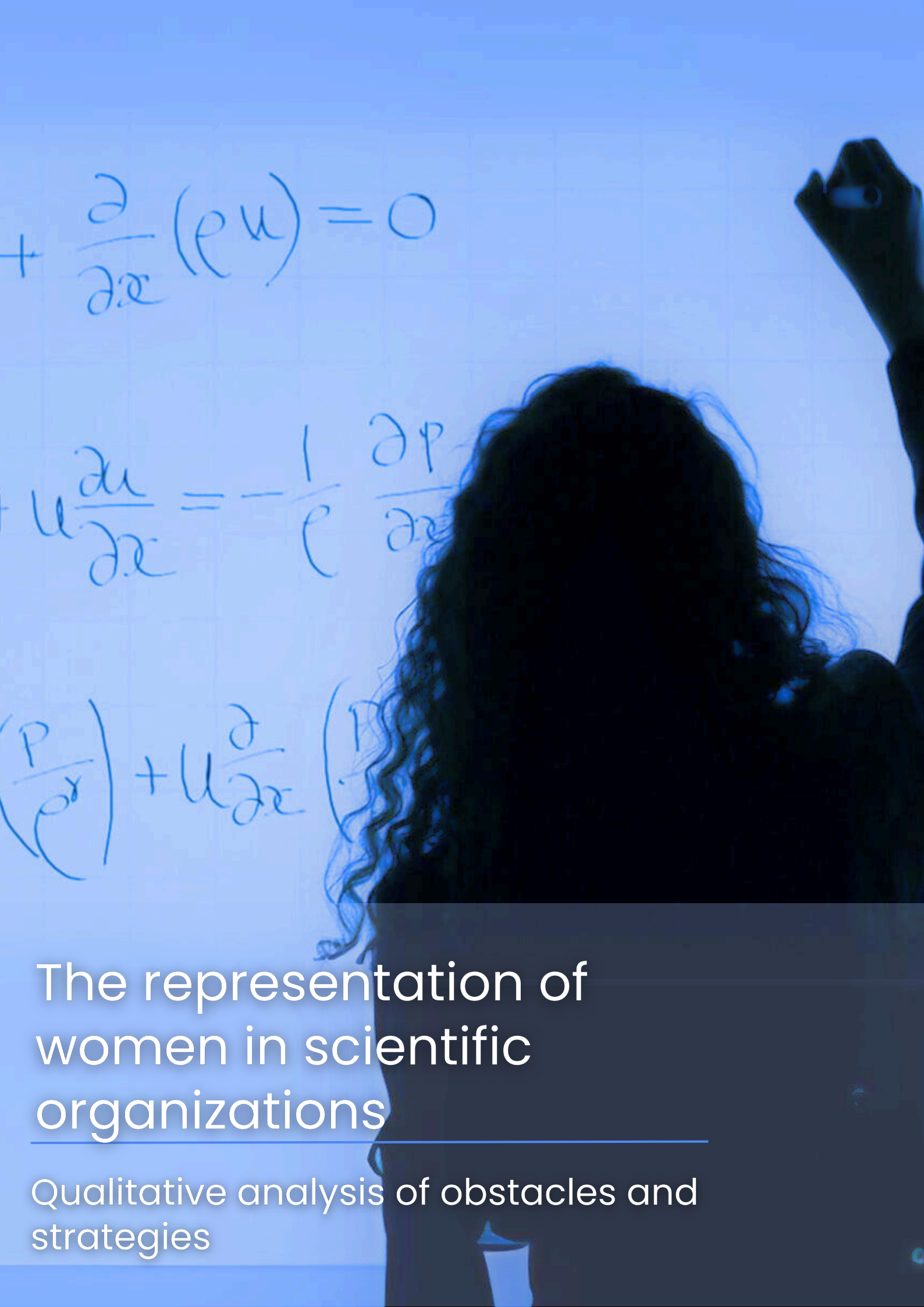

The representation of women in scientific organizations

Qualitative analysis of obstacles and strategies

UNIVERSITÉ PARIS 8

PSYCHOLOGY BACHELOR

The Representation of Women in Scientific Organizations: Qualitative Analysis of Obstacles and Strategies

Abstract

This study explores the underrepresentation of women in scientific organizations, specifically science academies and international unions, through qualitative interviews with ten women scientists from various disciplines and regions.

The research aims to identify the systemic and personal factors influencing their participation and success in these organizations, as well as the strategies they employ to overcome gender-related challenges in their careers and institutional engagement.

The interviews reveal significant barriers, including gender stereotypes, sexist academic and professional climates, and institutional biases, which deter women from pursuing and persisting in STEM careers. The study also highlights the proactive efforts of women scientists to create supportive networks, promote gender equality through international engagement, and advocate for inclusive practices within their organizations.

Based on these findings, we propose recommendations to promote the representation of women in scientific organizations and mitigate the impact of gender stereotypes and academic climates, including the implementation of transparent nomination processes.

Keywords

Gender equality, gender in science, science academies, science unions

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Academic Year 2023 - 2024

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INTRODUCTION

According to UN data, women make up only 33% of all researchers and scientists worldwide. This disparity extends to the fields of engineering and advanced technologies: in the field of artificial intelligence, for example, only 22% of professionals are women. In academia, women constitute only 28% of all engineering graduates and 40% of all computer science graduates. Furthermore, according to the UN, the careers of female researchers tend to be shorter and less well-paid than those of their male counterparts, even when they have equivalent skills and positions.

There are also significant geographical disparities in the proportion of women scientists. According to data from the UNESCO Institute for Statistics, in South Asia and Southeast Asia, 23% and 27% of researchers, respectively, are women. In sub-Saharan Africa and Europe, an average of 32% and 34% are women. The Arab States, Latin America and the Caribbean, as well as Central Asia, have percentages above 40%, with 41%, 44%, and 47% of women scientists, respectively. Only Southeast Europe exceeds 50%, reaching 52% women researchers.

These differences between regions of the world suggest that the gender gap in science is not due to innate differences between men and women, nor to the economic development level of a country. These disparities rather reflect a set of societal, psychological, and cultural factors, as well as systemic obstacles in the sciences that hinder women’s and girls' access to scientific careers and prevent them from reaching higher positions or achieving success equivalent to that of their male colleagues.

In the context of this study, an important statistic to consider is the following: on average, according to the UN, only 12% of members of national science academies worldwide are women. These scientific academies, generally established at the national or regional level, bring together scientists appointed based on their merit. As representatives of the scientific community, their main missions are to advise governments on scientific issues, facilitate the dissemination of knowledge, and promote the advancement of science. The low representation of women within these academies therefore raises questions.

Using a qualitative methodology, based on semi-structured interviews with a phenomenological approach, I gathered ten testimonies from women scientists who are members of national academies or scientific unions. These interviews explored the factors influencing the representation of women and their participation in scientific organizations through major themes: the formation of personal interests and attitudes that lead to the choice of academic and career paths; the impact of gender on their professional trajectories; the modalities of their involvement in a scientific organization; the environment and culture within these organizations; organizational practices and policies in favor of gender equality; and finally, intersectional perspectives.

Thematic coding and qualitative analysis of the interview data provided me with a holistic view of the conditions and factors limiting the participation of women in scientific organizations. I found, in line with the literature, that interests, as well as obstacles, are formed from a very

young age. These interviews, with women who have overcome systemic biases and discrimination in the sciences, shed light on the personal dispositions and systemic conditions that have led to their success. Many attributed their success to support from loved ones, the presence of a mentor, or a field of specialization more open to women. It seems that for the majority, personal qualities such as determination and work ethic were also decisive. The possible presence of attribution bias or denial of the success encountered, or the difficulties faced also emerges—particularly in favor of luck or affirmative action.

It is particularly remarkable to note that these women, having reached decision-making positions, go against the grain of climates that would prefer them to keep a low profile, becoming drivers of institutional change and striving to create conditions that will facilitate the paths of their peers and future generations.

Armed with their determination, they employ various strategies throughout their studies and careers to overcome obstacles. They particularly mobilize the international arena, a neutral space, to form communities of women where support, initiatives, and exchanges of good practices are organized. Within these formal and informal networks, previously inaccessible opportunities arise, allowing these women to break free from conservative environments and claim their place in the sciences.

IMPLEMENTATION FRAMEWORK

In 2015, the InterAcademy Partnership (IAP) conducted the first survey aimed at evaluating the inclusion and participation of women within scientific academies. In 2020, a second survey was carried out by the International Science Council (ISC) in collaboration with the Gender Equality in Science Committee (SCGES), expanding the 2015 study to a broader panel of scientific organizations, including medical academies, social science academies, young scientists' organizations, and international scientific unions.

The objective of this 2024 pilot study, was not only to update the data but also to analyze the causes of the underrepresentation of women scientists within these institutions.

Scientific Institutions

There are many types of scientific institutions. In the context of this study, we decided to focus on the national academies and international disciplinary unions surveyed in 2020.

National academies of sciences are organizations that bring together national or foreign scientists. Their primary objective is to promote scientific research through conferences or awards, for example, and to provide advice to governments on scientific and technological issues. For a scientist, being admitted to a national academy is a significant recognition of their research and career. Some academies are multidisciplinary, mixing natural and social sciences, while others focus solely on the natural sciences.

On the other hand, international scientific unions are organizations that bring together national scientific unions from the same research field. Their members are not individuals but national unions. Their goal is to promote scientific research and encourage international collaboration among researchers through conferences, awards, and joint projects.

Main Observations and Conclusions of the 2020 Study

In 2020, the study coordinated by the ISC surveyed 85 national academies of sciences and 38 international unions using quantitative questionnaires.

This survey revealed an increase in the representation of women among academy members since 2015, from 13% to 17%, as well as an increase in female leadership within governance bodies, from 21% to 29%. However, the representation of women within national academies does not reflect the proportion of women scientists. There are also significant geographical disparities. According to the study, countries in the Latin America and Caribbean region have the highest proportion of women within their academies.

The differences between disciplines are also significant. Women are better represented in the fields of social and human sciences (26%), medicine and health (20%), biological sciences (20%), and agricultural sciences (19%). In contrast, physics and chemistry (11%), engineering (8%), and mathematics (7%) have the lowest female representation.

It is interesting to note that women are better represented in medical and health academies than in science academies. For example, the National Academy of Medicine in the United States has 28% women, while the National Academy of Sciences has 19%.

Finally, women represent 29% of governance positions within academies, a rate higher than their overall participation. For instance, although women make up only 28% of the members of the National Academy of Medicine in the United States, they hold 67% of the seats on its governing body. Similarly, at the National Academy of Venezuela, women make up 31% of the members but hold a majority of leadership positions, with 67% of these roles occupied by women.

Regarding the unions, 37% were chaired by a woman, and the proportion of women in governance bodies reached 67% in the social sciences disciplines, compared to 24% in the natural sciences. The study also recorded the percentage of unions with documents explicitly mentioning the need to increase women's participation, which was 45%, as well as the percentage of unions with a policy against sexual harassment, which was 40%.

In 2023, the SCGES conducted a survey of its union members to measure the gender gap in each scientific discipline represented by a member union. The collected data concerns the representation of women in scientific congresses and conferences, the awarding of prizes and honors, governance positions, and disciplinary scientific journals.

The SCGES also gathered information on the existence of web pages dedicated to gender equality on the sites of the various member unions, the existence of a structure and budget dedicated to gender equality within the union, and the existence of specific policies and activities.

THEORETICAL FRAMEWORK

The initial phase of this study entailed a comprehensive review of the existing literature on the factors contributing to the underrepresentation of women in science. This literature review was instrumental in identifying and synthesizing the critical theoretical concepts that informed the development of the interview guide.

Socio-Sexual Theories

Socio-sexual theories offer an in-depth analysis to explain how gender roles and stereotypes influence career choices and professional development (Avolio, Chávez, Vílchez-Román, 2020).

At the professional level, obstacles specific to women have been extensively studied and are conceptualized through three main metaphors: the “glass ceiling” (Marilyn Loden, 1978), the “glass labyrinth” (Eagly and Carli, 2009), and the “sticky floor.”

Unlike the “glass ceiling,” which refers to the implicit barrier limiting women's access to leadership positions within an organization, the “glass labyrinth” illustrates the numerous challenges encountered throughout their careers. The concept of the “sticky floor” was later theorized to highlight the obstacles that keep women in low-level, low-paying positions without opportunities for advancement.

Additionally, another concept specific to scientific fields was developed to describe how women gradually disappear over the course of their academic and professional careers: the “leaky pipeline” theory (Avolio, Chávez, Vílchez-Román, 2020). This metaphor highlights the various factors that contribute to a gradual loss of women throughout the academic and professional pipeline in science, technology, engineering, and mathematics (STEM), similar to a pipe that leaks. This theory and the realities it describes were confirmed by the testimonies collected during the interviews. “It was only when I started working and suddenly took the time to look around me that I thought, all these women who were moving forward with me... where did they go?”3

In their literature review, Avolio, Chávez, Vílchez-Román (2020) revisit the different models that have been theorized to explain the disparities in access, participation, and advancement of women in scientific careers.

The Deficit Model: External Factors

The deficit model by Sonnert (1999) emphasizes how structural obstacles within scientific systems create an environment that disadvantages women. According to Sonnert, women, as a group, receive fewer opportunities, which explains their less favorable career levels. He points out that although formal barriers to women's access and promotion in scientific careers have

been banned in several countries, including the United States, more subtle and informal barriers still exist—here is a selection:

The "Chilliness" of the Scientific Sector

Rayman and Brett (1995) studied the factors that influence women's persistence in scientific fields after graduation. They identified that the main obstacles are often defined in terms of structural barriers within science itself. These obstacles include exclusion, both informal and formal, biased admission practices in universities, a lack of training and research opportunities, as well as isolation within professional and collegial networks.

According to Blickenstaff (2005), the scientific environment is “chilly” and constitutes an unwelcoming and often “uncomfortable” environment for women. They may face sexist and degrading content and remarks, inappropriate teaching methods, and harassment from students, professors, and colleagues.

Sexist remarks in class or labs, lack of support, and harassment contribute to perpetuating a male-dominated culture and a sexist climate in scientific fields, as noted by Settles, Cortina, Malley, and Steward (2006). Moreover, their analyses highlighted significant differences between natural and social sciences. Scientists in natural sciences reported a more negative perception of the climate within their department and reported more cases of sexual harassment than their counterparts in social sciences.

The Importance of Family as Support...

Family factors, including family background, support, parents' education level, and family attitudes toward science, are determining elements in the choice of study orientation and persistence in that choice. According to Rayman and Brett (1995), family support is a key factor in women’s persistence in pursuing and progressing in a scientific career after obtaining an undergraduate degree in natural sciences or mathematics.

Similarly, having one or both parents in a scientific profession, whether academic, professional, or salaried, strongly influences women's decision to pursue scientific studies. In 1985, Ware, Steckler, and Leserman had already concluded that despite an initial interest in science, a significant number of female students abandoned their science courses before declaring a major in college, thereby contributing to the continued underrepresentation of women in scientific fields. However, they observed that parents' education level was a moderating variable: the higher it was, the more likely women were to pursue a career in STEM.

According to Scott and Mallinckrodt (2005), the relationship with the father also seems to play a significant role. Daughters who choose scientific courses in college reported increased confidence in their scientific abilities, a trend associated with strong parental support, and particularly with emotionally supportive fathers.

...or as an Obstacle

A 2008 study by Maffia suggests that domestic responsibilities are a major obstacle. In many cultures, women are often responsible for the family, including children and aging parents. Maffia discusses the "double workday" imposed on women, who must take on the majority of domestic responsibilities in addition to their professional careers. In the case of women scientists, Maffia indicates that they tend to delay or forego motherhood, pursue less ambitious careers, or even abandon scientific careers altogether to take care of their families. Furthermore, a study by Goulden, Mason, and Frasch (2011) revealed that family obligations are the primary cause of the "leak" of women between obtaining their doctorate and achieving tenure.

The Educational System

According to Seymour (1995), a key factor influencing the representation of women in STEM is the teaching culture during the early years of university. Seymour observed discrepancies between the expectations of female students and those of their male teachers and classmates. Women who enter science and mathematics courses at university often expect a positive learning environment, but they encounter a disconnect with the competitive nature expected by teachers and male peers, leading to a loss of confidence in their ability to succeed in these fields.

According to Blickenstaff (2005), even when women are as well or better prepared than men, they drop out of STEM fields at higher rates, suggesting that factors other than preparation contribute to their departure. He argues that the way sciences are taught and the academic environment seem to give female students the feeling that they do not belong. The lack of support and female role models can isolate them and cause a loss of confidence and decreased participation in class.

The Difference Model: Individual Factors

In addition to societal constraints and an unwelcoming scientific environment, Sonnert (1999) also identified internal factors contributing to the underrepresentation of women in STEM. According to the difference model, he suggests that the causes of gender disparities in professional success in science lie in inherent characteristics of women, which may be either innate or the result of gendered socialization (Sonnert, 1999).

Skills and Ability

Biological aspects that might explain gender differences have been extensively studied, notably by Ceci, Williams, and Barnett (2009). Their findings indicate that biological evidence concerning the underrepresentation of women in fields with a strong mathematical component is contradictory and inconclusive.

Moreover, research conducted by Ceci and Williams (2009, 2011, 2014, and 2015) illustrates the variation in academic performance in mathematics by gender and ethnicity. For instance, in some countries, women are significantly better represented among the top 1% in mathematics than in others, even among neighboring or ethnically similar countries. These observations suggest that sociocultural contexts have a more pronounced impact than biological factors on the gender gap observed in scientific careers.

Interests and Preferences

According to some studies, there is a link between personality type and career choice. Holland's (1985) career choice theory, also known as the RIASEC model, posits that career orientation is an expression of an individual's personality and is the result of various cultural and personal factors.

Another study by Ceci and Williams (2011) indicates that the underrepresentation of women in fields with a strong mathematical component in the United States does not result from hiring discrimination but is instead related to personal choices, whether freely made or constrained, regarding family, lifestyle, and career preferences. Additionally, they observe a tendency among women to favor careers focused on human relationships. This is reflected in their growing presence in fields such as medicine and biology, while they remain less numerous in mathematically intensive disciplines like engineering or physics.

Attitude Toward Science

Girls and women seem to have a different attitude toward science. According to VanLeuven (2004), young women's interest in scientific, technical, and mathematical careers decreases between middle school and high school. Several factors contribute to this decline in interest, including an aversion to the significant amount of work often required in STEM and a decrease in motivation to pursue higher education, likely due to socially transmitted concerns about the length and difficulty of the training required for these careers.

Blickenstaff (2005) emphasizes that the lack of female role models presented in class can also be an obstacle for young girls considering careers in these fields, contributing to their discomfort and perceived inaccessibility of the sciences.

The Social and Cultural Model: Socio-Cultural Biases and Stereotypes

Systemic and internal factors alone are not sufficient to explain the underrepresentation of women in science. Indeed, the climate, preferences and interests, attitudes, and family demands are all deeply influenced by cultural and social determinants. As Correll (2004) pointed out, beliefs about gender shape the career aspirations of men and women, suggesting that these aspirations are not merely personal choices but are influenced by societal expectations and

stereotypes. These biases significantly contribute to the underrepresentation of women in scientific fields.

Stereotypes

According to Master and Meltzoff (2016), stereotypes, particularly those associating STEM fields with men, act as psychological barriers that prevent women from developing interests in these fields from an early age. When children internalize these stereotypes, it can lead to a self-fulfilling prophecy where their academic choices and achievements are limited by the roles they deem appropriate for their gender.

Self-Efficacy Theory

Bandura's (1977) self-efficacy theory emphasizes that our confidence in our ability to succeed influences our actions and goals. This confidence stems from our experiences, observing the successes of others, and the encouragement we receive. In the context of science, biases and stereotypes alter women's perception of self-efficacy. Stereotypes reinforce the image of science as a male domain and women as naturally ungifted for science, especially natural sciences, thus significantly impacting women's confidence in their abilities. In a study conducted in China, Chan (2022) reveals that girls are less likely to pursue STEM fields due to a lower level of confidence in their ability to excel in these subjects.

Stereotype Threat

The stereotype threat, a theory developed by Steele and Aronson (1995), describes the threat experienced by an individual when they fear confirming a negative stereotype associated with their social group. This threat can cause anxiety that negatively affects performance in evaluative situations. Steele et al. (1995, 1997, 1999) studied the effect of this threat on the performance of women and African Americans in the United States, who, fearing judgment or confirming negative biases, showed significantly lower results on standardized academic tests, which could even lead to disinterest in certain school subjects.

According to Johns, Schmader, and Martens (2005), preparing women for the stereotype threat can help improve their performance in math tests by reducing the effects of anxiety related to gender stereotypes.

Beliefs About Intelligence and Genius

According to Bian and Leslie (2017, 2018), sexist biases against women and girls are particularly prevalent in environments that highly value intellectual abilities. Their research reveals a tendency among adults and children to associate women less frequently with high intelligence. These observations suggest that sexist biases in intellectual contexts emerge at a young age and persist, thereby compromising the success of women and girls in fields where intelligence is highly valued.

Role Congruity Theory

The role congruity theory, developed by social psychologists Alice Eagly and Sandra Wood (2002), examines the relationship between societal expectations related to gender roles and individual perceptions of these roles. According to this theory, individuals are more likely to succeed in areas where these roles align with societal expectations.

METHODOLOGY

I reflected on the best way to design, write, and use the interview guide. My professional experiences have taught me that the best interviews are those where the interviewee feels free to express themselves within the framework of a natural conversation. By moving beyond the question-and-answer format, I aimed to access rich and authentic testimonies, limiting the influence of expectations and preconceived ideas.

Having previously explored little of the theoretical framework of qualitative interviewing, I undertook a quick literature review to familiarize myself with the different theories and methodologies of interviewing.

Choosing the Ideological Paradigm

The book by Boutin (2018), titled *"L'entretien de recherche qualitatif"* ("The Qualitative Research Interview"), was an important resource for establishing the theoretical foundations of my methodological approach.

As the internship was conducted remotely and I could not, in any case, observe in situ the conditions of participation in scientific organizations of each of the study participants, the phenomenological approach seemed to me the most appropriate ideological framework. As Boutin (2018) reminds us, the phenomenological perspective, established by Husserl, aims to explore the subjective experiences of an individual or group of individuals in response to a given phenomenon.

Through the phenomenological approach, I sought to account for the key elements of women's experiences within scientific organizations, understand the meaning they ascribe to these experiences, and explore individual variations, particularly according to the type of organization, career level, discipline, country of practice, or culture.

In line with phenomenology, the "grounded theory" approach of Glaser and Strauss (1967), mentioned by Boutin, advocates abandoning traditional deductive processes and recommends not formulating hypotheses before the study begins, to then develop theories linked to the realities and complexities of human experiences. In accordance with this approach, I decided to only formulate my hypotheses on the underrepresentation of women in scientific academies

and unions once the interviews were conducted and the content analyzed, so that they would be informed by the lived experiences of the participating women.

Construction of the Interview Guide

Following the phenomenological approach, I did not seek to establish a list of specific questions but rather to list the major themes that would allow me to capture the participants' experiences and shed light on the various theories encountered during the literature review.

To construct the guide, I followed the method and drew inspiration from the model developed by Rondeau, Paillé, and Bédard (2023) in *"La confection d'un guide d'entretien pas à pas dans l'enquête qualitative"* ("The Step-by-Step Creation of an Interview Guide in Qualitative Research"). For each theme addressed, I associated a "prompt" question as well as "probing questions" and keyword-based reminders to guide the participant and facilitate the collection of relevant information. These "prompts" were designed to encourage deep reflection on the subject and help steer the discussion in the desired direction. The "probing questions," on the other hand, were developed to delve deeper into the participants' experiences and perspectives, allowing for a more comprehensive exploration of the themes.

The themes covered in the guide follow a chronological and then structural order. I wanted to obtain an overview of the family context and educational and professional backgrounds before addressing the participant's involvement in a specific scientific organization and studying the institutional climate, nomination processes, and practices and policies promoting women's participation.

The guide addresses six major themes: personal interests and career choice, professional trajectory, involvement in a scientific organization, organizational environment and culture, organizational practices and policies promoting gender equality, and finally, intersectional perspectives.

Thus, I sought to understand what had led each participant to choose a career in science. Was there a particular experience or influence? Follow-up prompts allowed for clarification of the presence or absence of a role model, mentor, or educational and/or family support, or a significant experience that may have been at the origin of their interest in science and their career choice.

Next, we explored together the potential impact of gender on their studies and professional trajectory before addressing the interviewee's participation in a scientific organization. I sought to clarify the reasons for their involvement, the climate within the organization, the specific roles and responsibilities of the participants, as well as the benefits and/or potential difficulties encountered in their participation.

We then discussed the functioning of the organization, particularly regarding the nomination or membership processes, and the existence or absence of specific policies aimed at promoting gender equality. The goal was also to assess, through the testimonies, the observed changes

and aspirations to improve the representation and participation of women, particularly in decision-making positions.

Some participants were involved in multiple organizations. Prior to the interview, I identified the most relevant ones for the study, sometimes selecting several, up to a maximum of three. This allowed for interesting comparisons, especially if the organizations were of different types or scales.

Finally, it was important for me to address intersectional perspectives and determine whether factors other than gender, such as economic status, culture, ethnicity, or religion, had also influenced the participants' professional and organizational trajectories.

At the beginning of the guide, an “ice breaker” on their research and scientific contributions allowed us to start on neutral and familiar ground, giving the participant time to acclimate to the interview and its remote modalities. Beyond providing a fascinating account of their research, this moment helped put them at ease and allowed me to check the connectivity of the video conferencing platform and the proper functioning of the audio recording tool.

Selection of Participants

When it came to selecting participants, we conducted an in-depth analysis of SCGES members to choose a sample that would be as representative as possible of the diversity of women in science. Of course, we were aware of the impossibility of obtaining a truly representative selection due to time and resource constraints. Since we could not interview all the women scientists on the planet, I decided to focus on a sample that would help better understand the quantitative data from the 2020 study (as the 2024 quantitative study had not yet been conducted during the internship period).

Thus, it seemed particularly important to me to succeed in interviewing at least one woman for each of the following criteria:

- A member of a national academy located in regions where women are better represented, such as the Cuban National Academy or other academies in Latin America and the Caribbean;
- A member of a national academy located in regions where women are least represented, such as the Iranian National Academy;
- A member of a medical academy, to understand why these academies have better representation of women compared to other scientific fields;
- A member of academies in disciplines where women are particularly underrepresented, such as physics, chemistry, engineering, and mathematics;
- Woman/women holding leadership positions within academies, to understand how they reached these positions and what challenges they faced along the way;
- A member of an academy that has implemented specific strategies or policies to increase women's participation, in order to assess their effectiveness and identify best practices;

- Representatives of international disciplinary unions, particularly the following unions:
  - International Union of Soil Sciences (8% women in governance positions)
  - International Mathematical Union (9%)
  - International Union of Biological Sciences (9%)
  - International Union of Pure and Applied Physics (25%)
  - International Union of History and Philosophy of Science and Technology (75% women members)
  - International Union of Immunological Societies (75%)

Various criteria were also taken into account, including fair representation between natural and social sciences, different career levels, and different geographic regions.

The SCGES members' network proved invaluable in compiling the list of potential participants. I also had the opportunity to participate online in the 2024 World Forum for Women in Science (WFWS) and studied the list of speakers to invite relevant participants to the study.

Thus, I was able to compile a list of about 35 potential participants, whom I contacted by email to inform them about the study and ask them to participate. About twenty responded, and I was able to interview ten during the internship period.

Domain(s) of Expertise	Title(s)	Organization(s)	Country
Mathematics	Professor, Founder	International Mathematical Union, African Women in Mathematics Association	Burkina Faso
Physics, Space Instrumentation	Researcher, Vice-President	International Union of Pure and Applied Physics	Great Britain
Geology	Researcher	International Union of Geological Sciences	Italy
Mathematics, History and Philosophy of Science	Professor	International Union of History and Philosophy of Science and Technology, Standing Committee for Gender Equality	France
Mathematics	Professor	International Mathematical Union	Italy
Botany	Outgoing President	Academy of Sciences of Bolivia	Bolivia
Political Sociology	Professor, Former President	Academy of Sciences of Brazil	Brazil

Food Microbiology, Law	Emeritus Professor	Caribbean Academy of Sciences	Trinidad and Tobago
Astrophysics	Professor, Former President	Academy of Sciences of Mexico, International Astronomical Union	Mexico
Physics, Cosmology	Professor	Astronomical Society of Iran, International Astronomical Union	Iran

Overall, the sample meets the established criteria, with the exception of a member from a medical academy and a member from each of the desired unions (three out of six). Additionally, geographical diversity was not fully represented, particularly for the Asian continent. I had to contend with a limited period for the interviews and the unavailability of some participants who were relevant to the sample during this period.

The Interviews

The interviews were semi-structured, organized around the key themes to be addressed in each session. The structure remained consistent from one interview to another, with a constant framework. I prepared a brief introduction explaining the purpose of the interview, the context of the project, as well as the ethical guidelines and considerations, such as confidentiality, data usage, anonymity, the participants' ability to stop at any time, and verbal consent for recording.

Given that the scientists were located around the world, the interviews were conducted via videoconference using the Teams software. Nine out of ten interviews were conducted in English, while one interview started in English and then continued in French. The duration of the interviews was set between 45 minutes and one hour. Only one interview exceeded this timeframe, lasting 1 hour and 20 minutes. This was the first interview, conducted with the President of SCGES, which served as a test for the interview guide and to gather potential suggestions for improvement.

During the interviews, I employed several verbal communication techniques, including echoing, reflecting, and clarifying. For example, I revisited certain significant words during the interviews, such as "crushing discouragement," "battle," or "I tend to believe I was just a woman that was there at the right time," to clarify their meaning. Before concluding, I consistently summarized the key points of the conversation, facilitated by my note-taking of keywords, to ensure that my understanding and the information were correct, and to invite the participant to make any final statements.

The interviews were recorded (following verbal consent from each participant) and automatically transcribed using the software otter.ai. Subsequently, I listened to, reread, and

verified each transcription to correct the numerous errors made by the automatic software. This method nevertheless allowed me to save valuable time without limiting my understanding or analysis of the discourse. This analysis was supported not only by note-taking but also by rereading and manually coding the transcriptions in a qualitative data analysis software called ATLAS.ti.

RESULTS

To analyze the content of the interviews, I proceeded with coding, which first required the development of a codebook. I was not at all familiar with qualitative analysis processes and acquired the basics through online research. I found several useful resources, including the website of the ATLAS.ti tool, which offers many explanatory guides, and the resources developed by Virginia Braun and Victoria Clarke on thematic analysis. These resources helped me understand the basic principles of coding and choose a method suited to my study.

I opted for inductive thematic coding, meaning I iteratively identified themes and thus developed the coding system based on the interview data, in line with the chosen methodological approach. I then coded each interview according to the thematic system I developed in the codebook using ATLAS.ti software. The codebook and the full-size charts are available in the appendix.

The thematic analysis of the interviews reveals the following results:

*

DISCUSSION

My understanding of gender equality in the scientific field, particularly regarding the participation of women in scientific organizations, was significantly enriched by the perspectives gathered during the interviews, building on the literature review.

Educational and Family Support

The testimonies confirm the crucial role of family and academic support in the success of women in science. Notably, the father's decisive role in fostering interest in science and choosing a scientific career, as mentioned by Scott and Mallinckrodt (2005), was evident in the interviews: "First of all, I have to say that I am the daughter of two scientists, doctors who were involved in medical and biological research. So, I knew what academia and research were like."; "My career in science was strongly influenced by my father, who had a degree in science and always emphasized its importance."; "My father would always take us on short trips to many places in the country. He was born in the Amazon, so he always took care to explain the natural cycles, how to cultivate plants, or how to harvest certain fruits (participant who became a biologist, specializing in palm trees)."

Support from a spouse was also spontaneously mentioned several times, even though the guide did not explicitly address marital life. Described as a "true partner" by one of the participants, the spouse's role is crucial, particularly depending on their involvement in family responsibilities. Several participants emphasized that it was possible to combine careers and scientific commitments with family life with the support of a partner.

Teachers are also key players, helping their female students overcome stereotypes and develop the confidence needed to excel in these fields. Several women interviewed even chose their field of specialization due to the influence and support of their teacher. Despite this, some accounts indicate that relatives, influenced by gender stereotypes, initially discouraged these women from pursuing careers in science, fearing the impact of long studies on their daughters' ability to marry and start a family. A mathematician participant summarized the situation as follows: "It all starts at school; when they are little girls, everything is fine. They love mathematics... but then, when they reach adolescence, they start being influenced by people saying that doing science is not suitable for them."

Academic and Professional Climates

As suggested by Blickenstaff (2005), the scientific sector indeed proves to be unwelcoming for women, particularly in fields considered the most demanding, such as mathematics and physics. The testimonies collected highlight various challenges, particularly gender stereotypes and institutionalized sexism. For example, seven out of ten women reported experiencing a sexist academic climate, exacerbated by the underrepresentation of women among both teachers and students. "Now, regarding sexism, it's every day. Even when I was in high school,

I remember that in my final year, there were not many of us, only 19, and I was the only girl." This female minority is sometimes extreme, with cases where some women were the first in their country to earn a doctorate in certain disciplines, such as mathematics or microbiology. These women noted that they faced considerable resistance to the acceptance of their presence and the recognition of their skills: "They know you're there because you have the qualifications to be there, but they do everything to show that you're inferior because they don't accept that you're there with them."

In the professional sphere, women working in traditionally male-dominated fields, such as engineering or applied geology, face significant obstacles. These obstacles include questioning their skills and authority, difficulties in establishing professional networks, and, in some cases, episodes of psychological harassment and gender-based and sexual violence: "During my career, I faced several instances of discrimination simply because I'm a woman; there was even a case of sexual blackmail."

The specific challenges of academic careers, including job insecurity, the difficulty of finding positions, and the particular demands of research, such as fieldwork, can be more arduous for women burdened with the "second shift." One participant mentioned that before becoming the first female professor in the Faculty of Agricultural Sciences at her university, she first taught part-time as a volunteer and then held a series of precarious contracts. With tenure-track positions and career advancement also subject to peer evaluation, she emphasized the need for greater transparency and fairness in academic evaluations and promotion processes.

Finally, the lack of female representation and role models in science, and the systematic invisibility of women scientists, was cited by all as a significant problem. This not only hinders female scientists from gaining confidence but also prevents girls from envisioning themselves in STEM careers.

One participant mentioned the "Draw a Scientist" test, developed by Chambers in 1983 in a study titled "Stereotypic Images of the Scientist: The Draw a Scientist Test." In this test, children are asked to draw a scientist. Historically, the results have shown that many children drew scientists as white men in lab coats, illustrating the existence of a male stereotype associated with science.

This lack of representation was significant for all participants, especially considering the time when most of them were studying. A participant from Burkina Faso stated, "When I was a student, practically the only woman we saw in science was Marie Curie. She was the most well-known, but she wasn't even in mathematics; she was in physics and chemistry. That's about the only role model we had. And unfortunately, she's not a model from our country. Because we live in a different country with a different culture." Beyond the lack of diversity, the question of representativeness also arises. Another participant rightly stated, "We can't all be Marie Curie!" It is therefore essential to promote more varied and realistic role models to illustrate what STEM careers are like today and to make science visible and attractive "beyond the Fields Medal or Nobel Prizes."

Attitudes Towards Gender Challenges in Scientific Environments

The interviews highlight a range of attitudes in response to these sexist climates, with several instances of impostor syndrome, self-doubt, and attribution bias. "I loved studying [physics] in high school... but I definitely needed some encouragement to believe that I was capable of it." One participant even attributed her academic success to being a token of diversity. "I'd like to think that I achieved what I did because I'm competent or deserving, but sometimes I think my opportunities came because I was a woman in the right place at the right time, and also because I come from the Global South. These two factors still weigh heavily on my mind."

The women interviewed all possessed a strong determination, which was a driving force behind their success, but several of them, who were professors, reported witnessing negative attitudes among their female students. Several expressed dismay at their students' refusal to accept certain opportunities, including nominations to academies, due to a fear of failure. Three also criticized their female colleagues, describing them as "lazy" or "timid." It seems, indeed, that in several cases, other women present in scientific organizations, and especially in science academies, tended to "keep a low profile."

Participation of Women in Scientific Organizations

The limited participation of women in scientific organizations can be attributed to systemic barriers that discourage many of them from pursuing science in the first place. Regarding actual participation, the testimonies collected highlight significant disparities in climate and treatment between different types of organizations, academies, and unions, as well as between countries.

Science Academies

Science academies operate according to different models. Some have a long tradition and a Masonic influence, viewing themselves as prestigious clubs open only to the most eminent scientists. Others are deliberately more open and inclusive, encouraging scientists to join from the middle of their careers. The nomination processes vary from one institution to another, each having its own statutes. For some, nominations result from a plebiscitary vote by all members, while for others, nominations are decided by a special committee with a list of clear and objective criteria. The introduction of transparent nomination criteria and the development of objective evaluations based on a point system are practices that promote greater diversity within these institutions. A notable example is Bolivia, where the president of the Academy of Sciences reformed the statutes to change the nomination process, shifting from a plenary session with a vote to a special committee responsible for nominations and admissions. This reform led to a significant increase in nominations, including those of female members, illustrating the positive impact of such initiatives on the inclusion of women in scientific spheres.

It appears that academies from developing states or island states tend to be more deliberately inclusive than those from countries in the Global North—the participant from the Caribbean Academy summarized the situation as follows: "If we don't encourage women and younger generations to join us, we cannot exist."

Additionally, several academies have established special committees and commissions related to gender equality. These bodies ensure, for example, gender parity during conferences organized by the Academy. However, the responsibilities of these bodies are sometimes poorly defined ("I was appointed diversity and gender equality champion a few months ago, and we're still working on what that entails.") and lack resources, resulting in few impactful activities. One participant mentioned being appointed to a gender equality commission in her union but quickly preferred to form her own association to be able to define its mandate, activities, and raise funds independently.

At the Brazilian Academy of Sciences, gender and diversity considerations are increasingly being integrated into their general policies—contrasting with most other institutions that have created specific committees, potentially risking isolating these issues from broader organizational considerations. The former president expressed concerns about tokenism, where women might be chosen for positions more because they are women than for their expertise.

In general, academies were described as male-dominated structures that have only recently begun to include women and to consider promoting gender equality, particularly under the influence of the first women in leadership positions. Their slowness and resistance to change were also highlighted.

International Disciplinary Unions

The climate within international unions is markedly different. Characterized by greater flexibility and a truly international dimension, these entities offer a more open framework that promotes inclusivity and flexibility. They also provide substantial opportunities for developing professional networks. According to the testimonies collected, these characteristics make international unions particularly effective in promoting gender equality in the scientific community. None of the participants interviewed reported encountering sexist prejudices or discrimination within these unions, which contrasts with the often more negative experiences in other contexts.

The unions also allow for a global perspective and focus on how gender equality issues vary across countries and cultures. The participants emphasized the need to adopt culturally sensitive approaches, stressing the importance of understanding and respecting these differences.

However, it is important to note that female representation varies significantly depending on the discipline, as mentioned in previous sections. The women interviewed expressed their commitment to fostering the integration of their female colleagues within these unions and actively encourage their peers to establish and lead their own gender equality committees.

This proactivity is characteristic of the women interviewed; all are at the forefront of advances for gender equality in their respective disciplines and institutions. They dedicate a significant portion of their time to these activities, despite them being voluntary. I was struck by their levels of activity and involvement, multiplying organizational commitments and initiatives: meetings, conferences, support, and mentorship. For example, one woman brought these gender equality issues to her university, her workplace, by creating a committee for equal opportunities.

Finally, within the unions, inclusivity extends beyond gender equality alone. The women involved expressed a strong desire to be truly inclusive, encompassing geographies, disciplines, and career levels: "Gender equality is not just about promoting women; it's about creating an environment in the scientific field that is genuinely inclusive, where every scientist can contribute equally."

STRATEGIES

The interviews highlighted a number of strategies implemented by women to overcome sexist obstacles and promote gender equality in the sciences. The complete list of these strategies can be found in the codebook, and I will review the main ones here.

International Engagement

First, it became apparent that women transcended the limitations imposed on them by multiplying their engagements at the international level. All the participants had international experience, most starting during their studies. This experience opened their minds to what was possible for them to achieve, especially when they came from more conservative countries. For example, one participant shared how her studies in astronomy, which she had to undertake abroad due to the lack of an astronomy institute in her country at the time, opened her eyes to a world radically different from the conservatism of her home society. Today, although she practices in her native country, her scientific engagement in a discipline like astronomy, which is particularly open to women, allows her to overcome the prevailing social constraints. The same observation was made in Iran, which the participant described as a "gender apartheid." She recounted that the enrollment rate of women in universities is very high, although this rarely translates into a professional career because those years of study represent the only possible bubble of freedom in an authoritarian and segregated society.

Creation of Networks and Exchange of Best Practices

Thus, as mentioned, women are the drivers of their emancipation in the sciences by creating their own networks and institutions to support and promote their professional interests. All the participants had created their own entities (associations, committees, working groups,

initiatives) to promote the participation of women and girls in the sciences. For example, an Iranian participant expressed her desire to create an exclusively female branch of the National Astronomy Institute to facilitate women's participation in activities that were otherwise barred to them, such as night sky observation.

In parallel, another effective strategy for promoting gender equality in scientific organizations is the exchange of best practices among women scientists. Through regional and international networks like the Inter-American Network of Academies of Sciences (IANAS), members of academies located in the Americas share successes and challenges faced by women scientists to identify best practices and implement them locally. For instance, the idea of creating an independent committee for nominations within the Bolivian Academy was inspired by another academy on the continent.

Creation of Conferences or Awards Specifically for Women

Organizing conferences and awards dedicated to women scientists is another important strategy. For example, the International Day of Women in Mathematics is celebrated on May 12 at the initiative of the Committee for Women in Mathematics of the International Mathematical Union, in honor of Maryam Mirzakhani, the first woman to receive the Fields Medal in 2014. The Emmy Noether Distinction, created in February 2013, which honors female mathematicians and physicists for their achievements, is another example.

Involvement of Men in Their Initiatives

Another strategy used is to actively involve men in the promotion of gender equality and related activities. In Burkina Faso, for example, the initiatives implemented by the African Women Mathematicians Association are also directed toward men, with capacity-building workshops and conferences open to everyone. This approach helps to break down the barriers around initiatives aimed at promoting women in science and engages men in conferences where women are highlighted as speakers, for instance. It is also a strategy that facilitates obtaining funding and aims to prevent men from "throwing a wrench in the works."

Promotion of STEM Careers and Female Role Models in Science

Raising awareness about the contributions of women in science and promoting female role models are other important strategies to inspire future generations of scientists. Initiatives such as awards, brochures, or conferences aim to highlight the achievements of women in STEM and encourage young girls to pursue careers in these fields. In Italy, for example, one participant organized a "bring your children to work" day so that the children of faculty members could be exposed to their parents' work and academic careers. Another participant published a book about the 26 women who have won a Nobel Prize in the sciences.

HYPOTHESES AND RECOMMENDATIONS

Following the interviews and data analyses, I was able to formulate the following hypotheses:

H1: Gender stereotypes directly impact women's interest in science and their participation.

- **H1a**: Gender stereotypes perceived from childhood reduce the likelihood that girls will consider careers in scientific fields.
- **H1b**: Family support, particularly from paternal figures, and exposure to diverse and realistic female scientific role models during childhood play a moderating role and increase the likelihood that girls will choose and persist in scientific studies.

H2: Academic and professional climates directly influence the persistence of women in scientific studies and careers.

- **H2a**: The prevalence of sexist and male-dominated academic and professional environments is negatively associated with women's perseverance in scientific studies and careers.
- **H2b**: Positive scientific pedagogy, a realistic representation of STEM careers, and a welcoming institutional climate increase the likelihood that women will choose and persist in a scientific career.

H3: Women develop strategies to counter stereotypes and overcome systemic obstacles in scientific environments.

- **H3a**: The international scale allows women scientists to overcome prevalent sexism at the national level, particularly in conservative countries and/or elitist institutions.
- **H3b**: They promote the creation of their own networks and organizations outside of established structures to form supportive communities, both formal and informal.

H4: Scientific organizations have a significant role to play in promoting gender equality.

- **H4a**: The implementation of transparent and equitable nomination and membership criteria increases diversity and positively influences the representation of women within scientific organizations.
- **H4b**: The active and widespread implementation of diversity and gender equality policies within scientific organizations is positively associated with an increase in women's participation.

We can then formulate the following recommendations to promote the representation of women in scientific organizations and create an environment conducive to their participation. These recommendations are designed to be practical and achievable, tailored to the constraints of organizations and their members who volunteer in addition to their professional activities.

- Implement strict policies, including codes of conduct or charters, against sexual harassment and discrimination in scientific institutions.
- Create integrated support and mentoring networks within organizations to support women scientists at all levels of their careers.
- Review institutional statutes to establish clear and objective criteria in nomination processes to increase transparency and fairness within scientific academies.
- Encourage nomination committees to explicitly consider diversity and inclusion criteria.
- Ensure that committees dedicated to gender equality have the necessary resources to be active and influential.
- Promote international exchange and cooperation within academies and unions to share best practices for the inclusion of women.
- Adapt approaches to cultural diversity to effectively respect and integrate perspectives from different regions and cultures.
- Generalize international days, conferences, and awards that celebrate the contributions of women to science, such as the International Day of Women in Mathematics or the Emmy Noether Distinction, to foster the representation of women in science.
- Encourage organizations to communicate and highlight these initiatives in the media, or through brochures, conferences, or exhibitions.
- Establish an evaluation system to regularly monitor progress in diversifying membership and improving the working environment for women. Use this data to adjust policies and practices accordingly.
- Other recommendations could be considered by organizations to address systemic barriers that manifest from childhood.
- Assist in the implementation of academic mentoring programs that involve parents and teachers to support young girls interested in science.
- Promote and advocate for a positive pedagogical approach to science that includes discussions on gender stereotypes and the promotion of equality from an early age.
- Promote an equitable and realistic vision of career prospects in STEM fields to encourage young people, especially girls, to consider these careers.

CONCLUSION

In conclusion, the interviews and data collected allowed me to gain a fairly comprehensive understanding of these women's journeys, the challenges they encountered or observed around them, as well as the personal dispositions and systemic conditions that contributed to their success. The analysis of the content and strategies implemented at a personal level or within the organizations they are members of also enabled me to formulate hypotheses regarding the low representation and participation of women scientists. I have also developed a list of recommendations aimed at addressing these structural deficits that influence women's interest and persistence in STEM careers.

However, I am aware of the limitations of my experimental setup. The interview guide would benefit from revision and improvement based on these preliminary interviews. Moreover, it would be wise to significantly expand the participant sample. I am not sure how many interviews would be necessary to reach saturation, where discussions no longer bring new data, but this number seems much higher than ten.

Additionally, it would be beneficial to accompany the qualitative interviews with a questionnaire designed to collect specific data in advance about the gender composition of each institution, their statutes, particularly the nomination and admission procedures and conditions, and the existence of committees or commissions dedicated to promoting gender equality. The interviews, which focused more on experience and personal accounts, sometimes lacked concrete information about the measures in place to promote gender equality within each organization. A complementary study of each organization's statutes thus seems like a necessary step.

It also seems critical to me to review the coding system, which was particularly challenging for me and, in its current form, seems improvable. I also acknowledge my lack of experience in qualitative data analysis, a subject not covered during my undergraduate studies. I had to learn how to use the software on the fly, and the resulting charts seem only somewhat enlightening.

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Annexes

- **Interview Guide**
- **Codebook**
- **Result Charts (word cloud and treemap)**

SEMI-STRUCTURED INTERVIEW GUIDE: TEMPLATE

Draft V3 (15 April 2024)

INCLUSION OF WOMEN IN INTERNATIONAL SCIENTIFIC ORGANIZATIONS

Organizational culture and practices, challenges and opportunities to foster gender equality

***NOTE**: This document serves as a guide for conducting interviews. It outlines the overarching themes to be discussed, but it is flexible and can be adjusted to suit each individual interview. It allows for adaptation based on the specific responses and input provided by the interviewee during the conversation.*

1. Introduction

Thank you for agreeing to this interview. The interview should take approximately one hour, depending on how much information you would like to share.

We are interviewing you within the framework of a project focused on examining the inclusion and participation of women within scientific organizations. **These include the national academy of sciences, national scientific societies, national young academies, international scientific unions and some international scientific networks, such as the Global Young Academy (GYA)**. This project builds upon previous surveys conducted in 2015 and 2020 by a consortium of partners, which showed some progress but also highlighted areas of needed progress. The goal is to understand the impact of organizational culture on gender inclusion and to identify strategies to promote greater and improved representation and participation of women in scientific organizations.

With your permission, I would like to audio record the interview. The content of this interview will also be transcribed and will be used as a basis for my analysis.

Your responses will be kept confidential. This means that your de-identified responses will only be shared with the research team. We will ensure that information included in the report will not identify you as respondent. You may decline to answer any question or stop the interview at any time and for any reason.

There are no right or wrong statements. I am not here to judge you or evaluate your experience, but rather to hear your testimony regarding women's inclusion in scientific organization. Your testimony is highly valuable, and I aim for the interview to be as flexible, friendly, and conversational as possible.

Do you have any questions about the structure and of this interview before we start?

2. Background information

Date	
Participant name	
Title	
Organization 1 (work)	
Organization 2 (engagement)	
Region	

3. Verbal consent

☐ Verbal Consent was obtained from the study participant.

☐ Verbal Consent was **NOT** obtained to participate in the study.

4. Establishing Rapport

Can you please tell me about your current role and give me an overview of your current research?

Are you a member of an international scientific organization, namely an academy, an union or any other recognized scientific organization?

+ Tailor a question to specific person and/or situation.

5. **Questions**

Theme	Prompts	Probing questions	Answer
Research and scientific contributions	Could the person share some insights into the projects they are or have been involved in?	• What specific questions or problems are you currently addressing in your research? • Could you describe a recent breakthrough or significant finding from your work? Primary area of research? Questions? Breakthroughs?	
Personal interests and career choices	How was the person motivated to pursue a career in science?	• Specific experience or influence that contributed to your interest and decision? Ability? Role model? Family support? **Integrate geographical, cultural and disciplinary perspectives.**	
Career journey	Can the person tell a little bit about their career path in science?	• Can you share any particularly rewarding moments from your	

		scientific journey? • How has gender played a role in your career? Pivotal experiences? Rewards? Awards? Opportunities? Discrimination? Harassment? **Integrate geographical, cultural and disciplinary perspectives.**	
Engagement/volunteering in scientific organizations (e.g. national academy of sciences, national scientific societies, national young academies, international scientific unions and some international scientific networks)	Could the person discuss their engagement in any national or international scientific organizations, such as national academies, unions, or other professional bodies?	• How did you get involved in [name organization]? • Why are you participating in [name organization]? Nomination process? Role and responsibilities? Leadership? Advocacy? • What challenges or opportunities have you encountered through your engagement in these scientific organizations? Recognition? Networking? Mentorship?	

		Access to resources?	
Environment and organizational culture	Can the person describe the culture within [name organization]?	• Have you found these organizations to be welcoming to women and supportive of women in science? Nomination track? Support? Sense of belonging? Community? **Integrate geographical, cultural and disciplinary perspectives.**	
Organizational policies and practices	How is the person's organization [name organization] enforcing practices related to gender equity and inclusion?	• Have you witnessed any positive changes in recent years regarding gender diversity within science institutions? • Are you involved in gender equality initiatives or activities? Diversity in membership? Nomination pool for membership Nomination pool for awards Initiatives and policies? Commission for Women in Science?	

		Gender equality committee? Sponsorship or mentorship programme? Awards? ('Women in Science' Award?) Grants, fellowships or awards for women? • What can your organization do to further promote gender equity and inclusion within their organizations?	
Disciplinary, geographical and intersectional perspectives	How is the person's socio-economic, cultural and geographical background impacting their situation?	• Differences perceived according to professional location? • Intersection of other discriminations? (socio-economic, culture, ethnicity, religion) International experiences? Racism? Social class?	

6. Conclusion

Thank you for your time and for sharing your experience! I hope this discussion was as interesting for you as it was for me. I truly appreciate your openness and your trust. I want to reassure you that your responses will be kept confidential and anonymized.

I will now quickly summarize the key points to make sure I have captured your testimony correctly. (…key words summary – 1 minute…)

Do you want to ask me any questions about the research process, its objectives or anything else? (…)

If you have any further thoughts or ideas you'd like to share, please don't hesitate to reach out. I wish you all the best, and I look forward to potentially connecting with you again in the future!

CODEBOOK

Theme	Code	Description
Familial Environment	Family support	The family (immediate relatives: parents, siblings) is supportive of the participant choice to pursue a superior education and scientific career.
	Positive father figure	The father has had an immediate positive influence of the decision to pursue a superior education and a career in science.
	Educated family	Other family members have pursued education.
	Science/Academic family	Family members are themselves scientists or pursuing an academic career.
	Supportive partner	
	Family pressure	The family (immediate relatives: parents, siblings) is not supportive of the participant choice to pursue a superior education and scientific career and has tried to change their decision.
	Family doubts	The family (immediate relatives: parents, siblings) is worried and is expressing doubts.
	Non-educated family	No family members pursued superior education.
	Non science/academic family	No family members have pursued a scientific or academic career.
	Extended family and/or peer pressure	Doubts expressed and pressure from extended family members or social group.
Academic Environment	Support from teacher(s)	Guidance and encouragement provided by educators to help the participant in their academic journey
	Support from peers	Assistance and encouragement received from fellow students.
	Positive pedagogy for science	Science is valued, taught in an interesting way, and interest in sciences is nurtured.
	Gender seggregated education	Education system segregating students based on gender.
	Underrepresentation of girls and women in cursus	A shortage or underrepresentation of female students within the academic program or field of study.
	Isolation	Feeling disconnected or socially excluded from the academic environment
	Everyday sexism in academic settings	Subtle or implicit biases and prejudices based on gender manifesting in everyday interactions and practices within educational settings.

	Prejudice from teacher(s)	Unfair treatment or negative attitudes directed towards students based on personal biases or stereotypes held by educators.
	Prejudice from students	Unjust treatment or discriminatory behavior towards fellow students based on personal biases or stereotypes.
	Harassment from teacher(s)	Persistent and unwelcome behavior from educators that creates a hostile or uncomfortable environment for the female student, meant to interfere with their academic success.
	Harassment from students	Persistent and unwelcome behavior from peers that creates a hostile or uncomfortable environment for students, potentially hindering their ability to learn and thrive.
	Discrimination in studies	Unfair treatment or unequal opportunities based on gender within educational contexts.
	Change of cursus	Modifying one's academic course or program of study, often due to changing interests, career goals, or other circumstances
	Competitive field	Academic field is described as highly competitive
	Lack of awareness about STEM careers	Insufficient knowledge or exposure to STEM (Science, Technology, Engineering, Mathematics) career paths
	Only woman at PhD level	Participant is the sole female participants in their PhD programs
	Lack of role models	Notable absence of female role models in the academic setting
	Non accepting of women	Academic settings that are unwelcoming or discriminatory towards women
Career	Feeling of belonging	A sense of connection, acceptance, and inclusion within a scientific institution, fostering a supportive environment the individual feels valued and respected.
	Recognition and Appreciation	Feeling appreciated for+ the contributions and achievements
	Safety	A sense of trust and confidence in the workplace environment, where employees feel comfortable speaking up, sharing ideas, and taking risks without fear of negative consequences or retaliation.
	Independant & transparent career advancement policies	Career advancement policies are clearly defined, openly communicated, and applied without bias
	No gender-related issues	Participant declared never had the perception of being discriminated against because of gender in her career
	Cold climate at work	A work atmosphere characterized by a lack of warmth, camaraderie, or emotional support, potentially leading to feelings of isolation and dissatisfaction among colleagues.
	Lack of opportunities	Little or no chances for career advancement, skill development, or recognition, which may hinder professional growth and fulfillment for employees.

	Pressures from colleagues	Feeling pushed or stressed by the expectations or competition from your coworkers.
	Pressures from hierarchy	Pressure exerted from higher-ups or organizational structure.
	Intimidation	Feeling scared or uncomfortable because of behavior or actions intended to instill fear, insecurity, or discomfort from supervisors or colleagues.
	Ordinary sexism at work	Pervasive gender-based discrimination, bias, or stereotyping present in everyday interactions and practices.
	Hostility	Acts or behaviors that are unfriendly or antagonistic in the workplace.
	Microaggressions	Subtle, often unintentional actions or comments that communicate negative messages or assumptions.
	Dismissal of Expertise	Women face skepticism or disbelief regarding their knowledge, skills, or qualifications, leading to their authority being undermined or disregarded.
	Fear of Speaking Up	Hesitation to voice their opinions, ask questions, or raise concerns due to fear of criticism, ridicule, or retaliation.
	Demanding Field	Career fields characterized by high pressure, intense workloads, and rigorous demands
	Harassment from powerful individuals	Individuals in positions of power exploit their status to harass women subordinates or colleagues
	Gender-based violence	Occurrences of violence directed at individuals based on their gender
	Lack of information	Deficiency of information necessary for career decisions, professional development, or understanding of rights within the workplace
	Male-dominated field	Environments where males significantly outnumber females, leading to bias, exclusion, or limited advancement opportunities for women
	Misrepresentation	Women are inaccurately or unfairly represented within professional contexts, affecting perceptions and opportunities
	Sexual harassment	Incidents of unwanted sexual advances, requests for sexual favors, and other verbal or physical harassment of a sexual nature in the workplace
Organizational environment	Welcoming of women scientists	The organization fosters an environment where women scientists feel welcome, valued, and able to contribute fully to the scientific community.
	Inclusiveness	Environment where all individuals feel welcome, valued, and able to fully participate and contribute to the scientific community.

	Gender-related responsibilities	Roles or tasks assigned within an organization relating to the promotion of gender equality
	Transparent nomination process	Nomination process for positions or awards within an organization that is clear, open, and equitable, allowing all members to understand and trust the criteria and decisions made.
	Unwelcoming	Opposite of inclusiveness, where women do not feel welcome or valued within the organization.
	Subjective nomination process	Nomination process for roles or recognition is based on personal opinions or preferences rather than objective criteria
	Lack of financial resources	Insufficient funding or financial support within the organization, affecting its operations and the resources available for projects relating to gender equality
	Lack of internal policies	Absence or inadequacy of formal policies rellating to gender equality in an organization

Stereotypes	Emotional	Stereotypes depicting women as overly emotional or irrational in their decision-making.
	Fragile	Stereotypical perceptions that women are emotionally fragile or less resilient than men.
	Incompetent	Stereotypes portraying women as inherently less competent or skilled in scientific fields.
	Maternal Expectations	Stereotypes imposing societal expectations that women should prioritize marriage and motherhood over their careers or other aspirations.
	Not capabale	Stereotypical beliefs that women are not as capable as men in scientific fields.
	Not fit for women	Stereotypical beliefs that some fields of expertise are unfit for women.
	Not smart enough	Stereotypical beliefs that women are not as intelligent as men.
	Stereotype Threat	Participant's discourse reveals underperformance due to anxiety about confirming negative stereotypes about women in science.
	Superficial	Stereotypes depicting women as shallow, focused primarily on superficial qualities rather than intellectual or capability.
	Unfit for Leadership	Stereotypes suggesting that women are less effective leaders or lack the qualities necessary for leadership positions.

Biases	Evaluation Bias	Women's work or contributions are undervalued or underestimated compared to their male counterparts.
	Hiring bias	Prejudice in the hiring process based on gender.
	Networking Bias	Bias in networking opportunities, where women have less access to professional networks or mentorship opportunities.

	Nomination bias	Bias in nominating individuals for awards, positions, or recognition based on gender.
	Opportunity bias	Unequal access to opportunities based on gender.
	Promotion bias	Unequal opportunities for promotion based on gender.
	Recognition bias	Unequal recognition or acknowledgment based on gender.
	Resource Allocation Bias	Bias in resource allocation, where women receive fewer resources or support for their projects or research compared to men.
	Salary bias	Unequal pay based on gender.
	Self attribution bias	Participant attributed successes to external factors, instead of her competencies.
Discrimination	Awareness of Internal Policies	The interviewee is aware of the organization's policies on gender equality/discrimination.
	Equal salaries	
	Discriminating policies	Policies within an organization that result in discrimination against women.
	Exclusionary Practices	Practices within the organization that systematically exclude women from certain opportunities, networks, or decision-making processes.
	Legal discrimination	Laws or regulations promoting gender discrimination.
	Retaliation	Negative consequences or reprisals faced by women who speak out against discrimination or harassment in the workplace.
	Tokenism	The practice of including women in visible roles or initiatives solely to create the appearance of diversity, without providing meaningful opportunities for their participation or advancement.
	Funding disparities	Disparities in financial resources andd funding opportunities between genders.
Attitudes	Personality	The participant attributes their advocacy and promotion of gender equality to their personality traits.
	Advocacy	Advocating for gender equality in science.
	Determination	Persistence and commitment to advocating for gender equality.
	Taking initiative	Proactively taking action to address gender inequality in science.
	Duty	Viewing the promotion of gender equality as a moral obligation.
	Agency	A sense of agency and empowerment to effect change within the scientific community
	Community Engagement	Involvement in community-based initiatives, organizations, or networks that promote gender equality and support women in science.
	Self-Reflection	A willingness to engage in self-reflection and introspection regarding one's own biases and privileges.
	Conformity	Adhering to societal norms and expectations regarding gender equality.

	Discretion	Participant reports witnessing other women keeping a low profile in science and not advocating for gender equality.
	Mistrust	Lack of trust in the institutions.
	Doubt	Participant reports witnessing other women doubting one's capacities or abilities to succeed in science.
	Imposter Syndrome	Women doubt their own abilities, feel like frauds, or attribute their successes to luck rather than competence.
	Abandon	Participant reports witnessing other women giving up on science career.
	Fear of Failure	Participants reported avoiding taking risks or trying new things due to a deep-seated fear of not succeeding
	Laziness	Lack of motivation or effort put forth by individuals to promote gender equality
	Refusing opportunities	Situations where individuals consciously decline chances for advancement, learning, or participation
	Shyness	Timidness or reticence in social or professional settings, potentially hindering their interaction and opportunities for advancement

Strategies	Community creation	Establishing organizations or initiatives to foster gender equality within or outside main organizations.
	Data Collection and Analysis	Conducting research and data analysis to identify patterns, inform evidence-based interventions, and track progress over time.
	Educational Programs	Implementing programs aimed at addressing gender bias, promoting diversity, and supporting the participation of women and girls in STEM education and careers.
	Exchange of practices	Sharing successful strategies and approaches for promoting gender equality.
	Fostering inclusiveness	Promoting environments that embrace diversity and inclusion.
	Intersectional Approach	Incorporating an intersectional lens into gender equality initiatives.
	Media and Public Engagement	Using media platforms and public engagement activities to raise awareness about gender inequality in science.
	Mentoring	The participant is providing guidance and support to students, particularly young women.
	Networking and Collaboration	Facilitating networking opportunities and collaborative initiatives among women scientists to share resources, experiences, and best practices for advancing gender equality.
	Persistance	Continuously raising issues and demanding solutions from peers and decision-makers.
	Policy Advocacy	Engaging in advocacy efforts to influence policy changes to promote gender equality in science.
	Raising awareness	Efforts to increase understanding and consciousness of gender inequality issues.
	Capacity-building	Enhancing the skills, abilities, and competencies of women in science settings
	Involving men	Inclusion of men as active participants and allies in initiatives to promote gender equality

	Promoting role models	Highlighting successful women in science who can inspire and guide others
	Promoting STEM careers	Increase awareness and interest in science, technology, engineering, and mathematics fields among women and girls
	Promoting visibility of women in science	Increasing the recognition and acknowledgment of women's contributions in scientific fields, enhancing their presence and influence
	Realistic image of women in science	Portraying women in science accurately and authentically, countering stereotypes and promoting a diverse representation of women in scientific roles

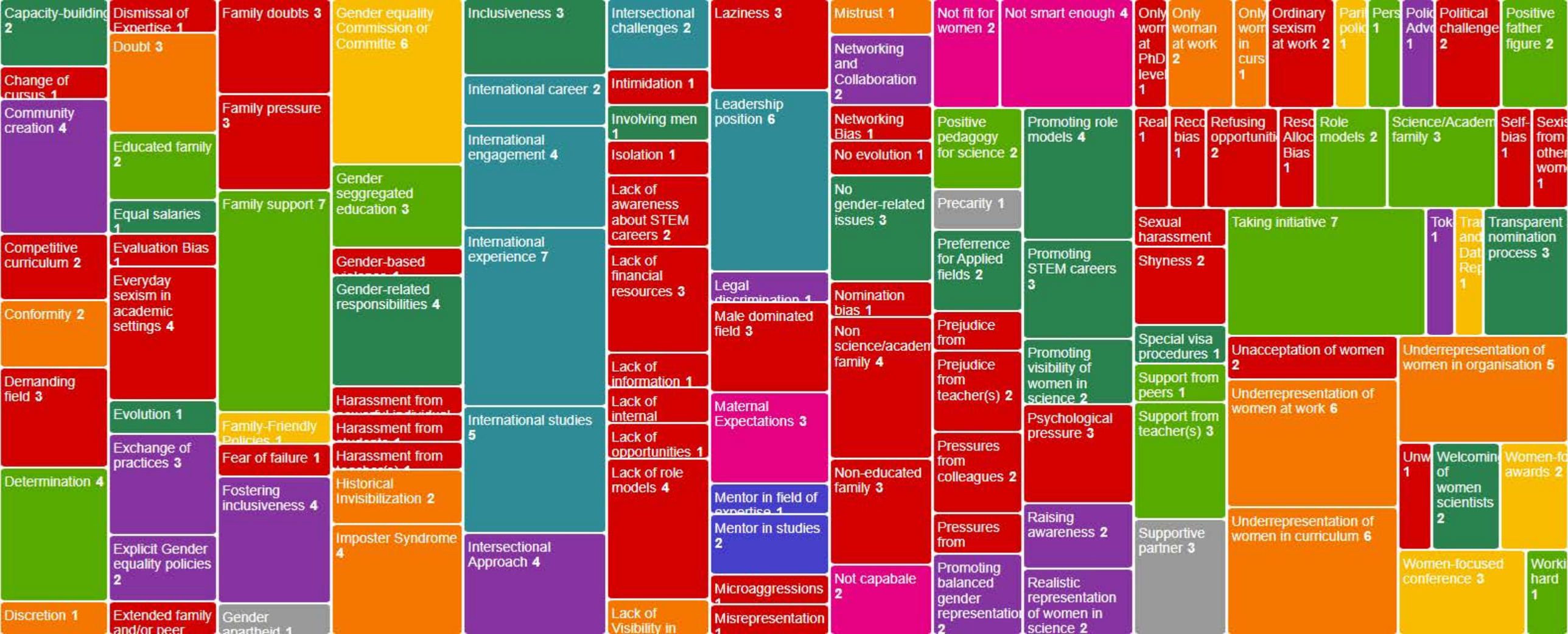
Mentorship	Mentor in studies	A knowledgeable and experienced individual who offers guidance, advice, and support to help the participant navigate their academic challenges and achieve their goals.
	Mentor in field of expertise	Experienced and knowledgeable professional who provides guidance, support, and career advice to the participant within their specific area of expertise, facilitating skill development and professional growth.
	Peer mentorship	Supportive relationships with peers for professional development.

Representation	Balanced gender representation in curriculum	Equal representation of genders in educational programs or courses.
	Balanced gender representation at work	Equal representation of genders in the workplace.
	Balanced gender representation in organisation	Equal representation of genders within organizational structures.
	Role models	Role models or examples that inspire the participant in their academic pursuits.
	Underrepresentation of women in curriculum	Insufficient representation of women in educational programs or courses.
	Underrepresentation of women at work	Insufficient representation of women in the workplace
	Underrepresentation of women in organisation	Insufficient representation of women within organizational structures.
	Only woman in cursus	Participant was the only woman in their educational program or course.

	Only woman at work	Participant is the only woman in their workplace.
	Only women in organisation	Participant is one of the few or the only woman within their organization.
	Lack of Visibility in Leadership Roles	The lack of visibility and representation of women in leadership positions within educational institutions, workplaces, or organizational hierarchies.
	Historical Invisibilization	Systemic erasure and marginalization of women scientists and their contributions throughout history.
International	International experience	Experience working or studying in international settings.
	International studies	Participation in academic programs or courses with an international focus.
	International engagement	Involvement in international initiatives or projects.
	International career	Career opportunities or experiences that involve working in different countries or with diverse cultural settings.
	Worked in different cultural settings	Experience working in environments with diverse cultural backgrounds.
Policies and practices	Barriers to policy implementation	Challenges hindering the successful implementation of gender equality policies.
	Gender equality Commission or Committe	Committees or groups within organizations dedicated to promoting gender equality.
	Parity policies	Policies aimed at achieving gender parity or equality within organizations.
	Policy effectiveness	Perceived effectiveness of gender equality policies and practices.
	Women-focused awards	Awards or recognitions specifically dedicated to women in science.
	Women-focused conference	Conferences or events specifically focused on women's issues or achievements in science.
	Flexible Work Policies	Policies that support flexible work arrangements, such as telecommuting, flexible hours.
	Family-Friendly Policies	Policies and benefits designed to support employees with family responsibilities.*
	Implicit Bias Training	Training programs or workshops aimed at raising awareness of unconscious biases and providing strategies to mitigate their impact.
	Reporting and Accountability Mechanisms.	Systems and procedures for reporting incidents of discrimination, harassment, or bias, as well as mechanisms for addressing and remedying such issues in a fair and transparent manner.
	Transparency and Data Reporting	Commitment to transparency in data collection and reporting related to gender diversity, including the publication of gender disaggregated data.

Perception of Progress	Evolution	Positive changes or advancements in gender equality efforts.
	Slow progress	Progress towards gender equality that is perceived as slow or insufficient.
	Lack of progress	Absence of significant or meaningful progress in gender equality efforts.
	No evolution	Lack of change or improvement in gender equality efforts.
Leadership	Leadership position	Participant is or has been in a leadership position in their organization.
Intersectionality	Intersectional challenges	Additional challenges faced due to intersecting identities such as race, ethnicity, sexual orientation, etc.
	Political challenges	Challenges faced by scientists due to their nationalities
Interests	Preferrence for applied fields	Preference declared for applied field rather than theoritical fields of science


Duty
Parity policies
Change of cursus
Promotion bias
Emotional
Mentor in studies
Psychological pressure
Lack of financial resources
Conformity
Educated family
Hostility
Intersectional Approach
International engagement
No gender-related issues
Lack of opportunities
Safety
Community creation
Evolution
Lack of role models
Nomination bias
Precarity
Gender-related responsibilities
Underrepresentation of women at work
Demanding field
International studies
Fragile
Isolation
Working hard
Family doubts
Discretion
Determination
Doubt
Taking initiative
Laziness
Imposter Syndrome
Evaluation Bias
Everyday sexism in academic settings
Family support
Leadership position
Inclusiveness
Non science/academic family
International experience
Intimidation
Fostering inclusiveness
Non-educated family
Not smart enough
Gender equality Commission or Committe
Capacity-building
Mistrust
Gender seggregated education
Only woman in cursus
Underrepresentation of women in curriculum
Fear of failure
Family pressure
Shyness
Support from teacher(s)
Promoting role models
Exchange of practices
International career
Family-Friendly Policies
Male dominated field


Capacity-building 2
Change of cursus 1
Community creation 4
Competitive curriculum 2
Conformity 2
Demanding field 3
Determination 4
Discretion 1
Dismissal of Expertise 1
Doubt 3
Educated family 2
Equal salaries 1
Evaluation Bias 1
Everyday sexism in academic settings 4
Evolution 1
Exchange of practices 3
Explicit Gender equality policies 2
Extended family and/or peer
Family doubts 3
Family pressure 3
Family support 7
Family-Friendly
Fear of failure 1
Fostering inclusiveness 4
Gender
Gender equality Commission or Committe 6
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Gender-based
Gender-related responsibilities 4
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Historical Invisibilization 2
Imposter Syndrome 4
Inclusiveness 3
International career 2
International engagement 4
International experience 7
International studies 5
Intersectional Approach 4
Intersectional challenges 2
Intimidation 1
Involving men 1
Isolation 1
Lack of awareness about STEM careers 2
Lack of financial resources 3
Lack of information 1
Lack of internal
Lack of opportunities 1
Lack of role models 4
Lack of Visibility in
Laziness 3
Leadership position 6
Legal
Male dominated field 3
Maternal Expectations 3
Mentor in field of
Mentor in studies 2
Microaggressions
Misrepresentation
Mistrust 1
Networking and Collaboration 2
Networking Bias 1
No evolution 1
No gender-related issues 3
Nomination bias 1
Non science/acaden family 4
Non-educated family 3
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Not fit for women 2
Not smart enough 4
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Only wom in curs 1
Ordinary sexism at work 2
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Polic Advo 1
Political challenge 2
Positive father figure 2
Positive pedagogy for science 2
Precarity 1
Preferrence for Applied fields 2
Prejudice from
Prejudice from teacher(s) 2
Pressures from colleagues 2
Pressures from
Promoting balanced gender representatio 2
Promoting role models 4
Promoting STEM careers 3
Promoting visibility of women in science 2
Psychological pressure 3
Raising awareness 2
Realistic representation of women in science 2
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Role models 2
Science/Academ family 3
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Sexual harassment
Shyness 2
Special visa procedures 1
Support from peers 1
Support from teacher(s) 3
Supportive partner 3
Taking initiative 7
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Transparent nomination process 3
Unacceptation of women 2
Underrepresentation of women at work 6
Underrepresentation of women in curriculum 6
Underrepresentation of women in organisation 5
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Women-focused conference 3
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