A Gender Study of Principal Investigator lead Public R&D Centres and Funding

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Abstract

To survive and grow public Research and Development (R&D) centres need to raise competitive funds (Bazeley 1998; Lee and Om 1996; Munoz 2007; Santamaria, Brage-Gil and Modrego 2010). The factors that can influence the capacity of national R&D teams within R&D centres to apply for and obtain competitive funding does not seem to have been studied in depth. The purpose of study is to firstly, to examine whether a consistent set of priorities defined by R&D centre lead principal investigators secures more competitive funding. Secondly, to examine whether the PI gender moderates the effect of the PI's priorities on the amount of competitive public funds that the R&D team of the PI obtains. Our study focuses on R&D activities carried out in Spanish public centres in the areas of Health and Biomedicine. Our results found that there were no gender differences in relation to the acquisition of competitive funding which is contrary to findings of other studies (Mayer and Rathmann 2018; Lerchenmueller and Sorenson, 2018).

Keywords: Gender; Principal Investigators; Public funding; R&D

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Introduction

Increasingly, public institutions strive to increase productivity of research funds, fostering research strategies, improving innovation and promoting policies to increase the effectiveness in securing funding (Nielsen 2015; Kaló et al. 2019). From a policy perspective it is essential to ensure that the available funding is appropriately distributed, bearing in mind the needs of society and, the research areas that need to be developed further in order to improve people's quality of life (Gómez-García et al. 2014). For national governments public R&D can realize several benefits such as increasing technological and scientific capacity, further wealth creation through patents, spin off firms and ensuring societal outcomes (Link and Leyden 2016). For public institutions and R&D centres such funding is essential to build sustainable research relationships with stakeholders, to strengthen their existing research capacity as well as developing new scientific knowledge, deepening existing research areas or opening up new research avenues (see Cunningham et al. 2014). For scientists in the PI role securing public funding is essential and critical to furthering their research programmes and sustaining the research teams that depend on them (see Cunningham et al. 2018). As a consequence, to obtain public funding for research has become a highly competitive market (Fang and Casadevall 2015).

Nevertheless, public funds scarcity intensifies the competition between R&D centres and the PIs that lead them. Only those highly competitive projects that can meet and realize several spheres of impact – scientific, economic, societal, technological – secures the necessary funds. This means decreasing the number of projects financed under public R&D programmes (see Muñoz 2007; Kaló et al. 2019). For this reason, the ability to attract funds on a competitive basis is a key factor for the survival of the

research programmes (Wadman 2009) initiated by PIs within R&D centres. This natural selection of R&D projects ensures the most efficient distribution of the R&D public funds. Actually, competitive public funding processes frequently establish some minimum requirements such as on composition and size of the R&D team (Cummings and Kiesler 2014), because funding usually addresses groups rather than individual researchers (Beaudry and Allaoui 2012). It is the scientist in the PI role that leads the response these public funding calls with research programme grant applications and in doing so mobilizes industry and academic partners. The existing literature has highlighted the importance of public funding programmes for research, even though relatively few studies have focused on identifying those factors which contribute to its acquisition (Ebadi and Schiffauerova 2015; Galsworthy and McKee 2013).

The R&D team is defined as "a stable team formed by one or more scientific leaders, several researchers, young people on training internships and technical support personnel, that share technical-scientific goals, resources, infrastructure and equipment, with joint participation in research, development and innovation projects" (CICE 2006). The success of R&D teams in obtaining public competitive funding is influenced by a number of factors, whose better understanding is a key issue both for the public R&D system and R&D team's PI (Kaló et al. 2019; Ebadi and Schiffauerova 2015). One and the other can benefit from this knowledge and can improve opportunities to secure funds. In order to continue to secure competitive funding PIs constantly strategize and are open to collaborate with a range of stakeholders to realize their scientific mission (O'Kane et al. 2015). PIs capture value from public R&D through two value capture mechanisms, boundary spanning and brokering (O'Kane et al. 2020). However, PIs experience ongoing managerial challenges in leadings public R&D

programmes and they learn how to manage and lead on the job as a PI (Cunningham et al. 2014). In essence PIs are managers and need to have know-how capabilities particularly with respect to commercialization and technology transfer (Cunningham et al. 2020). Moreover the PI role demands management capacity –which reflects 'the tacit management know-how' (Zorn et al. 2017, 1491)– and capability –which represents the responsibility to get things done effectively and efficiently (Boardman and Ponomariov 2014) and play a central role when developing certain types of activities in relation to competitive projects (see Barnett 2008; Barreto and Patient 2013; Cho and Hambrick 2006).

One of ongoing challenges scientists have in the PI role is how best to allocate their time in relation to dealing with a range of responsibilities such as research, technology transfer and commercialization (see Cunningham et al 2016). Taking attention-based view of the firm is as Ocasio, (1998) states "what decision-makers do depends on what issues and answers they focus their attention on." Based on this, managers focus their attention on certain issues by observing and interpreting the stimulations present and the environmental features on which they focus and to which they respond (Ocasio 1997). The PI role identify –science networkers, project manager, research contractor and entrepreneurs– as posited by O'Kane et al. (2020) shapes how their decisions on which R&D activities they have to spend their resources on and in doing so they define their priorities. For this reason, it is proposed that their priorities can be one of the factors affecting the efficacy of R&D teams achieving public competitive funds.

Notwithstanding the increase in the number of women in science, gender differences still persists in relation to gender balance and research productivity (West et al. 2013;

Mayer and Rathmann 2018; Beaudry and Larivière 2016). Some studies have found some differences in obtaining public funds when R&D teams' PIs are women (Burns et al. 2019; Hechtman et al. 2018). For example, Burns in a large scale Canadian study the reviewed 55,700 grants involving 4,087 researcher found women 31.1 per cent of grant applications, experienced lower grant success rates and had lower personnel award success. Burns et al. (2019) conclude: 'Gender disparity existed overall in grant and personnel award success rates especially for grants directed to selected research communities. Funding agencies should monitor gender differences in grant success rates by content and explore possible explanations for gender disparity when identified.' Similarly Hechtman et al. (2018) found that women accounted for 31 per cent of grantees of the National Institutes of Health in the US and that they had similar funding longevity compared to men. So not only are we studying the relationship between the priorities that the PIs establish in their R&D teams and the competitive public funds that they obtain, but also the gender effect in this relationship. This also responds to the call to improve gender equality in research fields (Mayer and Rathmann 2018; Burns et al. 2019).

In this study, we have addressed the aforementioned gap in the research by proposing a model which analyse the effects that the priorities established by PI has on the success in obtaining competitive public funds, considering the moderation role of gender. We organize the paper as follow. After this introduction, our literature considerations focus on priorities in the R&D environment and gender differences in submitting and acquiring R&D competitive public funding. Then we develop an exploratory K-means cluster analysis to identify PI profiles in the sample and we also conducted a multiple regression analysis. Then the results are presented. After presenting the conclusion and

discussion is developed, some limitations are presented along with further research avenues.

2. Background literature and research hypothesis

2.1 Priorities in the R&D environment

There is a growing pressure on R&D centres to maintain and grow their research activities, income and human capital. However, they face a constant lack of financial funds and intense competition in obtaining funds has increased (Kaló et al. 2019; Clausen et al. 2012; Nielsen 2016). The capacity and the ability to attract funds to finance their research projects has been highlighted as essential for them to ensure the viability of R&D centres and to foster their future sustainability (Wadman 2009; Cunningham et al. 2014). Obtaining competitive public funds not only rewards the hard work of the research that has been carried out, but also provides the resources needed to continue with present and future lines of research (Larivière et al. 2011). The ability to obtain these funds is related to the number of projects submitted, which in turn will have a positive impact on the final amount of funding they will be able to receive (Burns et al. 2019). Furthermore, as more projects are submitted, more expertise is accumulated in the submission process that can benefit future project submissions. In this sense, those who incorporate past reviewers' recommendations in their next project submissions can enhance their proposal writing skills for funding programmes thereby, they can increase their probabilities of obtaining funds (Ebadi and Schiffauerova 2015).

To attain this level of competitiveness required by funders the priorities of R&D centres need to be clearly established, the objectives to be achieved need to be clearly defined (Ocasio 1997). The unique and particular nature of the research environment makes it

even more important to have clear objectives and priorities for the R&D teams in order to achieve the desired objectives and maintaining the viability of the R&D centre and associated scientific and support personnel (Stock et al. 2014; Zhu and Chen 2016). Furthermore, it influences research development favorably (Shepherd et al. 2017). Taking the attention-based premise (Ocasio 1997), R&D team's PI will establish the set of priorities depending on the competitive funding environment. In this sense, these priorities are designed to enhance the probability of obtaining competitive funding that meets the funders expectations and that are aligned to the current and or future industry and market needs. The creation of priorities can depend on such issues as defining the scale and scope of disciplinary focus, the fields of use for the knowledge created along with the industrial sector setting and end customer application. Such clear priorities can then enable the R&D team to scope out and respond in a focused manner to public competitive funding calls. Moreover, having a consistent set of priorities provides clarity of purpose and focus for the R&D team and certainty overtime. It also not alone the PI but also the R&D team to adapt a proactive strategic posture rather than a reactive one that can lead to poorer outcomes (see O'Kane et al. 2015). Priorities also make it easier for R&D centre researchers and PIs and key stakeholders to be clear about the strategic direction and scope of R&D activities. As long as the PI clearly identifies the priorities of the R&D team in order to achieve the established objectives, it contributes to the process obtaining funding in such a competitive environment as the research environment has become (Bazzoli et al. 2000; Cunningham et al. 2014, O'Kane et al. 2015). By doing this, PIs establish R&D teams' priorities over a specified period of time as part of a proactive strategy that is designed to support the probability of obtaining funding. The PI determines those activities that will be undertaken earlier

than others, establishing an order, and sending a clear message about the activities on which efforts and resources should be focused (Lin et al. 2005).

There are a sparse number of studies that have focused on the factors that determine which teams obtain funding with respect to others (Ebadi and Schiffauerova 2015). Although none have focused on studying the influence that an internally consistent set of priorities defined by PI has over the funding of R&D team projects. So, knowing the priority of the PI will be crucial to a better understanding how R&D teams obtain competitive public funds and what make them different from the others. For that reason, the following hypothesis is proposed:

H1: A more consistent set of priorities defined by PIs, more funds are obtained by competitive public funds.

2.2 Gender differences in submitting and acquiring R&D competitive public funding

Notwithstanding the appearance of similarity in the possibilities for men and women, throughout the literature there is a significant evidence of the difference between them still persists (Burns et al. 2019; Lynn et al. 2019). Even though women representativeness has increased in recent years in science, there are evidences that still deep gender differences remain in a number of spheres as scientific production, career progression, commercialization, number of submission applications and acquiring competitive public funds, or successfully maintaining their line of research (see Bordon et al. 2003; Rose and Dawson 2006; Mayer and Rathmann 2018; Lerchenmueller and Sorenson 2018). All these drawbacks, seriously inhibit the progression of women into more senior positions (Abramo et al. 2015).

From the existing literature, it has been demonstrated that for a female scientist is tougher to get to a leader position, so they have to break through a lot of barriers (Fox 2005; Howe-Walsh and Turnball 2016). Fox (1991) asserted that formal network –institutional support– or/and informal network –interaction with colleagues inside and outside their organisation– affect their likelihood of receiving information about funding processes. Even though, recently it has been suggested that gender inequality has been decreasing (Ceci and Williams 2011), differences still persist if we compare scholarly authorships (West et al. 2012). In some research areas it is even harder, such as science, technology and engineering (West et al. 2012). In some cases, it has been identified *boys club* in these disciplines (Barnard 2009). Thus, gendered cultural within academia go against women progression in particular within science, technology and engineering seniority positions, for instance, the predominance of men among recruiters, selectors and promoters (Howe-Walsh and Turnbull 2016). This reinforces the notion that there is a need for role models in which women can be identified (Ecklund et al. 2012; Stout et al. 2015).

Previous studies have highlighted lower presence of women in peer-review journals which inhibits them from making the requisite advancement in their scientific career to achieve the necessary prestige (West et al. 2013; Mayer and Rathmann 2018). Moreover, becoming a project PI and managing R&D teams is seen as a prestigious scholarship standing indicator and a milestone achievement in a professional career (Cunningham et al. 2014). There are more male PIs than female PIs, in some cases this difference reaches 20% (see Bornmann et al. 2007; Lerchenmueller and Sorenson 2018).

There are academic career differences in accessing and developing their academic careers (Ding et al. 2006; Probert 2005; Leahey et al. 2008). Moreover, Cunningham et al. (2017, 239) found that gender differences among PIs: ‘with respect to commercial experiences, sources of funding, numbers of projects and career planning’ and male PI had secured more international funding than women PIs. Previous studies have also found the level of specialization, the research collaborations and the limitations associated with the pivotal role of women in the family unit as causes of gender difference in scientific productivity and academic career progression (Fox 2005; Leahey 2006; Abramo et al. 2013). Witteman et al. (2019) suggested three main ideas to explain the reasons why women are poorly evaluated than men when they submit for competitive public funds: reviewers' subjective evaluations, the unfairly evaluations favouring male PIs and less compellingly applications.

Despite these gender differences and inhibitors found in previous studies, the success rate of women and men acquiring funds is similar, although men submitted much more applications than women (van den Besselaar and Sandström 2017). Nevertheless, there are no studies that have investigated the moderating effect of gender on the impact of the R&D teams’ PI priorities in obtaining competitive public funding. Being able to obtain competitive public funds is one of the requirements academic career progession (West et al. 2013). Therefore, women who want to develop a career and aspire to be promoted to senior positions must demonstrate their ability doing it (Howe-Walsh and Turnbull 2016). Even though, in literature there is a majority of researchers who posit that there are disadvantages for women (Head et al. 2013; Witteman et al. 2019), some other researchers state that women in PI roles achieve similar results. In this case, the

difference is in number of competitive public funding submissions (van den Besselaar and Sandström 2017; Sotudeh and Khoshian 2014; Ceci et al. 2014). In this study, we address Burns' call (2019) to find an explanation for the gender gap in the acquisition of competitive public funds, examining the moderating effect of gender on the relationship between the R&D team's PI priorities and the funds obtained. So, we propose the following hypothesis:

H2: The PI gender moderates the effect of the PI's priorities on the amount of competitive public funds that the R&D team of the PI obtains.

3. Methodology

3.1 Background, Data and Sample

The study was conducted in R&D teams of Spanish R&D public centres which research is focused in the areas of Biomedicine and Health. In the Spanish context, during the process of submitting funding applications R&D teams can rely on Research Management Office. Actually, one of the most common functions of Research Management Offices is to support R&D teams in the process of searching for funding sources. Furthermore, they offer advice on the verification of funding applications. In addition, not only do they provide support in the process of submitting applications to the relevant funding agencies, but also in the reception and acceptance processes. Therefore, even though they review the formal aspects of the submitting applications, they do not review the quality of the proposal (Red OTRI de universidades). Furthermore, in Spain the directors of the research centres, where the R&D teams are, do not review the quality of the proposal either. One reason for this is because in many cases they are not experts in all fields, and another is that in many cases they are

designated by political rather than scientific criteria. Nevertheless, there are many authors that disagree with the benefits proclaimed by Research Management Offices, and define them in some cases as hampers in these processes, in which they should be facilitators (Siegel et al. 2004; Grimaldi et al. 2011; Belitski et al. 2019).

Several secondary sources of information were considered to identify the population. Our study was limited to those R&D teams who had applied for competitive funding projects from national or international programmes from 2011 to 2016. In this period of time, there were not any kind of dedicated equality support for female scientists in the PI role, in the Spanish context –national or regional level– (European Regional Development Fund 2017). The resulted list of R&D public centres was consulted to a panel of experts from the ISCIII European Office and the European Office of the Spanish Ministry of Economy, Industry and Competitiveness through the Secretary of State for Research, Development and Innovation (SGCTI) to evaluate its suitability and relevance. They agree with the final list, and they also recommended to include some other important R&D centres and associated PIs to the population list. Therefore, the population is comprised of 68 Spanish R&D public centres. We sent e-mails to the whole population. In fact, emails were sent to every single director of the 68 R&D public centres. In the email we explained in detail the procedure we planned for collecting the data and requested her/him to inform each of the R&D teams' PIs that existed in her/his centre that we would be contacting them. Finally, we received answered questionnaires from a total of 47 R&D public centres (69,11%). In these R&D public centres are 128 R&D team's PIs. We received valid answered questionnaire from a total of 97 R&D team's PIs (75,78%), where 23,71% are women. Therefore, the final

sample is comprised of 97 R&D team's PIs which research is focused in Biomedicine and Health areas.

Previous to sending the questionnaire, a pre-test analysis was developed. A draft questionnaire was sent to a group of experts in the fields of Biomedicine and Health and Management Research. This allowed us to review some typo and rewrite some information on the presentation of the questionnaire. Then the questionnaire was sent to the target population through the SocialSci platform to be answered directly through its online platform. A total of 128 answered questionnaires of the R&D teams' PIs were received. The questionnaire included some demographic questions both of PI such as gender, experience (years in PI position) and of the R&D team like size. Experience of the PI, which was measured by the number of years in an R&D team's PI position; and the size of the R&D team, which was measured by the number of members who comprise the R&D team, were utilized as control variables. Also, a seventeen-items scale of five-point likert scale by Clausen et al. (2012) was included asking in order to identified R&D team's PI priorities (Table 1). The dependent variable in this study is national competitive public fund which is measured by the amount of public competitive funds that the R&D teams of the PIs obtained from national calls.

<Insert Table 1 about here>

3.2 Method 1: Cluster analysis

For our analysis, a K-means cluster analysis was developed to identify the different PI profiles. Previously a hierarchical cluster analysis was carried (Ketchen and Shook 1996) to determine the number of profiles depending on the sample. Based on the

resulting dendrogram two profiles were the most accurate number of profiles for this sample. After developing a K-means cluster analysis, two different profiles of PIs were identified with 41 and 56 cases each that were based on the priorities that the PIs chose. ANOVA indicated that all items were significant for clustering except one 'to get higher long-term financing associated to projects' (Table 2).

<Insert Table 2 about here>

3.3 Method 2: Multiple Regression Analysis

A new variable was defined to capture belonging of respondents to a profile 1 - *Supporting and Empowering R&D Focused PIs* or 2 – *Prioritized R&D Team Focused PI*, which we termed based on our analysis. Multiple regression analysis was utilized to check the hypotheses. Three models were estimated. Model 1 only contain the effect of the control variables (experience of the PI and size of the team) on the national competitive public funds acquired. In the Model 2 and Model 3 the two hypotheses were tested. In Table 3 are represented the descriptive statistics –minimum and maximum values, means and standard deviations– and the correlation matrix of variables of the proposed model. Multiple regression analysis runs fine when independent variables have weak correlations, as is the case in this study, where the variance inflation factor (VIF) of all independent variables are close to 1. Therefore, it does not exist a problem of multicollinearity (Stock and Watson 2015; Greene 2000). Having applied the Welch and Brown-Forsythe test, it is confirmed that there is a relationship between all the variables in the model, even though the standard errors are robust for heteroscedasticity (Vallejo y Ato 2012)

<Insert Table 3 about here>

4. Analysis

Supporting and Empowering R&D Team Focused PIs is comprised of 41 R&D team's PIs. Just 7 out of 41 are women, thus 17% of this profile are female PIs. They are those PIs that have ranked each of the priorities with the lowest average scores of the sample. This group represents a profile of PIs who are aware of supporting and empowering the R&D team, but it is not such a priority. They demonstrate a moderated intensity in priorities towards achieving competitive public funds. For them attracting good researchers and retaining them by improving employment opportunities are the two most valued priorities, but not as high as in prioritized R&D team focused PI profile. As in prioritized R&D team focused PI profile, the group ranked 6 priorities the same, although in a different order and with a difference of one point between the averages of the scores (Table 4). Therefore, we have considered that the PIs comprising this group are aware that they should support and enhance the R&D team, but not what they focus on most.

Prioritized R&D Team Focused PI profile is comprised of 56 R&D team's PIs. About 17 out of 56 are women, thus 30% of this profile are female PIs, almost the double than profile 1. PIs within this group present a profile that demonstrates an intense focus in supporting and empowering the R&D team. They are those PIs that have valued each of the priorities with the highest average scores of the sample. These PIs demonstrate a higher intensity in priorities towards achieving competitive public funds. In this case, the set priorities with the highest average score are also those oriented to strengthening the resources of the R&D team, but with a higher average of the scores. For instance,

the two most valued priorities are focused on supporting and fostering the R&D team's human resources. The first of them refers to attracting good researchers and the other to retaining them, both of which are basic principles in HR policies (Nyberg et al. 2018).

<Insert Table 4 about here>

From the following six most valued priorities, five are variables that are highly valued in the assessment processes to achieve competitive public funding. These are scientific production variables such as, number of publications and applicability of research project results. Moreover, improving international collaborations and collaborations with industry are key to obtain public competitive funds (Beaudry and Allaoui 2012; Ebadi and Schiffauerova 2015). In addition, another variable is to develop a better scientific programme, which indirectly has a positive effect on the quality and consistence of the submissions.

<Insert Figure 2 about here>

As Table 5 depict hypothesis 1 is supported, but it is not the same with hypothesis 2. Contrary to expected H2, the PI gender does not moderate the effect of the PI's priorities on the amount of competitive public funds that the R&D team of the PI obtains. The estimation of the third model was not significant. This result is contrary to the extended idea that there is a gender difference in acquiring competitive public funds (Mayer and Rathmann 2018; Lynn et al. 2019).

<Insert Table 5 about here>

5. Discussion

In the career of PIs acquiring competitive public funding has become an essential feature (Kaló et al. 2019; Larivière et al. 2011). Because obtaining funding is crucial in the promotion process to higher career positions of the scientists in the PI role. Previous empirical studies found gender differences persists in acquiring competitive public funds (Mayer and Rathmann 2018; Lerchenmueller and Sorenson 2018), hence our study was to analyse gender differences in the process of obtaining funds. Therefore, it is important to understand the factors that influence on the amount of funds that PIs of the R&D teams acquire, as well as knowing the moderating effect of gender on this relationship (Ebadi and Schiffauerova 2015).

There are few studies in the literature so far which have focused on the factors that can demonstrate the acquisition of competitive public funds (see Kaló et al. 2019; Ebadi and Schiffauerova 2015; Galsworthy and McKee 2013). This study proposes a new factor that explains it based on the attention-based theory (Li et al. 2010). From an exploratory cluster analysis, two different profiles of R&D teams' PIs establishing priorities of their teams were defined. This identification of the different profiles of the PIs contributes to clarify the influence that priority setting has on the amount of competitive public funding, which is crucial in the career progress of the PIs and on the survival of the R&D team (Wadman 2009; West et al. 2013).

We approached this theme by studying the relationship between the priorities of R&D teams' PIs and the amount of competitive public funding obtained by those PIs, in a sample of R&D teams in the fields of Biomedicine and Health Sciences from Spanish

R&D public centres. Results have revealed that those R&D teams' PIs who, through the establishment of their priorities, have an intense focus on supporting and empowering the R&D team will obtain a greater amount of national competitive public funds. However, as the priorities of the R&D teams' PIs become less focused on supporting and empowering the R&D team, the number of national competitive public funds will decrease. Therefore, the hypothesis 1 is supported (Table 5). From the cluster analysis we can conclude that the profile in which there is the highest female representation –actually the prioritized R&D team focused PI profile it is almost double that of supporting and empowering R&D team focused PI, 30% versus 17% respectively– is the one where exists an intensity of priorities more ambitious and determinate to improve R&D teams' opportunities of achieving more competitive public funds. Therefore, prioritized R&D team focused PI profile is more successful obtaining funding in national calls.

Moreover, it is interesting to reflect on the difference between the experience average of the profiles and its average of the sample. In prioritized R&D team focused PI profile the average number of years in the same position is lower than the sample average. Surprisingly, something that may seem negative at first and according to Ebadi and Schiffauerova (2015), in this case we observe that it is not. This may be the result of a new vision of how an R&D team should be managed, renewed strength or the enthusiasm for reaching a needed objective in their career progress (Robson, Schlegelmilch and Bojkowszky 2012). This is the opposite for supporting and empowering R&D team focused PIs where the average experience is higher than the sample average. It might be because this profile is mainly comprised of PIs who have already reached the desired career level and they are in their later stages of their careers,

so their ambitions have been already fulfilled (Robson et al. 2012). Therefore, their efforts in the acquiring competitive public funds are decreasing and focusing on other types of priorities. The variable measuring the size of the R&D teams is significant and positively related to competitive public funds acquire. This result can be explained by the fact that with more people on the team, there is a higher probability of submissions for national public competitive funds, and their subsequent obtainment (Burns et al. 2019).

Even though, the representation of women in higher education in the last few years has increased (Mayer and Rathmann 2018) and the number of female and male scientists are almost similar (Spanish Universities Rectors Conference 2017). In our sample female PIs are underrepresented in comparison to male colleagues so, there is a structural underrepresentation of female PIs. This is not uncommon and similar to what Cunningham et al. (2020) of their large-scale study of PIs that successfully secured EC structural funding. Unfortunately, this ratio is more common than it should be (Howe-Walsh and Turnbull 2016; Lerchenmueller and Sorenson 2018).

Nevertheless, the study does not demonstrate the moderate effect of gender differences in the relationship of the model proposed (Figure 1), in our sample, most female PIs are committed to establish an intense focus of priorities oriented towards improving the R&D team to enhance their chances of obtaining more competitive public funds. That profile is more efficient than the first one. These results lead us to assume that although hypothesis 2 has not been supported, it is necessary a further understanding of gender differences.

6 Conclusions and Implications

Based on the results we can conclude that the priorities established by PI's in their R&D teams have a positive influence on the acquisition of competitive public funding and that the PI profile that is most efficient in achieving these objectives – prioritized R&D team focused PI profile is where there is a greater female presence. Furthermore, we can also conclude that gender does not have a moderating effect on the relationship priorities of the R&D teams' PIs and the amount of public competitive funds that the R&D teams of the PIs obtained from national calls. Even though there is not a gender moderating effect in the relationship between PI's priorities and the amount of competitive public funds that the R&D team of the PI obtains, one may conclude that although in absolute numbers men are able to submit more applications for national public funding, women obtain the same success percentage when submitting in relative terms. Thus, when they reach the position of PI of an R&D team they are as successful as men can be. One might even say that they are more efficient, because although they present fewer applications and accumulate less experience in these processes, they are still able to achieve the same success rate (van den Besselaar and Sandström 2017).

Therefore, it might not be so much a question of the quality of the application submitted, but a question of the capacity to lead teams able to submit a higher number of proposals and about the knowledge of these competitive public funding applications, and the composition of their network and relevant sources of information (Whittington and Smith-Doerr 2005; Lutter 2015; Woehler et al 2020). This might be explained on the basis that the quality of the projects submitted may not differ in terms of gender, but there are still some obstacles in the race to reach PI positions for women (Grimaldi et al. 2011; Belitski et al. 2019). In this sense, women are at a disadvantage compared to

men, which slows them down and often even prevents them from reaching for higher career positions, such as PI roles (Lutter 2015). Moreover, since many decision panels and managerial levels have a higher percentage of men than women, it does not benefit their progression in the academic career (Lutter 2015; Howe-walsh and Turnbull 2016). Nevertheless, it remains interesting that there is an underrepresentation of females in PI roles, while the percentages of men and women among researchers are much more balanced, especially in certain knowledge areas such as health research.

Our research is not without limitations given the narrow scope of this study. One of the limitations is related to the self-reporting bias with both of the variables involved in the proposed model: priorities of the R&D teams' PIs and the amount of public competitive funds that the R&D teams of the PIs obtained from national calls. However, in all cases we asked, in a complementary survey to the Research Management Office representatives, about the number of total projects submitted and achieved by each research center, and the data is consistent with the numbers and percentages of success reported by the PIs. In any case, future studies might ask to the co-PIs or the director of the R&D department to assess the former variable and might ask for corroboration of the latter variable, such as a confirmation of the amount of public competitive funds that the R&D teams of the PIs obtained from national calls. Another limitation is related to the size of the studied population. Even though the Spanish R&D public centres of the fields of Biomedicine and Health Sciences were chosen because research in this area is frequently considered to demonstrate how knowledge is produced and often leads to important results in research policy, the population is not as large as would be desirable. An additional limitation is the contextual and constraints characteristics of the Spanish public research system. Defining our dependent variable as the amount of

public competitive funds that the R&D teams of the PIs obtained from national calls is another limitation, because we are limiting the effect of the priorities of the R&D teams' PIs to that specific competitive public funding. However, all public research centers in Spain pay a lot of attention to the national research program, and all of them apply regularly to these funding calls, and consequently we think that this measure may be a good indicator of the proactivity and efficiency of research teams in terms of getting funds for research.

Since the difference between the two profiles was the intensity in which PIs determined each of the different priorities, it offers the possibility of broaden the investigation of the factors that influence the acquisition of competitive public funds from a gender perspective. Therefore, a possible future research can be based on the self-determination theory, since the contextual characteristics and individual differences of each of the PIs from a gender perspective and their motivations can be factors that influence to increase the competitive public funding obtained (Dewett 2007; Harris 2019). Future research should be focused on widening the range of financing instruments as well as including international competitive public funding calls. It could be interesting to study the influence on the acquisition of competitive public funds of the relational capital of the PIs within their R&D team members, with R&D team's members of other areas and also with the research management office's members and manager who manage their funds submission. Does gender influence matter? Studying the direct effect of gender of the R&D team's PI on the amount of public competitive funds that the R&D teams obtained is an interesting future research line (Sotck and Watson 2015).

Another limitation might be that gender may include internal elements that may overlap the actual effect. It would have to be considered whether or not, on a contingent basis, there is gender discrimination, and therefore whether or not the same results are obtained. In our research we have not asked for contingent circumstances of the PI –for example, cultural circumstances, family circumstances, surrounding circumstances–, in order to compare whether these issues explain the differences in funding results instead of the gender itself. However, differences in the roles assumed by men and women in all occidental societies are still different and these aspects have been frequently documented as factors that hinder the possibilities for women to develop a more successful professional career in comparison with men (Ely et al. 2014). Hence, a future line of research could be to undertake a more in-depth study on the contextual differences between genders, which would capture that information and allow for a broader analysis.

Finally, our study raises an important issue for policy makers in relation to the under representation of women PIs being in a position to compete for and ultimately secure public funding for large scale research programmes. New support and funding instruments, different career and funding evaluation criteria and other appropriate equality and diversity measures need to be considered by policy makers in the design of public research programmes. Our study clearly demonstrates that there is not a moderating effect of gender in the relationship between priorities of the R&D teams' PIs and the amount of public competitive funds that the R&D teams of the PIs obtained from national calls and since women PIs are in position to acquire public competitive funding they can be as successful as male PIs, which is contrary to what Mayer and Rathmann (2018) and Lerchenmueller and Sorenson (2018) found in their studies.

However, the ongoing challenges is a systemic one that requires proactive measures and policies to deal effectively with women under representation and to ensure as Link (2017, 2) succinctly notes so to: 'ensure opportunities for underrepresented minorities and women in the entrepreneurial ecosystem.'

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Table 1. Priorities of the R&D teams' PIs.

To get higher long-term financing associated to projects.
To get more basal funds not coming from national or international projects
To increase the number of international scientific publications
To attract good researchers
To improve the international collaborations
To develop a better scientific program
To get more support from the CEO and TMT
To improve the scientific leadership of the R&D area
To achieve better support from the policy makers institutions
To improve the researchers' employment opportunities
To increase collaborations with industry
To develop education & training programmes
To get practical and applicable results from the developed research projects
To get more support from other R&D areas
To improve the research culture of the area and the centre
To increase the support from other local or regional R&D areas
To face communication or collaboration internal problems

Source: Clausen et al. (2012)

Table 2. Cluster analysis

GROUPING VARIABLES	ANOVA	
	F	Sig.
To get higher long-term financing associated to projects	3,901	0,051
To increase the number of international scientific publications	14,018	0,000
To attract good researchers	21,134	0,000
To improve the international collaborations	11,612	0,001
To get more basal funds not coming from national or international projects	44,49	0,000
To develop a better scientific programme	53,411	0,000
To get more support from the CEO and TMT	29,392	0,000
To improve the scientific leadership of the R&D area	23,307	0,000
To achieve better support from the policy makers institutions	27,742	0,000
To improve the researcher's employment opportunities	22,838	0,000
To increase collaborations with industry	24,625	0,000
To develop education & training programmes	36,252	0,000
To get practical and applicable results from the developed research projects	52,159	0,000
To get more support from other R&D areas	44,649	0,000
To improve the research culture of the area and the centre	40,287	0,000
To increase the support from other local or regional R&D areas	49,629	0,000
To face communication or collaboration internal problems	26,529	0,000

Table 3. Descriptive statistics and correlation matrix

	Variable	Min	Max	Mean	SD	1	2	3	4	5
1	National Competitive Public Funds (dependent variable)	0	4	2,180	1,211	1				
2	Experience of the PI (control variable)	1	3	1,990	0,777	0,028	1			
3	Size of the Team (control variable)	0,69	5,71	2,689	1,269	0,644**	0,163	1		
4	Profiles	1	2	1,58	0,497	0,284*	-0,205	0,074	1	
5	Gender of the PI	0	1	0,75	0,434	-0,08	-0,034	0,12	0,015	1

** Correlation is significant at the 0.01 level; * Correlation is significant at the 0.05 level

Table 4. Cluster Supporting and Empowering R&D Team Focused PIs and

Prioritized R&D Team Focused PIs

GROUPING VARIABLES	Supporting and Empowering R&D Team Focused PIs (Means)	Prioritized R&D Team Focused PIs (Means)
To get higher long-term financing associated to projects	4,71	4,89
To increase the number of international scientific publications	3,66	4,37
To attract good researchers	3,63	4,59
To improve the international collaborations	4,1	4,7
To get more basal funds not coming from national or international projects	3,56	4,62
To develop a better scientific programme	3,37	4,61
To get more support from the CEO and TMT	2,73	3,95
To improve the scientific leadership of the R&D area	3,05	4,09
To achieve better support from the policy makers institutions	3	4,11
To improve the researcher's employment opportunities	3,95	4,71
To increase collaborations with industry	3,24	4,18
To develop education & training programmes	2,56	3,73
To get practical and applicable results from the developed research projects	3,41	4,61
To get more support from other R&D areas	2,71	3,95
To improve the research culture of the area and the centre	2,63	3,84
To increase the support from other local or regional R&D areas	2,51	3,84
To face communication or collaboration internal problems	2,17	3,38

Table 5. Results of multiple regression analysis

Variables	Model 1		Model 2		Model 3	
Constant		(0,37)		(0,543)		(0,536)
Experience of the PI (control variable)	-0,079	(0,158)	-0,028	(0,156)	-0,048	(0,155)
Size of the Team (control variable)	0,657***	(0,091)	0,631***	(0,088)	0,651***	(0,088)
Profiles			0,232*	(0,23)	0,313*	(0,256)
Profiles x Gender of the PI					-0,175	(0,158)
R^2	0,421		0,472		0,494	
Durbin-Watson					2,203	
Overall F	24,342***		19,645***		15,872***	

N= 70. Standardized regression coefficients are report, standard errors are in parentheses. *p < 0.05, ** p < 0.01, *** p < 0.001

Figure 1. Model proposed.

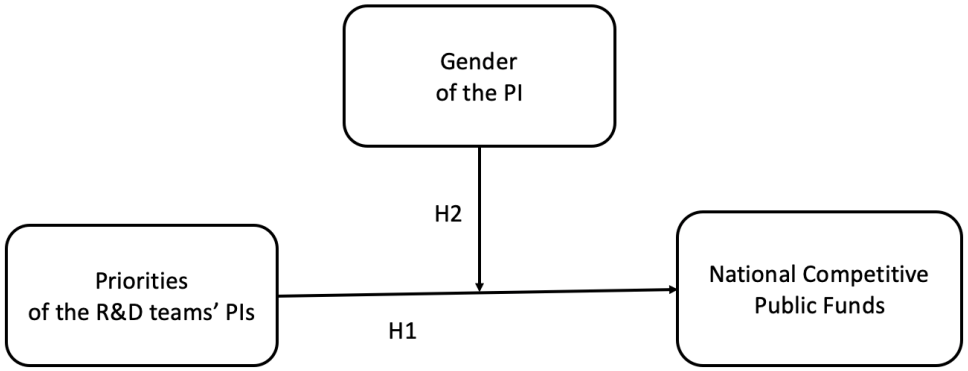
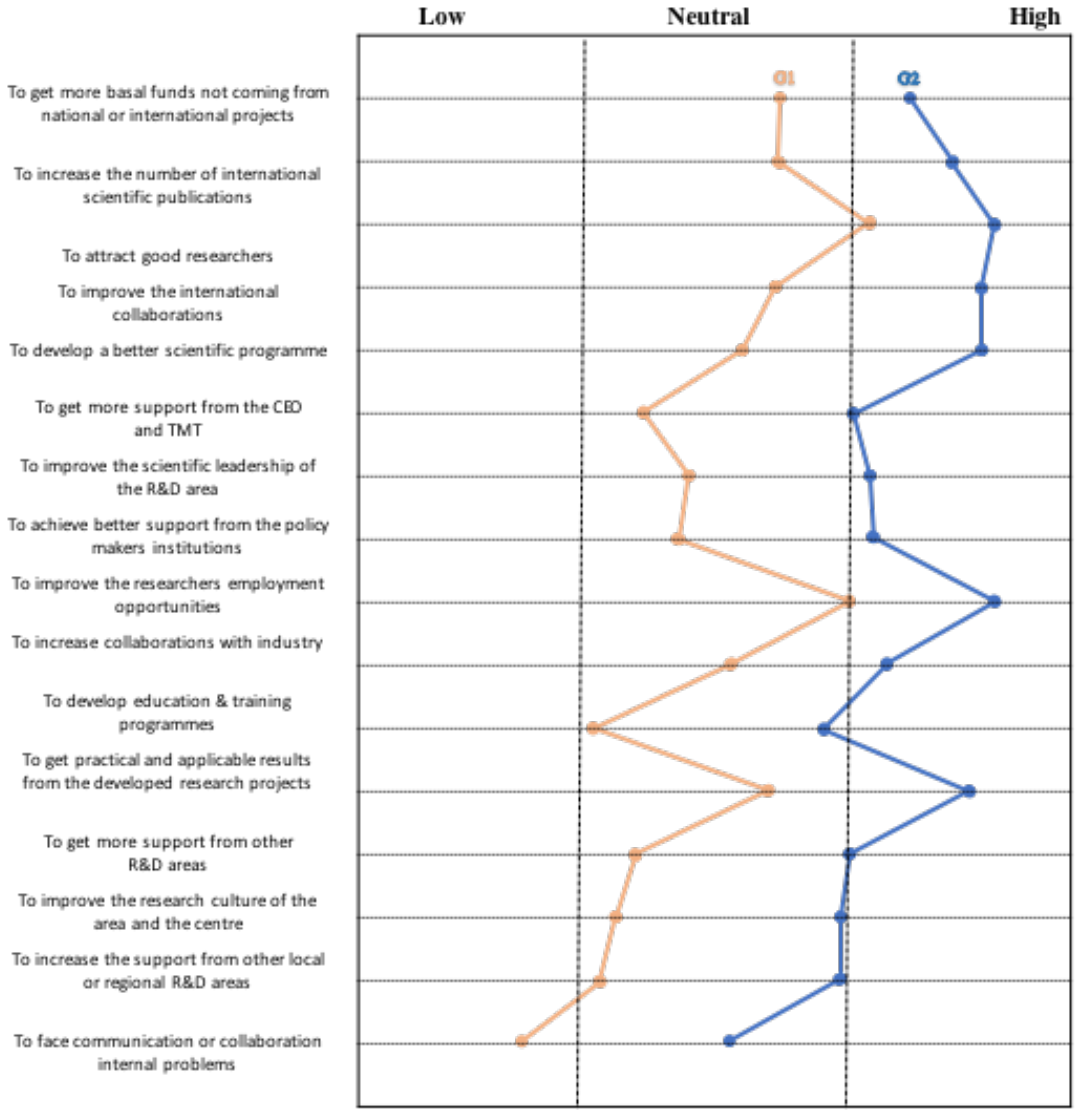


Figure 2. R&D team's PIs profiles.



G1: Supporting and Empowering R&D Team Focused PIs. G2: Prioritized R&D Team Focused PIs