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PREDICTORS OF KNOWLEDGE CREATION PERFORMANCE. A QUANTITATIVE QUALITATIVE COMPARATIVE STUDY OF EUROPEAN DOCTORANDI

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PREDICTORS OF KNOWLEDGE CREATION PERFORMANCE.

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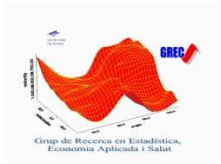

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The presentation of the Doctoral Thesis entitled "Predictors of Knowledge Creation Performance. A Quantitative Qualitative Comparative Study of European Doctorandi", written by Mrs. **Aina Maria Capó Artigues**, under our supervision and delivered in order to obtain the doctoral degree by the University of Girona.

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To finish, I would like to highlight that all chapters contain substantial results that have been presented at international conferences or published in international peer reviewed journals, as explained below:

Chapter 2: Survey Design for Comparing Performance across countries**.** Design and Evaluation of a Web Survey for Social Network Data. Is published in Loosveldt, G., Swyngedouw, M. and Cambré, B. (Eds), *Measuring Meaningful Data in Social Research*. ACCO, Leuven, 233-256.

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Chapter 5: Egocentered Networks of PhD Students and Academic Performance: A Comparison between Spain, Slovenia and Germany was presented at the 2nd European Survey Research Association (ESRA'07) in Prague in June 2007.

Chapter 7: Qualitative study was presented at the Applied Statistics International Conference in Ribno (Slovenia) in September 2007.

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Chapter 1

INTRODUCTION

1.1 Objective and structure of the dissertation

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1.4 Organization of PhD studies in different countries

1.1 Objective and structure of the dissertation

This thesis belongs to a wider project designed to predict PhD students' academic performance carried out by the INSOC (International Network on Social Capital and Performance). The INSOC research group is composed by the universities of Girona (Spain), Ljubljana (Slovenia), Giessen (Germany) and Ghent (Belgium).

The first aim of this thesis is to develop quantitative comparative analyses about the PhD students' academic performance across Spain, Slovenia and Germany from the individual academic performance results obtained in each university member. The international nature of the research group implies that we strongly emphasize comparative research. We use together background variables, attitudinal variables and social network variables for predicting performance. The second aim of this thesis is to qualitatively understand why network variables fail to quantitatively predict performance in the University of Girona (Spain). Thus, this thesis fit into the multimethod tradition.

In order to achieve these objectives we address in order the following issues:

In Chapter 1, we define concepts related with performance and we give a list of each of the independent variables (social network, background and attitudinal variables) with a literature summary. Finally, we explain how PhD studies are organaized in the different countries.

Drawing from these theoretical explanations, in the next chapters we first present the questionnaires used in Spain, Slovenia and Germany to measure these different types of variables. Then, we compare the variables which are relevant in order to predict PhD student performance in each country. After that, we fit alternative regression models to predict performance across countries. In all these models network variables fail to predict performance in the University of Girona. Finally, we use a qualitative study to understand this unexpected result.

In Chapter 2, we explain how we designed and conducted a survey in the different countries with the aim of explaining the PhD students' performance obtained in Spain, Slovenia and Germany.

In Chapter 3, we create comparable indicators wherever some comparability problems arose with particular questions in Spain, Slovenia and Germany. In this chapter we explain how we used all three countries' variables in order to create comparable indicators. This step is very important because the main goal of the INSOC research group is to compare the PhD student's performance between the different countries.

In Chapter 4 we compare regression models obtained to predict PhD students' academic performance in the universities of Girona (Spain) and Slovenia. Explanatory variables are characteristics of PhD student's research group understood as an egocentered social network, background and attitudinal characteristics of the PhD students and some characteristics of the supervisors. We find that egocentered network variables do not predict performance in the University of Girona.

In Chapter 5 we compare the Slovenian, Spanish and German data, following the methodology used in Chapter 4. We conclude that the German case is very different. Predictive power of network variables does not improve.

In Chapter 6 the PhD student's research group is understood as a duocentered social network (Coromina et al., 2008), in order to obtain information regarding the mutual relationship between PhD students and their supervisor and the ties of both to their alters in the network. The inclusion of duocentered network variables does not improve the predictive power of the regression model using egocentered network variables.

Chapter 7 attempts to understand why networks fail to predict performance in the University of Girona. Using the mixed method approach, we expect that a qualitative study can uncover the reasons why the quality of the networks fails to translate into the quality of the students' work. For data collection in the qualitative research we used in-depth interviews.

Finally, in Chapter 8 we summarize the conclusions of this thesis.

1.2 Creative knowledge environment

In this section we want to understand how PhD students use their creativity or knowledge production ability to improve their performance. Because of that, we analyse what constitutes a "creative knowledge environment" and how this might be stimulated or improved. The aim of this section is to explain how important the group are members in order to create a good environment for others, since most creative work involves interaction or even collaboration with other people.

First at all, we follow the definition of Hemlin et al., (2004) on creative knowledge creation environments as "those environments, contexts and surroundings the characteristics of which are such that they exert a positive influence on human beings engaged in creative work aiming to produce new knowledge or innovations, whether they work individually or in teams, within a single organization or in collaboration with others."

The university knowledge creation environment, which is of our interest, differs from the industrial knowledge creation environment in several ways. The most important difference is that in the university context, researchers need to publish in scientific journals, while in the industries; they need to improve the profits. Another difference is that most university researchers carry out other activities besides research (in particular, teaching and administration) whereas researchers in industry are involved only in research activities. University and industrial knowledge creation environment are also heterogeneous within themselves. Different types of disciplines (for example, natural sciences and social sciences) require different knowledge creation environments. Thus, different disciplines have different cognitive and social styles (Becher, 1989; and Whitley, 1984). This means that the nature of innovation (Laudan and Laudan, 1989) and the assessment of what is "creative" vary, for example, between natural sciences and social sciences.

A third type of knowledge production context is the government or public sector. The conditions for knowledge creation environments may be quite different in this area compared with those in academia and industry. Knowledge production in the public sector is aimed at an improvement in the living conditions and welfare of the population as well as at the development and effectiveness of public organizations.

A number of empirical studies have been carried out to identify the main factors influencing the performance of research groups in universities and other public research organizations and in private R&D laboratories (Andrews, 1979; Bland and Ruffin, 1992; Martin and Skea, 1992; Pelz and Andrews, 1966; and Stankiewicz, 1980). Hemlin et al., (2004) grouped them in categories. First, individual researchers and their characteristics are important to research performance. Second, a successful research environment must possess a certain sufficient level of basic resources as well as a participative and collegial management and working style. Finally, a creative knowledge environment has specific psychological and organizational characteristics.

1.2.1 The role of individuals

Individuals are perhaps the main components of creative knowledge environments. Without them no knowledge would be produced and creativity would not exist. Hemlin et al., (2004) say that "creativity is enhanced in environments where individual autonomy is stimulated (but only to a certain degree and often when linked to a collective goal), where individuals are left alone to fulfil tasks that are not done better in a group (for instance, brainstorming is enhanced by letting individuals prepare ideas alone before meeting to brainstorm in comparison to letting groups of individuals meet directly to brainstorm together; see Paulus and Yang, 2000)".

There are a number of studies that have attempted to identify the crucial personal characteristics of the successful and creative researcher (see Hemlin, 1996; and Simonton, 2003). A study by Hirschberg and Itkin (1978) showed that PhD students who produce research publications (this being taken as a measure of success) are more brillant, achieving, enduring, committed to the field and skilled in research than other PhD students who do not publish. Similarly a study by Rushton et al., (1983), focusing on university professors, concluded that the creative professor is ambitious, energetic and enduring, looks for clarity, is dominant, shows leadership, exhibits independence and is aggressive but not meek or particularly supportive of others.

Rushton et al., (1983) found that motivation; ambition and achievement are important factors in predicting who will be a successful and creative researcher. As a result it can be conclude that the selection of individuals with those personal characteristics might conduct to creativity. Also the personal characteristics found to be associated with creativity may be fostered by the environments in which the individual act. For example, at least some of these characteristics, such as the tendency to work hard, could be enhanced by providing the members of knowledge-intensive groups with appropriate reward structures.

Kaperon (1978) found that personal characteristics do not explain success among academic and industrial researchers. Instead he concluded that creativity on the part of researchers is linked to patterns of information use.

1.2.2 The role of groups

In general, creativity involves interactions between one or more individuals (for instance, interactions between their respective talents and abilities), situations (for example, in meetings between individuals), contexts (for instance, supportive and encouraging circumstances), processes (for example, processes creating a certain amount of constructive tension), products (for instance, a revolutionary scientific article or technology) and evaluators (who assess whether something is creative or not) over different time periods (in which creative acts may happen more or less frequently) (Hemlin et al., 2004).

Autonomy is often named as a basic characteristic of good research units, in addition to a "loose organizational structure" (Pelz and Andrews, 1966; and Premfors, 1986). It can be expected that researchers do not like "burocracy", particulary if it takes time away from the research activities (Spangenberg et al., 1990; and Martin and Skea, 1992). However a strong focus on individual autonomy has also been described as low-rated university departments (Andrews, 1979; and Bennich-Björkman, 1997) and poorly performing industrial and governamental R&D project units (Kim and Lee, 1995). In high performance units, autonomy is coupled with a common vision, strong

group cohesiveness, active supportive leadership, and an unusually high degree of interaction or external pressure (Pelz and Andrews, 1966; Kim and Lee, 1995; and Bennich-Björkman, 1997). Amabile (1988) found that good project management, sufficient resources, encouragement, recognition, a climate marked by collaboration and a certain degree of pressure can be beneficial to creativity. Amabile (1988) also found that individual traits are principal to creativity, but process of selection of relatively creative individuals for certain types of jobs (like research) implies that organizational factors may still account for much of the difference in creative output.

Hemlin et al., 2004, said that collaboration among researchers is a crucial component for enhancing creativity in knowledge environments. The ability to draw on different cognitive and organizational backgrounds in networks of collaborating researchers is often critical in promoting creativity. The fact that interaction with researchers from different background is likely to promote creativity is one reason for collaborating. Thus, collaboration with other groups is a strong positive contribution to creative knowledge environments, yet collaboration takes time and effort to develop and manage (Katz and Martin, 1997). Wilke and Kaplan (2001) showed that one explanation for the lower productivity found when using the technique of "brainstorming", as compared with nominal groups consisting of individuals working independently of one another, is that listening to others may cause group members to forget their own ideas or hinder individuals' own reflections (see also Paulus and Yang, 2000). At the same time, interaction with other disciplines can be very important for creativity (Alwood and Bärmark, 1999).

Group characteristics such as the size of the group, the leadership style, the degree of tension or harmony, and the heterogeneity or homogeneity of group members are potential influences on creativity (Unsworth and Parker, 2003; Anderson, 1992; and King and Anderson, 1995). The heterogeneity of group members in terms of a number of cognitive and social parameters in groups is generally beneficial. In particular, a variety of expertise is often necessary to ensure creativity. Groups including members from different cultural or disciplinary backgrounds tend to be more creative than groups with members sharing a more homogeneous background. In addition, a lively and outspoken minority is likely to facilitate group creativity (Wilke and Kaplan, 2001). However, a harmonious social atmosphere does not necessarily lead to greater creativity. Instead different creative cognitive styles that may cause some "irritation" should be tolerated and indeed encouraged in the light of earlier comments about the beneficial effects of "creative tensions" (Kunh, 1963). However, a more fundamental difference in beliefs or underlying assumptions among group members is probably not beneficial if this leads to entrenched positions with respect to the way to approach a problem or, even worse, what problems to pursue. Moreover, a tight time frame for the task might make such a situation more tense and difficult to handle.

The leadership of research groups has often been found to be a crucial factor in relation to performance including creativity (Pelz and Andrews, 1966). To enrol leaders who have a long experience and wide-ranging competence in the field and who express clear goals and grant autonomy to team members is likely to promote creative performance in research (Hemlin et al., 2004).

Regarding the size and the structure of work groups, studies indicate that the form of the task and the stage of the work process appear to be more important than group characteristics per se (Hemlin et al., 2004).

Hemlin et al., (2004) found that the physical environment has some bearing on the creativity of individuals and groups. In particular, facilities that make it easier for individuals to contact one another when needed are likely to be beneficial to creativity. In addition, individuals need facilities that offer solitude, where creative thoughts and ideas can be nurtured and where reflections on other people's ideas can be arrived at. These two functions of providing both places for meeting other people and individual spaces for reflection are probably basic to any human creative act. Such places should be created in such a way that the wishes of the individuals working there are met as far as possible.

In conclusion, it seems that there is interplay between able individuals, their colleagues and environmental characteristics that should be taken in account when planning for knowledge creation environment.

1.3 Performance in knowledge creation and its predictors

Performance has been associated with the creation of social and intellectual capital (Bourdieu, 1986; Burt 1992; and Nahapiet and Ghoshal, 1998). The performance drive to the knowledge creation capability was defined by Collins et al., (2001) as the ability of a firm to develop new ideas and understandings on a continual basis. Then, a high performance can become a group advantage or a "network advantage" (Harvey et al., 2002). The same definition can be used in the academic field, where these new ideas and knowledge can be shown through publications. Also, Kram (1983) explained that mentoring in regular business organizations resembles most closely the relation between a PhD student and his or her supervisor.

Several studies at university or research group level have been done using the performance concept, which has been defined in many ways depending on the field of research. For example, Harvey et al., (2002) used publications, generation of grants and fellowships. Hanneman (2001) applied ideas from social network analysis to data on the flows of faculty among departments and ranked the departments as a prestige hierarchy.

This performance requires knowledge creation capability and it drives us to the creative knowledge environments. The literature reports creation of knowledge to be dependent on the ability of members in a group or organization to exchange and combine existing information, knowledge and ideas (Kogut and Zander, 1992). The creation of new knowledge, which results in academic performance, requires a necessary knowledge base (background variables) and the necessary motivation (attitudinal variables) to share (network variables) this new knowledge in the group.

In this thesis we want to find the predictive variables that make a difference in the performance of PhD students. Our interest is to study the performance of PhD students who belong to academic research groups. Performance in teams or working groups has been studied from the managerial and education perspectives. On the one hand, the managerial perspective tends to use empirical studies and usually focuses on one type of variable at a time (background, attitudinal or network). On the other hand, the literature in the field of education theoretically suggests that all three types of variables may be influential for individuals but less often uses empirical research. Along this thesis these three types of variables will be studied simultaneously, namely characteristics of the research group understood as social network, and individual background and attitudinal characteristics of the PhD students and their supervisors in order to find which ones make a difference.

A first group of authors studied performance stressing the role of background variables such as education, experience and age (Braun and Mohler, 2003), also called human capital by Pfeffer (1998) or Becker (1964), latent knowledge by Hargadon and Fanelli (2002) or stocks of knowledge by Smith et al., (2005). Cohen and Levinthal (1990) related levels of education and experience to knowledge creation. Regarding management, Bantel and Jackson (1989) studied the education in top management teams related to creative organizational outcomes. Hitt et al., (2001) focused in the importance of background variables for the relationship between strategy and firm performance. Also Pfeffer (1998) studied the influence of these same variables on entrepreneurial profit. Others who studied performance from background variables are Mincer (1993) who showed that human capital is capable of generating differential levels of economic returns for individuals, and Strabuck (1992) who showed that firms with knowledgeable employees are more likely to develop new ideas.

Another group of authors analysed the role of attitudinal variables such as group atmosphere, job satisfaction or motivation. Ivankova and Stick (2007) used a quantitative and qualitative study and found that self-motivation and online learning environment among others were predictive variables for performance in a doctoral program. Wentzel and Wigfield (1998) pointed out that the motivation of the students is higher if they realize that are learning new things and have interest in the issue. Pintrich and Schunk (1995), and Wolters et al., (1996) showed the importance of group climate

in job training. Similar findings are also found in the managerial field, for instance Nonaka and Takeuchi (1995) explained the importance of motivation for sharing knowledge among workers.

A third group of authors focused on the role of social network relationships within groups, including trust and communication among social network members (Wasserman and Faust, 1994). The basic idea behind this perspective is that an individual's success is strongly dependent on the relations with relevant others inside and outside the organization (Burt, 2000) because network structure provides the opportunities for individual actions. The importance of social relations in the network structure concerning individual performance can be captured by the concept *social capital*. Delamont et al., (1997, 96-99) and Rudd (1984) explained that being isolated in a research group can be one of the main problems for a PhD student. Cryer (1996) theoretically explains the importance of the relationship between students and supervisor (asking for advice, for instance), who must have mutual respect and trust.

These three types of variables have rarely been used together for predicting performance in knowledge intensive jobs. This has been criticized by Simon (1991) and Ulrich (1997). Collins et al., (2001); Harvey et al., (2002); and Smith et al., (2005) included background factors such as experience or education and network factors such as number of contacts or importance of having strong contacts. The use of the three types of variables together for explaining the success of PhD students was suggested by Delamont et al., (1997, 178-188) who criticised that the main and sometimes only criterion that universities use for recruiting PhD student is the possession of undergraduate studies. They also suggested that the most important factors for selecting students should be high motivation on the topic, capacity to work independently, skills and abilities adequate for the research group, intellectual creativity and critical thought. Concerning network structure of the groups, Delamont et al., (1997, 96-99) explained the isolation problem, less problematic for PhD students who are doing scientific work in a lab, and more serious for students in humanities, social sciences and part-time students of all disciplines; the problem may be mitigated by actions on social relations by the supervisor. However, Delamont et al., (1997) did not empirically test the influence of all these factors on academic performance. Hemlin et al., (2004) suggest that scientific achievements of young researchers (PhD candidates) reside not only on psychological factors (individual motivation) but arise also in social interaction within the research groups. As it is explained by various sociologists of science, scientific creativity largely depends on the social organization of science as well as on young scientists' position in research group, participation in scientific work, engagement in routine or more demanding research tasks and opportunities to come to scientific publications (see Delamont, et al., 1997).

Related with the case of predicting performance for PhD students, we focus on previous studies done by authors belonging to the INSOC project. In Coromina (2006) the performance of PhD students at the University of Girona (Spain) was already studied by using these three types of variables simultaneously. According to Coromina (2006) attitudinal and background variables were good predictors of performance. Ziherl et al., (2006) used Slovene data and fitted a model using network variables which were found to be good predictors of performance. Matelič et al., (2005) used the same data to fit a model using attitudinal and background variables which were both found to be good predictors of performance. This thesis will mainly draw from the results of the three studies mentioned in this paragraph with the aim to compare them. These studies measured academic performance by the number of international and national papers, books, book chapters, international and national conferences attended and internal research papers.

In the next sections we will give a list of each of the independent variables (social network, background and attitudinal variables) of our model to predict the PhD students' academic performance, with a literature summary.

1.3.1 Social network variables

Social capital consists basically of relations among people that facilitate action. This capital is rather intangible because personal relations are involved. The social capital concept could refer to the individual level (relations which a researcher has with the rest of the research group as an individual), or to the group level (social relations of the research group with other research groups). In this dissertation we are interested in the former.

Some features should be considered before defining networks. The first is that the actors and their actions are viewed as interdependent rather than independent. The second is that ties among actors are the channels through which resources are transferred. The third is that in network models based on individual performance, it is the network structure that provides the opportunities for individual actions. Thus, social networks can be defined as the pattern of ties linking a defined set of people. Each person can be described in terms of his/her links with other people in the network, and the relations defined by the linkages between units are important network components.

In order to study the implication of the social capital associated to a specific social structure on the competitive advantage of individual actors, two types of social capital should be distinguished (Guia 2000; and Putnam, 2000). On one hand, the particular position actors occupy within their relational networks determines the stock of differentiating or *bridging* social capital at their disposition. It is a capital exclusive to each actor, and on which his/her capacity to access information and opportunities depend, and consequently, his/her potential capacity to maintain and improve his future

competitive position (Burt, 1992). On the other hand, the cohesion of an actor's relational network determines his stock of integrative or *bonding* social capital. This type of capital, shared by all members of the same cohesive group, has effects on the efficiency in coordinating and controlling the collective actions carried out by every actor in the network. Thus, the more embedded in his local environment an actor is, the more integrative or *bonding* social capital will be at his or her disposition and the lower the coordination and control costs of his or her collective actions within the group will be (Putnam, 2000). For instance, ties within closely connected groups (cliques) are more likely to be strong between persons with the same characteristics (Granovetter, 1973; and Seibert et al., 2001), and ties are important for understanding the mechanisms at work when a team is confronted with changes in its organization (Krackhardt, 1992).

Some individuals have social capital due to their connection with persons that have the appropriate information or resources for them to enhance their performance. This is based on the social relations and the resources embedded in positions reached through such relations (Lin et al., 1981, 395; and Lin, 1990). Resourceful persons may be connected by weak ties, but the strength of a tie is a consequence, rather than the cause of the information and resources flowing through such relations.

The most relevant contact that PhD students have is that with their supervisors. Here, the role of good mentor is very important. Paul Samuelson summarized the importance of mentors in creative development of young researchers on the following way: "I can tell you how to get a Nobel Prize….to have great teachers" (Samuelson, 1972). A good mentor can help PhD candidates to develop the beginning of a well-rounded CV, provide a list of useful contacts and a set of strategies for professional advancement. If the training in general scientific skills are part of the PhD student stage then the role of tacit knowledge which is acquired by training is also important. These kinds of skills are best acquired in training and less easily through formal teaching. As it is noticed by Hemlin (2006) "….in this task, mentors fulfill an important role as guides and models for creativity to doctoral students and junior researchers." "Certainly, the typical scientific career trajectory differs from discipline to discipline. But professional relationship between mentor and doctoral student is almost invariably important in all scientific fields" (Richard, 1984; and Ravetz, 1971).

The types of networks analyzed in the universities belonging to the INSOC research group were scientific advice, collaboration, getting crucial information, trust, getting along well with colleagues, socializing and emotional support networks. A factor analysis done by De Lange et al., (2004) obtained three factors where these networks can be included. The first factor concerned work-related networks where the scientific advice, collaboration and getting crucial information networks can be included. The second factor was friendship where the trust and getting along well networks can be included. The third factor was social support or social companionship

where the emotional support network can be included. We also include the socializing network in order to study the influence of the activities with colleagues outside the work context.

The importance of some of these networks is strongly supported by the literature. According to De Lange (2005), the advice network focuses on the information exchange between actors and concerns knowledge sharing and knowledge creation. Cross et al., (2001) focused on the importance of informal advice networks and their benefits for the organizational process of knowledge creation. Krackhardt and Hanson (1993) also stressed the informal network of advice, which reveals the people to whom others actually turn to get work done. Following the literature, advice is an important network and we measure it as the frequency with which PhD students asked for scientific advice to their colleagues during the last year.

Cooperation is a more formal and long-term relation than advice and could even include some request for advice. Complexity is related to the need for specialization, which requires collaboration if wider questions are to be addressed (Ziman, 1994). Sparrowe et al., (2001) related scientific cooperation networks to performance. We measure with which frequency people in a research group collaborate in research aspects with others.

Another important network concerns emotional support (van der Poel, 1993). Waege and Agneessens (2001) focused their attention on non-professional relations rather than professional relationships, including sentimental or personal relationships. We measure this by asking with whom and to what extent PhD students would discuss serious problems at work.

Finally, another type of network mentiones by literature is trust. Buskens (1998), and Glaeser et al., (2000) stressed the importance of the trust network and its measure. Luhmann (1979) showed that trust increased the potential for a system to deal with complexity. We measure trust by asking to what extent respondents trust their colleagues concerning work-related matters.

1.3.2 Background variables

The background variables used for the prediction of PhD students' performance were related to the student's personal characteristics, educational career, and experience and knowledge diversity. These groups of characteristics represent the amount of knowledge or background in a firm at a certain point of time (Dierickx and Cool, 1989; and Smith et al., 2005). This definition can also be translated to research in the academic field.

All background variables used in the INSOC project were placed in one of the aforementioned groups. Personal characteristics include the variables age, gender and having children. Educational career includes the licentiate degree mark average and the year in which students obtained their most recent licentiate degree. Experience includes the seniority at the department and the year in which students started their doctorate at the university. Knowledge diversity includes the supervisor's academic performance and the field of study in which PhD students are doing their doctorate.

1.3.3 Attitudinal variables

The attitudinal variables used are described below.

A first group of variables is related to the reasons to start a PhD. Some examples are the PhD student's great interest in the topic, the intellectual freedom, the independence at work, ambitions for an academic career, and the prestige of being a PhD student. These variables represent the motivations of people who decided to start a PhD. For instance, it could be motivation for autonomy (Gulbrandsen, 2004) or motivation and identification with the researcher's job (Pierce and Delbecq, 1977).

A second group is related to PhD students' relationships with supervisors (Cryer, 1996; and Hemlin, 2006). Some examples are informal contacts with the supervisor, advice from the supervisor concerning the development of PhD students' project, and PhD students' stress when they discuss things with supervisors.

A third group is related to the integration of the PhD thesis within the research group tradition. Some examples are the extent to which the PhD thesis is embedded in a larger project already running in the research group, and the extent to which the PhD thesis concerns a completely new research issue in the field of research of the group.

A fourth group is related to the social atmosphere in the research group. The atmosphere in the research group is important for knowledge creation according to Nonaka (1991), who related group atmosphere to group cooperation, or to Tushman and O'Reilly (1997), who studied the influence of group atmosphere on creativity. Some examples are friendliness, productiveness and helpfulness.

A fifth group is related to the attitudes towards publishing (Deschrijver et al., 2001). Some examples are the extent to which publishing is stimulating and motivating, and the extent to which publishing is useless. Attitudes towards work (Cook et al., 1981, 117-120; and Furnham, 1997, 293) are present in this group as well. Some examples are: doing overtime to finish a task even if not paid, most things in life being more important than work, and the major satisfaction in PhD students' life coming from their job. Feelings of PhD students at work are also included. Some examples are

exchanging views with their colleagues about research, and research giving students a chance to demonstrate their creativity.

Finally, a sixth group is satisfaction at work. Some examples are the PhD student's job feeling like a hobby, finding real enjoyment in their work, and the PhD student having to force himself/herself go to work.

1.4 Organization of PhD studies in different countries

In this section the organization of PhD programmes in the different countries at the time of carrying out of the study is discussed, regarding access requirements, PhD studies organization, working as a researcher and research group organization. This information is specified for Spain, Slovenia and Germany. At the time the study was conducted, PhD studies in each country were not yet adapted to the Bolonia reform.

1) Access requirements

In Spain, official master programmes did not yet exist at the time of carrying out the research, and students who had completed a degree programme called "licenciatura" (about 300 credits to do in 4 to 6 years) could directly gain access to a PhD programme. No other requirement was generally enforced but individual PhD programmes were autonomous to decide which and how many students to admit, although programmes with little demand have no choice, as they need a minimum number of students to be kept on offer.

In Slovenia, enrolment requirements for doctoral studies (the relevance and type of previous education) are defined by individual faculties or public research institutes. On a general basis a minimum undergraduate mark is required. Both universities and public research institutes in Slovenia organise doctoral study in equal terms.

A regular university study in Germany lasted 8 to 12 semester and was finished with the degree of either diploma (Dipl.) or Magister Artium (M.A.) or a first state examination (for teachers, legal profession, medical practitioners, and pharmacists). Equipped with this academic degree (M.A. or Dipl. or the state examination) enrollment for a PhD study is possible. A committee in the department or faculty will decide whether the knowledge and qualifications the student has already acquired will qualify him or her for taking a doctorate at a German university, for example, having graduated with good mark or fulfilling language requirements. While one university may admit the student to the doctoral studies without setting any prior conditions, other may set conditions. This is all part of the autonomy which German universities enjoy.

2) PhD studies organization

In Spain, PhD programmes were divided into three distinct periods. The first academic year involved attendance to about 200 hours of courses and seminars. Typically the courses included advanced materials both on the topic of the PhD and on research methodology. During the second academic year students undertook one or more research projects. These research projects had obvious similarities to the master thesis that were common in other countries at the time and were to be common in Spain later. The project(s) together with the whole work of the student during the first two PhD years was publicly evaluated in an oral exam. If successful in his exam, the student was awarded the so called “diploma de estudios avanzados”/advanced studies diploma. This had obvious similarities to a master degree, although it did not have the stand alone recognition masters had in many other countries, and was considered by many as a mere first step of a PhD.

At latest, at the beginning of the third year the student was asked to submit the proposal for the PhD thesis. The thesis was supervised by one or more doctors of whom at least one had to belong to the departments organising the PhD programme. At the time of conducting the survey, thesis supervisors were not asked to fulfil any additional requirement. It was not even required for them to have authored or co-authored any publication. This resulted in a high diversity of publication performance of supervisors.

Formally there was no time limit for delivering the thesis. Depending on the field of study, the median time needed to complete it was between three and six years at the University of Girona. This made the whole PhD last for between five and eight years. It has to be taken into account that grants only lasted four years and thus only supported students during their first two years of thesis. Once the thesis was complete, a general university PhD commission approved that the thesis fulfilled the needed formal requirements and the composition of a five-member jury to evaluate it.

In Slovenia, there are three degrees of the postgraduate study: specialization, master’s studies and doctoral studies. Masters are thus stand-alone degrees, as well as first steps to the PhD.

The German system is essentially different from other systems. There are no graduate-study programmes at the end of which the doctoral thesis will be completed. Instead, the phase of research on the doctoral project starts with having been accepted as a doctoral candidate.

A doctorate (PhD) can only be gained by attending a university or a university-status institution. A professor, called "doctoral father / mother" will act as the academic supervisor for the doctorate. This academic supervisor will formally set the topic of the student's doctoral thesis and will advice the PhD student on how to proceed with the

studies and with the research. Finding a "doctoral father / mother" is just like applying to an employer for a job. The student should arrange and formulate his/her application carefully. After the student has found a supervisor for his/her thesis he or she should formally enrol.

After a student has been accepted as a doctoral candidate there are no longer any formal problems. There are generally no graduate studies to be completed in order to obtain the PhD in Germany. After being accepted as PhD student, is possible that the candidate has to attend one or two semesters of additional lectures, courses, or seminars before he/she can start the thesis. Each department or faculty at a German university has its own doctoral regulations.

Graduate colleges represent another opportunity for taking a doctorate in Germany and have been founded only recently. Within a graduate college, several doctoral candidates work together on a major research project, with each candidate taking on responsibility for a project section. Additionally there are some graduate studies, where the student has to register for. These colleges existed in Germany already at the time of carrying out the research but there were not as many as there would be later. Particularly the colleges in the University of Giessen appeared in 2004 and it was too late to participate in our study.

3) Working as researcher

In Spain, admittance to a PhD programme did not automatically imply a grant or that the student would belong to the university personnel. Some students thus earned a living in the private sector while doing the PhD. However, a substantial number of PhD students did belong to the university personnel. Grants could be obtained from the government of the Kingdom of Spain, from the regional government, and from the university itself, which gives 20 such grants yearly. Legally these PhD students could not teach more than 60 hours a year. Research thus constituted their main job. These grants implied that the PhD student got formally involved in a research group. Some students already belonged to the teaching staff prior to starting the PhD. The lowest categories of teaching staff at the time of conducting the study did not require a PhD. The members of these categories of course needed a PhD if they wanted to get promoted, which was the reason why many of them actually started a PhD. Teaching was usually their main job. For these students, belonging to a research group was not compulsory.

In Slovenia, there is a very stable system of grants financing PhDs: doctoral students have regular, fixed-term employment contracts. The Research Council in Slovenia finances their pay, social contributions, as well as material and non-material costs for research through the so called “Young Researchers Program” (“Program mladih raziskovalcev”). Today, young researchers are employed for a specified period:

2.5 years until master's degree, 2.5 years until doctor's degree, 4 years of integral doctoral studies, 3 years of doctoral studies abroad (PhD students can participate also in short training programmes abroad for a maximum of 1.5 years in the form of study projects at foreign universities or foreign research institutes). Doctoral students are involved in the research group projects or programmes, so their training includes research work as well. From the beginning the action attracted a lot of interest from the graduates. In fact, more than 300 graduates per year were engaged in the first years of governmental program for the financial support of young researchers. In total, 6076 of young researchers were included into programme during a period of twenty three years. In Slovenia it is also possible to enroll in a PhD without a grant from the "young researchers programme", but it is very unusual.

In Germany, there is not any system of financing. A PhD student can have a job at university in a research project or as an assistant. Alternatively a PhD student can have a job outside university, perhaps in a research institute, or in another institution, or can be without a paid job. The majority of students fall in the last category.

4) Research group organization

In Spain, despite the fact that the University of Girona had an official list of research groups, in some cases these research groups were not a good reflection of whom actually works with whom. The way the university distributed research founds encouraged groups of an unrealistically large size, some with members that were not particularly active and others with a cluster of fairly independent subgroups working on different topics. Only PhD students with a grant are obliged to belong to a research group.

In Slovenia, thanks to policy action officially called "Young Researchers Program". PhD students in Slovenia are formally included in research groups. PhD studies are constructed in the context of research groups. PhD students as members of research groups need already before the defense of their doctoral thesis to come to some scientific publications.

In Germany, identifying a research team is more complicate. The PhD student can identify contact partners (a) by seeing which authors have written about his or her special area of interest, (b) by meeting people from his/her discipline and asking them for advice, (c) by finding information about specific research teams and institutions in the internet (i.e. "research gateway Germany"). In most cases the student works only with the doctor father or mother.

Chapter 2

SURVEY DESIGN FOR COMPARING PERFORMANCE ACROSS COUNTRIES

2.1 Introduction

2.2 Study design

2.3 Descriptive results

2.1 Introduction

The main goal of this chapter is to explain how we designed and conducted a survey in the different countries with the aim of explaining the PhD students' performance obtained in Spain, Slovenia and Germany. Explanatory variables are characteristics of PhD students' research group understood as a social network and background and attitudinal characteristics of the PhD students. The performance was measured from the publications and conference participations of PhD students achieved in the last three years. Data for some of those variables were obtained differently in each country.

In Spain and Slovenia data were obtained by means of a web survey (Coromina, 2006).

Web surveys have already proved to be a valid and reliable survey method for classic survey questionnaires (Couper 2000, 2001; Dillman, 2000; Couper et al., 2001; Vehovar et al., 2002; and Coromina and Coenders, 2006). This data collection mode is especially well suited for questionnaires including social network questions, which can be considered to be sensitive and complex to answer. Self-administered questionnaires produce a better data quality for sensitive questions (Comley, 2002; Dillman, 2000; and Tourangeau and Smith, 1998). The less an interviewer interferes in the data collection process, the more anonymous the respondent will feel and the less the respondent will tend to give socially desirable answers (De Lange, 2005, 72; De Lange et al., 2004).

Using web administration, some complexity due to the social network questions can be avoided by using routings, which makes the questionnaire less burdensome for the respondent, and by hiding some of the obstacles to deliver an answer. For instance, the questionnaire might have lots of boxes to be filled with the names of connected people in the network (alters) but some of them will be empty for the whole questionnaire. This can be avoided by electronic survey routings, which would remember the length of the provided list of names for the whole questionnaire. This is visually richer, more attractive, less burdensome and permits a faster answer by the respondent.

In spite of this, there still exist only a few questionnaires with network questions designed via web. The few exceptions are Marin (2004), Koren et al., (2003), Lozar Manfreda et al., (2004) and Snijders and Matzat (2005) who used a web questionnaire for collecting egocentered network data.

Web surveys of course also have their disadvantages. The main one is coverage error, as there is no known census of internet users and only respondents with internet access can be sampled. However, coverage was not a problem in our case because all

PhD students were known; they used the computer on a daily basis for their job and had fast internet connection.

In Germany the data were collected by paper and pencil mail survey. Being a self-administration mode is also appropriate for sensitive network questions.

2.2 Study design

2.2.1 Population

The population studied in this comparative analysis is composed by the PhD students who began their doctoral studies at the University of Girona (Spain), at different universities and research institutes of Slovenia and at the University of Giessen (Germany) in the academic years 1999/2000 and 2000/2001. In addition, in Slovenia and Girona these PhD students had to have an official link with their university, in other words, these students must have grants, be assistants or be researchers hired for particular research projects. Most of them (all of them in Slovenia) had grants, the rest being assistant professors or research assistants hired for particular research projects (only in the University of Girona). This choice has been made because these students have frequent contact with other researchers and they can spend a lot of time doing research as their main job. The relatively small population size of PhD students (N=189 in Slovenia, N=86 in Girona and N=653 in Giessen, made us decide not to sample but study the complete frame. In Germany also PhD students not working at university and starting the PhD before 1999 or after 2001 were interviewed but for comparative purposes only those working at university and starting between 1999 and 2001 are included in the analysis.

The lists of the PhD students were obtained from the administrative records of the University of Girona and from the Ministry of Science, Education and Sports of the Republic of Slovenia. In Germany the lists of PhD students were obtained from registrar's offices in faculties of Social Sciences, History, Language, Literature and Cultural Sciences, Home Economics and Nutritional Sciences, Economics, Agricultural Sciences and Natural Sciences at the University of Giessen.

In Slovenia the Ministry also provided the names of each student's supervisors. In the University of Girona students had to be interviewed by phone to get these names. In the University of Giessen the supervisor names were not obtained.

2.2.2 Definition of PhD students research groups

In Spain and Slovenia, the students more or less formally belong to a research group. The members of the research group that the student and the supervisor belonged had to be identified because they were needed for the network questions.

In that stage, the main problem was to find out a common definition of the research group for the participant universities in the INSOC project. With this purpose, each university carried out similar focus groups (Morgan, 1997; and Krueger, 1998) with leading researchers of different fields of study. The aim of those focus groups was not only to create a common concept of the research group but also to define which questions should be asked (name generators) to the supervisors in order to obtain the names of people in their research group connected to the research topic of their PhD students. The groups could coincide with an official research group recognized by the university or not. In Figure 1.1 we show the final questions asked to supervisors in order to obtain the names of the research group members whom the doctoral students are working with.

1. Name all the teaching assistants (or doctoral assistants) whose research is mainly under your supervision.

2. Name all the researchers of whom you are formally the mentor and who work on or participate in a research project.

3. Name your colleague professors, senior researchers, junior researchers or people working in the private sector with whom you substantially work together on those research projects in which PhD student X [name PhD student] is involved.

Figure 2.1 Name generator questions

In Spain and Slovenia, supervisors were asked the name generators, in Figure 2.1, and additionally required to provide the name of the institution in which each research group member was working. Table 2.1 shows the average research group sizes (excluding the PhD student) and the average number of different institutions the members of the research group belong to.

	Spain	Slovenia
Average research group (excluding PhD student)	7.4	6.2
Average of different institutions within the group	2.5	3.1

Table 2.1 Average research group characteristics

In Spain and Slovenia the web questionnaires, which were later administered, were personalized and included the names of the research group members.

In Germany young academics doing their doctorate do not necessarily work in a research group or an organised, institutionalised scientific context. They usually do not belong to the university staff or are embedded in a funded research project located at a university or at a research institute. This is especially true for graduate students in social sciences. A very few have grants. As the majority of German students do not belong to any research group, we did not use name generators. Therefore a list with all the members of the research group was neither available nor necessary.

External students hold jobs having nothing in common with their PhD thesis and their only contact to the university is the supervisor. They are obligated to contact the university at only twice year and often this is the (normal) frequency of contact to the supervisor. These students were interviewwd but are not included in the analysis.

2.2.3 Data collection

Once the research group was defined, the web survey was administered. In Girona respondents were students and supervisors. In Slovenia respondents were also all research group members. In Germany respondents were only PhD students.

In both Spain and Slovenia, once we got the names for each student's research group members each questionnaire was personalized and network questions included the list of their research group member names. The web questionnaire was designed and administered by e-mail.

In order to enhance the credibility of the survey and prevent the e-mails from being treated as spam (Vehovar et al., 2002) respondents first received a letter with an official envelope of the university. Next, personalized e-mail invitations were sent to all respondents with a link to their own web questionnaire address. A different address for each respondent's questionnaire prevents respondents from accessing the wrong survey and from completing the survey several times (De Lange, 2005, 101). In the e-mail text there was a short introduction explaining the goal of our research, the universities that were also using the same questionnaire and the confidentiality of the answers. In the first questionnaire page, each university explained the instructions to complete the questionnaire and how the responses would be used.

In the University of Girona, a total of 158 e-mails with a link to web questionnaires were sent (86 questionnaires for PhD students and 72 for supervisors). In Slovenia, the total was 1365 (190 questionnaires for PhD students, 190 questionnaires for supervisors and 985 to other research group members). The questionnaires resided in a server at the University of Ghent, and were programmed using the SNAP software, Version 7 (Mercator Research Group, 2003).

In Germany we have only questionnaires for PhD students and all of them are identical and contain empty boxes where respondents are asked for the names of their network members. The questionnaires were administered by paper mail.

2.2.4 Follow-ups and non-response evolution

A commonly mentioned threat to web and mail surveys is low response rate. A follow-up design is one of the most efficient techniques to reduce the non-response rate (Schaefer and Dillman, 1998; Dillman, 2000; Kaplowitz et al., 2004; and De Lange, 2005) since in our project pre-paid incentives (Berk et al., 1993) were not offered. The use of mixed-mode follow-ups increases the response rate for those who are more sensitive to specific modes (De Lange, 2005). For instance, when people are not most of time connected to internet or have strong spam filters, they can still be reached by researchers through other methods (Dillman, 2000) such as telephone or mail.

In Spain, the survey was conducted from November 2003 to February 2004 and a mixed-mode follow-up was chosen. The first reminder was sent by e-mail to the whole population, to thank respondents and draw the attention of non-respondents. Letter and phone were used for the second and third reminders to non-respondents only. A PhD student phoned non-respondent students and non-respondent supervisors were phoned by a professor in order to increase the response rate using the liking strategy (a respondent is more willing to comply requests of liked others, see De Lange, 2005, 18). Telephone is the most effective way to understand whether the respondents do not want to participate or they are planning to answer the questionnaire later or even they are still unaware of the request to complete the survey. In this last reminder, respondents were also offered the possibility of a face-to-face interview or a paper-and-pencil self-administered interview in what can be considered a mixed-mode questionnaire administration. Two respondents chose this alternative. By the first reminder we obtained an additional 12.5% of supervisor respondents and 20.9% of PhD students' respondents. By the second and third reminders we obtained an additional 38.9% for supervisor respondents and 22.1% for PhD students. In Slovenia the survey was conducted from January 2004 to March 2004. Two reminders were sent by using only e-mail. After the first reminder an additional 12.2% of respondents filled the questionnaire and after the second reminder an additional 3.8% was obtained.
In Germany, the survey was conducted from March to June 2004. 653 questionnaires were sent to students registered as doctoral students in registrar's offices in faculties of Social Sciences, History, Language, Literature and Cultural Sciences, Home Economics and Nutritional Sciences, Economics, Agricultural Sciences and Natural Sciences at the University of Giessen. In May a reminder postcard was sent to those students having not answered so far. Non-respondents working at the University of Giessen were contacted by mail. The response rate was 33% leaving us with 218 completed questionnaires. From the enrolled PhD students at the University of Giessen responding

to the questionnaire, 41% (89 individuals) had a job at the university when starting with their PhD dissertation, had started the PhD between 1999 and 2001 and are thus used in our analysis. The remaining PhD students were employed in jobs outside the university in either public (4%) or private (1%) research institutes, in concerns (13%) with working contexts extraneous to their PhD research. A small group of 10% of PhD students were self employed and a further group of 18% was unemployed.

The final response rates in all countries are shown in Table 2.2. Variations in response rates between countries are often reported in the literature on comparative research. Understanding the cause of the differences in response rates across countries is by itself an interesting cross-national research question. In our case it can be at least partly attributed to the different reminder strategies. More importantly, differences in response rates are a cause for concern in itself, as differential non-response bias may affect the validity of group comparisons (Harkness et al., 2003).

	Response rate PhD students	Response rate supervisors	% complete student-supervisor pairs	Number of complete student supervisor pairs
Spain	78%	75%	63%	54
Slovenia	62%	54%	36%	68
Germany	33%	____	____	____

Table 2.2 Response rates for PhD students and supervisors

2.2.5 Questionnaire structure

The web questionnaire design was a complex process led by Daniëlle de Lange and involved two years of discussion within the INSOC research group, several international meetings, several focus groups and pre-tests (De Lange, 2005). For this project, data were collected via web by three of the INSOC participant universities (Girona, Slovenia, and Ghent) and via mail by the University of Giessen. The fact that we had to produce comparable versions in four languages (Catalan, Flemish, Slovenian, and German) and the differences between the three university systems lengthened the process even further and involved two independent translations, a pre-test of the translated questionnaires and further discussions and modifications. Discussion of the meetings and evolution of the questionnaire design are detailed explained in Coromina (2006, 31-32).

Two different questionnaires were designed, one for the PhD students and another for their supervisors and other research group members, though most of the questions were asked to all. Some of the survey questions were country specific, since some differences exist between universities and countries, for example, regarding research groups or the organization of doctoral studies.

The topics of the web questionnaire identified for Slovenia and Girona (Spain) are shown in Table 2.3 in the same order as questions were asked; each topic includes several questions, which are explained in greater detail later, and is classified into the background, attitudinal or social network type.

Variable type	Supervisor and other research group members	PhD Student
Background	Educational career	Educational career
Background	Experience and knowledge diversity	Experience and knowledge diversity
Attitudinal		Reasons to start a PhD
Network	Contact with colleagues (egocentered network)	Contact with colleagues (egocentered network)
Network	Proxy measurement of the complete network (only asked in Girona)	
Attitudinal		Relationship with the supervisor
Attitudinal		Integration of the PhD thesis within the research group tradition
Attitudinal	Atmosphere in the research group	Atmosphere in the research group
Attitudinal	Attitudes towards publishing and towards work	Attitudes towards publishing and towards work
Attitudinal	Satisfaction at work	Satisfaction at work
Dependent	Publications and performance	Publications and performance
Background	Personal characteristics	Personal characteristics

Table 2.3 Web questionnaire structure

German questionnaire structure

In Germany questions were only asked to the PhD students. Besides PhD students do not belong to any research group and most of them do not work at university. Because of that, all variables from supervisors were missed and also variables referring to integration of the PhD thesis within the research group and atmosphere in the research group (Table 2.4).

Variable type	PhD Student
Background	Educational career
Background	Experience and knowledge diversity
Attitudinal	Reasons to start a PhD
Network	Contact with colleagues (egocentered network)
Attitudinal	Relationship with the supervisor
Attitudinal	Attitudes towards publishing and towards work
Dependent	Publications and performance
Background	Personal characteristics

Table 2.4 German questionnaire structure

2.3 Descriptive results

Educational career (background variable)

The first topic asked was the educational career. The questions were about the year respondents started and completed their undergraduate studies and about the average mark obtained. Table 2.5 shows that the average time for completing university studies is 5 to 6 years for three countries' PhD students and very similar for supervisors, and means that PhD students started their doctorate immediately after finishing their licentiate degree. In Germany, the questionnaire was not administered to supervisors and the average year of beginning and finishing their studies cannot be obtained.

	PhD student			Supervisor	
	Spain	Slovenia	Germany	Spain	Slovenia
Average of the year of beginning degree	1993	1994	1993	1979	1975
Average of the year of finishing degree	1998	1999	1999	1985	1981

Table 2.5 Educational career questions

As regards the average mark, educational systems differ markedly across countries. Thus items to measure educational levels ideally need to cover both national and international frameworks (Braun and Mohler, 2003). The final scale was constructed also by taking into account the distributions in the three countries. The scale includes categories A+, A, B and C. The percentage distribution for each university is shown in Table 2.6. The details about the creation of these comparable categories will be explained in Chapter 3.

The differences in Table 2.6 can be partly explained by the different access requirenment explained in Section 1.4.

	Spain	Slovenia	Germany
A+	5%	51%	18%
A	27%	35%	49%
B	52%	14%	32%
C	16%	0%	1%

Table 2.6 Average mark of PhD students

Experience and knowledge diversity (background variable)

Experience was asked as the year when the respondent was first employed at the department (s)he is currently working for. The average years were 1999 for PhD students in Girona, 1992 for supervisors in Girona, 2000 for PhD students in Slovenia and 1986 for supervisors in Slovenia. It must be noted that the start year of Slovene PhD students is rather constant, while in Spain some started many years ago. This is possible because in certain fields and contract types, a PhD is not required to teaching staff in Spain, and some start a PhD later in order to get promoted (see Section 1.4). In Germany this question was not asked.

The field of study was constructed from administrative records in Spain and Germany and from a question on the school, institute or PhD program the respondent belonged to and a question on the dissertation topic in Slovenia. The field of study classification had big differences between countries. The procedures used to develop a common classification are explained in Chapter 3. Table 2.7 shows the percentages of

the comparable classification. In this table it is shown that PhD students are mainly working on their doctorate in the Sciences and Techniques fields of study.

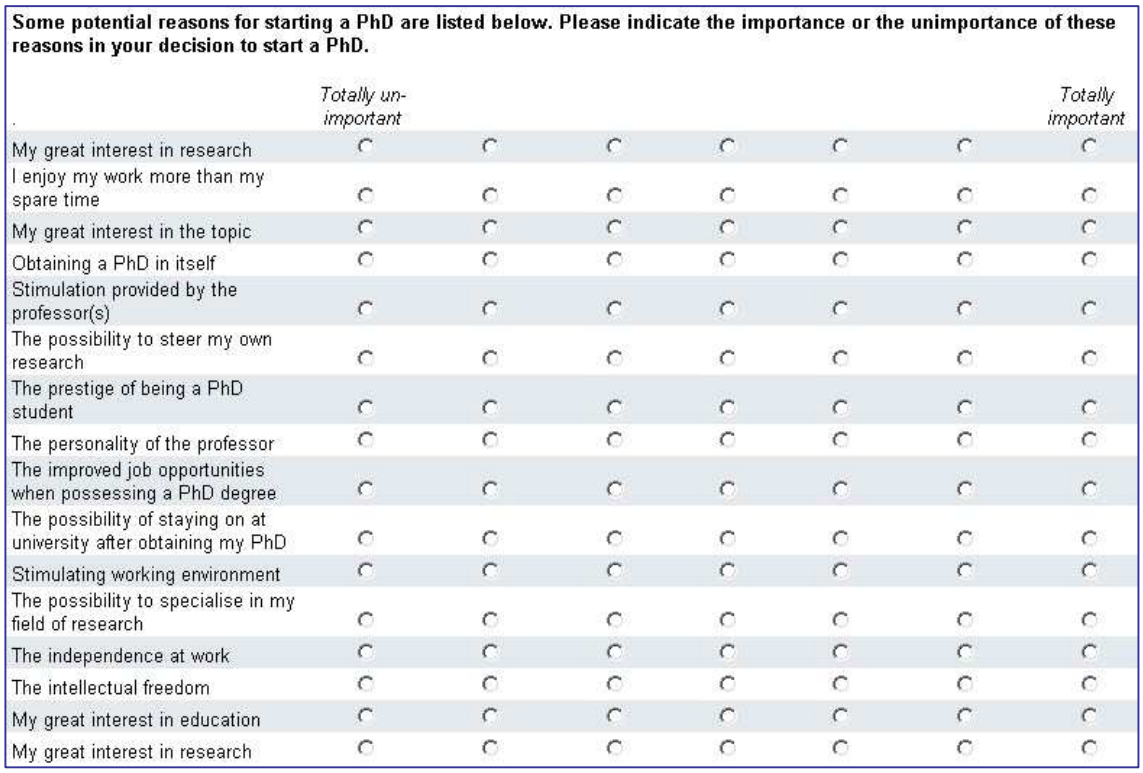
	Spain	Slovenia	Germany
Sciences	42%	47%	56%
Technical	30%	32%	11%
Humanistics	15%	9%	18%
Social Sciences	13%	12%	15%

Table 2.7 Distribution of PhD students across research fields

Reasons to Start a PhD (attitudinal variable)

PhD students were asked about sixteen potential reasons for starting a PhD (Deschrijver et al., 2001), which are listed in Table 2.8. The question used a scale from "totally unimportant" (1) to "very important" (7). See Figure 2.2.

It is important to note that for all PhD students the most important reasons are the great interest in research and the topic. Before they started a PhD program, the students' intention in a doctorate was to carry out research on a topic which they were interested in. The intellectual freedom, the possibility to steer their own research, the specialization in a field of research and the independence at work were also important. This could indicate that PhD students are people highly motivated for contributing to the field of research they are interested in and obtaining specialization and independence as a reward. In Slovenia and Germany, the great interest in education is also important. The least important reason to start a doctorate for all institutions is the prestige of being a PhD student. Students do not start a doctorate for their personal prestige in the face of other people because they know that they won't have this kind of recognition. Obtaining a PhD in itself is important for German students and it could be because the German labour market values the PhD by itself as Germany also gives the highest score to the item on job opportunities.



Some potential reasons for starting a PhD are listed below. Please indicate the importance or the unimportance of these reasons in your decision to start a PhD.

.	*Totally un-important*						*Totally important*
My great interest in research	○	○	○	○	○	○	○
I enjoy my work more than my spare time	○	○	○	○	○	○	○
My great interest in the topic	○	○	○	○	○	○	○
Obtaining a PhD in itself	○	○	○	○	○	○	○
Stimulation provided by the professor(s)	○	○	○	○	○	○	○
The possibility to steer my own research	○	○	○	○	○	○	○
The prestige of being a PhD student	○	○	○	○	○	○	○
The personality of the professor	○	○	○	○	○	○	○
The improved job opportunities when possessing a PhD degree	○	○	○	○	○	○	○
The possibility of staying on at university after obtaining my PhD	○	○	○	○	○	○	○
Stimulating working environment	○	○	○	○	○	○	○
The possibility to specialise in my field of research	○	○	○	○	○	○	○
The independence at work	○	○	○	○	○	○	○
The intellectual freedom	○	○	○	○	○	○	○
My great interest in education	○	○	○	○	○	○	○
My great interest in research	○	○	○	○	○	○	○

Figure 2.2 Question on reasons to start the PhD

	Spain	Slovenia	Germany
My ambitions for an academic career	4.6	4.1	3.8
The reputation of the research group	3.4	4.0	3.1
My great interest in the topic	5.6	6.1	5.8
Obtaining a PhD in itself	4.2	3.8	5.0
Stimulation provided by the professor(s)	3.9	4.0	3.7
The possibility to steer my own research	5.3	5.1	5.3
The prestige of being a PhD student	2.9	3.0	2.7
The personality of the professor	3.9	3.8	3.1
The improved job opportunities when possessing a PhD degree	3.8	4.1	4.8
The possibility of staying on at university after obtaining my PhD	3.9	3.6	3.9
Stimulating working environment	4.5	4.8	4.8
The possibility to specialise in my field research	5.2	5.5	4.4
The independence at work	5.2	5.6	5.4
The intellectual freedom	5.3	5.9	5.4
My great interest in education	4.2	5.6	5.5
My great interest in research	5.9	6.1	5.7

Table 2.8 Average importance of potential reasons for starting a PhD

Contact with colleagues (network variable)

The next topic is social networks and social capital and it concerns the contacts respondents have with colleagues, that is, their egocentered networks. Respondents are asked to give information about their relations with the list of alters obtained through the name generator questions previously asked to the supervisor (see Section 2.2.2). The German questionnaire does not have lists of research group members. Each German PhD student writes relationships with whomever the student considers to belong to the network. The network questions are asked differently in the German questionnaire.

For Spain and Slovenia there are thus seven network questions. The first four ask for frequency of contact:

a) *Consider all the work-related problems you have had in the past year and that you were unable to solve yourself. How often did you ask each of your colleagues on the following list for scientific advice?"* Question related to the scientific advice network. Germany asked separately for advice on the dissertation and on the job.

b) "*Consider all situations in the past year in which you collaborated with your colleagues concerning to research, e.g., working on the same project, solving problems together… The occasional piece of advice does not belong to this type of collaboration. How often have you collaborated with each of your colleagues concerning research in the past year?"* Question related to collaboration.

c) "Consider all situations in the past year in which you needed crucial information, data, software, etc., for your work but did not have it in your possession. How often did you ask each of your colleagues for information/data/software, etc., in the course of the past year?" (Asked to PhD students only) Question related to the getting crucial information. Germany asked for advice related to the dissertation only.

d) How often did you engage in social activities outside of work with your colleagues in the past year?" Question related to the socialising network.

The frequency in all these questions was referred to the last year in Girona and Slovenia. The network questions make use of grids and all research group members are mentioned (Trotter et al., 1996; and Bondonio, 1998). These questions made use of a scale from "not in the past year" (1) to "daily" (8) with other frequencies in the middle. An example of a social network question in Girona and Slovenia is shown in Figure 2.3. Two extra options, namely *"I do not know this person"* and *"That's me"* were included only in the first question. If the respondent chose any of these two options, these names did not appear any more in the questionnaire. This could be easily done

due to the fact that a web questionnaire was used and the routine of hidden empty boxes was used.

Consider all situations in the past year (namely since 1 november 2002) in which you collaborated with your colleagues concerning research, e.g. working on the same project, solving problems together, etc. The occasional piece of advice does not belong to this type of collaboration. How often have you collaborated with each of your colleagues concerning research in the past year?

.	*Not in the past year*	*Once in the past year*	*Several times a year*	*About monthly*	*Several times a month*	*Weekly*	*Several times a week*	*Daily*
Name 1	○	○	○	○	○	○	○	○
Name 2	○	○	○	○	○	○	○	○
Name 3	○	○	○	○	○	○	○	○
Name 4	○	○	○	○	○	○	○	○

Figure 2.3 Social network questions about collaboration

Figure 2.4 is an example of network question asked in Germany; respondents could also provide the names of external contacts to their university.

While working on the thesis many problems can arise. When you have problems with your dissertation, to whom do you go? Please, mention the first name of the people whom you go.

a) To whom do you go if you need specialized advice?

		How often do you go to each of the named people?						
First name	Is this a Colleague Friend Supervisor External specialist	1 per year	Several times a year	1 per month	Several times a month	1 per week	Several times per week	Daily

Figure 2.4 Social network questions about advice in Germany

For the networks concerning scientific advice and collaboration, in Girona and Slovenia, respondents were asked to use name generators to include also contacts outside the research group. One example of this type of questions is shown in Figure 2.5. They were allowed to type a maximum number of twenty other names. If respondents fill all twenty boxes a new question pops up asking how many additional persons are influential. One of the advantages of a web survey is the ability to hide unnecessary questions to the respondent, as shown in Figure 2.5: only when respondents clicked *yes*, did the second question appear. Then the relationships with these additional alters were measured with the same questions as before (Figure 2.3).

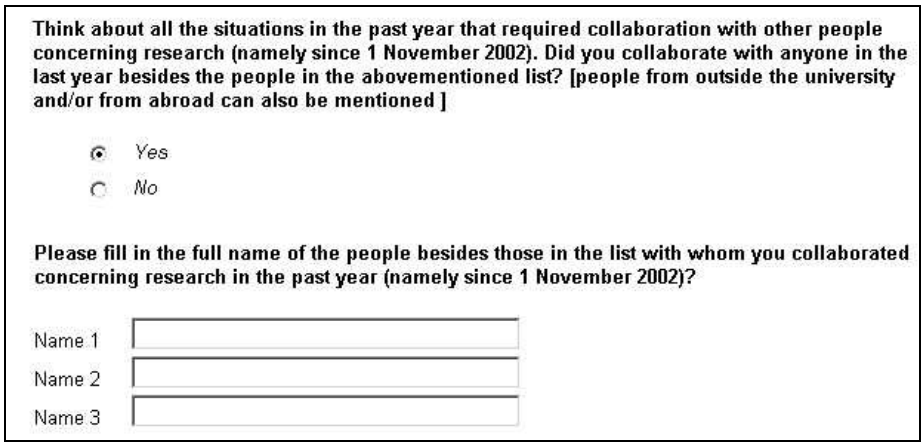


Figure 2.5 Example of name generator question

Another set of social network questions concerning only the research group members was also asked only in Girona and Slovenia. They are not frequency questions, though:

e) *"Imagine being confronted with serious problems at work; e.g., lack of motivation, problematic relationship with a colleague. To what extent would you discuss these problems with each of your colleagues?"* This question is related to the emotional support network and used a scale from "certainty not" (1) to "certainty yes" (4).

f) The question concerning the trust network used a scale from "complete distrust" (1) to "complete trust" (7). See Figure 2.6.

g) *"Sometimes colleagues at work do not get along, while others get along well. Maybe there are some colleagues you do not see eye to eye with, whereas you have a good relationship with other colleagues. How well or how badly do you get along with each of your colleagues?"* This question measures the getting along well network and used a scale from "very badly" (1) to "very well" (7) and was concerning the friendship network variable.

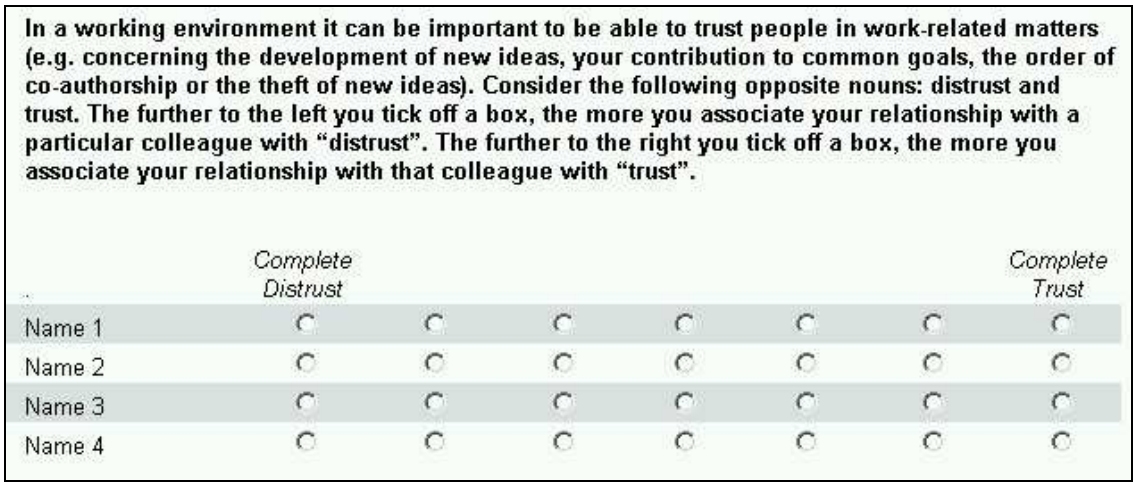


Figure 2.6 Example of social network question related to trust

Summaries of the average of the network sizes for PhD students are shown in Table 2.9. In Spain and Slovenia, responses "not in the past year", "certainly not", "complete distrust" and "very badly" are not used for counting the number of network members. In Spain and Slovenia the question related to the getting crucial information network referred to any kind of information asked to research group members. In Germany the question referred to information regarding the thesis asked to anyone. This question was considered not to be comparable. In Spain and Slovenia the socialising question referred to research group members. In Germany was referred to anyone. This question was considered not to be comparable. In Germany the thus advice questions concerning job and thesis were aggregated by deleting duplicate the names. In order to get an equivalent to the Spain and Slovenia advice questions (see Section 3.6). Germany had and additional question about to whom would respondents go when facing a motivation problem.

	Spain	Slovenia	Germany
Advice	8.01	8.09	3.57
Collaboration	5.82	6.03	__
Crucial information	4.54	4.00	__
Trust	7.12	5.82	__
Getting along well	7.33	6.00	__
Social support	5.01	4.06	__
Socializing	3.73	1.79	__
Motivation	__	__	2.17

Table 2.9 Network sizes for PhD students

Proxy measurement of the complete network (only in Girona)

In Girona the questionnaire was not administered to all research group members. In order to obtain measurements of the complete networks within the research group, supervisors were asked to rate the relationship between all possible pairs of research group members. Three different questions were asked about the scientific advice, collaboration and getting on well questions. Two extra response options as "I do not know" and "these persons do not know each other" were incorporated.

An example of the scientific advice network is shown in Figure 2.7. Having network actor measure relationships among third parties is known as proxy measurement.

Relationships among all research group members had to be answered by supervisors. These questions can become burdensome if large research groups exist.

In average terms for all three proxy questions, only 39% of the proxy relationships were reported. Moreover when five or more people composed the network, this percentage dropped to 28%. The least reported network was "how well or badly colleagues get along with each other" for which only 27% of relationships were reported, dropping to 14% for networks composed by five or more members.

Consider all work-related problems each of your colleagues had in the past year (namely since 1 november 2002) and that he/she was unable to solve him/herself. How often did your colleagues go to each other for scientific advice when they were confronted with those problems?

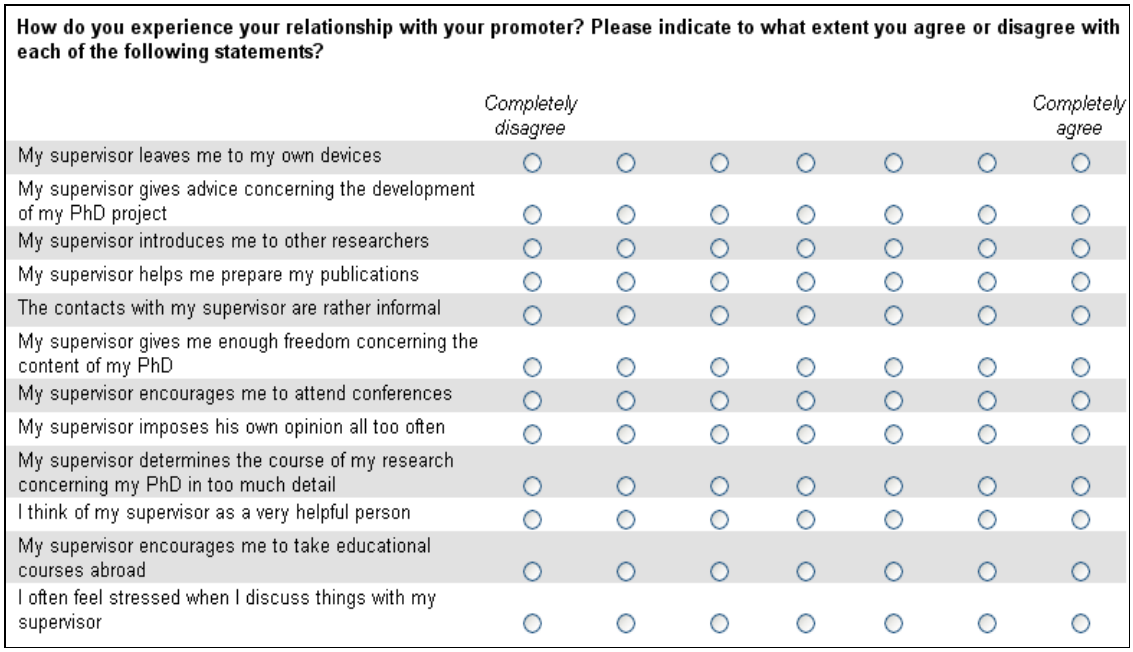
	Not in the past year	*Once in the last year*	*Several times a year*	*About monthly*	*Several times a month*	*Weekly*	*Several times a week*	*Daily*	*These persons do not know each other*	*I do not know*
Name 1 - Name 2	○	○	○	○	○	○	○	○	○	○
Name 1 - Name 3	○	○	○	○	○	○	○	○	○	○
Name 1 - Name 4	○	○	○	○	○	○	○	○	○	○
Name 1 - Name 5	○	○	○	○	○	○	○	○	○	○
Name 2 - Name 3	○	○	○	○	○	○	○	○	○	○
Name 2 - Name 4	○	○	○	○	○	○	○	○	○	○
Name 2 - Name 5	○	○	○	○	○	○	○	○	○	○
Name 3 - Name 4	○	○	○	○	○	○	○	○	○	○
Name 3 - Name 5	○	○	○	○	○	○	○	○	○	○
Name 4 - Name 5	○	○	○	○	○	○	○	○	○	○

Figure 2.7 Example of question for proxy respondent in scientific advice network

We decided not to use these proxy measures in our analysis.

Relationship with the supervisor (attitudinal variable)

The next topic is the relationship of PhD students with their supervisors (Deschrijver et al., 2001), and was asked to PhD students only. This question used a scale from "completely disagree" (1) to "completely agree" (7) for the different items (see Figure 2.8). The questions and their averages are shown in Table 2.10.



How do you experience your relationship with your promoter? Please indicate to what extent you agree or disagree with each of the following statements?

	Completely disagree						*Completely agree*
My supervisor leaves me to my own devices	○	○	○	○	○	○	○
My supervisor gives advice concerning the development of my PhD project	○	○	○	○	○	○	○
My supervisor introduces me to other researchers	○	○	○	○	○	○	○
My supervisor helps me prepare my publications	○	○	○	○	○	○	○
The contacts with my supervisor are rather informal	○	○	○	○	○	○	○
My supervisor gives me enough freedom concerning the content of my PhD	○	○	○	○	○	○	○
My supervisor encourages me to attend conferences	○	○	○	○	○	○	○
My supervisor imposes his own opinion all too often	○	○	○	○	○	○	○
My supervisor determines the course of my research concerning my PhD in too much detail	○	○	○	○	○	○	○
I think of my supervisor as a very helpful person	○	○	○	○	○	○	○
My supervisor encourages me to take educational courses abroad	○	○	○	○	○	○	○
I often feel stressed when I discuss things with my supervisor	○	○	○	○	○	○	○

Figure 2.8 Question on the relationship with the supervisor

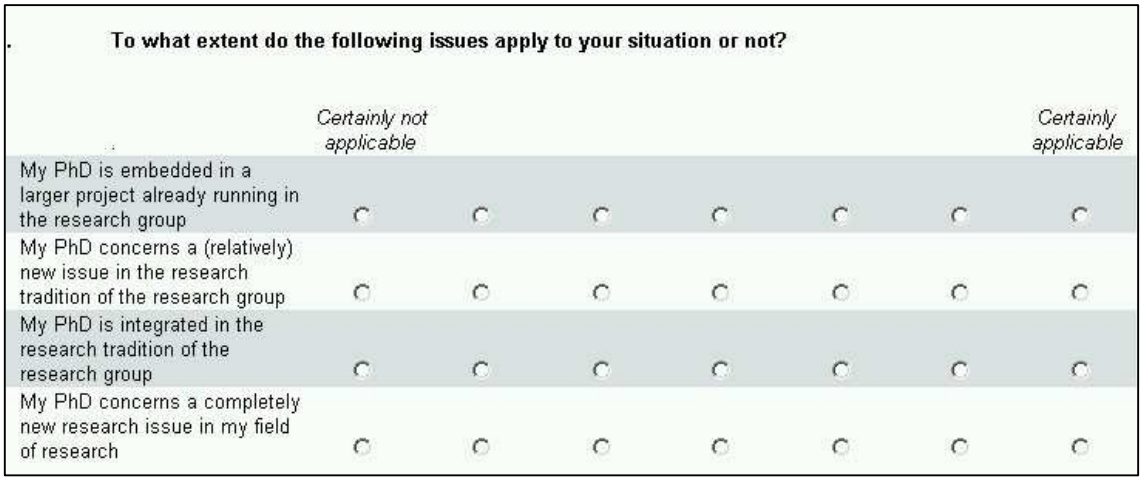
	Spain	Slovenia	Germany
My supervisor leaves me to my own devices	4.9	5.5	6.5
My supervisor gives advice concerning the development of my PhD project	5.2	5.3	4.7
My supervisor introduces me to other researchers	4.7	5.2	4.0
My supervisor helps me prepare my publications	5.2	4.9	4.0
The contacts with my supervisor are rather informal	5.4	5.1	3.8
My supervisor gives me enough freedom concerning the content of my PhD	5.4	6.0	6.0
My supervisor encourages me to attend conferences	4.6	5.3	4.6
My supervisor imposes his own opinion all too often	3.3	2.6	2.4
My supervisor determines the course of my research concerning my PhD in too much detail	2.7	2.1	2.0
I think of my supervisor as a very helpful person	4.6	5.6	4.3
My supervisor encourages me to take educational courses abroad	3.9	4.6	2.6
I often feel stressed when I discuss things with my supervisor	3.5	2.8	2.3

Table 2.10 Averages of the relationship with the supervisor question

Results from Table 2.10 show differences between countries. In Germany the supervisors leaves the PhD students to their own devices more than in Slovenia or Spain. Besides, in Germany the supervisor helps less prepare publications, encourage less to attend courses abroad and introduce the student less often to other researchers. In Spain and Slovenia PhD students and their supervisors have an informal relationship. It can be a sign of confidence between them and it can be related to the fact that the supervisor gives enough freedom to the student to develop some aspects of the thesis while advising and helping the student to do the thesis and to prepare publications. In all countries students disagree that the supervisor imposes too much his /her ideas and that the supervisor determines the course of the PhD student's research in too much detail. These results show that supervisors let some initiative to their PhD students who think that supervisors give valuable advice while trusting them to carry out the research.

Integration of the PhD thesis within the research group tradition (attitudinal variable)

The next question concerns the integration of the research within the research group tradition and asked to what extent some statements applied to the PhD research. The question used a scale from "certainly not applicable" (1) to "certainly applicable" (7). See Figure 2.9. The question items and their average are shown in Table 2.11. The German questionnaire does not have this question because PhD students do not belong to any research group.



To what extent do the following issues apply to your situation or not?

	Certainly not applicable						*Certainly applicable*
My PhD is embedded in a larger project already running in the research group	○	○	○	○	○	○	○
My PhD concerns a (relatively) new issue in the research tradition of the research group	○	○	○	○	○	○	○
My PhD is integrated in the research tradition of the research group	○	○	○	○	○	○	○
My PhD concerns a completely new research issue in my field of research	○	○	○	○	○	○	○

Figure 2.9 Question on integration of the PhD thesis within the research

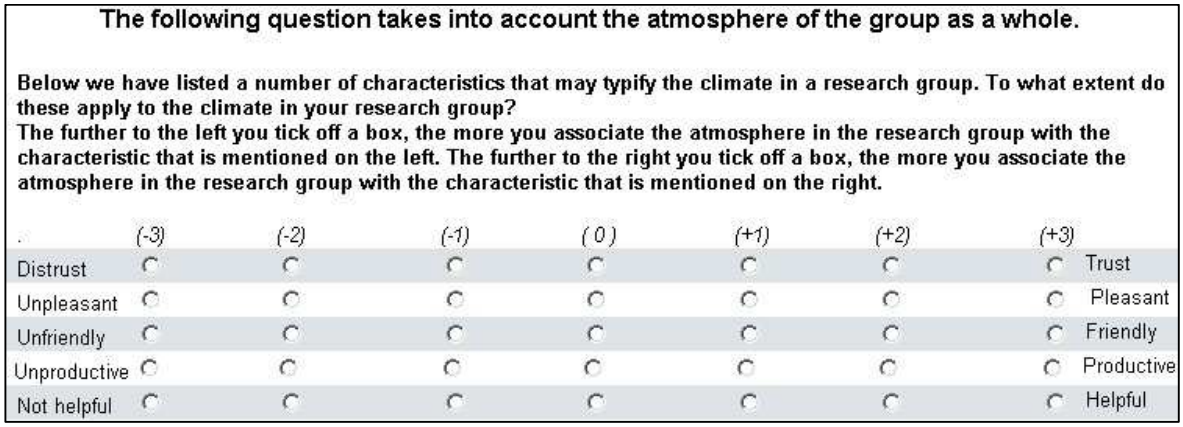
	Spain	Slovenia
My PhD concerns a (relatively) new issue in the research tradition of the research group	4.8	5.5
My PhD is embedded in a larger project already running in the research group	4.7	4.6
My PhD is integrated in the research tradition of the research group	4.6	4.7
My PhD concerns a completely new research issue in my field of research	3.7	4.3

Table 2.11 Average of integration of the PhD topic within the research group tradition

Results from Table 2.11 show to what extent the thesis carried out by PhD students departs from the research group's tradition. Most PhD students are working on relatively new issues in the research group, especially in Slovenia which is a good indicator of progress or improvement for any university. However, these new issues tend to be embedded in the group's projects and tradition.

Atmosphere in the research group (attitudinal variable)

The next topic concerns the atmosphere in the research groups as a whole. There was a list of characteristics that may typify the "social climate" in a research group formulated through semantic differential scales (Cook et al., 1981, 242-245) from 1 to 7: distrust-trust, unpleasant-pleasant, unfriendly-friendly, unproductive-productive and not helpful-helpful. See Figure 2.10. The averages of these scales for both PhD students and their supervisors are shown in Table 2.12. This question is not asked in the German questionnaire.



The following question takes into account the atmosphere of the group as a whole.

Below we have listed a number of characteristics that may typify the climate in a research group. To what extent do these apply to the climate in your research group?
The further to the left you tick off a box, the more you associate the atmosphere in the research group with the characteristic that is mentioned on the left. The further to the right you tick off a box, the more you associate the atmosphere in the research group with the characteristic that is mentioned on the right.

.	(-3)	(-2)	(-1)	(0)	(+1)	(+2)	(+3)	
Distrust	○	○	○	○	○	○	○	Trust
Unpleasant	○	○	○	○	○	○	○	Pleasant
Unfriendly	○	○	○	○	○	○	○	Friendly
Unproductive	○	○	○	○	○	○	○	Productive
Not helpful	○	○	○	○	○	○	○	Helpful

Figure 2.10 Question on atmosphere in the research group

	PhD student		Supervisor	
	Spain	Slovenia	Spain	Slovenia
Unpleasant-pleasant	5.9	5.5	6.4	6.1
Unfriendly-friendly	5.8	5.6	6.2	6.0
Distrust-trust	5.7	5.5	6.1	6.2
Unproductive-productive	5.3	5.3	6.0	6.0
Not helpful-helpful	5.1	6.0	6.1	6.2

Table 2.12 Averages of the group atmosphere question

The results in this table show a good climate in the research groups in all respects, even a better one from the supervisor's responses. This may be the result of the research groups being defined by the supervisor, who answered the name generators. The different universities follow the same structure according to this question.

Attitude towards publishing and towards work (attitudinal variable)

The next topic concerns the PhD student and supervisor's attitude towards academic publishing (Deschrijver et al., 2001) and towards work (Cook et al., 1981, 117-120; and Furnham, 1997, 293). The first two questions used a response scale from "completely disagree" (1) to "completely agree" (7). The first question concerns motivation for academic publishing as show in Table 2.13.

	PhD student			Supervisor	
	Spain	Slovenia	Germany	Spain	Slovenia
Publishing is stimulating and motivating	5.8	6.0	5.0	6.0	6.4
Publishing is an important means of getting feedback	5.6	5.5	4.7	5.7	6.0
Publishing is annoying because it is very time-consuming	3.6	2.7	3.3	3.0	2.3
I only publish because I'm supposed to	2.6	3.4	2.9	2.2	2.6
Publishing is useless	1.6	1.6	1.5	1.7	1.4

Table 2.13 Motivation averages for academic publishing

Results from Table 2.13 show the same motivation academic publishing structure for PhD students and supervisors for all countries. Large differences among items are obtained due to the reverse meaning of the sentences. For respondents publishing is motivational, an important way to get feedback of their research; they do not publish only because they are obligated to, and they disagree with the uselessness of publishing. The three universities have the same distribution on motivation for academic publishing for PhD students. Germany does not have the questionnaire for supervisors.

The second question concerns job involvement. The items and averages for the question are shown in Table 2.14.

	PhD student			Supervisor	
	Spain	Slovenia	Germany	Spain	Slovenia
I'll do overtime to finish a job, even if I'm not paid for it	5.7	5.4	6.0	6.1	6.3
The major satisfaction in my life comes from my job	2.9	3.7	3.0	3.0	5.0
The most important things that happen to me involve my work	3.0	3.4	3.4	2.9	4.5
Some activities are more important to me than work	5.6	5.9	5.7	5.7	4.8
To me, my work is only a small part of who I am	4.7	4.0	3.1	4.0	2.6
Most things in life are more important than work	4.0	3.7	4.1	3.4	2.3

Table 2.14 Averages of the work importance question

Results from Table 2.14 show the same structure for PhD students and supervisors about the importance of work. Germany does not have the supervisors' questionnaire. All respondents can work longer hours without extra payment in order to finish some experiment or work. It would mean they like the job they are doing. However, they are also aware that not everything is work, but there are other important things in life. They thus disagree with the fact that the most important things in life come from or are related to work. We can thus observe a differentiation between job and private life. This differenciation is lower for Slovene supervisors.

The third question was about the feeling of PhD students at work (Cook et al., 1981; Furnham, 1997; and Deschrijver et al., 2001), and was asked to PhD students only. The question made use of a scale from "certainly not applicable" (1) to "certainly applicable" (7).

	Spain	Slovenia	Germany
Working in a PhD is a lonesome activity	4.3	4.0	3.7
I often think I lack the necessary insight in my PhD research	5.1	3.1	2.9
At the start of my PhD research, I gave myself a considerable chance of succeeding	5.2	4.1	5.2
My PhD research gives me a chance to demonstrate my creativity	4.9	5.5	4.4
My PhD research appears to be less fascinating than I expexted	3.8	2.7	3.3
I feel like I'm doing meaningful work with my PhD	5.0	4.7	3.3
During my PhD research I often feel as if I am alone on an island	4.2	3.4	3.7
I often exchange views with my colleagues about my PhD research	5.2	4.4	4.1
More and more often, I get the feeling that doing a PhD is too difficult for me	2.9	2.1	2.1

Table 2.15 Averages of the feeling at work question

Results from Table 2.15 show the feelings of PhD students in their third or fourth year of PhD. We can observe some differences between countries: for instance, in Spain, PhD students feel lacks of necessary insight in their research, while in Slovenia and Germany it does not happen. In Slovenia they feel they can demonstrate more creativity than in Spain or Germany. German PhD students give the lowest score to the item on meaningfulness of the PhD job. In all countries they disagree with the fact that, more and more, doing a PhD is a difficult task and with the statement that the PhD is less fascinating. Overall, it seems that PhD students have good feelings regarding their PhD.

Satisfaction at work (attitudinal variable)

The next topic concerns satisfaction with several work-related aspects (Cook et al., 1981, 16-19; and Furnham, 1997, 306), but it is not asked in the German questionnaire. This question used a scale from "strongly disagree" (1) to "strongly agree" (7). Items and averages are shown in Table 2.16; they have again the same structure for students and supervisors. According to the results, both feel happy with their work in both countries. Moreover they have the feeling of being happier in their work than most other people in other kinds of work. They are not bored in their job, do not regret having taken it and they find real enjoyment in their work. Satisfaction at work is somewhat higher for Slovenian supervisors than for the remaining three groups.

	PhD Student		Supervisor	
	Spain	Slovenia	Spain	Slovenia
My job feels like a hobby to me	5.0	4.1	4.8	5.0
I enjoy my work more than my spare time	2.9	3.2	2.8	4.1
I'm often bored with my job	2.7	2.2	2.0	1.8
Most of the time I have to force myself to go to work	2.8	2.3	2.0	1.9
I definitively dislike my work	1.7	1.6	1.5	1.3
I think I'm happier in my work than most other people	4.4	5.2	4.7	5.4
I find real enjoyment in my work	4.8	5.0	4.9	5.6
I'm sorry I ever took this job	1.9	1.7	1.5	1.4

Table 2.16 Averages of the satisfaction related to work question

Publications and performance (background/dependent variable)

The next topic is performance, as measured mainly by weighted academic publications and conference papers. In order to measure performance, respondents were asked to recall the number of research outputs they had authored or co-authored during the past three years (Figure 2.11).

Each type was given different weights according to the importance of the publications. We worked with different weighting schemes and even with uniform weights, but the weights we finally used reduced the skewness of performance and its variance between fields of study. The measure of performance was computed by assigning the weight 1 from Table 2.17. In the German questionnaire books, chapters and papers in proceedings were asked without mentioning whether they were or not reviewed. For comparative purposes we created a second measure of performance with alternative weighting scheme (weight 2 in Table 2.17). This second measure of performance is used only when comparative analysis includes the German data, that is is in Chapter 5. Results from both weighted measures are shown in Table 2.18.

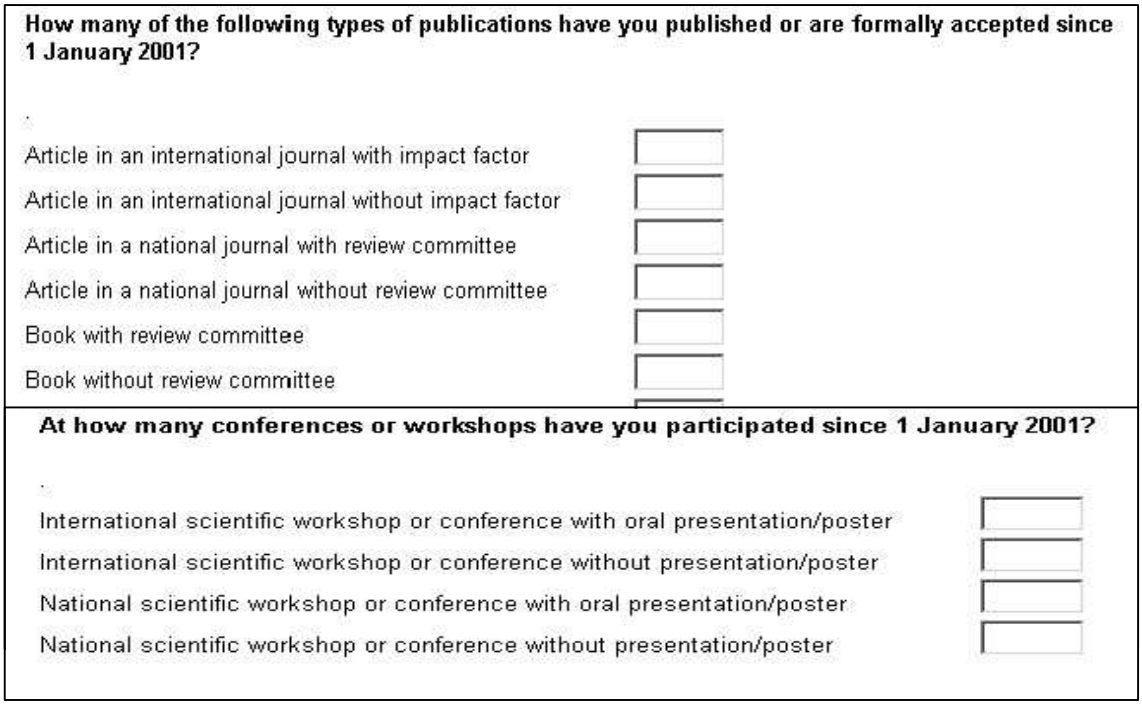


Figure 2.11 Performance question

Type of output	Weight 1	Weight 2
Article in an international journal with impact factor	2	2
Article in an international journal without impact factor	2	2
Article in a national journal with review committee	2	2
Book with review committee	2	2
Book chapter with review committee	2	1
Paper in proceedings with review committee	2	1
Article in a national journal without review committee	1	1
Book without review committee	1	2
Book chapter without review committee	1	1
Paper in proceedings without review committee	1	1
Internal research paper	1	1
International conference with oral presentation/poster	1	1
National conference with oral presentation/poster	1	1

Table 2.17 Weights for the different types of outputs

	PhD Student	Supervisor
First Measure of Performance (weight 1)		
Spain	12.61	34.30
Slovenia	13.30	35.33
Comparative Measure of Performance (weight 2)		
Spain	7.62	---
Slovenia	8.48	---
Germany	6.21	---

Table 2.18 Average of performance in each country of students and supervisors

Academic performance for PhD students will be used as dependent variable and supervisor's performance as one of the explanatory variables within the background and network variable group. Average performance is slightly higher in Slovenia and slightly lower in Germany, compared with Spain.

Personal characteristics (background variable)

The next topic concerns personal characteristics. There were only two questions for supervisors: gender and age. The percentages and averages are shown in Table 2.19, where a significant gender difference between PhD students and supervisors is revealed. We can see differences between countries. In Spain and Slovenia, roughly one fourth of supervisors and one third of students are female, which means that a lower difference between genders will exist in the future, when these PhD students have the possibility to become supervisors. In Germany we find more or less the same percentage of male and female, PhD students which are also the oldest.

	PhD students			Supervisor	
	Spain	Slovenia	Germany	Spain	Slovenia
Male	63%	61%	49%	75%	74%
Female	37%	39%	51%	25%	26%
Age Average	29	30	32	43	48

Table 2.19 Percentages by gender and average age of respondents

Other PhD students' personal characteristics are described in Tables 2.20 to 2.22. The questions were about who their housemates (multiple choices) are, who provides their income, their marital status and whether they have children or not.

Living with	Alone	Partner	Children	Friends	Parents	Others
Spain	6%	41%	10%	20%	39%	11%
Slovenia	16%	63%	19%	6%	24%	12%
Germany	16%	7%	12%	27%	0%	57%

Table 2.20 PhD students' housemate

In Table 2.20 we observe that living with partner is the most frequent option for students from Spain and Slovenia but we find important differences between countries. Spain students tend more to live with their parents or share expenses with friends. Slovene students tend more to live alone, with their partner or with their children, which suggests that Slovene PhD students are more economically independent, which is confirmed by Table 2.21 and the extensive grant system in the country. German PhD students do not have this question on income sources.

	Spain	Slovenia
Only student	18%	20%
Student and partner	42%	58%
Student and other resources(parents)	34%	18%
Student, partner and other resources (parents)	6%	4%

Table 2.21 PhD student's income sources

According to Table 2.21, only 18% of Slovene students need parents' resources in comparison with 34% in Girona. Here, it is obvious that if students are living with their partner more frequently in Slovenia, both individuals also more frequently provide income sources.

	Spain	Slovenia	Germany
Married	18%	28%	26%
Not married, with a committed relationship	48%	51%	50%
Not married and without committed relationship	34%	21%	24%
Having children (regardless of marital status)	12%	28%	26%

Table 2.22 PhD student's marital status and having children

Table 2.22 is the final confirmation that Slovene PhD students are more economically independent as a larger percentage is married and/or has children. The German distribution is close to the Slovene in this question.

Chapter 3

COMPARABLE INDICATORS

3.1 Introduction

3.2 Cross-cultural comparison

3.3 Creation of comparable background variables

3.4 Comparable attitudinal variables

3.5 Methods of dealing with measurement error

3.6 Network variables

3.1 Introduction

The aim of this chapter is to create comparable indicators wherever some comparability problems arose with particular questions in Spain, Slovenia and Germany.

Properly translating a questionnaire is not enough for valid comparative research. The researcher must also show that it exhibits appropriate levels of semantic and conceptual equivalence relative to the source language and that the procedures through which it is administered minimize any problems created by lack of equivalence. By equivalence we mean both semantic equivalence, which involves the choice of terms and sentence structures that ensure that the meaning of the source language statement is preserved in the translation, and conceptual equivalence, which refers to the degree to which a concept, independent of the words to operationalize it, exists in the same form in the source and target cultures (Behling and Law, 2000).

The questions that "ask the same question" allow researchers to target the highest form of equivalence for the comparison. If translated questions measure identical dimensions and score equivalence has been established, findings can then be compared item-for-item and scale-for-scale across a series of countries. In sum, well-developed and well-tested new instruments should reduce problems of equivalence (Harkness et al., 2003).

Most of the variables are easily comparable across universities due to the translation procedure explained in Chapter 2, to the pretests of the translated questionnaires and to the relatively few differences we observed in the way PhD studies are organised in different universities.

If we compare all PhD students' and all supervisors' questions between the three countries we find that nearly the same questions were asked both in Slovenia and in Spain. In Germany, only the PhD students' questionnaire exists. However, due to the lack of supervisor's questionnaire and the fact that there were a small number of different questions for Germany, these ones cannot be used in the comparative study. In cross-cultural questionnaires these limitations are normal because some questions are necessarily country specific. For instance, the PhD student questionnaires in Spain contained a question about their type of contract with the university. This question cannot be asked in Slovenia because there only one type of contract is possible for PhD students, namely the grant awared by the Young Researchers Programme. In Germany research groups are rare, therefore questions on collaboration, trust, getting on well, atmosphere and interpretation of the PhD topic within the research group make no sense.

In the next sections, we explain in more detail how we used all three countries' variables in order to create comparable indicators. These indicators are variables included in the background, attitudinal or social network classification, defined in Chapter 2.

3.2 Cross-cultural comparison

Social scientists seek to understand complex realities and the usefulness of comparative research for generating and testing social theories is well established (cf. Nowak, 1989; and Kohn, 1989). Comparing groups, cultures, nations or continents is an essential means of distinguishing between local conditions and universal regularities (e.g., Roth, 1971; Apter, 1971; and Kohn, 1989). Not surprisiling, therefore, survey research has a clearly delineated international and cross-cultural tradition (e.g., Almond and Verba, 1963; Prezeworski and Tenue, 1966, 1970; Barnes and Kaase, 1979; and Krebs and Schüssler, 1987) found in Harkness et al., 2003.

Up to the late 1970's, the majority of comparative surveys consisted of behavioural and demographic studies (e.g., the World Fertility Study and the Multinational Time Use Studies; cf. Gauthier, 2000). Many surveys before that time were not comparative in design, implementation and intention. They were instead, what Gauthier (2000) calls "ex post harmonized survey agglomerates", that is national survey data which were recorded according to a "comparative" scheme (Harkness et al., 2003).

Following intensive efforts in the 1960s (cf. Rokkan et al., 1969; and Armer and Girimshaw, 1973), by the early 1970s, a new kind of multinational survey project had appeared. The Eurobameter, an ongoing attitudes and value orientation survey series is a prime example. The most recent multinational addition to date is the European Social Survey, which focuses on social and political values measured as attitudes, opinions and behaviour (Harkness et al., 2003).

In the cross-cultural research one of the most important points is the quality of cross-cultural measurement. It depends on factors as diverse as appropriate theory, instrument design, sampling frame, mode of data collection, data analysis, and documentation across all the cultures involved. The total quality is the net result of the combination of outcomes of these factors. Exclusive reliance on appropriate instrument design, or statistical analysis, or some other factor in the process, may challenge the overall quality of a study, as can concentrating on best or worst case outcomes. Neither an exclusive focus on theory nor an exclusive reliance on the repair capacities of advanced statistics can guarantee the survey quality (Harkness et. al, 2003). In this INSOC project, the frame and data collection mode were identical across countries as shown in Chapter 2. All universities also contributed to the questionnaire design, by taking into account the diversity in PhD studies organisation across countries. The common data analysis is performed in this thesis.

Most cross-cultural research is undertaken to compare countries, cultures, or groups on some characteristic. When these characteristics are physical attributes, the likely significance of the findings is clear. The inferences from attitudinal variables are less obvious. Some challenges to cross-national comparability arise from differences in various response effects (Hui and Triandis 1985; and Usunier, 1999). Though response effects are a source of measurement error in all surveys, cross-national surveys are especially vulnerable to various error components being correlated with country. Thus, differences observed across countries may represent differences in response effects rather than in substance. Work by Saris (1998) across 13 cultural groups/nations indicates the measurement error is not constant. He notes that "even if the same method is used, one can get different results due to differences in the error structure in different countries". Among the most important cross-national sources of measurement variation are effects related to social desirability, acquiescence, extremity, no opinion, middle options, response order, context and order, and mode. Thus, differences in means across countries need not point to actual differences. The populations could, for example, differ in the social desirability of demonstrating the particular attitude (for example, in one population showing that attitude may be a cultural norm, while in the other not).

Problems of competing interpretations are typical for studies in which the relationship between the measurement operations and the underlying constructs is only of statistical (probabilistic) nature. Because latent constructs such as attitudinal variables cannot be measured directly in the way that for instance height can, there is no manifest external criterion on the basis of which to test the validity of the measurement. Instead, validity assessments are carried out on the basis of extensive statistical testing using for instance factor analysis models as is done in this thesis (Harkness et al., 2003).

In sum, various measurement effects can influence survey responses. In a number of cases, we know that these effects can vary across subgroups and/or countries, and in other cases such variable effects are plausible, albeit not empirically demonstrated. This is not suggesting that response effects always differ among different groups and across societies. Though the body of rigorous cross-national measurement studies is small, the research has documented a number of consistent results. Variable measurement effects remain a serious concern to which researchers must be alert and to which this thesis only affers a partial solution (Smith, 2003).

3.3 Creation of comparable background variables

The first group of comparable indicators that had to be worked out is composed by different background variables, which are related to the field of study where PhD students' and supervisors' (not for Germany) are currently working and their previous education.

Field of study

The original classifications of field of study for Spain, Slovenia and Germany were different due to their specific university characteristics. Thus, we had to build a comparable field of study variable for all countries, the final aggregation was:

1) *"Science"* is composed by Biology, Chemistry, Environmental Sciences, Ecology, Mathematics, Physics, Medicine, Pharmacy, Magnetic Resonance, Nursing, Geology, Mineralogy, Medicine, Meteorology, Genetics and Botanics.

2) *"Technical studies"* are formed by Computer Sciences, fields of Engineering (including for instance, agriculture, civil, electronics, and mechanics), Information technology, Nuclear, Materials, and Nutrition.

3) *"Humanistics"* contain History, Literature Studies, Geography, Theology, Philosophy, Music, Psychology, Anthropology, Theology, Social Pedagogy and Teaching.

4) *"Social Sciences"* contain Economics, Law, Sport and Education, Communication science, Sociology, Political Sciences, Public Administration, Business Administration and Criminalistics.

Mark average

The mark variable refers to the undergraduate mark average for PhD students. This question was asked in the PhD students' questionnaire in Spain and Slovenia. In Germany, they didn't ask this question because they had the information in administrative records.

This variable was differently measured for Spain, Slovenia and Germany, therefore the creation of a comparative measure or indicator was necessary in this case. In Spain and Slovenia different 0 to 10 scales are used. In Spain, 5 and 6 translate into "pass", 7 and 8 into "noticeable", and 9 and 10 into "excellent" and 10 into "excellent with honors". In Slovenia, 6 translates into "pass", 7 into "sufficient", 8 and 9 into "good", and 10 into "excellent". In Germany, a different scale is used and 4 and 3 translate into "pass", 2 into "good", 1 into "very good" and 0.7 into "excellent". The

fact that in Spain only the verbal labels of the grades were available and in Slovenia also the numeric ones somewhat constrained our possibilities. The final scale was constructed also by taking into account the distributions in all countries. For instance, Slovenia has a larger number of 10 which was worth considering in a separate category, and the minimum value was 8 due to the more stringent rules for the admission of PhD students in that country. Thus, keeping 8 and 9 together in that country would have left us with a binary indicator.

The final indicator was composed by "A+", which corresponds to 10 in Spain and Slovenia and to 0.7 in Germany, "A", which corresponds to 9 in Spain and Slovenia and to 1 in Germany, "B", which corresponds to 7 and 8 in Spain, to 8 in Slovenia and to 2 in Germany and C, which corresponds to 5 and 6 in Spain, to 6 and 7 in Slovenia and to 3 and 4 in Germany. The percentage distribution for each data set is shown in Chapter 2.

3.4 Comparable attitudinal variables

The attitudinal variables used in each country come from the questionnaire described in Chapter 2 and are the following: reasons to start a PhD, relationships with the supervisor, integration of the PhD thesis within the research group tradition, atmosphere in the research group, attitudes towards publishing and towards work and satisfaction at work.

From these variables, each country used factor analyses to detect sets of unidimensional items from which summated rating scales or SRS (Likert, 1932; and Spector, 1992) were computed. The SRS attitudinal variables are shown in Table 3.1 and are the following:

Motivation to start a PhD: Autonomy

It refers to aspects such as intellectual freedom, independence at work and self organization for the PhD student.

Motivation to start a PhD: Academic career

It refers to aspects such as expectation for the future and interest in staying at the university after finishing their PhD.

Motivation to start a PhD: Research interest

It refers to aspects such as importance of the research and specialization in the field of research the PhD student is interested in.

Motivation to start PhD: Career advantages

Career advantage aspects are related to consequences of obtaining a PhD (e.g., prestige or improved job opportunities).

Guidance of the supervisor during the PhD

Extents to which the supervisor gives advice and helps, or lets the PhD student work on his/her own devices concerning research and publications.

Too close supervision by supervisor

It refers to the lack of freedom that the PhD student has when working on his/her PhD. For instance, the supervisor's opinion could be imposed in too much detail or the supervisor could determine the course of the PhD student's doctorate in too much detail.

Promotion of contacts

Extent to which supervisors can be used by PhD students as a bridge or contact network in order to reach third persons who can be important for the development of the research, to advise about courses abroad or to attend conferences.

Job involvement

Job importance compared to other aspects of life, measured by items such as "the major satisfaction in my life comes from my job" or "the most important things that happen to me involve my work".

Attitude towards publishing

This variable measures feeling about publishing from positive (e.g., "publishing is stimulating and motivating") to negative (e.g., "I only publish because I'm supposed to").

Meaninglessness

It is the lack of importance, meaning or interest of the research done at the university.

Loneliness

It is the lack of contact with supervisor or group members when doing research.

The next attitudinal variables are referring to the research group or to the PhD student's job and were asked in Spain and Slovenia only.

Atmosphere in the research group

Different group characteristics measured by semantic differential scales such as distrust-trust, unpleasant-pleasant, unfriendly-friendly, unproductive-productive and not helpful-helpful.

Integration of the PhD thesis within the research group

Extent to which the topic is relatively or completely new in the tradition of the research group.

Job satisfaction

Extent to which PhD students are enjoying their jobs. Different items related with satisfaction at work were described (e.g., "I find real enjoyment in my work" or "my job feels like a hobby to me").

3.5 Methods for dealing with measurement error

Reliability of a SRS is usually computed as Cronbach's α (Cronbach, 1951) under the assumption that items are at least tau-equivalent.

We use an alternative method for estimating reliability, which is based on the more relaxed congeneric measurement assumption. An observed consequence of congeneric measurement when the number of items is equal to or larger than four is that a unidimensional factor analysis model (Spearman, 1904) fits the inter-item correlations or covariances well (the opposite does not hold, i.e., the one-factor model may perfectly fit the correlations and yet items may fail to be congeneric). A unidimensional factor analysis model can be equivalently estimated as an exploratory factor analysis model (Lawley and Maxwell, 1971) or as a confirmatory factor analysis model (Jöreskog, 1969). Whatever approach is chosen, if the model is estimated by maximum likelihood, most commercial software packages will produce a χ^2 test of the fit of the model to the correlations.

Heise and Bohrnstedt's Ω coefficient of 1970:

$$r = \Omega = 1 - \frac{\sum \left[Var(item_j) \times (1 - h_j) \right]}{Var(SRS)} \qquad (3.1)$$

where h_j is the communality of item j (squared standardized loading)

Var ($item_j$) is the sample variance of item j

and Var (SRS) the sample variance of the SRS

If only two indicators are available, both h_j are replaced by their correlation.

Coromina (2006) fitted factor analysis models and computed Ω for the unidimensional sets of items thus identified in the Girona sample. We replicated the analysis for the Slovenian and German samples. The variables with correlations below 0.3 with items of the same dimension in the Slovenian and German samples were dropped and they were also dropped from the Girona sample to keep the SRS comparable, in which case the Girona Ω were reestimated. The results are shown in Table 3.1.

SRS and Item names. Minus sign shows reverse scoring	Item standardized loadings			SRS Reliability (Ω)			Original Attitudinal variables (defined in Chapter 2)
	Spain	Slovenia	Germany	Spain	Slovenia	Germany	
Motivation to start PhD: Autonomy				.799	.849	.736	
Q9f .The possibility to steer my own research	.694	.682	.532				
Q9m. The independence at work	.763	.854	.699				
Q9n. The intellectual freedom	.818	.883	.846				
Motivation to start PhD: Academic career				.563	.464	.613	
Q9a. My ambitions for an academic career	.627	.550	.666				
Q9j. The possibility of staying on at university after obtaining my PhD	.627	.550	.666				
Q9o. My great interest in education	---1	----1	----1				
Motivation to start PhD: Research interest				.709	.799	.560	Reasons to start a PhD
Q9p. My great interest in research	.842	.786	.524				
Q9c. My great interest in the topic	.578	.819	.559				
Q9l. The possibility to specialise in my field of research	.598	.694	.560				
Motivation to start PhD: Career advantages				.465	.515	.691	
Q9i. The improved job opportunities when possessing a PhD degree	.550	.593	.725				
Q9g. The prestige of being a PhD student	---2	---2	---2				
Q9d. Obtaining a PhD in itself	.550	.593	.725				

Table 3.1 Scale names and reliabilities. Item names and standardized loadings

1. Q9o had very low correlations with other variables in the Germany sample (at most .009 and its standardized loading was .001).
2. Q9g had very low correlations with other variables in the Germany sample (at most .252 and its standardized loading was .460).
3. ATMOSP can not be comparable because in Germany the PhD students do not belong in any research group and they do not have this question in their questionnaire.
4. TOPIC can not be comparable because in Germany the PhD students do not belong in any research group and they do not have this question in their questionnaire.
5. Q28c had very low correlations with other variables in the Slovene sample (at most .254 and its standardized loading was .254).
6. Q29a had very low correlations with other variables in the Slovene sample (at most .256 and its standardized loading was .288).
7. Q30d had very low correlations with the remaining items (minimum 0.170, maximum 0.272) in the Spanish sample.
8. Q31d had very low correlations with other variables in the Germany sample (at most .239 and its standardized loading was .639).
9. Q32d had very low correlations with other variables in the Germany sample (at most .281 and its standardized loading was .584).
10. Q32h had very low correlations with other variables in the Germany sample (at most .177 and its standardized loading was .104).
11. Q39a and Q39f had correlations below 0.3 in the Slovene sample (their standardized ladings were .291 and .6)
12. JOBSAT cannot be comparable because in Germany the PhD students do not belong in any research group and they do not have this question in their questionnaire.

SRS and Item names. Minus sign shows reverse scoring	Item standardized loadings			SRS Reliability (Ω)			Original Attitudinal variables (defined in Chapter 2)
	Spain	Slovenia	Germany	Spain	Slovenia	Germany	
Atmosphere in the research group				.961	.926	---3	
Q27b. Trust-distrust	.881	.869	---3				Atmosphere in the
Q27c. Unpleasant-pleasant	.982	.903	---3				research group
Q27d. Unfriendly-friendly	.910	.881	---3				
Q27e. Unproductive-productive	.667	.738	---3				
Q27f. Not helpful-helpful	.766	.824	---3				
Integration of the PhD thesis within the research group				.594	.696	---4	Integration of the
Q28b. My PhD concerns a (relatively) new issue in the research tradition of the research group	.650	.731	---4				PhD thesis within
Q28c. **(-)**My PhD is integrated in the research tradition of the research group	---5	---5	---4				the research group tradition
Q28d. My PhD concerns a completely new research issue in my field of research	.650	.731	---4				
Guidance of supervisor during PhD				.840	.790	.771	
Q29a. (-) My supervisor leaves me to my own devices	---6	---6	---6				
Q29b. My supervisor gives advice concerning the development of my PhD project	.851	.808	.792				
Q29d. My supervisor helps me prepare my publications	.851	.808	.792				
Too close supervision by supervisor				.806	.667	.699	
Q29f. **(-)** My supervisor gives me enough freedom on the content of my PhD	.821	.710	.714				Relationships with the supervisor
Q29h. My supervisor imposes his own opinion all too often	.821	.710	.714				
Promotion of contacts				.830	.765	.785	
Q29c. My supervisor introduces me to other researchers	.805	.701	.710				
Q29k. My supervisor encourages me to take educational courses abroad	.797	.711	.658				
Q29g. My supervisor encourages me to attend conferences	.760	.755	.837				
Job involvement				.764	.807	.776	
Q30b. The major satisfaction in my life comes from my job	.877	.932	.671				Attitude towards
Q30c. The most important things that happen to me involve my work	.784	.862	.784				publishing and
Q30d. (-) Some activities are more important to me than work	---7	---7	---7				towards work
Q30e. (-) To me, my work is only a small part of who I am	.551	.486	.532				
Q30f. (-) Most things in life are more important than work	.382	.428	.743				

Table 3.1 Continued

SRS and Item names. Minus sign shows reverse scoring	Item standardized loadings			SRS Reliability (Ω)			Original Attitudinal variables (defined in Chapter 2)
	Spain	Slovenia	Germany	Spain	Slovenia	Germany	
Attitude towards publishing				.830	.698	.742	Attitude towards
Q31a. Publishing is stimulating and motivating	.833	.763	.862				publishing and
Q31b. Publishing is an important means of getting feedback	.671	.615	.649				towards work
Q31c. (-) I only publish because I'm supposed to	.740	.470	.539				
Q31d. (-) Publishing is annoying because it is very time-consuming	---8	---8	---8				
Q31e. (-) Publishing is useless	.705	.598	.595				
Meaninglessness				.668	.603	.602	
Q32d**. (-)** My PhD research gives me a chance to demonstrate my creativity	---9	---9	---9				
Q32e. My PhD research appears to be less fascinating than I expected	.709	.657	.656				
Q32f. **(-)** I feel like I'm doing meaningful work with my PhD	.709	.657	.656				
Loneliness				.675	.751	.758	
Q32a. Working on a PhD is a lonesome activity	.714	.775	.781				
Q32g. During my PhD research I often feel as if I am alone on an island	.714	.775	.781				
Q32h. (-) I often exchange views with my colleagues about my PhD research	---10	---10	---10				
Satisfaction at work				.784	.815	---12	
Q39a. My job feels like a hobby to me	---11	---11	---11				
Q39f. I think I'm happier in my work than most other people	---11	---11	---11				Satisfaction at
Q39g. I find real enjoyment in my work	.736	.600	---12				work
Q39c. (-) I'm often bored with my job	.717	.821	---12				
Q39d. (-) Most of the time I have to force myself to go to work	.641	.738	---12				
Q39e. (-) I definitively dislike my work	.685	.795	---12				

Table 3.1 Continued

3.6 Network variables

Out of the seven networks we used in the web questionnaire, only the scientific advice network was asked in a comparable way for all three countries. Spain and Slovenia had two questions related to internal (research group) and external advice relationships. Germany had two questions asking about advice on the thesis and on the job. By combining both questions we could get on equally comprehensive egocentered advice network for the PhD student. It must be taken in account that in Spain and Slovenia both the research group presented in the name generation list and external contacts are present in the questionnaire if some of the research group members have zero contact. Research group members with zero contact had thus to be omitted from all calculations. In Germany there was no list, and thus zero contacts are absent from the start. Two comparable network variables were measured:

- Size of the advice network.
- Frequency of advice of the PhD supervisor to the student, as the supervisor is a key member of the student's network.
- Average frequency of advice of all network members to the PhD student.

	Girona	Slovenia	Germany
Average network size	8.01	8.09	3.57
Average frequency of supervisor advice	5.81	4.77	3.60
Average frequency of advice of all members	3.68	3.23	2.35

Table 3.2 Social network variables

Network variables were asked in an identical way in Spain and Slovenia. When comparing only these two countries, many more network variables are usable, as shown in Chapters 4 and 6.

Chapter 4

EGOCENTERED NETWORKS OF PhD STUDENTS AND ACADEMIC PERFORMANCE: A COMPARISON ACROSS SPAIN AND SLOVENIA

4.1 Introduction

In this chapter we compare regression models obtained to predict PhD students' academic performance in Spain and Slovenia. Explanatory variables are characteristics of PhD student's research group understood as an egocentered social network, background and attitudinal characteristics of the PhD students and some characteristics of the supervisors. Academic performance was measured by the weighted number of publications.

We used a regression model in which the country was introduced as a dummy coded variable including all possible interaction effects. The optimal transformations of the main and interaction variables are discussed.

4.2 Variable selection and preliminary analyses

Our aim is to explain the academic performance of PhD students from all three types of variables defined in Chapter 2, by specifying a regression model to determine the best predictors of performance for both countries and the predictors that have different effects across countries.

As it would not prove practical to use all the variables described in Chapter 2, we select only those variables which proved to have predictive power for academic performance in the individual studies done in Spain (Coromina, 2006) and Slovenia (Matelič, 2005), which are shown in Table 4.1.

Variable type	Spain (Coromina, 2006) [1]	Slovenia (Matelič, 2005)[2]
Attitudinal	Motivation to start a PhD: Autonomy Motivation to start a PhD: Academic advantages	Motivation to start a PhD: Autonomy Motivation to start a PhD: Academic advantages Motivation to start a PhD: Academic career Guidance of the supervisor during the PhD Too close supervision by supervisor Motivation to start the PhD: Research interest
Background	Supervisor's academic performance Seniority at the department Having children (dummy, 1:yes) Age	Supervisor's academic performance Supervisor's age.
Network		Frequency of supervisor advice

Table 4.1 Predictive variables for academic performance used in previous studies in Spain and Slovenia

[1] The Spanish study also used the field of study variable, but it was discarded here due to its high collinearity with other more relevant variables.
[2] The Slovene study also included supervisor's gender which was discarded here due to its political connotations.

The types of networks analyzed in Spain and Slovenia were (see Chapter 2):

a) *Scientific Advice*: PhD students and supervisors were asked about how frequently they asked for scientific advice to their colleagues.

b) *Collaboration*: PhD students and supervisors were asked about how frequently they collaborated with their colleagues.

c) *Crucial information*: PhD students were asked about how often they asked their colleagues for information/data/software.

d) *Socializing*: PhD students were asked about how often they engaged in social activities outside of work with their colleagues.

e) *Emotional Support*. PhD students and supervisors were asked about to what extent they discuss about serious problems with colleagues.

f) *Trust*: PhD students and supervisors were asked about to what extent they trust or distrust their colleagues.

g) *Getting on well*: PhD students and supervisors were asked about to how they get along with each of their colleges.

A factor analysis done by De Lange et al., (2004) obtained three predictive factors for performance where these networks can be included. The first factor was *work-related*, where the scientific advice, collaboration and getting crucial information networks can be included. The second factor was *friendship*, where the trust and getting along well networks can be included. The third factor was *social support*, where the emotional support network can be included. We also included the *socializing* network in order to study the influence of the activities with colleagues outside the work context.

In order to extend the small set of network variables in Table 4.1, we defined additional variables from the egocentered network of the PhD student:

1) Research group size.

2) Count of additional contacts external to the research group provided by the PhD student for the advice network (see Chapter 2).

3) Count of additional contacts external to the research group provided by the PhD student for the collaboration network.

4) Number of different institutions to which research group members belong to.

5) Average contact intensity between the PhD student and the research group members for the work-related networks (which includes the scientific advice, collaboration and getting crucial information networks. For comparability reasons, this excludes the additional contacts provided by the PhD student for advice and collaboration, see Chapter 2)

6) Average contact intensity for the friendship network (which includes the trust and getting on well networks).

7) Average contact intensity for the social support network (which includes the emotional support network).

8) Average contact intensity for socializing (which includes the socializing network).

4.3 Specificities of regression models for comparative studies

The standard practice to compare two regression equations in two populations is to specify a model on the pooled data including all variables, a population dummy and its product by all variables. If we only have one variable *x* and *D* is the population dummy (in our case country, Spain is the reference group and Slovenia is coded as 1), the equation looks as:

$$E(y) = \beta_0 + \beta_1 x + \beta_2 D + \beta_3 Dx$$

$$\text{If } D = 0 \quad E(y) = \beta_0 + \beta_1 x \qquad (4.1)$$

$$\text{If } D = 1 \quad E(y) = (\beta_0 + \beta_2) + (\beta_1 + \beta_3)x$$

The β_0 intercept and the β_1 main effect coefficient of the *x* variable refer to the population coded as 0. The β_3 interaction coefficient gives the increase or decrease in slope when we move to the population coded as 1.

The β_2 coefficient of the dummy variable country measures the difference in expected performance for the value 0 of all other variables (Irwin and McClelland, 2001). Thus, it is advisable to mean-centre all numeric variables, so that this interpretation refers to a meaningful situation (and not to a PhD student aged 0 years, for instance). Besides, using mean-centred variables reduces collinearity (Irwin and McClelland, 2001). In any case, mean-centring must be done always before computing the product variables for the interaction effects, never after. This is so because if we later transform the variables in any way, then the interaction variable fails to be equal to the product of both main effect variables.

This is why standardized effects are not interpretable in a model with interaction effects. If one wants to get estimates in comparable units, one must manually standardize numeric main effect variables prior to computing the product interaction variables, which will not generally have either a zero mean nor a unit standard deviation. As standardized main effect variables have a zero mean, the collinearity problem described above is also solved. We thus standardized all numeric main effect regressors, but left binary dummy coded regressors and the dependent performance variable in their original units (one performance unit equals one conference paper, one non-reviewed publication, the half of a reviewed publication or the half of an international article).

Thus the main effect β_1 is interpreted as the expected increase in performance units resulting from a standard deviation increase in *x* in Spain. The sum $\beta_1 + \beta_3$ is interpreted in an identical manner in Slovenia. β_0 and $\beta_0 + \beta_2$ are the intercepts in Spain and in Slovenia respectively, that is the expectation of the dependent variable corresponding to the mean value of *x*.

As all variables have to be multiplied by the country variable, an exceedingly complex model may result. The procedure we used to drop the irrelevant variables and thus simplify the regression model also has some specificity. Variables with a t-value lower than 2 in absolute value (α =5 %) can in principle be removed from the regression model one by one starting with those with a non-interpretable effect sign. However, the main effect variables can only be removed if interaction effects have been removed before. This is so because an interaction effect without its own main effect is not interpretable (Irwin and McClelland, 2001). On the contrary, a main effect without its own interaction effect is nicely interpreted as an effect that is constant across countries. The main country effect also has to be in the model if at least one interaction term is.

4.4 Results

The first model's estimates are shown in Table 4.2. In this table we show all the variables that we used and the effects in each country (the effect in Spain as the main effect and the effect in Slovenia as sum of main and interaction effects). The t-values for Spain show the significance of the main effects and the t-values for the interaction effects show the significance of the differences between the effects in both countries.

After removing the non-significant variables, the final model is shown in Table 4.3. All interaction effects have a t-value, in absolute value, higher than 2. Some main effects have a t-value lower than 2 but they have to be in the model because their interaction effects are.

The intercepts in Spain and Slovenia are not significantly different, which means that for the value zero of all variables (i.e. for childless students with the mean value of the numeric variables) Slovene and Spanish students publish about the same. The remaining interaction t-values show the significant differences between the two countries. Thus the effects are different between countries for the variables seniority at the department, motivation to start PhD: research, frequency of supervisor advice, count of researchers external to the research group that have advice relationships with the PhD student and social support mean contact intensity from the research group members to the PhD student.

Adjusted R^2=0.47	$\hat{\beta}$ Spain	$\hat{\beta}$ Slovenia	t-value Spain	Interaction t-value
Intercept	21.6	16.9	6.3	-1.1
Supervisor performance	10.2	12.5	3.4	0.6
Seniority at the department	6.0	-3.2	2.8	-2.0
Motivation to start PhD: Research	-2.1	3.1	-0.8	1.2
Motivation to start PhD: Autonomy	4.6	4.7	1.7	0.0
Motivation to start PhD: Academic career	2.0	-1.1	-0.8	-1.0
Motivation to start PhD: Academic advantages	-0.9	0.8	-0.4	0.5
Too close supervision by supervisor	-1.9	-1.7	-0.9	-0.5
Age	-1.4	4.6	-0.7	1.0
Supervisor Age	0.6	-1.2	0.2	-0.5
Student has children	-10.2	-6.5	-0.9	0.3
Frequency of supervisor advice	-3.7	4.8	-1.2	2.3
Research group size	0.0	-0.4	0.0	-0.1
Number of different institutions	1.0	0.8	0.3	-0.1
Number of external student's advice relationships	1.7	-3.7	0.6	-1.7
Number of external student's collaboration relationships	-1.1	1.5	-0.6	0.8
Work related mean contact intensity	-1.0	1.3	-0.3	0.5
Socializing mean contact intensity	-2.0	-1.7	-0.7	0.8
Social support contact intensity	3.3	-3.0	0.9	-1.4
Friendship mean contact intensity	-0.4	0.1	-0.2	0.4

Table 4.2 Estimates by country for the initial model

According to Table 4.3, the supervisor's performance has a high positive influence in both countries on the PhD student performance. A high motivation for autonomy has the same positive effect in both countries. Too close supervision has the same negative influence in both countries and having children also reduces performance in both countries. Seniority at the department increases performance only in the Spanish case. A high motivation for research prior to starting the PhD increases performance in Slovenia but not in Spain. Regarding the network variables, they show very high differences between countries. On the one hand, the frequency of supervisor advice is significant in both countries, but this variable affects negatively in Spain and positively in Slovenia. On the other hand, the number of external student's advice relationships and the social support mean contact intensity are not significant in Spain, while in Slovenia they affect performance negatively.

Variable type	Adjusted R^2=0.59	$\hat{\beta}$ Spain	$\hat{\beta}$ Slovenia	t-value Spain	Interaction t-value
	Intercept	20.3	18.0	11.6	-0.9[1]
Background	Supervisor performance	10.7	10.7	8.2	---[2]
	Seniority at the department	6.0	-1.6	4.7	-2.5
	Student has children	-7.7	-7.7	-2.6	---[2]
Attitudinal	Motivation to start PhD: Research	-2.2	2.7	-1.2	2.2
	Motivation to start PhD: Autonomy	4.1	4.1	2.9	---[2]
	Too close supervision by supervisor	-2.2	-2.2	-2.2	-2.2
Network	Frequency of supervisor advice	-3.8	4.3	-2.3	3.7
	Number of external student's advice relationships	1.9	-3.0	1.0	-2.1
	Social support mean contact intensity	2.0	-2.6	1.2	-2.0

Table 4.3: Estimates by country for the final model

[1] For the intercept, it shows the significance of the main effect of country.

[2]Absent because the interaction term has been removed from the model: the effect estimates are the same in both countries.

4.5 Conclusions

In order to predict the academic performance of PhD students, we use a regression model, for both countries, combining three types of variables: background, attitudinal and social network. Previously, comparable indicators had to be created (see Chapter 3). The country was introduced as a dummy coded variable including all possible interaction effects in order to test for country differences. Although it would be interesting to also test for differences across fields of study (like for instance would be the case if some fields require more individual efforts while the others depend more on team work), our sample size was not large enough to include all needed interaction terms. We carefully considered and explained the choice of the most convenient transformation of the main effect and interaction variables, as these variables play an important role for comparative research.

The results show that not all variables have the same influence in order to predict the academic performance for PhD students in Spain and in Slovenia. The final predictive variables and their influence are the following:

Supervisor's performance has the same high positive effect on the PhD student's performance in both countries.

Seniority at the department increases performance in Spain. In Slovenia this variable has a negative effect; however, descriptive statistics revealed that seniority was nearly constant in Slovenia, so that the effect of this variable should be very small in practice in this country. In Spain, on the contrary, many PhD students have been employed as assistants for many years before starting their PhD, which results in a high diversity in seniority.

A high *motivation for research* prior to starting the PhD increases performance in Slovenia but not in Spain. On the contrary, *motivation for autonomy* prior to starting the PhD has the same positive effect in both countries.

Too close supervision by the supervisor and *having children* have a negative influence in both countries.

The effects of the background and attitudinal variables described above are intuitively meaningful and coincide with the previous INSOC results. Background variables such as experience and family obligations are important for predicting performance as reported by Braun and Mohler (2003). Attitudinal variables such as motivation are also important for prediction performance (Nonaka and Takeuchi, 1995). On the contrary, we find rather counter-intuitive estimates for the network variables as discussed below. This result contradicts Burt (2000) tstatement that an individual's success is strongly dependent on the relations with relevant others inside and outside the organization because network structure provides the opportunities for individual actions. Delamont et al., (1997, 96-99) and Rudd (1984) also explained that being isolated in a research group can be one of the main problems for the PhD students. Because of that, we will study in the next chapters the results of these network variables in greater depth.

Frequency of supervisor advice is significant in both countries, but this variable affects negatively in Spain.

The number of external student's advice relationships and *social support* mean contact intensity are not significant in Spain, but they have a negative effect in Slovenia.

In conclusion, while the use of these three types of variables together seems to be the best way to predict the performance of the PhD students, there are large country differences in the way in which these variables operate. In particular network variables operate differently and in a counter-intuitive way, which we want to explore by means of a follow-up qualitative study in Chapter 7 and by improving the network measurement in Chapter 6, and by analyzing the somewhat different German data in Chapter 5.

Chapter 5

EGOCENTERED NETWORKS OF PhD STUDENTS AND ACADEMIC PERFORMANCE: A COMPARISON BETWEEN SPAIN, SLOVENIA AND GERMANY

5.1 Introduction

The aim of the INSOC research group is to develop comparative analyses about PhD students' academic performance across different European countries from the individual academic performance results obtained in each university member. In Chapter 4 we compared regression models obtained to predict PhD students' academic performance in Spain and Slovenia. In Chapter 5, we introduce the German data in the regression model. As in Chapter 4, we used a regression model in which the countries were introduced as a dummy coded variables including all possible interaction effects. As opposed to Chapter 4, this model includes fewer variables, due to the comparability problems of the German data discussed in Chapters 2 and 3. These Chapters 4 and 5 are complementary; the first explores as many variables as possible and the second as many countries as possible, the global aim being the same.

5.2 Variable selection and preliminary analyses

Our aim is to explain the academic performance of PhD students from all three types of variables defined in Chapter 2, by specifying a regression model to determine the best predictors of performance for three countries (Spain, Slovenia and Germany) and the predictors that have different effects between countries. Performance was measured using the second weights in Tables 2.17 and 2.18.

Our first idea for comparing the three countries was to take the final model shown in Table 4.3. However, as we saw in Chapters 2 and 3, the German questionnaire was only asked to PhD students and some networks were measured in a different way. Because of that, the following significant variables from the final regression models comparing Spain and Slovenia in Table 4.3 are not usable: supervisor performance, seniority at the department, number of external student's advice relationships and social support mean contact intensity. Thus, we had few variables left to compare between countries.

As it was desirable to base the comparison on a large number of variables we included all background and attitudinal variables available in all three countries in a regression model containing Spanish and Slovenian data and we added the network variables of advice.

1) The size of the advice network (excluding zeroes –which were absent in Germany- but including external and internal contacts together –which were undistinguished in Germany, see Section 3.6).

2) The frequency of supervisor advice.

3) Average frequency of advice of all members.

The model was constructed using the same methodology as in Chapter 4, but raising α to 10% in order to have a greater pool of variables.

Finally, the regression model with the significant variables for Slovenia and Spain is shown in Table 5.1.

Variable type	Adjusted R^2=0.1	$\hat{\beta}$ Spain	$\hat{\beta}$ Slovenia	t-value Spain	Interaction t-value
	Intercept	9.0	10.3	11.5	-0.9[1]
Background	Student has children	-2.9	-2.9	-1.7	---[2]
Attitudinal	Motivation to start PhD: Career advantages	-2.1	-.07	-.82	1.6
	Too close supervision by supervisor	-1.2	-1.2	-1.8	---[2]
	Job involvement	1.3	1.3	2.0	----[2]

Table 5.1 Significant variables in Slovene and Spanish regression model

[1] For the intercept, it shows the significance of the main effect of country.

[2]Absent because the interaction term has been removed from the model: the effect estimates are the same in both countries.

Then, we did the same with the Germany data. We took all the original set of variables and we saw which were significant for Germany (Table 5.2).

Variable type	Adjusted R^2=0.2	$\hat{\beta}$ Germany	t-value Germany
	Intercept	6.9	9.4
Attitudinal	Guidance of supervisor during PhD	-1.6	-2.1
	Promotion of contacts	1.3	1.6
	Attitude towards publishing	2.0	3.4

Table 5.2 Significant variables in the German regression model

Summarizing, the significant variables for the three countries are shown in Table 5.3.

	Slovenia	Spain	Germany
Motivation to start PhD: Career advantages		X	
Job involvement	X	X	
Student has children	X	X	
Too close supervision by supervisor	X	X	
Attitude towards publishing			X
Guidance of supervisor during PhD			X
Promotion of contacts			X

Table 5.3 Significant variables in the different countries

Finally, we took all the variables from Table 5.3: student has children, motivation to start PhD: career advantages, too close supervision by supervisor, job involvement, attitude towards publishing, guidance of supervisor during PhD and promotion of contacts and added them to the attitudinal variables from Table 4.3: motivation to start PhD: Research and motivation to start PhD: autonomy, and to the advice network. We constructed a regression model comparing the three countries including all these variables.

The reference country was Slovenia, dummies and their products were constructed for Germany and Spain and F tests were used for hypotheses involving more than one parameter to eliminate the nonrellevant variables.

The F test is useful for testing multiple hypotheses in the context the multiple regression models. In our case, we include pairs of interaction terms (variables multiplied by the Spain and Germany dummies) to test for differences in slope across the three countries. Thus, two coefficients are involved in the test. To see how the joint test works, consider the multiple regression models:

$$Y = \beta_0 + \beta_1 + \beta_2 D_{SP} + \beta_3 D_{GER} + \beta_4 D_{SP} x + \beta_5 D_{GER} x + \varepsilon \quad (5.1)$$

where D_{SP} and D_{GER} are the dummy variables for Spain and Germany.

We call this model the *unrestricted model UR,* since no assumptions have been made about any of the regression coefficients. Suppose that we wish to test whether the country has an interaction effect (in our case the two coefficients involving a variable multiplied by the Germany and Spain dummies are jointly equal to zero).

If the last 2 coefficients are both equal to zero, the correct model will be the *restricted* (by the zero coefficients) *model,* denoted R:

$$Y = \beta_0 + \beta_1 x + \beta_2 D_{SP} + \beta_3 D_{GER} + \beta_4 D_{SP} x + \beta_5 D_{GER} x + \varepsilon \quad (5.2)$$

The null hypothesis, then, is that $\beta_4=\beta_5=0$

The test of the null hypothesis is straightforward. When we drop the 2 variables from the model and estimate the restricted model in Eq. (5.2), the R^2_R must be smaller than the R^2_{UR} associated with the unrestricted model. This is equivalent to the result that R^2 always increases when additional variables are added to the regression model. If the null hypothesis is correct, dropping the 2 variables will have little effect on the explanatory power of the equation and R^2_R will be only slightly smaller than $R^2_{UR.}$ Of course, any test of the null hypothesis must account for the number of restrictions, i.e., the number of coefficients set equal to zero, and the number of degrees of freedom available in the unrestricted regression model.

The appropriate test statistic is:

$$F_{2,N-K} = \frac{(R^2_{UR} - R^2_R)/2}{(1 - R^2_{UR})/(N-K)}$$

(5.3)

If the null hypothesis is true, the test statistic given in (5.3) will have an F distribution, with 2 degrees of freedom in the numerator and N-k in the denominator. As a general rule two separate regression equations must be estimated to apply test correctly. This F test is not equivalent to doing a set of individual t tests on each of the $\beta 4$ and β_5 coeficients.

Our testing procedure thus had the following steps:

1) Test the significance of the interactions (differences in slopes across countries) by means of an F test of the two products of the variable with the Germany and Spain dummy variables (α = 10%).

2) If the interaction above is not significant, remove it from the model (drop both product variables).

3) For those variables for which interactions have been removed, test the significance of the main effect of X by means of a t-test (α = 10%). Drop insignificant ones.

5.3 Results

Tables 5.4 and 5.5 show the significant variables for each of the three countries.

Variable type	Adjusted R^2=0.095	$\hat{\beta}$ Slovenia	$\hat{\beta}$ Spain	$\hat{\beta}$ Germany	t-value Slovenia	Interaction F value	p-value of F
	Intercept	9.35	9.45	6.78	10.51		
Attitudinal	Motivation to start PhD: Career advantages	-.85	1.50	-.87	-.88	2.44	.021
Attitudinal	Motivation to start PhD: Autonomy	.67	2.45	-1.17	.74	3.29	.039
Attitudinal	Job involvement	1.09	1.09	1.09	1.99	---[1]	---[1]
Attitudinal	Attitude towards publishing	.04	-.32	1.99	.03	2.58	.078
Networks	Frequency of supervisor advice	2.68	-1.96	-.94	2.00	3.96	.039

Table 5.4 Relevant variables for each country

[1]Absent because the interaction term has been removed from the model: the effect estimates are the same in the three countries.

According to Table 5.4, motivations to start PhD (career advantages and motivation for autonomy), have a positive influence only in the University of Girona. Job involvement is the only variable which is significant in the three countries. Attitude towards publishing is significant only in Germany and on the other hand, the only network variable, frequency of supervisor advice is significant only in Slovenia. In Table 5.5 we summarize these results.

	Slovenia	Spain	Germany
Motivation to start PhD: Career advantages		X	
Motivation to start PhD: Autonomy		X	
Job involvement	X	X	X
Attitude towards publishing			X
Frequency of supervisor advice	X		

Table 5.5 Relevant variables for each country

5.4 Conclusions

As we see, the results are not very elegant. Only one variable has the same effect in all three countries, the rest affect in only one. The three countries are not comparable because Germany is very different to the others. It has to be said that the PhD studies in Germany are organized totally in a different way and the questionnaire was also differently designed and administered.

The R squared is very poor, which mainly results from the unavailability of the variable “supervisor performance”.

Finally, only one network variable is significant, and it is so only for Slovenia. At the end of Chapter 4 we suggested three ways of improving the understanding of network variables. The addition of the German data has not helped. In Chapters 6 and 7 we use different strategies.

Chapter 6

PREDICTION OF PERFORMANCE BASED ON DUOCENTERED MEASURES: COMPARISON ACROSS SPAIN AND SLOVENIA

6.1 Introduction

Chapter 4 compared the regression models predicting PhD student's academic performance in the universities of Girona (Spain) and Slovenia where research group was understood as an egocentered social network around the PhD student. In consequence, the network measures used had to do only with relationships between the PhD student and other members of the research group. The results of the network variables were either non-significant or counter-intuitive. In this chapter the PhD student's research group is understood as a duocentered social network (Coromina et al., 2008), in order to obtain information regarding the mutual relationship between PhD students and supervisors and the ties of both to their alters in the network.

Ziherl et al., (2006) analyzed the INSOC Slovenian network data using complete networks and a clustering approach. This made it possible both to include richer network information and to consider non-linear effects of network structure on performance. Using this approach the authors found network variables to be significant predictors of performance.

In this chapter we reanalyse the data of Chapter 4 using a clustering approach with duocentered networks. This network structure (Coromina et al., 2008) also provides richer network information than egocentered networks, and it can be used as a compromise if complete networks are unavailable, which the case is for Spanish data as we found proxy measures of the complete networks not to be usable (see Chapter 2). Duocentered networks can be used when we find a pair of relevant central actors in a network. This kind of network is composed of a pair of central egos and their relationships with alters, while the ties amongst these alters are neglected. In our case, we know that one ego (PhD student) has an especially relevant connection with another actor (the supervisor). The pair of egos is thus made of the PhD student and his/her supervisor. Supervisors might have some important contacts with alters and these relations can influence the academic performance of the PhD students even if they do not belong to the students egocentered networks.

The aim of this chapter is thus to study whether the inclusion of duocentered social network variables can improve the predictive power of the regression model using egocentered network variables. The duocentered networks we use are scientific advice, collaboration, trust and emotional support.

6.2 Duocentered network structure

The most typical network structures found in the literature are complete and egocentered networks, the former is found when the structure of the network as a whole is relevant to a research problem, and the latter when only the ties of a particular actor are considered to be relevant to the problem at hand. In some cases a pair of actors may be central (e.g., husband and wife, buyer and seller) and we may intend to study the behavior, performance or social capital of these two specific actors in their network. In these cases, egocentered networks are difficult to interpret because only one ego is considered while this ego has an especially relevant connection with another actor.

For the case when there is a pair of relevant central actors in a network, Coromina et al., (2008) suggest a new type of network called duocentered network. Its main characteristic is that it is built around a pair of central egos. Network information is obtained from these two egos and there is no information gathered from alters. The ties among alters in the network are thus not measured. This does not mean that these ties do not exist, but only that they are not observed or taken into consideration. This means that the pair of central egos (from now on we denote them as Ego_A and Ego_B) provide us with information regarding their mutual relationship and their ties to their alters in the network, but not about relationships among alters.

Our study about PhD students' performance fits particularly the concept of duocentered network. The reason of using duocentered networks is that PhD students' performance cannot be well explained leaving out their supervisor's influence. Therefore, not only should the students' egocentered network be analyzed, but also should the supervisors' egocentered network. If we just take the students' network and dismiss the supervisor's network, that is, if we consider the supervisor as simply another alter in the student's egocentered network, we are dismissing some of the supervisor's contacts who might be very relevant to the student's performance.

A graphical example of a duocentered network is shown in Figure 6.1.

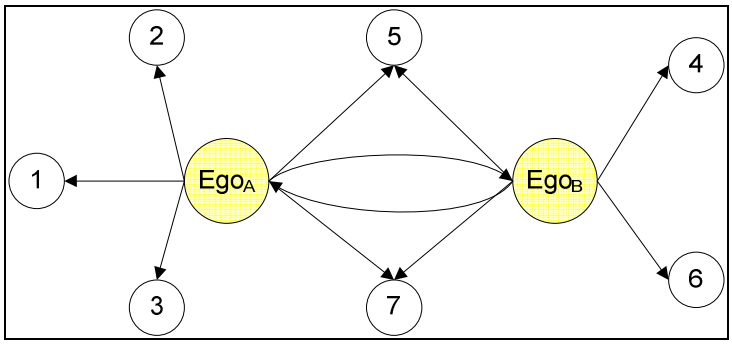


Figure 6.1 Example of duocentered network around Ego$_A$ and Ego$_B$

Figure 6.1 shows different ties in a duocentered network, which represents a general example of directed ties for the advice network, understood as to whom the PhD students and their supervisors ask for advice. The types of ties for the duocentered network from Figure 6.1 are named and defined in Table 6.1. For undirected ties d = e.

Measure	Definition	Tie in Figure 6.1
a	From only Ego$_A$, except contact to Ego$_B$	From Ego$_A$ to alters 1, 2 and 3
b	From only Ego$_B$, except contact to Ego$_A$	From Ego$_B$ to alters 4 and 6
c	Shared between Ego$_A$ and Ego$_B$	From Ego$_A$ and Ego$_B$ to alters 5 and 7
d	From Ego$_A$ to Ego$_B$.	
e	From Ego$_B$ to Ego$_A$.	

Table 6.1 Duocentered measures

Summarizing, the following characteristics of duocentered networks should be considered:

- Two main actors (Ego$_A$ and Ego$_B$) have to be clearly central and are considered as egos.
- Actors who are not defined as Ego$_A$ or Ego$_B$ are called alters.
- No relationships are observed among alters.
- Actors who do not have any contact with the egos are considered as isolates. These isolate members are not considered as a part of the duocentered network, so they do not appear in the network.
- Relationships or ties can be of different types: directed or undirected and valued or binary.

6.3 Network measures for duocentered networks

To begin with, some social network measures defined by Nieminen (1974); Freeman (1979); Freeman et al., (1980, 1991); Marsden and Lin (1982); Faust and Wasserman (1992); and Everett and Borgatti (1999) are used. The first type is degree centrality (Bonacich, 1987), measuring how well connected an actor is within the network. The second type is diversity (the extent to which the two actors in a duocentered network are different), and the third type is density (general level of cohesion in a network). These measures are defined in Coromina et al., (2008) together with some tailor-made measures, which are measures specifically designed to solve our particular research problem.

6.3.1 Degree centrality

This type of centrality, which can we computed for duocentered networks, is called degree centrality, and is a measure that indicates how well an actor is connected within the network. This type of centrality focuses only on direct or adjacent contacts (Wasserman and Faust, 1994). The more contacts an ego has, the more central in terms of degree the ego is.

Nieminen's (1974) degree measurement counts the number of adjacencies for an actor p_k:

$$C_D(p_k) = \sum_{i=1}^{n-1} t(p_i, p_k) \qquad (6.1)$$

where:

- $C_D(p_k)$ is the number of direct contacts to actor k (in our case Ego A).
- $t(p_i,p_k)$ is a tie from p_i to p_k (0 or 1 for binary networks or any non-negative real number for valued networks).
- n is the duocentered network size including both egos and all their alters.

For undirected networks a general measure of degree centrality is obtained for Ego_A and Ego_B. For directed networks, depending on the information we have (contacts from the egos, to the egos or both), outdegree $C_{DO}(p_k)$, indegree $C_{DI}(p_k)$ or both centralities can be computed equivalently, as counts or sums (binary data) or only as sums (valued data).

Freeman (1979) proposed a relative measure of degree centrality, $C'_D(p_k)$, related to network size (Scott, 2000):

$$C'_D(p_k) = \frac{\sum_{i=1}^{n-1} t(p_i, p_k)}{n-1} \qquad (6.2)$$

Equations (6.1) and (6.2) can be computed using standard software for social network analysis such as Pajek or UCINET. As an alternative, computation by hand is very simple if we realize that in an undirected duocentered network there are only 4 types of ties (*a*, *b*, *c* and *d=e*) as shown in Table 6.1, which only need to be added.

In undirected duocentered networks, we can compute Equation 1 for Ego_A and Ego_B respectively, as follows:

$$C_D(p_A) = a + c + d \qquad C_D(p_B) = b + c + e \qquad (6.3)$$

where *a*, *b*, *c* and *d=e* are defined in Table 6.1 and p_A and p_B refer to Ego_A and Ego_B.

6.3.2 Diversity

Diversity in a duocentered network indicates how different both egos are. More precisely, Coromina et al., (2008) defines this measure as the difference between degree centrality scores of both central actors (EgoA and EgoB):

$$D_D = \frac{C_D(p_A) - C_D(p_B)}{(n-1)} = C'_D(p_A) - C'_D(p_B) \qquad (6.4)$$

The interpretation of this measure is as follows: If the result is positive it means that EgoA is more central than EgoB; in other words, that EgoA has a larger non shared network. Since we only have two egos, the diversity measure provides all needed information about degree centrality.

6.3.3 Density

As diversity, density (Burt and Minor, 1983) is also a measure for the whole network structure. The simplest idea is that the more actors are connected to one another, the denser the network is. According to Wasserman and Faust (1994), the density of a network is the proportion of ties that are actually present in the network over the maximum possible number of ties that could be present if the network were complete. Coromina et al., (2008) discuss several alternative measures to adapt this idea to duocentered networks, of which the simplest is:

$$C'_D(p_A) + C'_D(p_B) \qquad (6.5)$$

This measure is the sum of relative degree centralities. Implicitly it gives a double weight to the relationship between both egos (as it counts both d and e), which is not unreasonable given the importance of this key relationship in a duocentered network. Unlike Wasserman and Faust (1994) measure, equation 6.5 is not bounded between 0 and 1.

6.3.4 Tailor-made measures for duocentered networks

The main idea behind these tailor-made measures is to go back to the origin and make them as closely related as possible to a, b, c and d=e and meaningful to specific research questions.

In our study, we predict the performance of Ego_A (PhD student) and because of that measures for this purpose have been created. Other measures could be developed to predict the performance of Ego_B or of the team composed by both egos. The flexibility of these tailor-made measures enable researchers to create their own measures that are useful for their specific study.

For instance, for our specific research question, parameter *a* from Table 6.1 can be considered as a measure on its own, since it indicates the alters that are linked to Ego_A and to no one else. Then:

- *a* is the count or sum of direct contacts of Ego_A with alters other than Ego_B and Ego_B's contacts.

Other measures that can be meaningfully related to the performance of Ego_A could be:

- *c* is the count or sum of shared contacts of Ego_A and Ego_B. In a duocentered network, the number of shared contacts is closely related to density.

- *d* is the direct contact between Ego_A and Ego_B.

- $d(b-\bar{b})$ measures the influence on Ego_A from Ego_B's contacts through Ego_B. The influence of these indirect contacts is given a weight depending on the intensity of the contact with Ego_B. Statistically speaking this is an interaction term, as it is computed from the product of two variables. The main effect of the variables, in this case of *d*, refers to the zero value of the other variable $b-\bar{b}$. The subtraction of $\bar{b}$ results in the effect of *d* being interpreted for a mean value of *b*.

6.3.5 Sets of variables for predicting performance

As has been said, the aim of this chapter is to find the best set of duocentered network variables in order to predict PhD studnt's performance.

Duocentered networks have basically four dimensions (a, b, c, d=e), thus using a larger number of measures will lead to perfect collinearity. Coromina et al., (2008) define alternative meaningful ways of combining up to four measures.

A first possibility is to use some of the specific tailor-made measures created for the duocentered network. These measures are:

- *a*
- *c*
- *d*
- $d(b-\bar{b})$

A second possibility is to use key characteristics of duocentered networks, which are the relative measures of density and diversity and network size. Degree centrality measures are not needed because diversity already provides this information:

- $C'_D(p_A)+C'_D(p_B)$
- $C'_D(p_A)-C'_D(p_B)$
- n

We can interpret this in the following way: when we sum centralities (density) we consider all contacts between egos and alters in the network. When we use the difference of centralities (relative diversity), we consider the difference between the networks of Ego_A and Ego_B. This model construction has the attractive feature that the sum and the difference will tend to have low collinearity.

The third possibility is very similar to the second, even regarding interpretation, but using the absolute density and diversity measures instead of the relative measures and size, which results in greater parsimony:

- $C_D(p_A)+C_D(p_B)$
- $C_D(p_A)-C_D(p_B)$

6.4 Constructing the model using duocentered networks for predicting performance

Coromina et al., (2008) attempted to combine the duocentered measures for different models and four networks (scientific advice, collaboration, emotional support and trust) into a single model to predict the student's performance. The best predictors were the absolute density for the collaboration and emotional support networks (which conceptually would point at group cohesion), and also the frequency of supervisor advice (d). We took the final model shown in Table 4.3 and we simply substituted these duocentered social network variables for the egocentered social network measures to see if this duocentered model improves prediction of PhD students' academic performance in Spain and Slovenia. Table 6.2 shows the predictive variables for PhD student's performance, their estimates and significances.

Variable type	Adjusted R^2=0.54	$\hat{\beta}$ Spain	$\hat{\beta}$ Slovenia	t-value Spain	Interaction t-value
	Intercept	20.3	17.7	11.0	-0.9[1]
Background	Supervisor performance	10.6	10.6	6.8	—[2]
	Seniority at the department	5.7	-1.5	4.2	-2.1
	Student has children	-8.0	-8.0	-2.5	—[2]
Attitudinal	Motivation to start PhD: Research	-1.4	2.2	-0.8	1.5
	Motivation to start PhD: Autonomy	3.6	3.6	2.5	—[2]
	Too close supervision by supervisor	-2.1	-2.1	-1.9	—[2]
Network	Frequency of supervisor advice	-3.3	3.9	-2.0	3.2
	Absolute density collaboration	-0.2	-0.5	-0.1	-0.1
	Absolute density emotional support	-1.0	0.0	-0.5	0.4

Table 6.2 Predictive variables for duocentered network model

[1] For the intercept, it shows the significance of the main effect of country.
[2]Absent because the interaction term has been removed from the model: the effect estimates are the same in both countries. The effect in Spain is considered as the main effect and the effect in Slovenia as sum of main and interaction effects. The t-values for Spain show the significance of the main effects and the t-values for the interaction effects show the significance of the differences between the effects in both countries (see Chapter 4 for details).

Background and attitudinal estimates are very similar to the ones found in Chapter 4. The frequency of supervisor advice is significant in both countries, but this variable affects negatively in Spain and positively in Slovenia which is a quite count-intuitive result. On the other hand, absolute density collaboration and absolute density emotional support are not significant in either country.

Then, the frequency of supervisor's advice is the only duocentered variable which is significant but the same variable is also found in Chapter 4. Unfortunately, we have to conclude that the introduction of duocentered variables in the regression model does not improve the model to predict academic performance of PhD students using egocentered networks.

6.5 Alternative procedure for introducing duocentered network variables

Section 6.3.5 defined a lot of different duocentered network variables which can be computed for the scientific advice, cooperation, trust and emotional support networks. Using them all together and adding the appropriate interaction terms with the country variable is not practically feasible. In order to summarize the large amount of information contained in the duocentered networks from the variables mentioned in Section 6.3.5, to detect likely non-linear effects of certain combinations of network characteristics, we performed a cluster analysis of the network variables (Capó, 2006; and Ziherl et al., 2006) and assessed the significance of clusters membership on performance.

The first step was to record the unstandarized residuals obtained from the regression model without the network variables. The estimates are shown in Table 6.3.

Variable type	Adjusted R^2=0.51	$\hat{\beta}$ Spain	$\hat{\beta}$ Slovenia	t-value Spain	Interaction t-value
	Intercept	18.9	17.1	10.9	-0.7[1]
Background	Supervisor performance	9.6	9.6	7.2	___[2]
	Seniority at the department	6.1	-1.6	4.4	-2.2
	Student has children	-8.5	-8.5	-2.7	____[2]
Attitudinal	Motivation to start PhD: Research	-1.3	3.3	-.7	2.0
	Motivation to start PhD: Autonomy	2.7	2.7	1.9	____[2]
	Too close supervision by supervisor	-2.0	-2.0	-1.7	____[2]

Table 6.3 Estimates by country for background and attitudinal variables

[1] For the intercept, it shows the significance of the main effect of country.

[2]Absent because the interaction term has been removed from the model: the effect estimates are the same in both countries.

After that, we performed a cluster analysis using Ward's method on the squared euclidean distance obtained from the duocentered network variables in Section 6.3.5 for all 4 networks (scientific advice, collaboration, trust and emotional support) which had been previously standardized. The final number of cases was 111 but only 97 student-

supervisor pairs were used because they were who answered all these duocentered network variables in the questionnaires. A cluster analysis was carried out for each of the three groups of variables explained in Section 6.3.5. The first set of variables includes the specific tailor-made measures *a, c, d* and $d(b-\bar{b})$ created for the duocentered networks of scientific advice, collaboration, trust and emotional support, thus 16 variables in all. The second set of variables includes the relative measures of density and diversity and size for the same four networks, thus 12 variables in all. The third set is similar to the second but using the absolute density and diversity measures instead of the relative measures and size, thus 8 variables in all.

For each set of variables solutions with 2 to 5 clusters were obtained. Cluster memberships were related to the unstandardized residulas from the regression model with background and attitudinal and variables by means of ANOVA models.

The number of clusters and their relationships to the regression residuals obtained for each set of variables is presented in Table 6.4:

First set			Second set			Third set		
a,c,d, $d(b-\bar{b})$			$C_D(p_A)+C_D(p_B), C_D(p_A)-C_D(p_B)$,n			$C_D(p_A)+C_D(p_B), C_D(p_A)-C_D(p_B)$		
#Clusters	Sig.	Eta^2	# Clusters	Sig.	Eta^2	# Clusters	Sig.	Eta^2
5	.375	.046	5	.753	.029	5	.165	.095
4	.228	.044	4	.821	.014	4	.652	.025
3	.228	.044	3	.729	.010	3	.455	.024
2	.828	.001	2	.980	.00	2	.558	.005

Table 6.4 ANOVA models relating unstandardized residuals to the cluster membership

Sig: significance of ANOVA F test

Eta^2: % of residual variance explained by clusters

The first set of variables with the tailor made measures for the duocentered networks shows that the clusters are not significantly related to the residuals (Sig. > 0.05). This means that the residuals of the PhD student's performance are not significantly explained by cluster membership, and thus including these clusters in the regression model would not improve prediction of PhD student's performance.

The second set of variables has the same interpretation than the first one. This set of variables (the relative measures of density, diversity and size) cannot either be introduced in the regression model.

For the third set of variables, the same is also true, and there is no difference in performance residuals across the different clusters when absolute measures of density and diversity are used. Therefore, these clusters were not either introduced in the regression model.

6.6 Conclusions

It is known that PhD students are highly influenced by their supervisor (Cryer, 1996; Samuelson, 1972; Hemlin, 2006; Richard, 1984; and Ravetz, 1971). This relationship can be underestimated if the supervisor is considered as just an alter within an egocentered network. For this reason, we introduced duocentered networks in order to predict academic performance of the PhD students to see if these types of networks (Coromina et al., 2008) play a better role in predicting performance. The key characteristic of this network is that it is based on a pair of egos and the relationships between these two egos and alters, but leaving out the relations among alters. A large number of measures can be computed and we selected the ones defined by Coromina et al., (2008) for the four types of relations (scientific advice, collaboration, emotional support and trust) in order to predict the research performance of PhD students. We tried to replicate the final model in Coromina et al., (2008) for the universities of Spain and Slovenia and we made a further step in order to check if by aggregating duocentered network variables using cluster analysis we could find differences in performance across groups or clusters, but these differences were not significant as shown Table 6.4.

Summarizing, the introduction of duocentered networks in the regression model does not make any improvement on the model to predict academic performance of PhD students obtained through egocentered networks.

In conclusion, while the use of these three types of variables together (attitudinal, network and background) theoretically seems to be the best way to predict performance of PhD students, network variables, whether egocentered or duocentered, fail to have predictive power. The qualitative study in Chapter 7 will be aimed at revealing some reasons for the counter-intuitive effects of the network variables, specifically, within the University of Girona data.

Chapter 7

QUALITATIVE STUDY

7.1 Introduction

7.2 Qualitative research paradigm

7.3 Mixed methods reserach

7.4 Qualitative data collection: in depth interview

7.5 Sampling

7.6 Coding

7.7 Results

7.1 Introduction

In this chapter we attempt to understand some unexpected results from the previous quantitative research in the University of Girona in Chapter 4.

In our case, those unexpected results are the lack of predictive power of social network variables on PhD students' academic performance and even a negative effect of supervisor advice on performance. We expect that a qualitative study can uncover the reasons why the quality of the network fails to translate into the quality of the student's work. For instance it could be the case that a lot of collaboration contacts may imply a big workload of the students which diverts them from their main research and PhD related tasks or that a lot of intangible aspects of the networks failed to be accounted for by the quantitative questionnaire.

Combining quantitative and qualitative research belongs to the domain of mixed methods and multimethod studies which are explained in Section 7.3. Quantitative and qualitative methods can be combined in a number of different ways. We use qualitative research to explain quantitative findings. Qualitative research is briefly explained in Section 7.2. For data collection in the qualitative research we used in-depth interviews which are explained in Section 7.4. Sampling and coding issues are discussed in Sections 7.5 and 7.6. Results are presented in Section 7.7.

7.2 Qualitative research paradigm

Many authors have defined qualitative research. Creswell (1998) refers to the definition of Denzin and Lincoln (1994) as "multimethod in focus, involving an interpretative, naturalistic approach to its subject matter. This means that qualitative research studies things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them. Qualitative research involves the study; use and collection of a variety of empirical materials – case study, personal experience, introspective, life story, interview, observational, historical, interactional and visual texts - that describe routine and problematic moments and meanings in individuals' lives."

Creswell (1998) also provides his own definition. According to the author, "qualitative research is an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem. The researcher builds a complex, holistic picture, analyses words, reports detailed views of informants, and conducts the study in a natural setting."

Denzin and Lincoln (1994) made a good distinction between qualitative and quantitative research. For them, qualitative researchers stress the socially constructed nature of reality, the intimate relationship between the researcher and what is studied and the situational constraints that shape inquiry. Such researchers emphasize the value-

laden nature of inquiry. They seek answers to questions that stress how social experience is created and given meanings. In contrast, they said that quantitative studies emphasize the measurement and analysis of casual relationships between variables, not processes. Thus, qualitative researchers use ethnographic prose, historical narratives, first-person accounts, still photographs, life histories, fictionalized facts, and biographical and autobiographical materials, among others. On the other hand, quantitative researchers use mathematical models, statistical tables, and graphs.

A lot of authors agree that qualitative research questions are exploratory; while quantitative research questions are confirmatory. Tashakkori and Teddlie (1998) also believe that most quantitative research is confirmatory and involves theory verification, while much qualitative research is exploratory and involves theory generation. As Tashakkori and Teddlie (2003) said: "A major advantage of mixed methods is that it enables he researcher to simultaneously answer confirmatory and explanatory questions, and therefore verify and generate theory in the same study."

Sale et al., (2002) revisited the quantitative-qualitative debate and reviewed the arguments for and against using mixed-methods. First at all, they presented the two paradigms:

The quantitative paradigm is based on positivism. Science is characterized by empirical research. All phenomena can be reduced to empirical indicators which represent the truth. The ontological position of the quantitative paradigm is that there is only a truth, an objective reality that exists independent of human perception. Epistemologically, the investigator and investigated are independent entities. Therefore, the investigator is capable of studying a phenomenon without influencing it or being influenced by it, *"inquire takes place as through a one way mirror"* (Guba and Lincoln, 1994). The goal is to measure and analyze casual relationships between variables within a value-free framework (Denzin and Lincoln, 1994). Techniques to ensure this include randomization, blinding, highly structured protocols, and written or orally administrated questionnaires with a limited range of predetermined responses. Sample sizes are much larger than those used in qualitative research so that statistical methods to ensure that samples are representative can be used (Carey, 1993).

In contrast, the qualitative paradigm is based on interpretivism (Altheide and Johnson, 1994; Kuzel and Like, 1991; and Secker et al., 1995) and constructivism (Guba and Lincoln, 1994). Ontologically speaking, there are multiple realities or multiple truths based on one's construction of reality. Reality is socially constructed (Berger and Luckman, 1996) and so is constantly changing. On an epistemological level, there is no access to reality independent of our minds, no external referent by which to compare claims of the truth (Smith, 1983). The investigator and the object of study are interactively linked so that findings are mutually created within the context of the situation which shapes the inquiry (Guba and Lincoln, 1994; and Denzin and

Lincoln, 1994). The emphasis of qualitative research is on process and meanings. Techniques used in qualitative research studies include in-depth and group interviews and participant observation. Rather small, purposeful samples of articulated responses can be used because they can provide important information, not because they are representative of a large group (Reid, 1996).

7.3 Mixed methods research

A mixed methods study involves the collection or analysis of both quantitative and /or qualitative data in a single study in which the data are collected concurrently or sequentially.

Actually, researchers can be roughly categorized in three groups: In the first group we find quantitatively oriented researchers working within the positivist tradition and primarily interested in numerical analyses. The second group is composed by qualitatively oriented researchers working within the constructivist tradition and primarily interested in analysis of narrative data. Finally, in the third group we find mixed methodologists working within other paradigms and interested in both types of data.

The dominant and relatively unquestioned methodological orientation during the first half of the 20th century was quantitative methods and the positivist paradigm. This orientation was transformed during the 1950-1970 period as postpositivists responded to some of the most obvious difficulties associated with positivism, yet the method stayed quantitative. However, in sociology the work of the "Chicago school" in the 1920s and 1930s established the importance of qualitative research for the study of human group life.

7.3.1 History of mixed methods

Denzin and Lincoln (1994) describes five historical moments which simultaneously operate in the present:

1) The traditional period (1900-1950). During the first half of the 20th century the dominant methodological orientation was quantitative methods and the positivist paradigm.

2) The modernist or golden age (1950-1970) was marked in the history of mixed methods research by two events: a) the debunking of positivism and b) the emergence of research designs that began to be called "multimethod" or "mixed". While a distinct field of mixed methods had not emerged by this time, numerous important studies using mixed methodologies were carried out.

3) *The blurred genres moments* (1970-1986), are connected to the appearance of post-positivist arguments. At the same time, a variety of new interpretative, qualitative perspectives made their presence felt, including hermeneutics, structuralism, semiotics, phenomenology, cultural studies, and feminism. The blurred genres phase led to the next stage, *the crisis of representation.*

4) *The crisis of representation.* (1986-1990), in this period researchers struggled with how to locate themselves and their subjects in reflexive texts. The periods described by Denzin and Lincoln (1994) as "*blurred genres moments"* and "*crisis of representation*" coincide with what Tashakkori and Teddie (1998) have called "the ascendance of constructivism, followed by the paradigm wars". Tashakkori and Teddie (1998) explain that several significant events for mixed methodology occurred during 1970-1990 period such as a) qualitative methods and constructivism grew quite rapidly in popularity, b) the paradigm wars were launched based largely on the incompatibility thesis, which is the incompatibility of combining quantitative and qualitative methods in the same study c) mixed methods studies were introduced in conjunction with writings on triangulation, in which a researcher uses two or more different methods in an attempt to confirm, cross-validate, or corroborate findings within a single study and d) important mixed methods studies and syntheses appeared.

5) *The present moment or postmodern moment* (1990-present) is characterized by a new sensibility that doubts of all previous paradigms. Tashakkori and Teddie (1998) called this period "pragmatism and the compatibility thesis", which means that it is possible to combine quantitative and qualitative methods in the same study. Tashakkori and Teddie (1998) said that two significant events for mixed methodology occurred during this period: a) the pragmatism position was posited as a counterargument to the incompatibility thesis and b) several seminal works appeared aimed at establishing mixed methods as a separate field.

7.3.2 Combining quantitative and qualitative research

On a philosophical level, mixed methodologists had to counter the incompatibility thesis, which was predicated on the link between epistemology and method. Tashakkori and Teddie (2003) defend the incompatibility thesis by arguing that "compatibility between quantitative and qualitative methods is impossible due to the incompability of the paradigms underlying the methods". Denzin and Lincoln (1994) argue that methods are shaped by and represent paradigms that reflect a particular belief about reality. They also maintain that the assumption of the qualitative paradigm is based on a worldview not represented by the quantitative paradigm.

According to these theorists, researchers who combined the two methods are doomed to failure due to the differences in underlying systems.

Tashakkori and Teddie (2003) said that "to counter this paradigm-method link, Howe (1998) posited the use of a different paradigm: pragmatism. A major tenet of Howe's concept of pragmatism was that quantitative and qualitative methods are compatible. Thus, investigators could make use of both of them in their research. This position has been questioned by several scholars writing within the mixed methods literature."

The different assumptions of the quantitative and qualitative paradigms originated in the positivism-idealism debate of the late 19th century (Smith, 1983). The inherent differences rarely are discussed or acknowledged by those using mixed-method designs. The reasons may be that the positivist paradigm has become the predominant frame of reference in the physical and social sciences. In addition research methods are presented as not belonging to or reflecting paradigms.

Caracelli and Greene (1993) refer to mixed-method designs as those where neither type of method is inherently linked to particular inquiry paradigm or philosophy.

Having discussed some of the basic assumptions of the two paradigms, Sale et al., (2002) give some arguments for combining quantitative and qualitative methods in a single study. There are several viewpoints as to why qualitative and quantitative methods can be combined. Firstly, the two approaches can be combined because the share the goal of understanding the world in which we live (Haase and Myres, 1998). King et. al. (1994) claim that both qualitative and quantitative research shares a unified logic and that the same rules of inference apply to both.

Secondly, once the purest versions of positivism have been proven non realistic, the two paradigms are thought to be compatible because they share the tenets of theory-ladenness of facts, fallibility of knowledge, indetermination of theory by fact, and a value-ladened inquiry process. They are also united by a shared commitment to understanding and improving the human condition, a common goal of disseminating knowledge for practical use, and a shared commitment for rigor, conscientiousness, and critique in the research process (Reichardt and Rallis, 1994). In fact, Casebeer and Verhoef (1997) argue we should view qualitative and quantitative methods as part of a continuum of research with specific techniques selected based on the research objective.

Thirdly, as noted by Clarke and Yaros (1988), combining research methods is useful in some areas of research because the complexity of phenomena requires data from a large number of perspectives. Similarly, some researchers have argued that complexities of most public health problems (Baum, 1995) or social interventions, such as health education and health of promotion programs (Steckler et al., 1992), require the use of a broad spectrum of qualitative and quantitative methods.

Fourthly, others claim that researches should not be preoccupied with the quantitative-qualitative debate because it will be not resolved in the near future, and the epistemological purity does not get research done (Miles and Huberman, 1984).

Closely tied to the arguments for integrating qualitative and quantitative approaches are the reasons given for legitimately combining them. Two reasons for this are prevalent in the literature. The first is to achieve cross-validation or triangulation, which consists in combining two or more theories or sources of data to study the same phenomenon in order to gain a more complete understanding of it (Denzin, 1970). The second is to achieve complementary results by using the strengths of one method to enhance the other (Morgan, 1998). The former position maintains that research methods are independent (combinant); the latter, that they are dependent (additive). Although these two reasons are often used interchangeably in the literature, it is important to make a distinction between them.

The triangulation solution differs from that of merely using the strengths of each method to bolster the weakness of the other(s), or capturing various aspects of the same phenomenas. This implies an additive outcome for mutual research partners. Based on this assertion, qualitative and quantitative work can be carried out simultaneously or sequentially in a single study of series of investigations.

Finally, Sale et al., (2002) proposed a solution to mixed-methods research and the quantitative-qualitative debate. “Qualitative and quantitative research methods have grown out of, and still represent, different paradigms. However, the fact that the approaches are incommensurate does not mean that multiple methods cannot be combined. Each method studies a different phenomenon. The distinction of phenomena in mixed-methods research is crucial and can be clarified by labelling the phenomenon examined by each method. For example, a mixed-methods study to develop a measure burnout experienced by nurses could be described as a qualitative study of the lived experience of burnout to inform a quantitative measure of burnout. Although the phenomenon burnout may appear the same across methods, the distinction between lived experience and measure reconciles the phenomenon to its respective method and paradigm.”

The collection and combination of both quantitative and qualitative data in research has been influenced by several factors. Unquestionably, both quantitative and qualitative data are increasingly available for use in studying social science research problems. Also, because all methods of data collection have limitations, the use of multiple methods can neutralize or cancel out some of the disadvantages of certain methods (e.g., the detail of qualitative data can provide insights not available through general quantitative surveys, see Jick, 1979). Thus, there is wide consensus that mixing different types of methods can strengthen a study (Greene and Caracelli, 1997). Qualitative research has become an accepted legitimate form of inquiry in the social

sciences, and researchers of all methodological persuasions recognize its value in obtaining detailed contextualized information. Also, because social phenomena are so complex, different kinds of methods are needed to best understand complexities (Greene and Caracelli, 1997).

Ways for combining quantitative and qualitative research. Multimethod designs.

First at all, we have to distinguish between *mixed methods design* and *multimethod design*. This distinction depends on the process and procedures for combining research strategies within a single project (with methods to answer a particular question) and among different research projects as a series of complementary projects of a research program aimed at addressing one overall topic. In this context, when strategies derived from qualitative and quantitative methods are used in a single project, it is referred to as a *mixed methods design*. Qualitative and quantitative projects that are relatively complete, but are used together to form essential components of one research program, are referred to as a *multimethod design*. The major difference between a *single study* using multiple strategies (mixed method design) and a *research program* using multiple methods is that in a single study the less dominant strategies do not have to be a complete study in themselves. That is, the strategy may be used to develop indicators or to "test the waters" to follow a lead or hunch. If something of interest or importance is found, then this new finding may be used to complement or confirm something new or something that is already known or suspected. Within the research design, the new finding does not to have to be saturated or confirmed. Rather the finding may be verified or confirmed elsewhere in another data set.

In our case, we are using a multimethod design because we have two different researches relatively complete. The quantitative research is used to know what variables predict PhD students' academic performance and the qualitative research is used to know why network variables don't predict performance. Both researches can be understood separately, but used together form essential components of one research program. The major research question (to predict PhD academic performance) drives the research program, but the program consists on two or more interrelated studies. In a multimethod design each study is planned and conducted to answer a particular subquestion. In our case, we use the qualitative study to know why network variables do not predict PhD academic performance in the University of Girona, the source of Spanish sample.

The obvious strength of using a multimethod design is that it provides researchers with different perspectives on the phenomenon. While some authors have described this view or perspective as "having a different lens" or side (as provided by a crystal) (Sandelowski, 1995), the real strength in using multiple methods is to obtain a different level of data. For instance, one may conduct observational research and obtain information on group behaviour and then conduct a microanalysis study of touching

behaviour. These two studies are independent and together provide a more comprehensive picture than either would alone. The credence and weight that one places on the findings are important. Again, this is done with the study findings when the studies have been completed.

Projects can be conducted simultaneously or sequentially within the umbrella of the main project. Tashakkori and Teddie (2003) define them. "*Simultaneous design* is when used concurrently, one method usually drives the project theoretically. That is, one method forms the basis of the emerging theoretical scheme. This base project has more comprehensive relevance to the topic and is usually conceived at the design phase. The "supplemental" project(s) may be planned to elicit information that the base method cannot achieve or for the results to inform in greater detail about one part of the dominant project. *Sequential Designs* is when used sequentially, the method that theoretically drives the project is usually conducted first, with the second method designed to resolve problem/issues uncovered by the first study or to provide a logical extension from the findings of the first study."

Specific multhimethod designs

In this section, the plus sign (+) indicates that projects are conducted simultaneously, with the uppercase indicating the dominant project. The arrow (→) indicates that projects are conducted sequentially.

The first three designs discussed in what follows are those with an inductive theoretical drive. That is, they are primarily used for developing description and for deriving meaning and interpretation of the phenomenon, the qualitative part thus forming the foundation of the program.

1. QUALITATIVE + quantitative. A qualitative method used simultaneously with a quantitative method with an inductive theoretical thrust is employed when some portion of the phenomenon may be measured, and this measurement enhances the qualitative description or interpretation. Each project is complete in itself, and the results of the quantitative project inform the qualitative project. Once the projects have been completed, the results of the quantitative project are used to provide details for the qualitative project.

Example. An ethnographic study exploring responses to parturition pain in Fijian and Fiji Indian women revealed (Morse, 1989) that the response to pain varied between the two cultural groups. Interviews with traditional birth attendants provided cultural context of the interpretation of the behaviours. A paired comparisons test, comparing common painful events such as childbirth, enabled measurement of pain attribution in each culture. Thus, the study extended Zborowski's (1969) finding that pain behaviour

is culturally transmitted and found that the amount of pain associated with various conditions (and pain expectations) also differs between cultures.

2. QUALITATIVE → quantitative. This design is used when a qualitative and a quantitative method are used sequentially with an inductive theoretical thrust. This design is most often used to develop a model or theory and then to test the theory. Note that while testing is the second quantitative component (and forms a deductive phase), the overall theoretical thrust is inductive. As with the previous categories, each project must be methodologically independent and adherent to its own methodological assumptions. The quantitative study moves the research program along by confirming the earlier qualitative findings. If it is clear that the model or theory is incorrect, then the researcher must consider why. Perhaps, another qualitative study using a different design, or another quantitative study, will have to be conducted. However, it is difficult to find examples of this problem given that a researcher's failures are rarely published and, more likely, the qualitative study will result in minor modifications of the theory.

Example. A research program investigating adolescence's response to menarche consisted of five projects. First, a qualitative project used semistructured questions to determinate the experience of seventh and eight-grade girls with menarche and to establish the dimensions of the experience (Morse and Doan, 1987). Second, using the qualitative analysis, a Likert scale was developed (Morse et al., 1993) using categories such as dimensions and the adolescents' verbal expression to form scale items. Quantitative studies were then conducted to determine adolescent' preparation for menstruation (Kieren and Morse, 1992) and the influence of developmental factors on attitudes toward menstruation (Kieren and Morse, 1995). Regardless of the fact that most of these projects were quantitative, all of the projects rested on the first qualitative project (which is considered the core project), and the theoretical drive of the project remained inductive.

3. Quantitative → QUALITATIVE. It is a typical mixed methods design but a relatively rare multimethod design. When quantitative data precede qualitative data, the aim is to explore with a large sample first to test variables and then to study in a greater depth with a few cases during the main qualitative phase.

Example. A typical mixed methods example is when we use a small structured questionnaire to help recruit participants with adequate characteristics into a qualitative study. If the quantitative data are also valuable at their own, we move into the multimethod arena.

Finally we present designs with a deductive theoretical thrust. These designs are used primarily for hypotheses or theory testing.

4. QUANTITATIVE + qualitative. This design is used when a quantitative and a qualitative method are used simultaneously with a deductive theoretical drive. A theoretical model is created from the literature and previous research and is tested quantitatively. Because some of the components might not be quantifiable, or might require explanation or illustration, a qualitative study is conducted concurrently. Due to the quantitative core of the project, this design has less flexibility than its qualitative equivalent. Recall that both studies must be complete in themselves. The description is primarily from the quantitative data, with qualitative description enhancing particular aspects of the study.

Example. A study of infant feeding in Fiji was conducted to determine the influence of breast- and bottle-feeding on infant health. Regression analysis was conducted on data obtained from infants. Ethnographic interviews conducted with Fijian and Fiji Indian women (Morse, 1984) provided contextual data that enabled further interpretation of the quantitative data.

5. QUANTITATIVE → qualitative. In this design a main quantitative study is followed by a qualitative study. The studies are conducted sequentially using a deductive theoretical drive, although induction is used in the second project.

We use qualitative results to assist in explaining and interpreting the findings of a primarily quantitative study. This can be especially useful when unexpected results arise from a quantitative study (Morse, 1991). In this case, the qualitative data collection that follows can be used to examine these surprising results in a greater detail. In our case, those unexpected results are the lack of predictive power of social network variables on PhD students' academic performance. We expect that a qualitative study can interpret uncover the reasons why the quality of the network fails to translate into the quality of the student's work.

Example. A survey of a small town produced some unexpected results, requiring he investigators to step back and re-examine some assumptions about certain parts of the community.

6. Qualitative → QUANTITATIVE. It is a typical mixed methods design but a relatively rare multimethod design. As regards multimethod designs, when qualitative data collection precedes quantitative data collection, the intent is to first explore the problem under study and then follow this exploration with quantitative data that are amenable to studying a large sample so that results might be inferred to a population. In this alternative, we basically keep the sequential distinction as in the second design, but now the quantitative paradigm and its methods are dominant, while the less dominant aspect constitutes a smaller part of the study.

Example. An experimental hypothesis testing design predominates, while an open-ended pre-experimental interview is also conducted but not as an integral part of the study. An example is when a company is interested in to know what type of package is the most preferred by consumers for a particular product. First of all, they interview some consumers in a focus group to know their opinion about the different types of packaging. Then, the main part of the study consists on an experiment in which money is given to the participants to see really what type of packaging they buy in laboratory as a shop.

7.4 Qualitative data collection: in depth-interview

The goal of the qualitative study is to understand the PhD student's point of view, their feelings and perspectives about their performance and to know what or who helped them in their research performance and what or who made the research performance difficult within their network.

The major qualitative data collection methods are the in depth interviews focus groups and observation.

The main advantages of the interview against the focus group are that in personal interviews we can explore individual differences between participant's experiences, due to the fact that in depth interviews occur with one individual at a time to provide more involving experiences. Personal interviews are easier to conduct than group interviews and may uncover information that would not be brought up in a group. In personal interviews we can do more intense probing for deeper meaning and understanding of the responses.

A focus group is a situation in which a group moderator keeps a small and usually homogeneous group of about 6 to 12 people focused on the discussion of a research topic or issue (Johnson and Christensen, 2000; and Morgan, 1998a). Compared to in depth interviews they have the advantage that respondents often find it easier to easier to discuss among equals than with a researcher. A first disadvantage is that the focus groups can be dominated by one or two participants. Thus, in focus groups measurement validity is possibly low while in interviews you can have moderately high measurement validity for well-constructed and well-tested interview protocols. A second disadvantage is that the focus group meeting may be hard to fit into the participant's agenda.

When using observation, the researcher examines participants in natural environments. Observation has a clear advantage over interviews and focus groups because people do not always do what they say they do. A common problem of observation is reactivity, although reactivity may decrease significantly after the

researcher has been observing for a while. In interviewing, methodologists emphasize establishing rapport; the analogy in observation is to create an environment where people will act as naturally as possible without considering the researcher's presence.

We collected data using the in depth interview because to arrange meetings with all PhD students who answered the quantitative questionnaire in 2001 is difficult because most of them finished the PhD thesis and they are not currently working in the University of Girona; interviewing them separately was easier. Observation is not feasible because we are not interested in the current situation of the PhD students. Actually, we want to ask them about their past, that is when they were PhD students.

7.4.1 Designing the in depth-interview

To collect data using the in-depth interview means that the interviewer establishes rapport and asks the interviewee a series of questions. The interviewer is an important actor and he/she must always remain non-judgemental to the responses provided by the interviewee to help reduce the potentially biasing effect of the interviewer.

As Creswell (1998) recomended, we consciously consider ethical issues – seeking consent, avoiding the conundrum of deception, maintaining confidentiality, and protecting the anonymity of individuals with whom we speak.

Patton (1987, 2002) provided three types of qualitative interviews: a) The *informal conversational interview* is completely unstructured and the questions spontaneously emerge from the natural flow of things during field work, b) in the *interview guide approach*, the topics are prespecified and listed on an interview protocol, but they can be reworded as needed and are covered by the interviewer in any sequence or order, c)the *standardized open-ended interview* is based on open-ended questions and neither the wording nor the sequence of the questions on the interview protocol is varied, so that the presentation is constant across participants. We used the *interview guide approach* because we wanted to ask specific items from the PhD students and we wanted to be sure that interviewees talked about them in a natural way, because of that we considered that order was not important. Additionally, each student could report on issues especially relevant for him or her.

The interview guide helps us stay on track; helps us ensure that important issues/ topics are addressed; provides a framework and sequence for the questions; and helps maintain some consistency across interviews with different respondents. Its aim is to know what students were thinking about their doctorate, and we refrained from assuming the role of the expert researcher with the "best" questions. Prior to designing the interview guide we had a conversation with the leaders of the two unions of PhD students which are active at the University of Girona. Our questions changed during the

process of research to reflect and increased understanding of the problem. At the beginning our interview design was long and contained rather specific questions:

1) Could you tell me what type of problems did you find when you were doing your thesis?

2) Specifically, when you wanted to publish while doing your thesis, what type of problems did you find?

3) And actually, when you want to publish what type of problems do you have?

4) When you were doing your thesis did you have more or fewer problems than now?

5) When you were a PhD student, what or whom helped to you to publish?

6) With respect to your supervisor (give name), what did he do to help you publish and what did he do that hindered your publications?

7) Within this list (research group members), who helped to you to publish?

8) What or who made it difficult for you to publish?

9) Is there somebody else who helped you to publish?

10) Are you satisfied with your research group?

11) What did the group as a whole do to help you publish and what did it do that hindered your publications?

12) How do the thesis and the publications help you in your crrent job?

We changed the guide because the interviewees were not willing to answer the questions about which things or persons hindered them from publishing. We though they felt violent about explaining directly about who hindered them from publishing. When we asked the questions directly the interviewees responded too shortly for us to find us who helped or hindered them from publishing which was our main goal.

We redesigned the interview guide to have in mind the main issues and include fewer and more general questions with the aim of giving the respondents more freedom in expressing what helped them in their task or made it more difficult. We used probing in order that all relevant aspects were covered.

We decided to not have any established order because each interviewee responded differently each question. If interviewees did not answer what we wanted,

we reformulated the question. These were the three important questions to all the PhD students interviewed:

1) Could you explain your experience of doing your PhD at the University of Girona, please?

2) Everybody says that publishing is very important for PhD students. Could you explain me your publishing experience?

3) To finish, could you tell me what advice would you give to a new PhD student?

With these three questions we perceived that interviewees responded the questions more relaxedly and gave more details than before. With these questions we were able to know what or who helped or hindered them for publishing. For students it was easier in this way to speak about the problems that they had during PhD and explain anecdotes about their supervisor or colleagues.

7.5 Sampling

We used the sampling techniques called *extreme/deviant case sampling* and *typical case sampling.* Both techniques are designed to find cases that best illuminate the research question at hand. Using these purposive or nonprobability techniques we seek to focus and, where practical, minimize the sample size, generally in non-random ways, so as to select only those most informative cases. *Extreme/deviant case sampling* involves seeking out the most outstanding cases, or the most extreme successes and/or failures, so as to learn as much as possible about outliers. On the other hand, *typical case sampling* seeks those cases that are the most average or representative of the question under study.

Raywid (1999) conducted a case study using extreme case sampling on a high school to examine the components and qualities that combined to make the school successful. Over the past 10 years, the school selected, Central Park East Secondary in East Harlem, New York City, had received numerous awards, had been the subject of several research articles, and had a history of unusual educational success. This school was the ideal case to examine how a school can become successful when the odds are against success. Thus, the sampling unit in this case was the school, with the number of units in the study equal to one.

In our case, if network variables fail to predict performance it is because the four possible types of extreme PhD student cases are in more or less equal proportions:

1) Research group with high networking potential - student with higher performance than expected.

2) Research group with high networking potential - student with lower performance than expected.

3) Research group with low networking potential - student with higher performance than expected.

4) Research group with low networking potential- student with lower performance than expected.

The typical case is:

5) Research group with average networking potential, student with expected performance.

The qualitative design identified a few cases in each type and with in-depth personal interviews learned what other unknown variables made a difference between higher and lower performers than expected given a particular type.

In principle you could identify students with a lower or higher performance than expected from their network by detecting outliers in a regression model in which network variables are the predictors. Unfortunately in Girona these variables have zero or even uninterpretable effects and thus this strategy could be misleading. We thus need to construct from our best judgment a measure of "research networking potential" and work on the basis of that. Correlation matrices and principal component analysis can assist us in finding meaningful combinations of network variables.

We started by the additional variables defined from the egocentered network of the PhD student in Section 4.2. All variables were standardized.

1) Research group size (zgroup_total).

2) Count of additional contacts provided by the PhD student for the advice network (z_aeco).

3) Count of additional contacts provided by the PhD student for the collaboration network (z_ceco).

4) Number different institutions to which research group members belong to (zdif_instit).

5) Average contact intensity between the PhD student and the research group members for the work-related networks, which includes the scientific advice, collaboration and getting crucial information networks. For comparability reasons, this excludes the additional contacts provided by the PhD student for advice and collaboration, see Chapter 3 (zwork_mi).

6) Average contact intensity for the friendship network, which includes the trust and getting on well networks (zfriend_me).

7) Average contact intensity for the social support network, which includes the emotional support network (zeemi).

8) Average contact intensity for socializing, which includes the socializing network (zsemi).

A Principal Component Analysis of these measures (2 components, 52% explained variance) shows three clusters of variables that thus difficult to summarize in a single operational measure of networking potential:

1) Diversity (zgroup_total, zdif_inst).
2) External members (z_aeco, z_ceco).
3) All variables related to mean frequency or intensity (zwork_mi, zfriend_mi, zsemi, zeemi).

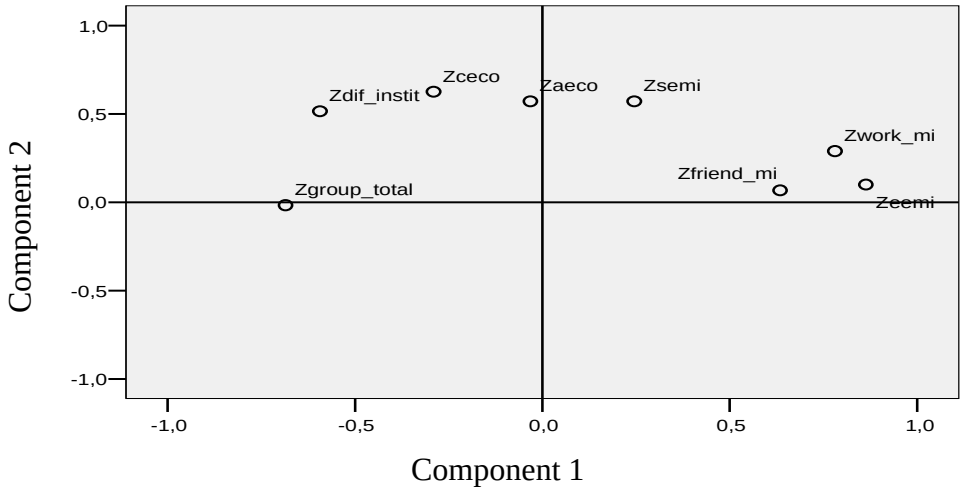


Figure 7.1 Principal Component Analysis loadings, 2 dimensions.

Previous studies of Coromina et al., (2008) suggest sums of contacts to be appropriate variables instead of averages. We thus try with total intensities (i.e. sums). These sums are closely related to size, which makes the count of additional contacts unnecessary. Besides, the seven individual networks are used instead of the four dimensions:

a) Research group size (zgroup_total; as before)

b) Number of different institutions the members of the research group belong to (zdif_instit; as before)

c) Sum of frequencies of advice contacts between the PhD student and research group members (zaest)

d) Sum of frequencies of collaboration contacts between the PhD student and research group members (zcest)

e) Sum of intensities of trust between the PhD student and research group members (ztesi)

f) Sum of emotional support contacts between the PhD student and research group members (zeesi)

g) Sum of frequencies of socializing contacts between the PhD student and research group members (zsesi)

h) Sum of frequencies of getting crucial information contacts between the PhD student and research group members (ziesi)

i) Sum of intensities of getting on well contacts between the PhD student and research group members (zgesi)

These variables have no negative correlations and only 6 out of 36 correlations are below 0.3. In a principal component analysis of these indicators the first dimension explained 53% of the variance and had substantial loadings on all variables. See Table 7.1 and Figure 7.2.

Indicator	Loadings
Research group size (zgroup_total)	.840
Number of different institutions the members of the research group belong to (zdif_instit)	.412
Sum of frequencies of advice contacts between the PhD student and research group members (zaest)	.694
Sum of frequencies of collaboration contacts between the PhD student and research group members (zcest)	.641
Sum of intensities of trust between PhD student and research group members (ztesi)	.874
Sum of intensities of emotional support contacts between PhD student and research group members (zeesi)	.772
Sum of frequencies of socializing contacts between PhD student and research group members (zsesi)	.788
Sum of intensities of getting crucial information contacts between PhD student and research group members (ziesi)	.563
Sum of frequencies of getting on well contacts between PhD student and research group members (zgesi)	.884

Table 7.1 Indicators of network potential of the research group communalities in a unidimensional principal component analysis

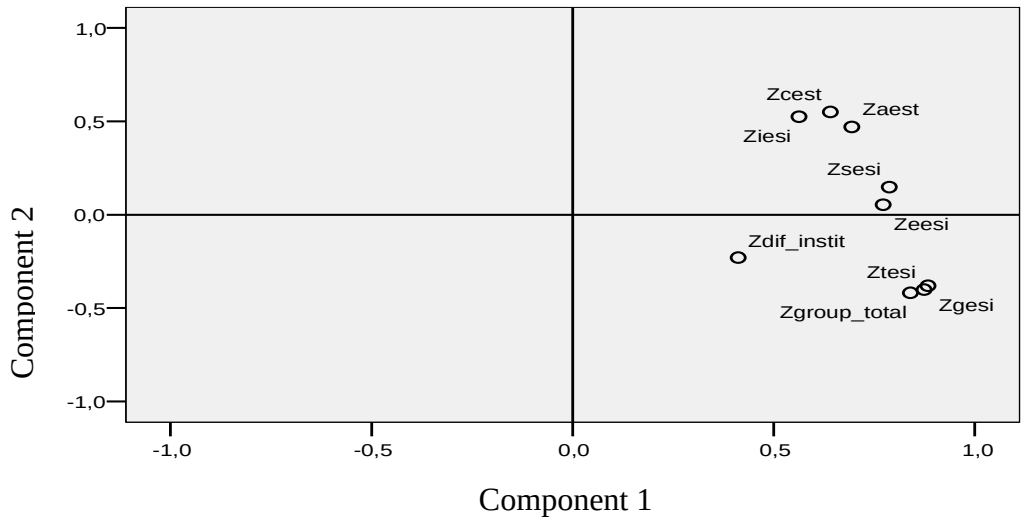


Figure 7.2 Principal Component Analysis loadings, 2 dimensions.

It makes thus sense to compute a summated scale of all these variables. The variable "research group networking potential" is just the sum of all these standardized variables (zgroup_total+zdif_instit+zaest+zcest+Ztesi+Zeesi+Zsesi+Ziesi+Zgesi), that is group size, number of different institutions and the sum of contacts for all seven networks in the questionnaire.

In order to compute a measure of how far performance (perform) is above or below prediction we took the final model in Chapter 4. The model estimates in Girona are:

Variable type	Adjusted R^2=0.59	$\hat{\beta}$ Girona	t-value Girona
	Intercept	20.3	11.6
Background	Supervisor performance	10.7	8.2
	Seniority at the department	6.0	4.7
	Student has children	-7.7	-2.6
Attitudinal	Motivation to start PhD: Research	-2.2	-1.2
	Motivation to start PhD: Autonomy	4.1	2.9
	Too close supervision by supervisor	-2.2	-2.2
Network	Frequency of supervisor advice	-3.8	-2.3
	Number of external student's advice relationships	1.9	1.0
	Social support mean contact intensity	2.0	1.2

Table 7.2 Regression model with Girona data

Since network effects are uninterpretable, we took the significant background and attitudinal variables (supervisor's performance, standardized, seniority at the department, standardized, motivation to start PhD: autonomy, standardized, too close supervision by supervisor, standardized, and having children, dummy) and reestimated the model using the Girona data only (Table 7.3).

Adjusted R^2=.292	$\hat{\beta}$	t-value
Intercept	-5.7	-1.0
Supervisor performance	0.2	3.1
Seniority at the department	3.3	2.9
Motivation to start PhD: Autonomy	1.0	2.3
Too close supervision by supervisor	0.1	0.1
Students have children	-18.4	-2.5

Table 7.3 Significant variables in Girona

The studentized residual is a practical measure for detecting observations above or below the predicted value. It takes into account the fact that extreme cases in the predictor space tend to have smaller residuals and magnifies them accordingly. Precisely extreme cases are what we are interested in.

For the identification of interesting cases we plot the studentized residuals against the research group networking potential variable and we create the following labels for the graph: n = science, t = technical studies, a = humanistic and s = social sciences, followed by student code.

The idea is to take some students in each of the five groups. To as great an extent as possible, selected students should belong to different fields of study. In the Girona research tradition usually two big families of fields of study are defined: scientific-technologic versus humanistic/social. According to this we could select for instance:

1) Research group with high networking potential- student with higher performance than expected: t3, n61a, a35.

2) Research group with high networking potential- student with lower performance than expected: n71, n56, n66, a40.

3) Research group with low networking potential- student with higher performance than expected: t17, n45, s28, a41.

4) Research group with low networking potential- student with lower performance than expected: n69, s14, a33.

5) Research group with average networking potential – student with expected performance: t2, a39, n48 and t4.

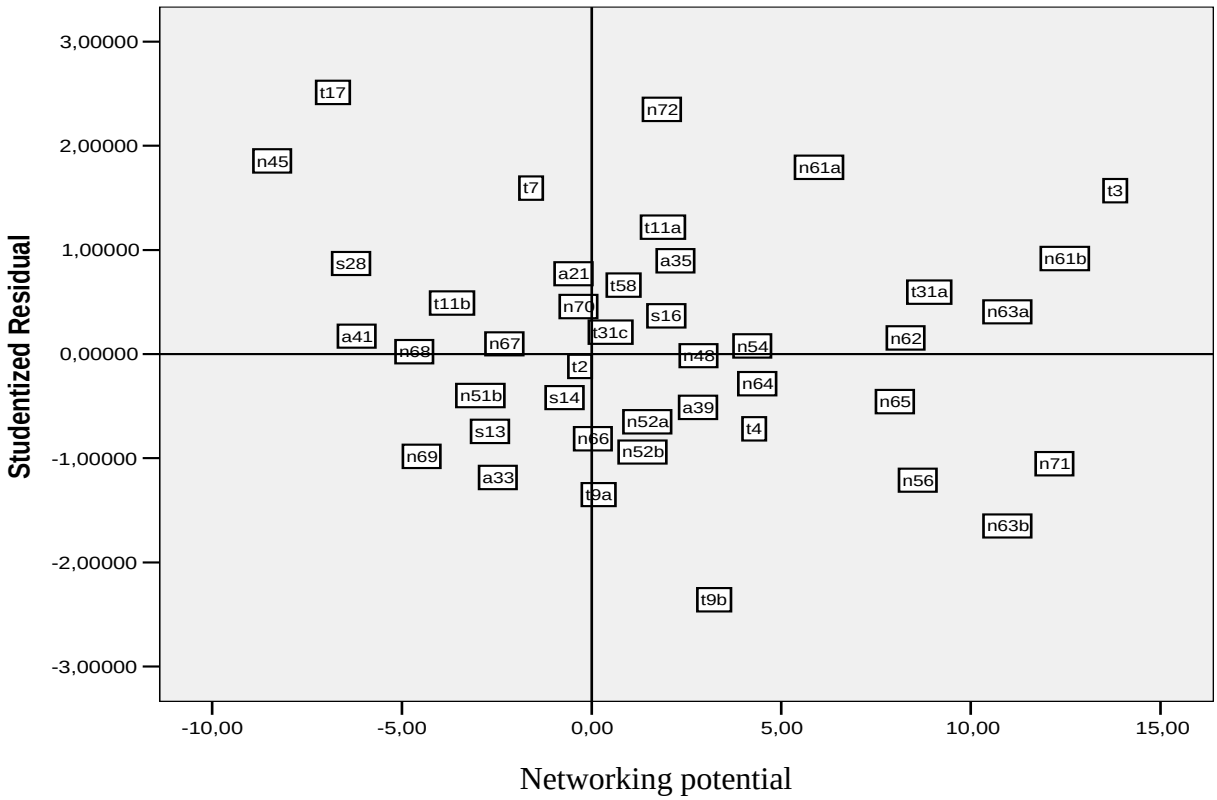


Figure 7.2 Identification of students according to their networking potential and performance residual

Apart for the overall contacts with the group, the advice contact with the supervisor is assumed to be a key variable with also an unexpected effect in Girona.

For the identification of interesting cases we plot the studentized residuals against the supervisor advice frequency variable.

According to this we could select for instance:

6) High supervisor advice- student with higher performance than expected: t3, t11a, a35.

7) High supervisor advice- student with lower performance than expected: s13, a40, n69, n56.

8) Low supervisor advice- student with higher performance than expected: t17, n45, n72, s28.

9) Low supervisor advice- student with lower performance than expected: n71, t9a, a33.

10) Average supervisor advice – student with expected performance: t4, s14, n67.

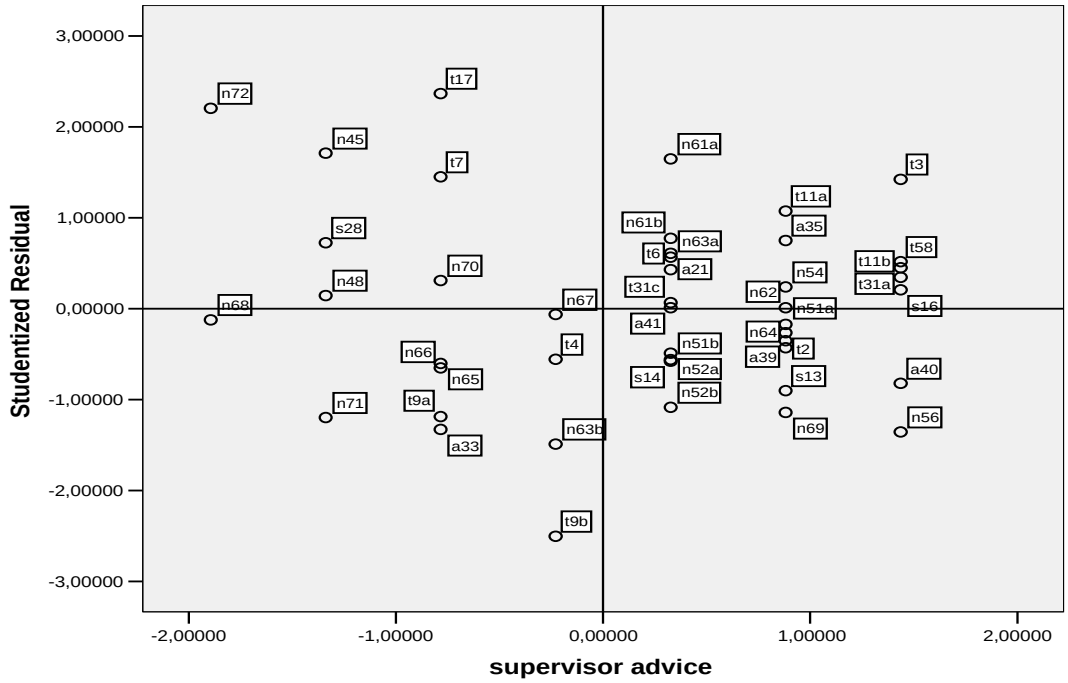


Figure 7.3 Identification of students according their frequency of advice and performance residual

Finally, the students interviewed were 16:

From arts and social sciences fields: a40, s28, a33, s14 and a39.

From technology and natural sciences: t3, n61a, t11a, n56, n66, t7, t17, n45, t11b, t2 and t4.

7.6 Coding

The interviews were conducted between July 2007 and May 2008.

The interviews were taped recorded, transcribed verbatim and coded by using the Atlas.ti software.

First at all, we reread 5 times all the interviews and we identified and classified the units of analyses that we considered relevant for our research questions, that is what helped publication or made it difficult. We classified the items PhD students reported that helped them to publish or hindered them for publishing during their PhD depending on whether the are related to the student's network or not.

We thus had 4 types of codes:

1) Items related with the networks which hindered the students from publishing.

2) Items unrelated with the networks which hindered the students from publishing.

3) Items unrelated with the networks which helped the students to publish.

4) Items unrelated with the networks which helped the students to publish.

7.7 Results

The items collected from the interviews mentioned by 3 or more students are in Tables 7.4 and 7.5 and they are classified in these four groups mentioned in Section 7.6:

As we see in Table 7.4 for the students it is easier to speak about the things that helped them to publish than about the things that hindered them for publishing ((Table 7.5). The fact that 112 out of the 165 mentioned items have to do with the network suggests networks to be more important than shown by the quantitative analyses. Besides, for some of the items their classification as non-network is not completely clear. Visiting other universities during the PhD and lacking economic resources were classified as non-network items. However, the access to other universities or to economic resources can be facilitated by network members with external contacts and with fund-raising abilities.

7.7.1 Network items helping students to publish

As we can see in the Table 7.4., 92 items of 115 mentioned as helpful for publishing by students were classified as network-related. The qualitative study thus shows that network variables are relevant for the PhD students' performance.

The mentioned networking items helping to publish have to do both with the supervisor, with the research group and with external researchers.

First, we analyze the items related with the *supervisor*. 12 students of 16 interviewed told that to receive a high supervisor advice was helpful during their PhD. To have a good supervisor is reported as indispensable in the academic literature (Samuelson, 1972; Richard, 1984; Ravetz, 1971; Cryer, 1996; and Hemlin et al. 2004). Supervisor advice provides to the students and without it students think the thesis will not be correctly finished. Analysing what students told us, we can say that a good supervisor is who orients and introduces the students into the research world and who guides them during the PhD. At the beginning, students do not have any acknowledgement with the research world and they need their supervisor to introduce

them into the research topic. Thus, they think the supervisors are the only persons who can provide them guidance and can solve their problems. Here are some examples of how important the supervisor advice is, specially at the beginning, for broad strategic orientations: "at some point my supervisors advised me to leave a specific part of the project and move on to another thing, (...) 'You're going astray, this is not the way to go'", "your supervisor is very important, especially in the beginning, so that they can lead you one way or another. More than anything, they see a chance to do something that hasn't been done yet. I think the figure of a thesis supervisor is very important", "because then your supervisor will tell you, 'Oops! I can't take this'", but also for problem solving on a regular basis "any time I've needed something, he has helped me", "any time I've had a doubt, he has always been willing to talk about it (...) above all he wanted me to learn as much as I could, I was given opportunities", "if your supervisor doesn't pay any attention to you, problems will arise and you won't be able to solve them because you won't have had any guidance".

These results are not surprising because in the questionnaire the average of the item *my supervisor gives advice concerning the development of my PhD project* was 5.2 (using a scale from "completely disagree" (1) to "completely agree" (7)).

It seems that students have in mind how a supervisor has to be. For instance, not everybody can be a supervisor because a good supervisor has to have some specific characteristics. Qualities that PhD students value about their supervisor are:

a) 7 students told us that a good supervisor has to be interested in the student's PhD thesis. This can be related with the supervisor advice because as we can see, the students perceived that a supervisor is interested in their PhD when the supervisor is worried about how the thesis is going at each moment: "with supervisors who have concerned themselves with the thesis. Sometimes you meet people... whose supervisors ignore them a big deal", "I can always count on him, and, well, in fact he has asked me about the research work and has shown interest in it", "they should be honestly interested in your doing your PhD with them", "with your supervisor you discuss topics such as how the thesis is going, the results you're getting and the right way to interpret them..." This item was not considered in the quantitative questionnaire, eventrhough, supervisors who are interested in the student's PhD thesis can be presumed to give a high supervisor advice.

b) 7 students considered that supervisors have to teach them how to publish, for instance, how to organize the articles and correct the language, "the first two articles were written almost entirely by my supervisor, I mean, I provided the tables, the figures, all the information, but the writing itself was practically done by my supervisor, and he showed me how it should be done", "he inspired me and helped me, especially with the correction of the articles, he helped me, and still helps me, with text structure and English. In the questionnaire average of the item *My supervisor helps me to*

prepare my publications was 5.2 (using a scale from "completely disagree" (1) to "completely agree" (7)).

c) Supervisor and student can easily meet. Students want to have informal meetings with the supervisors to talk about different types of things. Some examples told by students are: "My supervisor's office door was always open for me, not to mention that we used to have breakfast together, we used to go for a coffee together, I mean, whenever I had a doubt... Aah! This publication has just arrived; I'm bringing it to you, and have a look at this article! I could go in and out of my supervisor's office very… freely!" We did not ask this item in the questionnaire.

d) For the students is relevant to have trust with their supervisor. "I think my supervisor has always trusted me, we've known each other for many years now. I trust her completely and I'm sure she trusts me very much; we don't have any 'trust problems'". In the questionnaire the average of this item was 5.37 (using a scale from "complete distrust" (1) to "complete trust" (7)).

e) Collaborating with the supervisor helps the students because is a way to learn how to publish and have more contact with the supervisor. "Collaborating with my supervisor in papers not related with my thesis helps me at the beginning to know how I have to do it". In the questionnaire the average of this item was 3.0 (using a scale from "I do not collaborate with my supervisor in the past year" (1) to "I collaborate daily with my supervisor" (8)).

		Times mentioned
Network	High supervisor advice	12
	Meet researchers outside research group	12
	Easy meeting with group members	9
	Group pushes to publish	7
	Supervisor interested in my PhD thesis	7
	Supervisor teaches to publish	7
	Group helps during PhD	6
	Other PhD students in the group	6
	Supervisor collaboration	5
	Talk with experts about student's topic	5
	Group members are friends	4
	Group with high quality helps	4
	Supervisor easy meeting	4
	Supervisor trust	4
	Total network helps	92
Non-network	Visit other universities during PhD	6
	PhD thesis is the student's main task	5
	Research is the student's motivation	5
	Topic which the student likes	4
	Make a planning by him/herself	3
	Total non-network helps	23
	TOTAL HELPS	115

7.4. Most often mentioned network factors that help performance

Second, as regards the *research group* as a whole, many studies point at the colleagues as the main source of support for research (see Hemlin et al., 2004; Katz and Martin, 1997; and Paulus and Yang, 2000). For the students, to learn the researcher task is very important and they considered that the best persons who can teach it are their colleagues. 6 students gave general statements about group help. Some examples are: "It has helped me a lot at a personal level, (...) in the sense of learning how it works (...) I have learnt what a research group is, how to do research (...) Firstly, they're professionals, they've published a lot, they have many years of experience (...) they were very disciplined, and every month we did some reading, which helped us achieve group dynamics".

As Hemlin et al., (2004) we found that easily meeting with other research group members was mentioned by 9 students. Another thing that helped them is to have a room where they could meet easily: “we have a room for students to work in and which functions as well as a library, a meeting room”, “we are all professors from the same department, so it is... very easy for us to meet up, and also we all get on, which is essential (...) This is why if you can’t do something, someone else in the group will be able to do it.”

PhD students can get valuable help from the group members because of their availability to ask questions at any moment, which makes it easier than asking the supervisor. “You have many doubts, especially in the beginning, (....) you can’t go to your supervisor, say, with a thousand doubts, but the people around you can help you to have a clearer picture of many confusing points”.

To belong to a research group which pushes the students to publish helps. If students feel that their articles are important within the research group they are more motivated for publishing. “Being in a quality team has been of great help, I mean, I’ve been part of a group that was financially self-sufficient, and regarding quality, apart from being a leading group Spain-wide, it was also a leading group (....) Europe-wide (...) and, of course, this motivates you more, when you see your publications are important”, “the thing is that people make you move ahead. We have a research project going... and thanks to it I’ve been able to do my research work and my article writing”.

This is related to the culture of the group, as publications are a means for the group to obtain economic resources and to improve image and to scientific quality of the group. 4 students specifically mentioned group quality: “I’m in the number one publications group at the UdG and this also influenced me a little, not just regarding quantity but also quality (...), and it’s been so thanks to this policy, the policy of publishing the results you get when you do some research work”.

6 persons of 16 interviewed mentioned that having other PhD students in the research group helped them. To have colleagues of the same age is specially mentioned as they can understand the problems and the different situations of the students. “I think that personal contact when you have some kind of problem and contact with people who have the same problems as you can help you find solutions faster or which are better”, “You want to be... with people you get on with, and at the end of the day you want to be with people your age, people who worry about the things you worry about”. On the other hand, the students who are alone in a research group with no other students mentioned that they miss other students to share confidences: “History is my speciality. What we arts PhD students miss, particularly history PhD students, is group dynamics among students”.

4 students told how important it is to become friends with research group members. “He is my inseparable friend. When you are doing the thesis it is very important to have a good environment with your colleagues. We share a lot of moments and we helped each other. The PhD is most easy meeting when you have a friend”.

Meeting researchers outside the research group is very frequently mentioned as a positive factor as well (see Alwood and Bärmark, 1999). Some students recognized that to attend conferences is a good way to meet these researchers: “you appreciate it, building up your contacts, seeing what research is about in a particular place, all in all, meeting people and having contacts”, “this kind of contact does help very much, too. If I’d limited myself to the people I know… that would undoubtedly have meant fewer opportunities. (...) There are many contacts and that helps, (...) and you meet someone and, who knows, the two of you could even start a project together, (...) it’s useful”, “even though it’s not compulsory, it’s highly advisable to attend speeches, especially in the beginning, so that you can have a sort of database of contacts who can prove helpful at a given time.” In the questionnaire, we asked to the students if “my supervisor introduces me to other researchers” and the average of this item was 4.7 (using a scale from “completely disagree” (1) to “completely agree” (7)). Maybe the Girona’s supervisors should be more careful about it and introduce the PhD students to other researchers. Regarding the item “my supervisor encourages me to attend conferences” the average was 4.6 (using a scale from “completely disagree” (1) to “completely agree” (7)). Supervisors must encourage students more to attend conferences because it is a good way to meet other researchers who can help them in their topic. Students who belong to a small research group need most to meet other researchers because it is a way to obtain support and improve the knowledge in their own topic.

Related to this, to talk with experts about student’s topic is also helpful. “It is important to meet people from other universities to talk about your topic. My topic is very specific and I needed to find foreign people specialized on it”. “It is very important because sometimes you need help and people from your research group are not specialized in your topic.”

7.7.2 Non-network items helping students to publish

Other things that help students to publish are related to attitudes and working conditions, such as:

a) To have the PhD thesis as main task is good for finishing the thesis on time, "my priority was my first degree dissertation and then finish the thesis. This had to top the list. I wrote some articles but they weren't especially remarkable. (...) I had to focus on finishing my thesis", "during the four years of my PhD I wasn't burdened with additional tasks... for example classes, so I could devote my time to researching." Students who have the thesis as main task usually have a grant. Working conditions and time use were absent from the quantitative questionnaire.

b) To have a high motivation for research helps to the students to do their task "I think a researcher has to feel whatever they're doing, I mean, you have to like what you're doing because if you do not you can find it all very boring", "I did it very eagerly because it was what I wanted to do."In the questionnaire *my great interest in research* was considered very important (the average was 5.9, using a scale from "totally unimportant" (1) to "very important" (7)).

c) Choose a topic which they like "I do think you have to like it, and (...) it's better to go happily about it than think... 'What a bore, having to do this again'", "you have to like the topic very much, you have to have interest in it, (...) you have to choose it carefully."In the questionnaire the students yet valued *my great interest in the topic* with an average scare of 5.6 (using a scale from "totally unimportant" (1) to "very important" (7)).

d) Make a planning by himself/herself "I think it's important to set a schedule, realistic but ambitious at the same time, so that you can make steady progress with your thesis." It is important to fix objectives and time in order to finish the PhD on time.

7.7.3 Network items hindering students from publishing

As regards hindrances related to the networks, the interviews showed that a lack of network contacts hindered students from publishing (see Table 7.5). For instance, 6 students think that to belong to a research group with few members hindered them, because they have fewer people to share knowledge with, they think they have less support and fewer projects to work on. "It's a small group and this is why it is not very likely for people to want to be part of it… because small groups are rather unpopular", "if there are many people working in a group, you have more chances to discuss things", "if you're in a small group and you're the one who knows the most about a

certain subject, then you can't consult things", "it's a very small group. (...) I found support in it... but I can't say the same about power", "another negative thing I've had to face is that, at the Universitat de Girona, my group is very small, and I can't really do research the way I could during my stays abroad, where there were many experts, seminars given by foreign professionals, and you could discuss things with them... Here I'd say it's more individual." On the other hand, students who belong to a big research group think that this fact helped them to publish: "we were always between 15 and 20 people, so we could do many more things... Much more was going on than in other research groups here consisting of 2 or 3 people."

4 interviewees think that research is lonely and sometimes it is difficult to get motivated "here it's more individual work. You can talk about your articles with your thesis supervisor, but that's it". This is linked with the fact that they do not have people who can help them within he research group: "the research work is somewhat individual, as I see it, (...) from time to time doubts show up, during your PhD, but you have to take it easy, everyone goes through the same", "most days I'm alone at home or at the archive, also alone."

4 students told that to have low supervisor advice hindered them from publishing. Students think that supervisors should have a lot of time to help them with the thesis. "We haven't published anything else together. To tell the truth, we really haven't had the chance... because, since we belong to different departments, sometimes it's a bit difficult to meet up", "about my supervisor, (...) I haven't been able to see him really often because he is a very busy man", "your thesis supervisor (...) can help you with your research but after some time *you* are the expert, not him, and he can help you up to a point."

The research group's few meetings were also a commonly mentioned hindrance. To share knowledge with colleagues is very important for the students. "We should meet up more often and organise things better", "each of us was going their own way, we met up from time to time, (...) but we didn't have group dynamics", "one thing I miss here (...) are weekly seminars. (...) I think this kind of communication is lacking here."

When the group has a lack of PhD students this hinders them. "If I had had a colleague in the same situation as me I would have more support". "I think that the personal contact with others in front of the same problems can help you to find fast solutions or better solutions. I think to have other PhD students in the research group would have helped me."

7.7.4 Non-network items hindering students from publishing

In Table 7.5 we can see what items unrelated to the network hindered students from publishing.

Non-network aspects that hindered students from publishing are mostly related to the lack of time that they have to publish due to teaching or to administrative work. According to the literature, it can be expected that researchers do not like "burocracy", particularly if it takes time away from the research activities (Spangenberg et al., 1990; and Martin and Skea, 1992). In Girona, not all the students have a grant and because of that they need to do teaching and administrative work and they have less time for the thesis. "From the moment I took up management tasks it is been difficult for me to work on my first degree dissertation and my thesis. I've had to decide what to do, I've had to dedicate much time to management work and this hasn't allowed me to make progress with my dissertation", "since we had to teach classes, we could not devote all our time and efforts to our theses. We had many things to do, which reduced our dedication to our projects."

Other mentioned aspects did not have as much to do with hindrances as with the inherent difficulty of the task, such as slow process or failed experiments. "We work on historical sources and sometimes they are limited. The lack of information can stop the research". "Publishing is a slow process, I wrote a paper during two years and then I had to wait that the review accepted it… it is a slow process".

		Times mentioned
Network	Small research group	6
	Lonely research	4
	Low supervisor advice	4
	Few group meetings	3
	Group lack of PhD students	3
	Total network hinderances	20
Non-network	A lot of teaching	7
	Lack of economic resources	6
	Lack of time	5
	Publishing is a slow process	5
	A lot of administrative work	4
	Experiments do not work or lack of information	3
	Total non-network hinderances	30
	TOTAL HINDERANCES	50

Table 7.5 Most often mentioned network and non-network factors that hinder performance

7.7.5 Items with a questionnable network – non-network classification

Visiting other universities during the PhD and lack of economic resources were classified as non-network variables but this can be questioned. If a PhD student visits other universities it can be considered as a personal experience to know the place and other methods of working. "You just have yourself to take care of you when you're abroad, where a foreign language is spoken, where problems happen, (...) it helps you personally and above all professionally, because you get to see how other laboratories work", "I think it's essential to go abroad, (...) to learn about another culture and other ways of living and working. I think going abroad is highly important, it can help you mature, for instance, and regarding your PhD it can be very inspiring..." But when the students visit other universities they get involved with other researchers and they can share knowledge and work together: "In Amsterdam I met... this thesis supervisor. He's top in my field of research. He is one of the most influential people in the world." If we consider this side, this variable can be considered to be a network variable because actually this student can share his/her knowledge with this person and maybe in the future they will collaborate together in a project.

The lack of resources within the research group can be understood from a material perspective. "Few resources, especially of a financial nature… and I'm not referring to salaries. I'm talking about material, technical support… this kind of help". However, research groups obtain their resources depending on their performance and the fund raising ability of certain members, o even, as often mentioned, through sheer size "it's a small group and therefore it's not likely for people to want to be part of it… because small groups are rather unpopular. I'm happy with my group but I am not with the support we're given." This would be an argument to consider this item as a network item, at least partly.

7.7.6 Factors helping or hindering performance depending on the research group networking potential

In Tables 7.6 and 7.7 we analyse separately the PhD students depending on the research group's networking potential. Some differences emerge between the different groups.

In Tables 7.6 and 7.7 we can see differences between the 6 students within a high networking potential research group and the 7 students within a low networking potential group. Students within a high networking potential research group told more often that networks help to publish. For instance, they more often mention high supervisor advice, group pushes to publish, supervisor interested in my PhD, other PhD students in the group and group with high quality helps. Students within a low networking potential research group told more often that non-network aspects were

helpful, specially having the PhD thesis as a main task. As regards what network aspects hinder them, students within a high networking potential research group told that what most hindered them was that to belong to a small research group while students within a low networking potential research group that what most hindered them was to receive a low supervisor advice. Regarding what non-network items hinder them, students within a high networking potential research group told that what most hindered them was that publishing is a slow process while the students within a low networking potential research group that what most hindered them was the lack of time.

		Research group with high networking potential	Research group with low networking potential
	SAMPLE SIZE	6	7
Network	High supervisor advice	6	3
	Meet researchers outside research group	5	4
	Easy meeting with group members	3	4
	Group pushes to publish	4	2
	Supervisor interested in my PhD thesis	4	2
	Supervisor teaches to publish	2	3
	Group helps during PhD	2	2
	Other PhD students in the group	3	1
	Supervisor collaboration	2	2
	Talk with experts about student's topic	2	2
	Group members are friends	1	2
	Group with high quality helps	2	0
	Supervisor easy meeting	2	1
	Supervisor trust	1	2
	Total network helps	39	30
Non-network	Visit other universities during PhD	3	2
	PhD thesis is the student's main task	1	3
	Research is the student's motivation	2	2
	Topic which the student likes	1	2
	Make a planning by him/herself	1	2
	Total non-network helps	8	11
	TOTAL HELPS	47	41

Table 7.6 Most often mentioned network and non-network factors that help performance classified depending on the networking potential of the student's research group

		Research group with high networking potential	Research group with low networking potential
	SAMPLE SIZE	6	7
Network	Small research group	4	2
	Lonely research	1	2
	Low supervisor advice	0	3
	Group few meetings	1	2
	Group lack of PhD students	1	2
	Total network hinderances	7	11
Non-network	A lot of teaching	3	3
	Lack of economic resources	3	2
	Lack of time	0	4
	Publishing is a slow process	4	1
	A lot of administrative work	2	2
	Experiments do not work or lack of information	1	2
	Total non-network hinderances	13	14
	TOTAL HINDERANCES	20	25

Table 7.7 Most often mentioned network and non-network factors that hinder performance classified depending on the networking potential of the student's research group

7.7.7 Factors helping or hindering performance depending on the student's performance

Tables 7.8 and 7.9 compare students with higher (n=8) and lower (n=5) performance than expected. In Table 7.8 we see that students with high performance told more often that easy meeting with group members, supervisor teaching to publish and group with high quality helps them. Visiting other universities during PhD is also more helpful for the students with a high performance than expected. These items can be important for all PhD students and maybe the students with lower performance than expected did not mention them because they did not have the chance to experiment them. Thus, these items can make the difference between students with high and low performance than expected.

		Student with higher performance than expected	Student with lower performance than expected
	SAMPLE SIZE	8	5
Network	High supervisor advice	5	4
	Meet researchers outside research group	5	4
	Easy meeting with group members	6	1
	Group pushes to publish	3	3
	Supervisor interested in my PhD thesis	1	5
	Supervisor teaches to publish	4	1
	Group helps during PhD	2	2
	Other PhD students in the group	2	2
	Supervisor collaboration	2	2
	Talk with experts about student's topic	2	2
	Group members are friends	1	2
	Group with high quality helps	2	0
	Supervisor easy meeting	2	1
	Supervisor trust	2	1
	Total network helps	39	30
Non-network	Visit other universities during PhD	4	1
	PhD thesis is the student's main task	2	2
	Research is the student's motivation	2	2
	Topic which student likes	1	2
	Make a planning by him/herself	1	2
	Total non-network helps	10	9
	TOTAL HELPS	49	39

Table 7.8 Most often mentioned network and non-network factors that help performance classified depending on the student's performance

		Student with higher performance than expected	Student with lower performance than expected
	SAMPLE SIZE	8	5
Network	Small research group	5	1
	Lonely research	1	2
	Low supervisor advice	3	0
	Group few meetings	1	2
	Group lack of PhD students	2	1
	Total network hinders	12	6
Non-network	A lot of teaching	2	4
	Lack of economic resources	4	1
	Lack of time	2	2
	Publishing is a slow process	2	3
	A lot of administrative work	2	2
	Experiments do not work or lack of information	1	2
	Total non-networks hinderances	13	14
	TOTAL HINDERANCES	25	20

Table 7.9 Most often mentioned network and non-network factors that hinder performance classified depending on the student's performance

Belonging to a small research group and having a low supervisor advice hinders students with higher performance than expected. A lot of teaching hinders the students with lower performance than expected and the lack of economic resources hinders the students with higher performance than expected.

7.7.8 Factors helping or hindering performance depending on having a grant

In Tables 7.10 and 7.11 we see differences between students having or not a grant. Even if the no-grant group is nearly twice as large, they tend to mention comparatively fewer items. The count of items mentioned is thus close to being equal in both groups and both columms of the table are comparable.

		Grant	No grant
	SAMPLE SIZE	6	10
Network	High supervisor advice	5	7
	Meet researchers outside research group	6	6
	Easy meeting with group members	4	5
	Group pushes to publish	2	5
	Supervisor interested in my PhD thesis	3	4
	Supervisor teaches to publish	4	3
	Group helps during PhD	4	2
	Other PhD students in the group	3	3
	Supervisor collaboration	2	3
	Talk with experts about student's topic	3	2
	Group members are friends	2	2
	Group with high quality helps	2	2
	Supervisor easy meeting	2	2
	Supervisor trust	1	3
	Total network helps	43	49
Non-network	Visit other universities during PhD	4	2
	PhD thesis is the student's main task	4	1
	Research is the student's motivation	2	3
	Topic which student likes	3	1
	Make a planning by him/herself	2	1
	Total non-network helps	15	8
	TOTAL HELPS	58	57

Table 7.10 Most often mentioned network and non-network factors that help performance classified depending on if they have grants or not

		Grant	No grant
	SAMPLE SIZE	6	10
Network	Small research group	3	3
	Lonely research	2	2
	Low supervisor advice	2	2
	Group few meetings	3	0
	Group lack of PhD students	2	1
	Total network hinders	12	8
Non-network	A lot of teaching	2	5
	Lack of economic resources	2	4
	Lack of time	1	4
	Publishing is a slow process	1	4
	A lot of administrative work	1	3
	Experiments do not work or lack of information	2	1
	Total non-network hinderances	9	21
	TOTAL HINDERANCES	21	29

Table 7.11 Most often mentioned network and non-network factors that help performance classified depending on if they have grants or not

Students without a grant have to do extra work at university. This is why they more often mentioned that to work doing administrative work or teaching hindered them during their PhD or that they had a lack of time for other reasons or a lack of economic resources. Overall, students without a grant mentioned much more often non-network hindrances.

On the contrary, for students with a grant, non-network items were usually helpful. They more often mentioned having the PhD thesis as main task, being motivated for the PhD topic and visiting other universities. These visits are easier when there are no teaching obligations and travel money is available, which is generally the case for students with a grant.

7.7.9 Factors helping or hindering performance depending on the field of study

		Sciences / technology	Arts / social sciences
	SAMPLE SIZE	11	5
Network	High supervisor advice	9	3
	Meet researchers outside research group	9	3
	Easy meeting with group members	7	2
	Group pushes to publish	5	2
	Supervisor interested in my PhD thesis	4	3
	Supervisor teaches to publish	5	2
	Group helps during PhD	4	2
	Other PhD students in the group	5	1
	Supervisor collaboration	3	2
	Talk with experts about student's topic	4	1
	Group members are friends	2	2
	Group with high quality helps	3	1
	Supervisor easy meeting	3	1
	Supervisor trust	2	2
	Total network helps	65	27
Non-network	Visit other universities during PhD	5	1
	PhD thesis is the student's main task	2	3
	Research is the student's motivation	4	1
	Topic which student likes	1	3
	Make a planning by him/herself	2	1
	Total non-network helps	14	9
	TOTAL HELPS	79	36

Table 7.12 Most often mentioned network and non-network factors that help performance classified depending on the field of study

In Tables 7.12 and 7.13 we see differences between students with different fields of study. In sciences and technology the network seems to be more important (Hemlin et al., 2004). The research group is very important for the scientific students because for them is very important to share knowledge with others and meet easily with group members. A way to improve their knowledge about the topic is share experiences with other PhD students in the group. To share experiences with other PhD students help them to solve problems in the laboratory. Students from sciences told that to belong to a small research group hindered most because they did not have enough people with who discuss problems. Also, they felt that to belong to a small research group hindered them for obtaining economical resources. These students need a lot of economical resources for their research because their laboratory tools are very expensive and the lack of economic resources hindered their research. In sciences, students need high supervisor advice, because of that some of them considered that they did not receive enough advice. Scientific students need to share knowledge with experts and they consider that to visit other universities helps them to improve their knowledge.

On the other hand, in arts and social sciences is more important to choose the topic. They need to read a lot about the topic and the major of the time they are alone. They are not as worried as scientific students about the size of the group and sharing knowledge with others. In arts and social sciences, students consider that having the thesis as main task is very important because a lot of them have a lot of teaching and a lot of administrative work and they need longer time to finish the PhD thesis.

		Sciences / technology	Arts / social sciences
	SAMPLE SIZE	11	5
Network	Small research group	6	0
	Lonely research	3	1
	Low supervisor advice	4	0
	Group few meetings	1	2
	Group lack of PhD students	2	1
	Total network hinders	16	4
Non-network	A lot of teaching	4	3
	Lack of economic resources	6	0
	Lack of time	3	2
	Publishing is a slow process	4	1
	A lot of administrative work	2	2
	Experiments do not work or lack of information	2	1
	Total non-network hinderances	21	9
	TOTAL HINDERANCES	37	13

Table 7.13 Most often mentioned network and non-network factors that help performance classified depending on the field of study

Chapter 8

CONCLUSIONS

8.1 Summarizing of the results

8.2 Policy implications

8.3 Limitations of the research and further research

8.1 Summarizing of the results

In this thesis our main goal was to predict PhD students' academic performance in different countries. Explanatory variables are characteristics of PhD student's research group understood as an egocentered social network, background and attitudinal characteristics of the PhD students and some characteristics of the supervisors.

In Chapter 2, we presented the web survey design and saw that through a careful follow-up design we achieved high response rates in questionnaires administred via web (Spain and Slovenia), even higher than in the country which used paper and pencil questionnaires (Germany). The questionnaire design was centrally coordinated to facilitate comparability. Finally, some compare descriptive results were presented.

In Chapter 3, Slovene and Spanish data are generally comparable. The German data are comparable only with respect to a limited number of variables. On the other hand, estimates of realibility of attitudinal variables are appropriate.

In Chapter 4, we compared regression models obtained to predict PhD students' academic performance in the universities of Girona (Spain) and Slovenia. Here we have the main results group into the three type of variables:

Background variables: *Supervisor's performance* is an important variable and has the same high positive effect on PhD student's performance in both countries. *Seniority at the department* increases performance in the University of Girona.

Attitudinal variables: *Motivation for autonomy* prior to starting the PhD has the same positive effect in both countries.A high *motivation for research* prior to starting the PhD increases performance in Slovenia.

Network variables: *Frequency of supervisor advice* is significant in both countries, but this variable affects negatively in Girona, *the number of external student's advice relationships* and *social support* mean contact intensity are not significant in Girona.

In conclusion, while the use of these three types of variables together seems to be the best way to predict the performance of the PhD students, there are large country differences in the way in which these variables operate. We find that egocentered network does not predict performance in the University of Girona. The results of the network variables were either non-significant or counter-intuitive.

In Chapter 5, we compared Slovenia, Spain and Germany. The three countries are very different, particularly the German case. PhD studies in Germany are organized totally in a different way from the other two countries and because of that, the results are markedly different. Network variables are also non significant in Germany.

In Chapter 6, we included the duocentered network variables in the comparison across Girona and Slovenia. But it did not improve the predictive power of the regression model using network variables in Girona.

Summarizing, while the use of these three types of variables together (attitudinal, network and background) theoretically seems to be the best way to predict the performance of the PhD students, the network variables, whether egocentered or duocentered fail to have predictive power in Girona. The qualitative study in Chapter 7 was aimed at revealing some reasons for the counter-intuitive effects of the network variables. Specifically, in Girona we want to know why networks do not help predicting academic performance of PhD students.

The most significant results in Chapter 7 were that for the students it is easier to speak about the things that helped them to publish (92+23=115) than speak about the things that hindered them for publishing (20+30=50). The fact that 92+20=112 out of the 165 mentioned items have to do with the network suggest networks to be more important than shown by the quantitative analyses.

The mentioned networking items helping to publish have to do with the supervisors, with the research group and with external researchers. Related to supervisors, PhD students considered that supervisors have to give high advice, have to be interested in the students' PhD thesis, have to teach students how to publish, must easily meet with the student and it is important to have trust and collaboration with them. As regards the research group as a whole, most of the students point at the colleagues as the main source of support for the research. For the students, meeting easily with the group members, to be pushed to publish by the research group and to be helped during the PhD by the group are the most mentioned realted items with the group. Meeting researchers outside the research group is very frequently mentioned as a positive factor as well. Non-network aspects that helped students are to have the PhD thesis as the main task, to have a high motivation for research, to choose a topic which they like and to make a planning by themselves.

As regards hindrances related to the networks, the interviews showed that a lack of network contacts hindered students from publishing. For instance, students think that to belong to a research group with few members hindered them, because they have fewer people to share knowledge with, they think they have less support and fewer projects to work on. Non-network aspects that hindered students from publishing are related to the lack of time that they have to publish due to teaching or to administrative work.

Students without a grant have to do extra work at university. This is why they more often mentioned that to work doing administrative work or teaching hindered them during their PhD or that they had a lack of time for other reasons or a lack of economic resources. Overall, students without a grant mentioned much more often non-network hindrances.

On the contrary, for students with a grant, non-network items were usually helpful. They more often mentioned having the PhD thesis as main task, being motivated for the PhD topic and visiting other universities. These visits are easier when there are no teaching obligations and travel money is available, which is generally the case for students with a grant.

8.2 Policy implications

To improve the policies in the University of Girona can increase the performance of PhD students in straightforward manners.

First, it would be helpful to make sure that PhD students have supervisors with high performance and with time to get involved in the PhD thesis. The quantitative studies have shown that supervisors' performance is important for PhD students' performance. In the sample there was a high diversity in the publication performance of supervisors. If we consider publications of all kinds which are either international or submitted to a peer-review process we find that 25% of supervisors in the sample had 3 or fewer such publications while 25% had 19 or more of them (minimum:0, maximum:31, mean 10.5, SD 8.3). For many students, having a mediocre supervisor is thus a considerable hindrance. Fortunately, this situation has recently changed; according to current laws, students can only be supervised by doctors with proved experience, though individual universities enjoy some freedom in deciding how research experience is to be proven. This result should encourage universities to be strict in this respect.

Second, the qualitative study mentioned lack of resources as an important factor, often linked to small group size. An obvious policy implication is to improve the resources of high quality groups without considering their size. These resources need not to be only financial but can include the allocation of a large number of PhD students with grants, and travel money, as travel and a critical mass of PhD students were commonly reported as important in one way or another.

The qualitative study also revealed that the research group is a key factor of student success. An obvious policy implication is to allocate grants to high performing research groups. This is currently done at the University of Girona, which is giving more weight to the group CV (60%) than to the candidate's CV when allocating grants to groups. The Spanish ministry still allocates a very low percentage to the group CV (10%, although it allocates a further 20% to the Supervisor's CV). The regional government of Catalonia lets the individual universities participate in the allocation. In this case, the practice of the University of Girona is to assign only 10% weight to the group CV. Another obvious implication would be to mandate or at least encourage all PhD students' integration in a research group, having a grant or not.

Third, having a grant also emerged as a helpful factor the qualitative study. The obvious implication is the need of offer more grants for PhD students and ensure that PhD students with a grant really have the PhD thesis as a main task, as mandated by law. Yearly, the Spanish ministry is currently giving 950 grants country-wide, the University of Girona is giving 20 and the regional Catalan government allocates a further 18 to the University of Girona. If we take into account that the country as a whole had 72.741 enrolled PhD students in 2007, and Girona only 354, the university and regional grants have a far greater proportional impact than the country grants. In any case, the great majority of PhD students do not have a grant.

Fourth, the qualitative study reveals the importance of visiting other universities to contact with other researchers. Obviously, policies are needed to encourage the mobility of researchers during the course of their careers.

Finally, in current standards, degree mark average is one of the most used indicators to decide whether a person is able to obtain a grant, or to enrol a PhD program. This variable did not emerge as relevant in either the qualitative or quantitative analysis. On the other hand, motivational variables showed their relevance both in the quantitative and qualitative studies. The selection process should, therefore, take motivations into account and involve long interviews with candidates.

8.3 Limitations of the research and further research

The small number of PhD students at the University of Girona is a first limitation to be taken into account when fitting models with a large number of variables. In spite of this low number of observations, these constitute the whole population of PhD students who began their doctoral studies at the University of Girona in the academic years 1999/2000 and 2000/2001. According to this, we could consider this research as a case study restricted to the University of Girona, therefore any generalization beyond that university could be considered to be doubtful. On the other hand, for a qualitative study, to have a single case and a small sample is by no means a limitation.

We are aware that the operationalization of PhD student performance as academic output and especially as publications can have its implications. However, the choice is not unreasonable given the fact that publications are taken more and more into account by the government agencies providing habilitations or accreditations for jobs at university. The weights given to the different types of output are more uniform than what is usual in the aforementioned agencies (in our measurement of performance, for instance an article in an international journal with a high impact factor counts only twice as much as a conference paper). We also considered using less uniform weights but it increased the skewness of the distribution of performance and made it too much affected by the field of study, as certain fields of study tend to favor certain types of output only.

We are also aware that the final regression model may be mostly the result of chance, given the fact that the same data set was used to specify and test the model. The results should thus be validated with data of other Spanish universities, even if the convergence in many respects of the qualitative and quantitative findings is rather encouraging.

Finally, in spite of the care taken in coordinating the study design, some comparability problems across countries will remain, especially with regard to differences in university systems and variable measurement effects.

Further research is thus needed in order to learn more about these potential problems. Additional indicators of performance are needed, in order to more accurately explore the implication of network variables on the actors' performance. This study can be done in other universities to have a larger and diverse sample.

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