

# **<sup>1</sup>Life paths of successful women scientists in Spain**

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## **1. Introduction**

Gender studies have approached women's lives from different perspectives. By means of using the sex as variable and the concept of gender, patterns of exclusion and strategies for progress have been identified; lives of prominent women who excelled in their time have been documented as well as rescued their individual contributions to science, literature or art.

Our research team works in order to enhance the meanings and insights arisen from women's experiences, specifically in the sciences field. In previous papers, we have studied and presented women who contributed to development of science. To this end, we have performed biographical, statistical and prosopographical studies of groups of women scientists, and we have defined the context and the scientific profile of the Spanish pioneering women in sciences.

In their study on difficult private lives and careers of women scientists, Pnina G. Abir-Am and Dorinda Outram investigated the relationship between the personal lives and different models of careers of women who contributed to science. These authors deepened into the relationship between science and life, how the practice of science

affected the subjective experience of women scientists and how “the interplay between career and personal life has affected the participation of women in science” (Abir-Am and Outram, 1987, p. 1).

Abir-Am and Outram hold that the experience of both sexes was not in the past so radically separated (there was a broad tradition of amateurs in Britain and North America), and although most paid positions were occupied by men, these jobs were few and the amateurs, men or women, worked on a domestic basis. In the early nineteenth century men’s and women’s relations with science were heavily influenced by personal and family situations: “Historians have already stressed the opportunities that women scientists found in the ‘family firms’ of nineteenth-century science, in which many family members, if not entire households, engaged in the Enterprise of science” (Pycior, Slack & Abir-Am, 1996, p. 4).

The studied cases from different historical times made by those authors called into question two assumptions that are implicit in most works of history of science. Namely, 1) that the personal lives of those who practice science cannot explain the nature of their scientific work, and 2) that the development of modern science can be understood in terms of a gradual "professionalization".

Differently, these studies showed that taking science out of the domestic sphere influenced and contributed to the exclusion of women. The scope of this change in spaces is pending of being documented: how the science left the domestic sphere and why this process affected more women’s positions than men’s. We find contributions in this sense in the historical studies by Marsha L. Richmond on the group of Bateson (1900-1910), who in the early days of the Mendelian genetics developed scientific research using domestic spaces, with a high presence of women (Richmond, 2006).

As Abir-Am and Outram had said, it has been overlooked the influence of the exclusion of domestic sphere as a scientific production space in the gender structure of modern science (with its low representation of women). This does not mean denying that the exclusion of women scientists has been exercised primarily by the barriers erected to them in the process of science institutionalization (with the creation of universities, scientific societies and journals), but it could be one more element to take into account. Following this line of work, our group considered the possibility of researching the interactions between the life paths of women scientists and their contributions to science. To this end, our latest research has focused on the lives of successful alive women scientists, from which we have analyzed the factors influencing the development of their careers. We have investigated bridges and barriers within the institutions they worked for, difficulties and facilities they encountered during their training period, and how their personal lives have interacted with such a vocational and demanding activity. As Sandra Harding, we think that giving importance to the contributions of groups different to the hegemonic, in this case women, acts in the interest of science and knowledge (Harding, 1991).

## **2. Material, methods and hypothesis**

We focused on the lives of nine successful women scientists of the University and the *Centro Superior de Investigaciones Científicas (CSIC)*, the main research institutions in Spain. The nine scientists<sup>2</sup> we worked on belong to two generations. Four of them were born in the late 30's and the other five in the early 50's. All of them were known by the members of our group because of the results of their researches, related to our respective areas of scientific expertise: neurobiology (4), psychology (3) and physics (2). Many of their papers had been read and cited by us at different times in our research and teaching activities, and in some cases we attended their presentations at conferences

or lectures. We collected their CVs and publications, and initiated a personal contact with each of them, which led to the in-depth interviews, previously pre-designed, that were recorded and later on analyzed.

The measure of the "success" of these scientists has been based on the criteria used in scientific circles. Those criteria are not without debate (Monosson, 2008):

- To be appointed to the post of highest rank in the University or Research Center
- Being director of a research group
- Having publications in high impact journals
- Being a director and / or coordinating international groups
- Being a representative in international organizations
- Being referee of journals of high impact

The prior knowledge of their activities and scientific contributions led us to raise a number of questions in connection with their lives. Unlike those Spanish pioneers of the first third of the twentieth century we had previously studied, these scientists have achieved professional success, and they all are internationally renowned. Their desire to pursue research in a particular scientific field has been accomplished, and they have received a deserved recognition from their community of reference. Does this mean that there has been a significant change in the last century in relation to women in science? Has science changed or have women changed?

Even if the very fact of the existence of renowned women scientists means that there has been a change from the existing situation a century ago, following the approach of Enrichetta Sussi (1998) some questions remain: Is our sample an exception? Has there been an adaptation of women to male patterns prevailing in science? Or has there been a real transformation in scientific circles because of the participation of women?

Recent works by Mary Frank Fox, based on her study on doctoral education in science and engineering in America (Fox 2001), point to the first hypothesis: increasing number of women may not alter the “norms” or “standard practices” of education and work in sciences. Women working in sciences should accept a set of features supposedly “disembodied”, but really associated with men and masculinity”.

It is possible that the changes that have taken place in our society have produced a certain number of women able to cope with the high degree of competitiveness in the scientific world. Surely these women have exceptional qualities, an extremely outstanding intelligence, and a certain type of skills that enable them to cope with environments fraught with difficulties. But we know that many others, with similar desires and capabilities, have been unsuccessful in their dedication to science; what could be the difference?

Our research has provided some answers to these questions, some of them unexpected. Without denying the existence of factors intrinsic to science (from those related to its institutionalization, to its current organizational forms), in the results of our research social factors and personal choices stand out on their own. All this leads us to reconsider the importance of gender roles and the permanence of the sexual division of labor as factors that currently affect the practice of the scientific activity. The main difficulties that the scientists of the sample have had to overcome to pursue their scientific careers, have been those related to marriage and motherhood. They have left their boyfriends or have got married to other scientists. In some cases they have slightly changed their field of scientific expertise in order to work with their husband. In short, they made a series of adjustments in their personal lives in order to safeguard their professional development. Could we say the same for the successful men scientists? Did

they have to face the development of personal and professional life as a personal challenge not easy to fit?

### **3. Factors influencing the life paths of the scientific sample**

Through the life and professional experiences narrated by the scientists of the sample, we found some factors that respondents mentioned as being influential in explaining their trajectories. Among these factors, we distinguish two types. The first type includes factors clearly positive, since it represented a clear boost in the beginning of their studies, and increased their chances of finding ways of integration into the scientific community and making substantive contributions to a branch of science. We might say that this type of factors did not depend on them, but on their environment, and that they knew to take advantage of the situation. In the second type of factors we place a set of circumstances that have influenced in different ways their careers and lives, and have entirely depended on the particular way in which each one of them has faced crossroads in her life.

One factor that we wanted to explore, unrelated to their career but in connection with it (success and ability to influence the scientific community) is the role of being a model for other women, being students or colleagues. We called this factor "presence of women in their environment", in order to accommodate the assessment of that presence. We think over it and check if the success of these scientists has had a positive impact on other women, attracting and providing a channel for the professional development of them. This effect has been analyzed in other works, in which it is emphasized that the involvement of women in science is enhanced by the existence of models or precursors, that is, by the consciousness of having a "feminine genealogy" that offset, to some extent, the predominantly male thinking within the scientific world (Cabr  i Pairet,

1996).

## **2.1. Success factors related to the environment**

Among the positive factors we found: a) expectations and family influences, b) the novelty and timeliness of the scientific field, c) mentors that offered them options to go on, and d) travels and stays abroad.

### *a. Expectations and family influences*

The main conclusion in our study is that active and successful participation of women in scientific production has been possible through overcoming societal factors that have historically burdened the activity and freedom of women. In the case of the studied women scientists, this improvement came from the influence of the family environment in their childhood and youth.

The nine women scientists share the fact of having had parents with a favorable attitude towards their higher education, with an absolute confidence in their capabilities, and having received support and sustenance from their families at the beginning of their career.

The significant role played by the family environment has been recognized by each scientist interviewed: *"I admire my parents because they have given me the most important, the freedom to do what I want"* (G), one of them told us. Another commented: *"My family was convinced that I had to study a career, specifically in science, because until then I had got excellent grades in math and physics. We were four sisters, and each one of us made a degree, the one she wanted to"*(A).

Their families had no doubt they were going to study: *"My mother was an educational inspector; she never doubted I had to study. At home, there was no doubt I would follow*

*a path of study, I mean that I did not believe that I simply had to get married; I got married because I wanted"(F).*

Another said almost the same: *"You can say that my mother was the head of the family, she always taught us the importance of studying and having a degree, of having our own work; in this I have had her full support. For her, it has always been a priority that we studied and worked."* (I).

That was so even in the case of a scientist who finished college in 1953: *"I saw it in a very simple way, my family never told me "no". My family encouraged me, only an elderly aunt was surprised by me wanting to study; when I said I would study medicine, she hit the ceiling, but she didn't stop me"* (E).

Among the occupations of parents, being a teacher stands out. There are no cases of daughters of successful women or men scientists, and the choice of studies does not seem to be marked by the interests or professions of their parents. There has sometimes been an economic and local conditioning, choosing those degrees that could be studied in the place they lived: *"I would have chosen physical sciences, but I could not study it in my city, and had no money to go to another. My parents have not studied, they know how to read and write, of course, but I have two brothers and had no money"(G); "Initially I wanted to study engineering, but I could not do it in my city and I did physical sciences. I liked both. I wanted engineering because it seemed more concrete, more precise. But now I'm glad of having done physics"(A).*

In most cases, the value given to schooling was clearly above the school level of the parents: *"My mother influenced me very much. I began the baccalaureate at 10 with the knowledge that I was born during the war (I did not go to school during the war in case there were bombardments). My mother taught me very soon how to read and write, then*

*she taught me the four rules, to divide by all the numbers; that, my mother knew it" (D); "My parents did not have university degrees, my father had a professional degree, he was a post-office technician, and my mother had primary studies, general culture. But they were convinced that their children had to study a degree if they could" (C); "My father studied veterinary but then he did not practice it, because he married a person who came from a farmers' family, and devoted himself to the tillage of the fields belonging to his wife's parents" (E).*

Sometimes parents had great influence in the choice of the university degree in an indirect or even accidental way: *"My father was the reason I chose Biological studies, although I think afterwards he regretted it. He was an architectural technician and his illusion was literature. The house was full of literature; he read a lot and explained a lot of things to me, and when I was young he gave me a natural sciences book that I could hardly read, because I was eight years old. I read it with great effort, but I liked that book, all the things that were explained in it, the circulation of blood ... and I thought: I want to study this" (H).*

In one of the cases, the daughter did the same studies as her mother, although she did not follow a scientific career: *"My mother is a biologist, and we are four siblings, I have a sister who is a biologist, she works in scientific research also, so I have to say that my family has been very important. My mother had to resign her teaching when her third son was born, and she always felt sad because she could not follow a research career" (B).*

In another case, the family made her change her mind: *"As I liked nature so much, and it was so hard for me to study abroad, I was ready to study veterinary. But the person I*

*lived with, who was an uncle, because we were orphans, was a vet, and he told me that veterinarian professional opportunities were bad. So I chose medicine” (E).*

*b. The novelty and timeliness of the scientific field*

In every case the factors that influenced her option for a researching field were different. Nevertheless, after examining in detail the branch of specialty to which they have devoted themselves, we verify that all of them have chosen innovative perspectives in their field, that they have even been pioneers of new paths of research. The greater likelihood that a woman scientist is better accepted and successful in a new branch of science had been already mentioned by Margaret Rossiter in her classic *Women Scientists in America*, and the same remark is shown in more recent works (Marsha Richmond, 2006 and 2007).

Our research obtains the same conclusion: the success of women scientist is linked to their involvement in new scientific perspectives within their field. The branch of the optics, the new physics of particles, the study of aging, the glial cells role in neuroscience, the work in the functional assessment and aids technologies for communication or the investigations on the menstruation are advances in novel fields, not classical studies. Some of the women scientists in our study highlighted it in the interviews:

*“At the beginning the choice was made according to the real possibilities we had, but afterwards I was attracted by finding a part of physics closer to technology, with a clear use, e.g. in photography, in the system’s quality. If someone had told us fifteen or twenty years ago that there were things that remained to be discovered in photography we would have said no. And now all is new in the photography field! (...).We were particularly pioneers on the introduction of color, in the approach of not only the*

*identification of the form but also to the color's distribution of the bodies" (C).*

*"When I began my work, the aging studies were a necessary and a novel field, it was there scarcely 30 years ago and nobody was interested in it. As for me, I thought it was an observable problem, interesting and accessible for study" (F).*

*"We arranged a method for microglia stain that is used today in all the labs. It is very funny to see that you have done something that has served so well to lots of people (...). Especially in the microglia field I think we had provided different points of view that perhaps were not done in other labs" (H).*

The question of novelty in a field is often connoted by the hierarchy of the topics. So that in the topic's choice does not only count the existence of some vacuum space. Some topics are neglected by the scientific community being more available and leaving more room for a successful career. This is the case, inside the neuroscience field, of the studies in the glial cells, work field of some of the interviewed women scientists. Classically, these glial cells were assigned a secondary role in the brain's function, mainly as cells for nutrition and support of neurons. The hierarchy between neurons and neuroglia was projected into the researches focusing on these cells and into the people that studied them. Curiously, neurons were mainly studied by men, while the neuroglia was studied by women. The advances in the study of neuroglia have risen to new knowledge over their role in the brain function, and this has increased their value. Nowadays it is well known that the glia influences over the neuron's excitability and over the synaptic transmission such as the "tripartite synapses" constituted by two neurons and one glial cell (astrocyte). The role of neuroglia in memory and learning processes as well as in the nervous regeneration and degeneration is also well known.

In some cases, the choice of the research topic has become a challenge for these scientists. This is the case of the choice of menstruation as the topic for the Doctoral

Thesis of one of our interviewed scientists: this choice supposed an initial reject and isolation of her peers. With time, the relevance of this topic has prevailed over the initial resistances.

Also we have seen that women scientists have been frequently used as luxury workers, repeating the situation of crystallographer Rosalind Franklin: her work was used by Watson and Crick, who took advantage of her plaques to sign the interpretation of DNA helicoidally structure, and they won therefore the Nobel Prize, consigning Franklin to oblivion. Among the women scientists of our study we also found some cases in which they performed fundamental researching tasks that were used afterwards by their bosses, although this happened at the beginning of their careers.

Another issue discussed was scientific productivity. All the women interviewed present high levels of productivity and all of them are working in a very specialized frame. This circumstance matches with assets by Erin Leahey (2006) on STEM disciplines (Sciences, Technology, Engineering and Mathematics). She introduces the specialization variable in scientific productivity. Six out our nine women scientists are working in the called STEM disciplines, and the other three are psychologists. In this sense, we can say that these women adopt the standard masculine practices (Mary Fox 2001), as the unique or most professional practices, probably owed to the association of science with masculinity and the professional socialization processes within STEM disciplines (Laura A. Rothon 2011).

*c. Mentors that offered them options to go on*

The mentors we refer to are those persons who at some point met our women scientists. They were not usual mentors, not the type that design the way that a disciple must follow for a successful career. In most cases, they were persons that our scientists met in

their way, and it was their own determination and value what made the relationship start. Our women scientists were in control of their career.

They answered our questions about mentors:

*“I had two special mentors. One was in Spain and the other in the United Kingdom. We can say that they were two different kinds of mentors. They were not a permanent guide as they are nowadays. In some moments of my life, they helped me, but afterwards I had to rely on myself, or at least I chose it this way, I did not ask them for help too much. It was not the way of maintaining a constant relationship” (C).*

Given the predominance of male power in science, and still more years ago, is not surprising that most of the mentors have been men. It was the same in our sample, in which the majority of the mentors were also men. In some cases, the mentor was the own couple, and in fewer cases they were women, who are valued in a different way:

*“I would like to underline that my Thesis Director in the USA was one of the persons who has been more important in my research activity. She devoted a lot of time to me. And my first director of studies in Spain was also very important. My husband was a fundamental one, a person who has always supported me in all my decisions. Perhaps, as he is a scientist he can better understand what the necessities are” (B).*

*“To begin with, nobody taught us how to formulate a project. Maybe nobody knew it in those years. At the University, when we wanted to go abroad (I am talking about the eighties) only a woman scientist helped us. We did a short course with her, and asked how a research project could be done. Many male scientists had rejected us, however she wrote a draft which enabled us travel abroad for the first time” (G).*

#### **d. Travels and time spent abroad**

It is worthy to remember that, for the Spanish science, as well as for the whole society,

the 1936-1939 Civil War represented a tragic break with the previous period. In particular, it meant a major rupture with a scientific policy that had begun the JAE (*Board for Advanced Studies and Scientific Research*), the most important Spanish institution for development of science in the first third of the 20<sup>th</sup> century. The JAE launched a scholarship program for Spanish researchers to go abroad whose impact on their return to the country enabled the Spanish science to reach the level of the international science at the time. After the Civil War, Spain was isolated due to the alliance maintained with the Axis Countries during the Second World War. There were no relationships with international scientific institutions neither an established way to Spanish graduates or researchers to go abroad.

Later on, when our women scientists started their career, going abroad was still something not very usual. Given the importance of that point for a scientific career, we think the option of going abroad, that scientists of our sample had, was one of the factors that contributed to their success. Their stays at international research institutions were an important fact for the time, a relevant one in the development of their careers.

They talk about it:

*“I studied with a scholarship, and I had the opportunity to go abroad. It was very important that my professor made that offer to me and that I took it, because sometimes you say: I will take it later, and then there is not another opportunity (...) The networks of friends and acquaintances are also important because they support you. I stayed 14 months and in all senses it was as opening a new window to the world. I started publishing in international journals on topics more accepted within the scientist community and when I came back, I was ready to direct Thesis, to send a paper, without fear of peer-review, and discuss with colleagues or accept that I had made something wrong... I had come out of isolation” (C).*

They were fortuitous meetings, in Congresses, or conferences, which made it possible to meet a foreign teacher:

*"It was my luck that a very significant person in my field was invited to the Basque Country and that I too was invited to assist to his course. Then, during breaks we talked and this professor invited me to study in his country, the USA. I came back and still am I devoted to the same field"* (I).

Or the woman scientist concerned decided to travel on her own, to continue her studies:

*"After graduation I went to the United States to work on my Thesis (...) Then, in 1995 I stayed one year in Italy, and there I began a different project, that is basically what I have continued working till now"* (B).

*"In The United States, I was a Medicine lecturer. On my return I did my Doctoral Thesis and had the opportunity to apply for a Titular professor position"* (I).

*"I had a scholarship in Santander, and later in Germany, in Munich"* (E).

*"When I read my Thesis, I took the reins and I did not longer lean on anybody. I devoted myself to going abroad, to bringing new technologies, to sharing what I had learned with the persons that were here, to looking for projects. It was very hard, this stage was very hard (...) The first time I went to Strasbourg. I worked one year in the centre of Neurochemistry. Then I went to Dundee, Scotland, to the department of Anatomy at the faculty of medicine. Later, I went to Constance, in Germany (...) I also was invited to go to Tokyo, where I remained for several months"* (G).

In relation to foreign travel there is also the age factor: for the younger generations it was easier going abroad, because Spain already had gone out of its isolation. It was also easier for those women scientists who married a scientist, and better if, as happened in some cases, both shared the same field:

*"As both of us work on the same field, my husband and I have almost always travelled*

*together. We have done stays trying not to be separated one from each other for too long, so we were travelling where the other one was. I stayed in Denmark, for periods of four months each time" (H).*

## **2.2. Singularities linked to personal options**

The second type of factors includes those circumstances that accompany a life, and that, according to how they are solved, can be more a ballast than a support. In the cases of the studied women scientists, what has been decisive for their success is the form in which they have confronted them. The personal choices they made were concomitant of their development and personal balance, allowing them not only to progress in their careers, but continuing with the science option. These factors are: a) the couple, b) the motherhood, c) the teaching, and d) the foreign languages skills.

Once again we found a generational gap in the way of facing these circumstances, in particular the a) and b) factors.

### *a. The partners*

In our sample, it is noteworthy that the women scientists who live with a partner, in most of the cases throughout many years, both partners share the same field of investigation:

*"My husband and I studied together, well, he actually started one year before me, but we shared subjects" (I).*

*"I met my husband during my stay in NY, we got married and had a daughter" (B).*

*"I met my husband in the department where I was doing my Thesis, he had also studied Biology and was starting his Thesis there" (H).*

Some of them have linked so completely life and work that woman and husband belong

to the same team of research or they direct it together<sup>3</sup>: *“My husband and I are in the same research team. We are 24 hours as they say, either it works for you either it goes badly”* (H).

All of them think that their husbands have helped them very much in their professional career, they have understood their desires and needs, and have collaborated in the housework and in taking care of the children:

*“My husband has been fundamental in my career, supporting all my choices, supporting my scientific path. Probably, as he is also a scientist, he has understood my needs and assumed his responsibilities with the children”* (B).

*“I have had the support to be able to do it; it has been very important that my husband has understood many situations that probably other husbands have not. The feeling of being always two to do something is not the same as being alone”* (H)<sup>4</sup>.

*“I was unwilling to marry, I thought that I had to devote myself to this profession, then it cost me a bit until he convinced me, but well, he already convinced me and it was good for me, it was even better for my career that if I had not done it”* (E).

The support from their husband, in the sample, has existed even if they had a different job:

*“In the couple life I haven’t had any problem for working and going ahead, though my husband’s job is completely different from mine. Clearly, if one has no family responsibilities one has much more availability for work. In my house we have shared the housework”* (F). Although she also says that cooking and dealing with household chores is her business.

As for the housework, the answers are very different:

*“I dealt with the household chores, but had a service that helped me. I did the shopping*

*myself. So I've been the two things at once. I always got up early, so had time to prepare all things to study and work, and to take good care of the house” (E).*

Among the nine respondents, only two women believe that household chores are within their exclusive competence. In this aspect it is important the generation they belong to and their way of thinking. At the other extreme are those who have never liked household chores. This can be inferred from the fact that they do not talk about it, or hesitate when asked. But there are also cases in which they explicitly express it:

*“I cooked every day for many years, because I had to, we couldn't afford to eat out. But my intention was that as soon as we could, we would eat out (...) One day I sat in the dining room, and began to cry, because I could not stand any more the housework and the cooking; then my daughter told me: ‘Mom, when I'm older I will work and I will earn enough so that we can eat out’. That's how I saw the issue” (D).*

Another repeated feature is that their male partners have been ahead of them in developing their careers, reaching earlier the same or higher positions:

*“My husband is also a professor, but he got the chair before me. Here at the university many people asked me, why didn't both of you compete for the chair? And I said them no, because I had a 3 year old child at the time. It was not the time for me. I cannot be preparing for a competition with a 3 year old child. I want to enjoy my son; I want to take care of him as he needs it. Meanwhile his father is in competitions, someone has to be by him, taking the time you have to take. Well, he won the chair, and later I did compete myself. And then took care of all that I dealt with before. When I went for it I was excited, especially because my parents deserved it, almost as much as I deserved it. They had supported me a lot and I knew they would be thrilled. I was excited for my children as well. So, when I thought I could go, I had the full support of my husband too” (H).*

Sometimes, to choose the place of residence, security has prevailed over the desires, and they have chosen on the basis of the position achieved by the husband: *“My husband got a working position as a scientist at the Scientific Research Council, so we went to Madrid. I got a scholarship to work at a laboratory, where I spent several years working on a subject close to what I had done before, but not exactly the same”* (B). Later, this scientist returned to the subject she was particularly interested in, for which she performed a one-year stay abroad. During this time, her husband and his parents stayed by the children, the youngest of whom was barely one year old.

Another of the scientists, who adapted her career to her husband, explained her decision by the desire to work together: *“I did my Doctoral Thesis in Biology but it was at the Faculty of Medicine, where I arrived in a circumstantial way, where I met my husband. He also studied Biology and had begun his Thesis at the Faculty of Medicine, where he was offered a position. I was in the Faculty of Sciences, and things were very difficult in our department at that time. He had the chance to take a position as Full Professor, and I came as an Assistant Professor, which at that time was a lot ... I mean, I really lost quite a lot when I left the Faculty of Sciences, because there I had a position as a Professor. But we really wanted working together, researching together. And here there were more opportunities than at the Sciences Faculty. So I came here, and here I have stayed ever since”* (H).

As for the stay abroad, the situation was similar: *“We had the opportunity to go to Germany. He knew a little German, so he did all the German tests to be hired as a teacher lecturer. I went with a scholarship”* (E).

In the two previous cases, the story tells us that "he" got a better job before she did (this is the part where science does not seem to have changed very much), and it suggests

that, for women, it was worth it to modify or adapt their careers in order to work together. Regarding the latter, we wonder if men would have done the same in the opposite case.

Only the career of one of the women scientist suggests the opposite: she continued her way and her former partner did the same, living in different places and belonging to different research teams: *“I have never experienced it as a loss, and now when I think about it I don’t think it either. Every moment of life is what you have, it is a matter of choice, I have always had the choice”* (A). The success she has achieved has been far superior to her partner’s. But naturally, they are different particular cases in which many factors have acted, so we can’t draw general conclusions.

The scientists who did not join their life to another person also say that it was their choice. In some cases, considering the dilemma between pursuing a relationship and continuing their career, they chose the profession: *“That was not a resignation, but a choice... At that time, I was preparing for a professorship, and he did not want to wait any longer... maybe the breakup was not promoted by me, but while talking it was proved that one thing was incompatible with the other”* (C).

Options were not always easy: *“I’ve left everything behind. Even, playing with my nieces and nephews has been difficult. I was always somewhere else. Now, I play with the children of my nieces and nephews! I have very few friends, who have been with me all this time and understood what was happening”* (G).

These women who have progressed alone in their scientific career are more conscious of biases and barriers than those with scientific couple, confirming the statements of Laura Rhoton (2011). In our sample, four out of nine are in this case.

#### ***b. Motherhood***

This is a point that embodies the uniqueness of personal choices: to be or not to be a mother. The interviewed women scientists have been successful with either of both options. Five of the women scientists have got children, one of them at an early age, and they all have had a successful career<sup>5</sup>.

Our conclusions are consistent with previous investigations affirming that “gender, family characteristics, and productivity are complex considerations that go beyond being married or not married, and the presence or absence of children (...) Women with preschool children are found to be a socially selective group in their characteristics, particularly in their allocations of time” (Fox, 2005). We can also agree that “women with children are more productive than childless women, which in turn has been the basis for claiming that women's lower productivity cannot be due to maternal responsibilities” (Kyvik, 1990).

Other recent sociological studies analyze the relationship between motherhood and scientific productivity. In her book *Motherhood, the elephant in the laboratory*, Emily Monosson (2008) gives voice to 34 women scientists from different disciplines. Their stories show the many ways in which women can successfully combine motherhood and a career in science and also redefine and address what it means to be a successful scientist. We have found similar stories in our sample.

For those who chose to be mothers, family support was fundamental once the professional activity started, at critical moments in which motherhood and scientific activity seemed incompatible:

*“My parents took often care of the children. I just had to pick up the phone and say: something has come up; will you be able to come? Even my mother came with us on a*

*stay in Denmark because the child was very young. I told her: I do not know what to do, we have the opportunity, what we are offered seems interesting ... And she said: well, I'll go with you. So she could have not been more supportive” (H).*

*“When the child was very young, I knew I could leave him with my mother whenever I wanted, and she was delighted. Moreover, I was lucky because one of my aunts worked at my child's school: if I had any obligation before the time to take the child to school, I could leave him there after 6 AM. My sister took her children to the same school, and if one day I could not go because I had to work late, I asked her to take my child home. My sister lives in the same building as my mother. In this sense I have had many facilities, yes, and only one child ...if I had had ten children, it would have been more complicated” (F).*

Despite of the opportunities they have had, raising children while continuing their career demanded of these women scientists an extra effort. Most interviewees recognize it:

*“Even with all these possibilities, it is very tiring for women; we must say it like it is. There were times when I felt really tired, because you always have over your shoulders an extra burden. It is understood that certain things, children of course, are your business. Particularly when they are young, you have to be there, there and there, occupied by fifty things at once. I have three children, and there are times when you feel tired” (H).*

This great effort comes by the desire to combine all of this something which men seem to care less about. Women scientists, too, seems to be more concerned with children than men:

*“I normally leave at five, which is the time at which children leave school. My husband is in the office until his child calls him and says: I want to have dinner” (H).*

Interestingly enough, these women consider it as an enjoyable option. They defend their option of taking the time to parenting, although it delays reaching senior professional positions. The importance of this approach is that it denies the dichotomy that is posed to many young women, having to choose between motherhood and career. Some argue that it is an option for personal development, and also a right that we should not resign to:

*“There is an inevitable biological aspect. I think it is better a girl to be absent from work for four months in order to breastfeed her baby than come back to work quickly while the baby is bottle-fed by her husband. The biological aspect is worth it, it is part of the lives of women, and it is a very nice part. When you lose that, I think you lose something important. For me it has been an important part of my life. Those four months close to the child and breastfeeding him/her should never be denied to a woman. It should not affect the job; it should be recognized and accepted by all. I do not find it right for women to lose that portion of their life in order to not affect their work” (H).*

In any case, the women scientists who have got children have postponed or adapted their careers with the demands of motherhood. Some plans have been changed: *“I was very interested in a World Bank grant for a stay in France (...) but my son was then 3 years old, and I decided that it was not time, I could not go that way (...) Instead, I did a course at the Sorbonne during two and a half years. I went one weekend every month and a half. My husband stayed with the child” (F).*

### *c. The teaching*

To our interviewees, the partial dedication to teaching was not exactly a personal choice. In most centers where they carry out their work, teaching is linked to research. Eight out of the nine are university professors, and therefore have a teaching load. Only

one has a job as a researcher that does not include teaching; even so, she participates in some courses: *“Teaching I do little, it is not my duty, but I participate in master or doctorate courses, and I talk about topics related to what I do”* (B).

The place occupied by teaching is very different for each of the interviewees. Some value it very highly, others do not find it attractive, but they do see positive aspects. The downside they find is that teaching leaves less time for what interests them, which is research.

In this aspect, too, they seem to be influenced by the generation to which each one belongs. For the older ones, teaching has been very important, and they have devoted to it much of their professional activity:

*“I was a vocational teacher. For me, teaching has always prevailed over the investigation. I mean, I was doing research without undermining the teaching. When I had plenty of time, then I devoted it to research. I would give a 70% to teaching and a 30 % to research”* (E).

*“I like university. Classes are for getting in contact with young people, they are suitable for teaching others what you know, and for training others in what you can. I like the part of being a university professor. I have no such point of view held by some that teaching takes time from research; I do not feel that way. I feel that the two are complementary and enrich each other. Especially, the four years in which students are doing their Doctoral Thesis, and you discuss and go with them to congresses, and they present their projects. That part, which is somehow training for them, also provides training for me. And I like doing team research, holding meetings, to say where we are and where we are going to, together with people of all levels”* (C).

The youngest ones would have preferred not to undertake teaching, but eventually they

found in its positive aspects:

*“The position ... had the disadvantage of being at university ... and that I should teach and I did not feel like it ... But it has a positive side, it makes you think about some things, it helps you to learn how to explain these things to make people understand. And it is not a bad experience. I also had the good fortune that in my classes I only had to explain things I had worked with, and I could explain the experiments in which I was working” (A).*

Most of them consider that the teaching load, along with management tasks, is excessive ... and not well recognized. An excessive teaching load and the continuous changes in organizing the subjects are causing discontent among scientists:

*“We have a teaching load that is totally disproportionate ... people are asking too much ... we are required a level that does not match the recognition of the educational effort that we are being asked” (H).*

*“What I dislike in the teaching endeavor is that when something works, it is changed ... Teaching and bureaucracy around it are a lot of work” (I).*

#### *d. The foreign languages skills*

Since foreign languages skills are not really common among Spanish people, due to the isolation period mentioned above, for Spanish scientists this is a point to consider. Many men and women scientists with interesting research projects have seen their international projection limited because of lacking language skills.

Although rarely mentioned, all respondents have been forced to use languages other than their mother tongue, and half of them speaks at least three languages: their own, that of the European country where they stayed (mostly French or German), and English. It is remarkable because, at the time these scientists began their careers, in high

school it was taught only some French (or German), and at university a second language was not compulsory. The entry of English as a second language began in Spain in the 70's in high school, and reached primary school only in the 90's. By then, these women had already begun their research, learning languages on their own when they received grants for other countries. Nowadays some of them continue attending English lessons.

The predominance of English as a pidgin language in sciences, as imposed in Europe from the 50's, makes it compulsory for those engaged in science activities to use this language. Thus, developing language skills is one of the factors promoting integration in international research teams. This point is underscored by one of the interviewees, which highlights the support provided by her mentor:

*“She dedicated a lot of time to me. I was just a foreigner, my English was certainly not optimal, and she devoted much time and effort to make me understand the basic concepts of neurology, she corrected my English, and much more” (B).*

### **2.3. Women's presence around successful women scientists**

One of the issues we were trying to figure out is the sex ratio among scientists in the shared scientific areas, and if the presence of women scientists has any influence over other women. We ask if the women scientists in our sample had found support from other women working in the same field. And conversely, we ask whether their career and scientific positions has favored the presence of more women in the field. In short, we look for some answers to the question: does the success of a woman scientist have any impact in the increase of the number of women in her field?

As it is generally known, the existence of greater or lesser number of women depends on the discipline. In the areas of engineering, the presence of women is lower, and some of the women interviewed corroborate it:

*"Most engineers working in this field are men. There are women in engineering, but still they find it hard to enter" (I).*

*"As for the workspace, I think it is still very masculine. I get bored being among thousands of men. There are more women working on soft things, but on hard ones the number is very small. The existing few ones have to argue or fight with men. And if there are other women, you can maintain different links, another way of talking, at least with half of them, although there is also women with whom there is no empathy in terms of forms, or goals" (A).*

In Biomedical sciences the proportion among women and men is more balanced, a balance which is displaced towards women in some fields, such as Psychology:

*"We have always been fairly balanced. Now we are five women and four men, and the two technician women, but we've always been more or less. Last year most of the Thesis were presented by women, three women and two men" (H).*

*"The team is currently composed by three men and four women. Previously there were three more women but they left to another group. This is a field predominantly dominated by women" (I).*

*"In the lab we are about ten people, now one of the technicians and two students are male, the rest are women" (B).*

*"In my lab, we are nine women and three men" (G).*

*"In my current team we are all women" (F).*

Nonetheless, this balanced presence of women in the laboratory is not reflected in senior positions, confirming the existence, still, of the glass ceiling mentioned in gender studies:

*"There are places where the imbalance between men and women is still very noticeable, places where women are a minority. In a staff of 23 directors of institutes of my field,*

*two are female and the rest are males. Personally it does not bother me, but it is clear that there is still no clear parity. I don't know if there should be parity" (B).*

*"We are in a European network, and in this network there are more men than women. When I think of the different labs, I realize that most are men, although there are women also" (H).*

If the area is heavily populated by women, the balance of positions is also more easily achievable:

*"Because we are more women, we have held more jobs in research projects. Regarding the positions, charge of directors or managers, I see my department quite balanced: three men and three women, alternating" (I).*

The difference in the proportion of men and women as we climb the scale of charges is significant in almost all examples:

*"There are two women with a permanent position, one that has been a staff scientist for two or three years, and me. I have been here for many years. Then within the Ramón y Cajal fellows*

*<sup>6</sup>, there's a girl and three boys. And among the post-docs there are many girls, maybe four, easily up to 40%. With regard to students who are doing the doctorate, the proportion of women must be almost 50%" (A).*

Presence of women and men, that is, a gender balance in the respective areas of research, is highly valued by the scientists interviewed:

*"Regardless being very good, with the same level of scientific quality, I believe that both the sensitivity and the point of view of women are different. It's great to be together because this difference in sensitivity is important, since some contribute with one thing and some with another; the fact that the number of women has increased has had its*

*influence, I am sure, I could not say exactly how, but it has had influence, I am convinced. We are different” (H).*

*“In my lab there are many women. Actually I think it's good to have a gender balance in the laboratory, for several reasons, because we have a different way of thinking. I believe that science benefits from having different points of view” (F).*

The successful career of these women scientists, and possibly their own action in the recruitment, has had a positive impact in the presence of women in their research teams. Without having any concrete willingness to select women, just applying their criteria, there have been different results than in other teams led only by men. One of the interviewees commented:

*“In my field there is no such preference for boys, the predilection for boys that always comes out statistically. Men say that they always select the best, but statistically, when they select, more boys come out (...) Maybe the criteria are different, and we take into account more things: the interest, of course the IQ, the curriculum ... I do not know, I do not know why men always choose more boys and in our case we choose 50%-50% (...) I think we select more women perhaps because we apply a broader criteria. Not only you look if the curriculum is good, you look for more things. They say there are more guys because they are smarter, that's why the selection comes out this way. That kind of arguments are still said publicly ”(A).*

They also identify some difficulties in girls for their incorporation to science:

*“If I have ever had to insist for someone to continue in research, because they liked it, it has been with girls, never with boys. I use to tell them: if you like it you have to fight for it, you can balance your life, etc. I have never had to tell boys this, if they liked the subject they continued, and if not they left, but they have never had dilemmas like those of girls” (A).*

#### 4. Epilogue

The analysis of the life paths of these nine women scientists studied shows that effectively there is an interaction between personal life and contributions to science. Life path is the result of living in a particular social and historical context and of making a set of choices that, in this case, correlate with a successful outcome in their scientific careers.

Our study shows that if in the past it was important, for the involvement of women, the practicing of science in the domestic setting, today, in this regard, it is the organization of the household what has its importance, as well as men to assume their rightful tasks. Contrary to what stereotypes lead us to believe, a couple and motherhood need not necessarily to be a drag on the scientific activity, a conclusion which is coincidental with other sociological studies (Kyvik, 1990; Fox, 2005; Monosson, 2008).

Although it is not strictly a biographical study, the explored aspects along our research allow us to check what Linda Wagner-Martin (1994, p. 11) affirmed: *“If biographies of men are dominated by external events, most biographies of women are a blend of external and interior”*. We found similar comments in Pycior *et al.* (1996, p. 29): *“Increasing numbers of senior women scientists have written memoirs or granted interviews that, unlike traditional accounts of men scientists, focus on their family arrangements as well as scientific work”*.

In our case, the inquiry was guided by a questionnaire that included questions about personal life and family, and their answers confirm that indeed these issues weigh a lot in their professional achievements. The women of our sample don't live them apart, but in mutual interaction.

Now, back to the initial questions on the change of science, or the change of women, we

can say that, obviously, women have changed. Their willingness and organization as a social movement, feminism, has changed their life circumstances, their social contexts. The important thing is that the new contexts allow a greater compatibility between science and life for women. And also, to the extent that women have been able to develop a successful career, sciences have changed, have received additional contributions, and have been enriched.

Nonetheless, the thing that we cannot say is that the organizational structure of science has changed or promoted women's access. Subtle mechanisms of exclusion seem to keep women away from the highest levels of the scientific hierarchy (the so-called "glass ceiling"), as analyzed in other recent sociological studies (Rosser, 2004; de Cheveigné, 2009). That is worrying for what it means in relation to science. As Pnina Abir-Am wrote: "*If ... science cannot bring itself to reject gender stereotypes, how can science use its claim to objectivity to justify its unique epistemological authority in society?*"<sup>7</sup>.

Helga Satzinger (1998, p. 1) also notes: "*In feminist history and philosophy of science of the past few decades, enquiries into the effects of women's presence in the sciences over the last hundred years—which, while not exactly overwhelming, has at least been documented after much research— have been accompanied by hopes of uncovering positive processes of transformation in the sciences. Today, the search is for changes on the level of working conditions and research contents*".

The importance of the organizational context of science for the gender (in)equality in Science has been stressed by Mary Frank Fox in her article "Women, Gender, and Academia" (Fox 2001, p. 663): "*Because science is organizational work, subject to organizational signals, priorities, and rewards, it is important to identify and attend to*

*enabling or disabling features of the settings in which scientists study and work”.*

The stories of these successful women scientists underline the importance of everyday, domestic, private life and social factors that determine the roles. In the future, if we want to increase excellence and innovation, we think it would be necessary to take into account these factors, to underline its importance within the organization of science systems. The structure of science has to be made more attractive, accessible and compatible with the life choices of women and men who build it. In a world that squeaks by the separation between production and human development, the importance of harmonization of these spaces to achieve a full life needs to be highlighted again.

Reflecting on what public policies can learn from this study, we conclude that it is not only needed conciliation between familiar and professional life. We need an integrated model, a holistic paradigm capable of explaining and recognizing how our accomplishments are intertwined with our lives.

## APPENDIX

A brief piece of information (name, field of expertise and workplace) about the nine women scientists who have been interviewed for this project is shown below.

We want to express all of them our gratitude for having so kindly devoted some of their precious time to this task. We are confident that the spontaneity of their memories and the lucidity of their thoughts is a valuable contribution to the advancement of women in science, or, which is the same, the improvement of science as a whole.

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<sup>2</sup> We refer to them with identifying letters to preserve their anonymity

<sup>3</sup> On the division of labor within the couple see: Pycior, Helena M; Slack, Nancy G & Abir-Am, Pnina G (1996) and Helga Satzinger (1998).

<sup>4</sup> The support of the husbands was explained by Pnina Abir-am in the introduction to the series “Lives of Women in Science”. The first volume was precisely “Creative Couples in the Sciences”: “Cross-gender collaborative couples occupy, by definition, a joint public and private space. That means not only a blurring of personal and professional spheres but an expansion of their scientific and social opportunities (...) Because of women are often required to devote disproportionately more time and attention to social affairs, they have less control over their professional time; a husband-collaborator, who benefits from that joint social life, is more likely to tolerate the absences of his collaborator-wife from both home and lab” (p. XI).

<sup>5</sup> The results obtained in our study are not consistent with the results of the report by Jerome Bentley for the National Science Foundation (in Bhattacharjee, 2004).

<sup>6</sup> “Ramón y Cajal” fellowships are for scientists working abroad to come back to Spain.

<sup>7</sup> Series Foreword to Pycior, Slack and Abir-Am, 1996, p. XI.

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