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From Busy Bees to Science Geeks and Party Animals: A Typology of Slovenian Doctoral Students

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Abstract

In this paper, we focus on the importance of social relations for the performance of individuals and, more specifically, for the academic performance of doctoral students in Slovenia. The basic assumption here, which also finds support in the literature, is that a person's performance largely depends on the relationships they have with important others within the organization. An individual's performance is also the result of individual traits such as competence, intelligence, experience, attitudes and personality.

In this paper we are interested in how these different social (network) and individual factors shape the performance of doctoral students in Slovenia. On the basis of several factors established in previous studies we formulate a typology of Slovenian doctoral students. The study was conducted on a sample of 117 doctoral students in Slovenia. The data were collected in 2003 as part of the International Network on Social Capital and Performance (INSOC) research project.

The results show that a clustering into five groups is the optimal solution and confirms some findings of previous studies. Good integration into the research group, a good relationship with the supervisor, a strong motivation to do the PhD, and the importance of the work seem to be the factors most beneficial to academic performance. However, the results also reveal that social relationship and attitudinal indicators have a more complex and not always a linear relationship with performance.

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1 Introduction

There is a vast body of literature on the importance of social relationships in different spheres of human life. Much of this research has been done in the field of social network analysis. Among the topics researched are information flows (e.g., Michaelson, 1993; Shelley et al., 1995), relations among different political, economic and/or other social actors and decision-making processes (e.g., Friedman, 1988/1997; White, 1988/1997), the structure of relations within and/or among large formal organizations such as institutions or companies (e.g., Mokken and Stokman; 1978; Nohria and Eccles, 1992; Mizruchi and Galaskiewicz, 1994), intimate relations such as friendship (e.g., Zeggelink, 1994, 1995) and the functioning of informal social support resources (e.g., House, 1981; Gottlieb, 1983; Wenger, 1994). The research has been carried out on different levels of analysis, from egocentered (a single actor and their relationships toward their important others) and dyadic (pairs of actors) levels to the level of whole networks (groups of actors).

In this paper, one of our two main foci is the importance of social relations for the performance of individuals. The basic assumption here, which also finds support in the literature (e.g., Burt, 2000), is that a person's performance largely depends on the relationships they have with important others within the organization.[4] Formal (within a formal organizational structure) and informal relations (e.g., friendships) are important for an individual's performance and are often summed up in the term "social capital". However, since we are grounding our research in the field of social network analysis and social support, we instead use the term social relations with regard to the importance of social relationships for different outcomes on either the individual or group level.

There is a large and very diverse body of literature on social relationships. However, perhaps three major theoretical perspectives, at least in the field of social network analysis, may be distinguished: the weak ties theory (e.g., Granovetter, 1973); the structural holes theory (e.g., Burt, 1992) and the social resources theory (e.g., Lin, 1990). Further, social relations can be conceptualized and measured on different levels, the individual level, the group level as well as the level of relations of individuals and/or groups with outside individuals or groups (e.g., Borgatti et al., 1998).

The relationship between an actor and his/her most prominent professional other, the supervisor, is also very important. A good supervisor helps his/her protégé with vital professional knowledge and information, gives them emotional

[4] Relations outside an organization may also be relevant, but they are not the focus of this paper. Further, we are not dealing with relationships of the focal person with their important others in the sphere of private life (e.g., relatives, friends, neighbors and similar).

support and enables contacts with other important people (Ziherl, 2006). Supervisors sometimes function as some kind of role models for doctoral students who are also teaching assistants. They cherish the supervisors' availability for informal advice and discussion regarding teaching classes as well as more systematic, organized forms of help and advice regarding teaching and/or research (Austin, 2002). In a longitudinal study by Green and Bauer (1995) career mentoring by the supervisor and collaboration between the supervisor and the doctoral student was positively related to the doctoral student's publishing outcomes, although the effects were not statistically significant (but the effect of prior experience with research and publishing was positive and statistically significant). In addition, a stronger career commitment by the doctoral student was positively related to the supervisor's career mentoring. A later similar study by Paglis et al. (2006) showed that collaborative mentoring had a positive effect on the productivity and self-efficacy of doctoral students.

In contrast, supervision may also have negative aspects such as personal disagreements, manipulation, power misuse and too tight or too loose exercise of control (also see Matelič et al., 2007; Capó et al., 2007). Not an insignificant number of students has expressed disappointment over the lack of regular mentoring and advice from their supervisor, largely owing to the latter's time constraints and heavy work load (Austin, 2002).

Yet an individual's performance is also the result of individual traits such as competence, intelligence, experience, attitudes and personality. There is evidence that a person's attitudes to work are among the most important predictors of organizational success and motivation (e.g., Diefendorff et al., 2002). Some approaches consider performance in an even more complex way that takes both internal (psychological) as well as external (social) factors into account (e.g., see the discussion on so-called creative knowledge environments in Hemlin et al., 2004).

In this paper we are interested in how these different social (network) and individual factors shape the performance of doctoral students in Slovenia. Several studies have shown that social network aspects have a positive effect on students' performance (e.g., Eggens et al., 2008, Coromina et al., 2008).

Studies by Matelič et al. (2007), Ziherl et al. (2006), Kogovšek et al. (2004) and Hlebec et al. (2011) already provide some empirical evidence of the importance of these factors for doctoral students' performance in Slovenia. Matelič et al. (2007) concentrated on the importance of different factors on doctoral students' performance on the dyadic level (the student-supervisor relationship). They found that if a supervisor's control is too tight it has a negative effect on a doctoral student's performance. Conversely, strong professional advice and a good supervisor performance have a positive effect on a doctoral student's performance. On the level of attitudes, a doctoral student's internal motivation (interest in research and autonomous work) for doing doctoral research has a positive effect and external motivation (doing the PhD for prestige and better

chances of subsequent employment) has a negative effect on their performance. The majority of these findings were also confirmed in a comparative study by Capó et al. (2007). A qualitative study by Austin (2002) also found the importance of intrinsic motivation to do academic work, such as studying questions in their discipline, engaging in meaningful work, the opportunity to be creative, and to interact with interesting and diverse people.

On the level of whole networks (relationships within the research group to which a doctoral student belongs), Ziherl (2006) and Ziherl et al. (2006) found that, in general, a doctoral student's performance is strongly correlated with network size, the number of different institutions (from which the research group members come) and the number of the doctoral student's structural holes. The supervisor's performance and doctoral student's attitude to work are also important correlates of his/her performance. Further analysis with structural equation modeling has shown that research group cohesion is strongly related to supervisor performance and group cohesion has a further relatively strong effect on tie strength. The more successful the supervisor is, the stronger the ties they have with their colleagues since the group members probably have a strong motivation to cooperate with him/her. Strong ties and a high level of group cohesion may well be beneficial for a doctoral student's performance when working in such a research group with the supervisor acting here as a mediator and connector between the doctoral student and the other research group members. Supervisor performance and range (defined as an indicator of the diversity of research group members) have a strong positive effect on doctoral student performance. There is also an indirect, slightly weaker effect of supervisor range on doctoral student performance through the attitude to work and the number of people outside the "home" research group with whom the doctoral student cooperates. This could mean that someone who is able to cooperate with many different people is also a more interesting individual to co-operate with, enabling him/her to further broaden his/her network and to have access to more useful resources, which may then enhance his/her performance.

Previous analyses (Kogovšek et al., 2004; Hlebec et al., 2011) have also shown that, on the level of egocentered network data, the most important dimensions of social relations that affect a doctoral student's performance are emotional support, advice support, and co-operation in his/her work environment. It has also been found that these dimensions of support form a common factor of »social relations«, consisting of the number of persons with whom a doctoral student gets along well with, the number of persons they would ask for emotional support, the sum of his/her advice contacts and the sum of his/her co-operation contacts. Two other factors that statistically significantly predicted a doctoral student's performance were work centrality and length of stay (years) spent at the current work place (department). Most of these studies apply statistical analyses that assume linear relationships among the variables.

However, some studies (e.g., Austin, 2002) show that the professional development of doctoral students is affected in a complex, nonlinear way by several factors such as age, educational background, family circumstances, previous employment, the student's locus of control and sense of efficacy and, most importantly from our point of view, the student's ability to make effective connections with people and opportunities. Disciplinary and institutional contexts were also found to be important (e.g., doctoral students in the natural sciences often participated in research teams, whereas students in the humanities and social sciences often have one-to-one relationships with colleagues).

The aim of this paper is therefore to identify relevant factors related to the academic performance of doctoral students at the egocentered level (see Section 2.2. for details) and formulate a typology of these students on the basis of these factors. Since the previously mentioned studies have found complex relationships among those factors, the second focus of our paper is to ascertain which are the variables where we can identify linear relationships and which are those where the relationships are more complex and the assumption of linearity does not hold.

2 Method

2.1 Data

The questionnaire (see details in de Lange, 2005) was created by the INSOC (International Network on Social Capital and Performance) research group. The data collection was carried out in 2003 in three main phases. In Phase 1, the population of 236 doctoral students in their third year of doctoral study in the 2002/03 academic year was identified on the basis of the Ministry of the Republic of Slovenia for Science, Education and Sport database. In Phase 2, the doctoral students' research groups were defined by their official supervisors on the basis of three name generators:

1. Please name (name and surname) all doctoral students and teaching assistants whose research work is currently under your supervision.
2. Please name (name and surname) all researchers (not named so far) for whom you are the formal supervisor and who participate in at least one research project in which you also participate.
3. Please name (name and surname) your colleague professors, researchers and people from the private sector with whom you co-operate in research projects in which the doctoral student in question also participates.

The supervisors also provided contact details of the network members. 204 supervisors responded and, due to additional refusals (e.g., not having enough time, concerns about data security), 190 research groups were defined. In Phase 3,

respondents filled in a web-based survey (after an initial announcement letter sent by ordinary mail, one invitation letter and two reminders were sent by email). Out of 194 doctoral students who were contacted, 117 responded to the survey (a response rate of 60%).

2.2 Measures

In this paper, we deal with the research question by trying to obtain a typology of doctoral students on the basis of social relationships and attitudinal indicators that have proved important for their academic performance in previous studies, especially in Matelič et al. (2007), Ziherl et al. (2006), Kogovšek et al. (2004), and Hlebec et al. (2011).

Based on the results of these studies, the following variables were used to obtain the typology of Slovenian doctoral students.

1. **Network measures**

Social relations was measured by four indicators:

- number of persons with whom the ego gets along well (*In a work situation it can happen that members of a research group do not get along with each other. It could be that you have a row with some members of the research group, it could be that you try to avoid contact with particular colleagues, that you can't get on with someone etc. With which members of the research group can you not get along?)*;
- number of persons who the ego would ask for emotional support (*Suppose you are confronted with serious problems at work (e.g. a lack of motivation, a problematic relationship with a colleague). With which members of your research group would you discuss these problems?)*;
- sum of advice contacts (*Consider all the work-related problems you have had during the past year (i.e., since 1 November 2002) and for which you couldn't find a solution yourself. How often have you sought advice from each member of your research group?*. 0 to 7 scale: not in the last year, once in the last year, a few times a year, about once a month, a few times a month, weekly, a few times a week);
- sum of co-operation contacts (*Consider all situations in the past year (i.e., since 1 November 2002) in which you cooperated with some members of your research group. By cooperation we mean: working together on the same project, solving problems together etc. Occasional advice does not belong to this type of*

cooperation. How often have you cooperated with each member of your research group during the past year? The same scale as for advice contacts).[5]

Principal axis factor analysis (PAF) and the regression method were used to obtain factor scores to measure the doctoral students' social relations (see more information on factor analysis in Hlebec et al., 2011). In Appendix 1 factor loadings obtained by PAF and a scree diagram showing one important dimension are presented.

2. Attitudes to work

Work centrality scale (6 statements: *I'll do overtime to finish a job, even if I'm not paid for it. The greatest satisfaction in my life comes from my job. The most important things that happen to me involve my work. Some activities are more important to me than work. To me, my work is only a small part of who I am. Most things in life are more important than work.* An ordinal scale was used, ranging from 1 – completely disagree to 7 – completely agree. A Likert scale was calculated as the average of all items. Items 4, 5 and 6 were reverse-scored).

3. Attitudes to work towards the PhD

A PhD as an interesting work scale (Seven statements assessing how important different reasons for doing PhD studies were: *My great interest in the subject. The possibility to conduct my own research. The possibility to specialize in my research field. Independence at work. Intellectual freedom. My great interest in education. My great interest in research.*).
A PhD as a prestige scale (Five statements assessing how important different reasons for PhD studies were: *My ambitions for an academic career. Obtaining the PhD title as such. Prestige, given by the status of a PhD candidate. Better employment opportunities given by the PhD title. The possibility to stay at the university after obtaining a PhD.*).
A PhD as having good circumstances for work scale (Four statements assessing how important different reasons for doing PhD studies were: *Prestige of the research group. The support given by my professors. The professor's personality. Having good work conditions.*).

All items on attitudes to work towards a PhD used an ordinal scale ranging from 1 – very unimportant to 7 – very important. Three Likert scales were calculated as the item averages.

[5] In all cases, only the network members initially named by the doctoral students' supervisors were included in the calculations. Doctoral students could name additional network members only for the advice and the research co-operation network and, therefore, the comparability of networks across different support types would be lost if these were included. Further, in the preliminary analyses, network indicators calculated on additional network members proved to be unrelated to the doctoral students' performance and relatively few of them named a considerable number (3 or more) of these additional network members.

4. Relationship with the supervisor

Supervisor support scale (Eight statements: *My supervisor leaves me to my own devices. My supervisor advises me with regard to the development of my doctoral project. My supervisor introduces me to other researchers. My supervisor helps me prepare my articles. Contacts with my supervisor are fairly informal. My supervisor encourages me to attend conferences. My supervisor seems to be someone who is very willing to help. My supervisor encourages me to attend educational seminars abroad.* An ordinal scale was used ranging from 1 – completely disagree to 7 – completely agree. A Likert scale was calculated using the sum of all items divided by 8. Item 1 was reverse-scored).
Supervisor leaves freedom scale (Four statements: *My supervisor leaves me enough freedom with the content of my PhD thesis. My supervisor enforces his/her opinion on me too often. My supervisor guides the course of my PhD research in too much detail. When I discuss things with my supervisor I am often stressed.* The same scale was used as above. Items 2, 3 and 4 were reverse-scored).

5. Length of experience

Years spent at the current workplace (department) was measured by one indicator (*Since which year have you been working in the current department?* An open-ended question, a 4-digit year was provided by the respondent).

6. Performance of the doctoral student

Performance (*Y*) was measured by the respondents' self-reports on their publications and conference presentations in the last three years, ranging from peer-reviewed international journals to internal research reports and conference presentations. The publications were classified in four major groups:

1. an article in an international journal (with/without reviewers), a book/chapter in a book – with reviewers (X_1);
2. an article, a paper in proceedings – with reviewers (X_2);
3. an article, book/chapter in a book, a paper in proceedings, an internal research paper – without reviewers (X_3); and
4. an international/national conference/workshop – with an oral presentation or poster (X_4).

As academic publications are often valued differently, we decided that some types of publications should have a larger weight. Based on Coromina (2006) and a long discussion in the INSOC group, the index of performance was defined as:

$$Y = 2X_1 + 2X_2 + X_3 + X_4. \quad (2.1)$$

3 Results

Since some previous studies (e.g., Ziherl et al., 2006; Hlebec et al., 2011) have shown that the relationships between performance and its important predictors might in some cases be nonlinear we decided to use a clustering approach. In the first step, an initial clustering was obtained by a hierarchical clustering procedure. The Euclidean distance was used as a measure of dissimilarity and Ward's method was used to cluster the respondents. The dendrogram (see Appendix 2) suggested a clustering solution into five clusters. In the second step, cluster means of variables obtained by Ward's clustering method were used as the initial leaders in the k-means clustering method. This method was therefore used to optimize the initial clustering solution. In the third step, the final obtained groups were analyzed on the key predictors of performance and performance itself.

In Table 1 the means of performance and the key predictors of performance for each obtained cluster are presented. ANOVA showed differences among groups are statistically significant at the 0.1% level on all predictors except years at department.[6] The first group is relatively small. Members of this group have the lowest performance of all groups and are also the lowest on all aspects of motives for starting a PhD. They have moderate social relations as well as work centrality. They also stand out in the level of their supervisor freedom as they have the most freedom in their work of all groups. This group could be called »low performing "freestylers"«.

The second group of respondents scores lowly, but not necessarily the lowest, on most predictors of success. They publish below-average, work is not very central to their lives and they also have a low level of social relations. Their motivation to start a PhD is based neither on the PhD being interesting or prestigious, nor on having good work circumstances and therefore they have neither an internal nor an external motivation to do the PhD. Their supervisors support them moderately and give them relative freedom. Since on average they have been present at the department for the shortest time, perhaps their low performance and low embeddedness in the work environment at least partly depends on being relatively new to the current work environment. On the other hand, they also seem relatively uninterested in such work and we could ask whether this group of doctoral students has chosen the right profession for themselves. We could call this group the »disinteresteds«.

The third group could be called »interested beginners«. They have a low performance and also score lowly on social relations. They are fairly new to the current work environment. They seem to have the least productive relationship with their supervisors since the latter do not give their protégés much support and leave them the least freedom of all groups. In contrast, work is very central to their

[6] Post Hoc tests showed that in most cases pairs of groups 2 and 3 and 2 and 4 were significantly different.

lives and they have a high internal motivation to do work towards their PhD, which may perhaps be beneficial for their success in the academic world later on.

Table 1: Means of the key predictors of performance and performance for each cluster obtained[7].

	low performing "freestylers"	disinteresteds	interested beginners	the hard working ambitious	networkers	Total
N	9	30	19	39	4	101
Performance	16.78	17.03	17.89	19.97	23.25	18.55
Work centrality*	4.00	3.30	4.59	4.28	2.63	.06
Years at dept.	3.00	2.94	2.95	3.15	3.50	3.95
Social relations*	.04	-.12	-.14	.02	2.90	3.05
PhD=interesting*	3.26	5.60	6.05	6.19	6.25	5.71
PhD=prestige*	2.58	3.37	3.79	4.24	3.50	3.71
PhD=good circumstances*	2.65	3.46	3.62	5.39	3.94	4.17
Supervisor support*	5.32	5.35	3.18	6.16	4.88	5.24
Supervisor leaves freedom*	6.37	5.76	4.42	5.96	6.25	5.67

* p<.001

The fourth group is the largest of all. They perform fairly well and score highly to very highly on most indicators, but moderately on social relations. They are hard workers and have a very high internal and external motivation to do a PhD. They have the greatest supervisor support and also quite a high level of freedom in their work. We could call them »the hard working ambitious« since they also score the highest on prestige of the PhD.

The best performers are very few, the smallest group of all. They are the ultimate »networkers« since they have the highest social relations of all groups and are low on supervisor support. This can also be partly explained by the length of their stay in the current workplace, the longest of all groups. Work is not very central to their life, the lowest of all groups. They have a high internal motivation for the PhD (the PhD is interesting) and very high supervisor freedom.

[7] The clusters in the table are ranked from the lowest to the highest performance. For all other variables, the highest value is marked with dark grey and the lowest value with light grey. Some cases from the initial sample were lost in the analysis owing to missing values and listwise deletion. Therefore, there are only 101 cases in this table.

4 Discussion and conclusion

What can be said when summarizing the results of this study? From the point of view of policymakers, it seems that the most problematic groups of doctoral students are the disinteresteds and the low performing "freestylers". They do not publish a lot, are relatively unmotivated to do their PhD and the importance of work in their lives, which is one of the key factors in the academic profession, is low. The role of their supervisors is relatively ambiguous – the support they provide is in both cases moderate, but it seems that perhaps the excessive freedom in the case of the "freestylers" is relatively unproductive.

In several respects the interested beginners are similar to the disinteresteds and the "freestylers", but in contrast, they differ especially in their high work centrality and high internal motivation. In this sense, we could metaphorically also call them »busy bees«. Since they are fairly new to the current work environment, it is perhaps logical that their supervisors do not give them much freedom in their work. On the other hand, it is perhaps a little worrying that they also do not obtain much support from their supervisors. Several studies have stressed the importance of regular mentoring and support on the part of doctoral students' supervisors (e.g., Austin, 2002).

The fourth and fifth groups, the hard working ambitious and the networkers, seem to have a winning combination. Their performance is the highest of all the groups but they seem to reach it via slightly different paths. The hard working ambitious seem to move ahead on account of hard work, high motivation (internal and external) and a productive relationship with their supervisors (high support and a relatively high level of freedom). We could also call them »science geeks«. Conversely, the networkers seem to benefit from their social relations (»party animals«). Work is not very central to their lives, but they have a high internal motivation for doing the PhD. It seems that all these factors balance out the relatively low level of involvement of their supervisors.

It seems that these results confirm the findings of previous research on performance in academic settings, especially those of Matelič et al. (2007) but also others (e.g., Austin, 2002; Hemlin et al., 2004). Good integration within the research group (»social relations«), a productive relationship with the supervisor, with a lot of support and not too tight control, a high motivation to do the PhD and the importance of work seem to be the most important factors of success in academic life. However, as this typology shows, the combination of winning factors varies somewhat with different doctoral students. Some of them seem to thrive on a high work ethic, ambition, internal motivation, and a strong relationship with the supervisor and others more on their broader research network and relative freedom from the supervisor. In some sense, the importance of the network factor for performance is revealed since those with the highest score on social relations are also the most successful in publishing although, on the other

hand, this group is very small and we do not know what would happen if we had a larger sample. The results show that social relationship and attitudinal indicators are not all linearly related to the academic performance of doctoral students. The typology of doctoral students we obtained clearly shows that, among the considered variables, these relationships are more complex. The results regarding the effect of social relations differ somewhat from those of Ziherl et al. (2006). Even if the relationship between the strength of ties and performance emerged as non-linear, Ziherl et al. (2006) found that the moderate strength of social ties and moderate cohesiveness together, but with larger diversity in the co-operation network, seems to be the most beneficial combination for a high performance. There may be several reasons for this discrepancy. Firstly, the "network factor" was theoretically defined in a different way. Ziherl et al. (2006) operated only with the co-operation part of the network, whereas in our case we dealt with multiple dimensions of social relations (advice, co-operation, emotional). Secondly, both papers use a different level of network measurement. Ziherl et al. (2006) studied performance on the level of whole networks, whereas in our case we studied performance on the egocentered level. Thirdly, the papers of Ziherl et al. (2006), Matelič et al. (2007) and ours are based on different parts of the samples, with the first using only the subset of cases in which the whole network responded, the second the subset of cases in which both the student and the supervisor responded, while our paper used the complete sample. On the other hand, since the samples of Matelič et al. (2007) and Ziherl et al. (2006) were not significantly different from the overall sample of doctoral students in several key characteristics (e.g., gender, scientific discipline, year of employment), we presume that the differences mainly stem from the first two reasons. Further research is needed in the future to clarify these differences.

Not surprisingly, the only linear relationship is between "The PhD as interesting work" and "years spent at the current workplace" with academic performance: if a doctoral student finds the PhD work more interesting and has been at the workplace for a longer time he/she has a better academic performance. Those doctoral students with the highest academic performance have the most intensive social relations inside the research group. A typical nonlinear relationship is between perceiving the PhD as prestigious and academic performance: doctoral students with the lowest and with the highest academic performance attribute less importance to the prestige of the PhD, those with an about average performance attribute more importance to the prestige of the PhD. All of the other variables we considered have more complicated relationships with performance and are obviously not linear (including work centrality).

References

[1] Austin, A.E. (2002): Preparing the next generation of faculty: Graduate school as socialization to the academic career. *The Journal of Higher Education*, **73**, 94-122.

[2] Borgatti, S.P., Jones, C., and Everett, M.G. (1998): Network measures of social capital. *Connections*, **21**, 27-36.

[3] Burt, R.S. (1992): *Structural Holes*. Cambridge, MA: Harvard University Press.

[4] Burt R.S. (2000): The network structure of social capital. In B.M. Staw, R.I. Sutton (Eds.): *Research in Organizational Behavior*, 345-423. Amsterdam, London and New York: Elsevier Science JAI.

[5] Capó, A.M., Coromina, L., Ferligoj, A., Matelič, U., and Coenders, G. (2007): Networks of PhD students and academic performance: A comparison across countries. *Metodološki Zvezki*, **4**, 205-217.

[6] Coromina, L. (2006): *Social Networks and Performance in Knowledge Creation. An Application and a Methodological Proposal*. PhD dissertation. Girona: University of Girona.

[7] Coromina, L.I., Guia, J., Coenders, G., and Ferligoj, A. (2008): Duocentered networks. *Social Networks*, **30**, 49-59.

[8] de Lange, D. (2005): *How to Collect Complete Social Network Data? Nonresponse Prevention, Nonresponse Reduction and Nonresponse Management based on Proxy Information*. Unpublished doctoral dissertation. Ghent University, Belgium.

[9] Dieffendorf, J.M., Brown, D.J., Kamin, A.M., and Lord, R.G. (2002): Examining the roles of job involvement and work centrality in predicting organizational citizenship behaviors and job performance. *Journal of Organizational Behaviour*, **23**, 93-108.

[10] Eggens, L., van der Werf, M.P.C., and Bosker, R.J. (2008): The influence of personal networks and social support on study attainment of students in university education. *Higher Education*, **55**, 553-573.

[11] Friedman, H. (1988/1997): Form and substance in the analysis of the world economy. In B. Wellman and S. D. Berkowitz (Eds.): *Social Structures: A Network Approach*, 304-325. Greenwich: JAI Press.

[12] Gottlieb, B.H. (1983): *Social Support Strategies: Guidelines for Mental Health Practice*. Beverly Hills: Sage.

[13] Granovetter, M. (1973): The strength of weak ties. *American Journal of Sociology*, **78**, 1360-1380.

[14] Green, S.G. and Bauer, T.N. (1995): Supervisory mentoring by advisers: Relationships with doctoral student potential, productivity and commitment. *Personnel Psychology*, **48**, 537-561.

[15] Hemlin, S., Allwood, C.M., and Martin, B.R. (2004): *Creative Knowledge Environments: The Influences on Creativity in Research and Innovation*. Northampton, MA: Edward Elgar Publishing.

[16] Hlebec, V., Kogovšek, T., and Ferligoj, A. (2011): The influence of social support and personal networks on doctoral student performance. *Metodološki Zvezki*, **8**, 157-171.

[17] House, J.S. (1981): *Work Stress and Social Support*. Reading: Addison-Wesley.

[18] Kogovšek, T., Ferligoj, A., Matelič, U., and Hlebec, V. (2004): Social ties of doctoral students in Slovenia as social capital. Portorož: SUNBELT conference contribution.

[19] Lin, N. (1990): Social resources and social mobility: A structural theory of status attainment. In R.L. Breiger (Ed.): *Social Mobility and Social Structure*, 247-271. New York: Cambridge University Press.

[20] Matelič, U., Mali, F., and Ferligoj, A. (2007): Kreativno okolje in uspešnost mladih raziskovalcev. *Družboslovne razprave*, **23**, 71-94.

[21] Michaelson, A.G. (1993): The development of a scientific specialty as diffusion through social relations: The case of role analysis. *Social Networks*, **15**, 217-236.

[22] Mizruchi, M.S. and Galaskiewicz, J. (1994): Networks of interorganizational relations. In S. Wasserman and J. Galaskiewicz (Eds.): *Advances in Social Network Analysis*, 230-253. Thousand Oaks: Sage.

[23] Mokken, R. and Stokman, F. (1978): Corporate governmental networks in the Netherlands. *Social Networks*, **1**, 333-358.

[24] Nohria, N. and Eccles, R.G. (Eds.) (1992): *Networks and Organizations*. Boston: Harvard Business School Press.

[25] Paglis, L., Green, S.G., and Bauer, T.N. (2006): Does adviser mentoring add value?: A longitudinal study of mentoring and doctoral student outcomes. *Research in Higher Education*, **47**, 451-476.

[26] Shelley, G. A., Bernard, H. R., Killworth, P. D., Johnsen, E. C., and McCarty, C. (1995): Who knows your HIV status? What HIV+ patients and their network members know about each other. *Social Networks*, **17**, 189-217.

[27] Wenger, C.G. (1994): *Support Networks of Older People: A Guide for Practitioners*. Bangor: Centre for Social Policy Research and Development. University College of Wales.

[28] White, H.C. (1988/1997): Varieties of markets. In B. Wellman and S. D. Berkowitz (Eds.): *Social Structures: A Network Approach*, 226-260. Greenwich: JAI Press.

[29] Zeggelink, E. (1994): Dynamics of structure: An individual-oriented approach. *Social Networks*, **16**, 295-333.

[30] Zeggelink, E. (1995): Evolving friendship networks: An individual-oriented approach implementing similarity. *Social Networks*, **17**, 83-110.

[31] Ziherl, P. (2006): *The Effect of the Research Group Social Capital on Doctoral Students' Performance*. Ljubljana: Faculty of Social Sciences. Unpublished Master's Thesis (in Slovene).

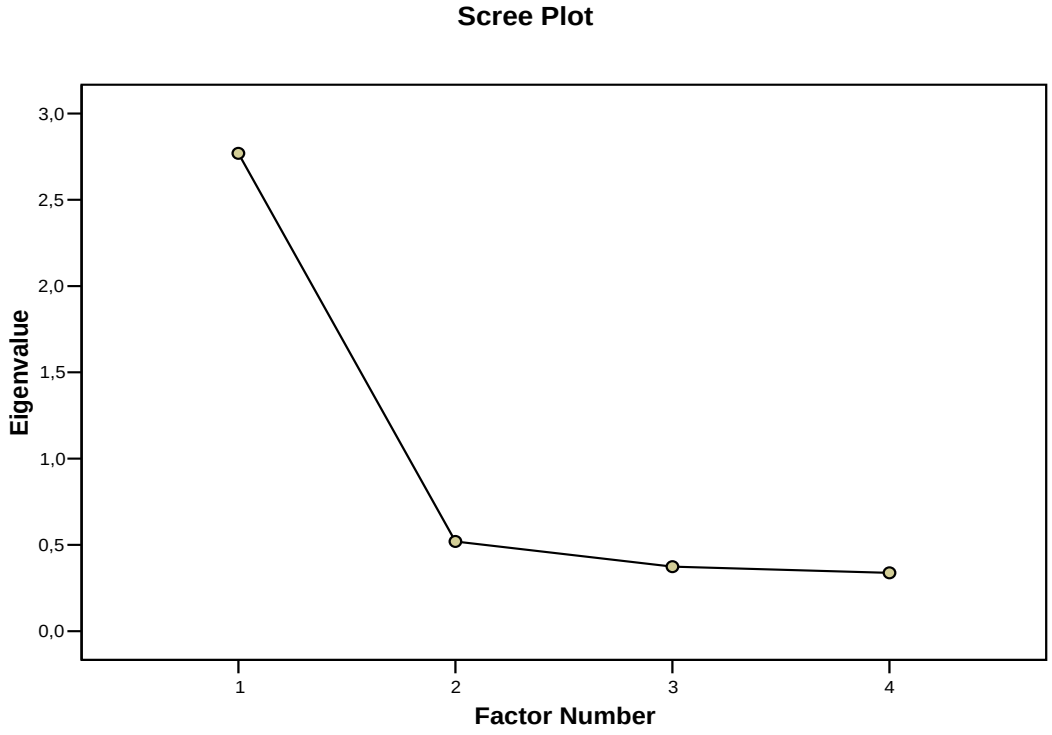
[32] Ziherl, P., Iglič, H., and Ferligoj, A. (2006): Research groups' social capital: A clustering approach. *Metodološki Zvezki* **3**, 217-237.

Appendix

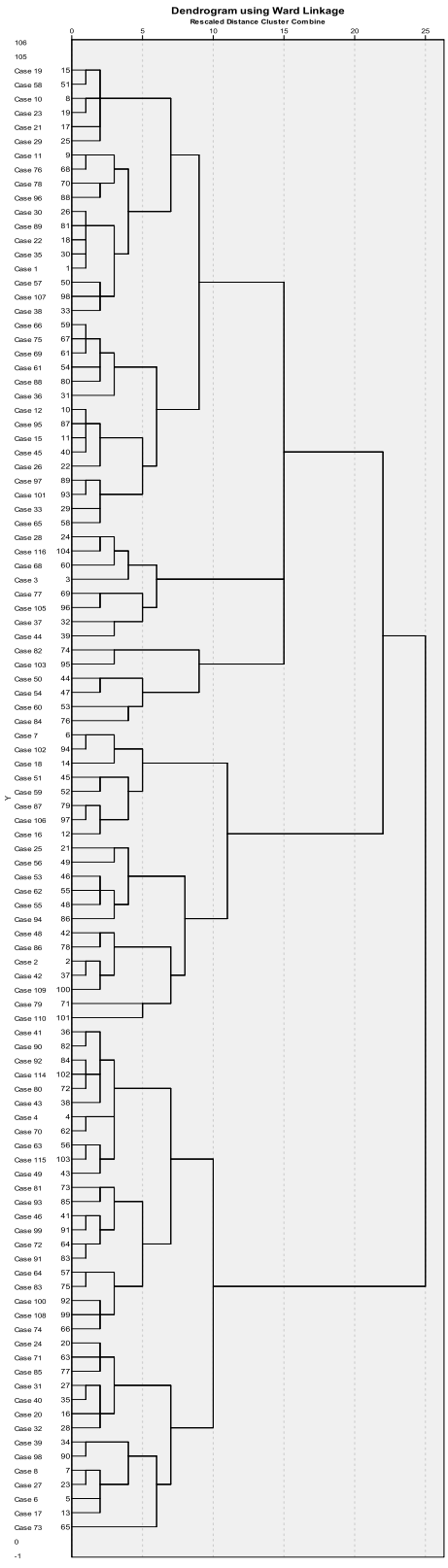
Results of the factor analysis (factor loadings and scree plot)

Indicator	Factor loadings
Number of persons with whom the ego gets along well	.769
Number of persons who the ego would ask for emotional support	.744
Sum of advice contacts	.761
Sum of co-operation contacts	.798

59% of variance explained



Dendrogram


Dendrogram using Ward Linkage
Rescaled Distance Cluster Combine
0
5
10
15
20
25
Y
106
105
Case 19 15
Case 58 51
Case 10 8
Case 23 19
Case 21 17
Case 29 25
Case 11 9
Case 76 68
Case 78 70
Case 96 88
Case 30 26
Case 89 81
Case 22 18
Case 35 30
Case 1 1
Case 57 50
Case 107 98
Case 38 33
Case 66 59
Case 75 67
Case 69 61
Case 61 54
Case 88 80
Case 36 31
Case 12 10
Case 95 87
Case 15 11
Case 45 40
Case 26 22
Case 97 89
Case 101 93
Case 33 29
Case 65 58
Case 28 24
Case 116 104
Case 68 60
Case 3 3
Case 77 69
Case 105 96
Case 37 32
Case 44 39
Case 82 74
Case 103 95
Case 50 44
Case 54 47
Case 60 53
Case 84 76
Case 7 6
Case 102 94
Case 18 14
Case 51 45
Case 59 52
Case 87 79
Case 106 97
Case 16 12
Case 25 21
Case 56 49
Case 53 46
Case 62 55
Case 55 48
Case 94 86
Case 48 42
Case 86 78
Case 2 2
Case 42 37
Case 109 100
Case 79 71
Case 110 101
Case 41 36
Case 90 82
Case 92 84
Case 114 102
Case 80 72
Case 43 38
Case 4 4
Case 70 62
Case 63 56
Case 115 103
Case 49 43
Case 81 73
Case 93 85
Case 46 41
Case 99 91
Case 72 64
Case 91 83
Case 64 57
Case 83 75
Case 100 92
Case 108 99
Case 74 66
Case 24 20
Case 71 63
Case 85 77
Case 31 27
Case 40 35
Case 20 16
Case 32 28
Case 39 34
Case 98 90
Case 8 7
Case 27 23
Case 6 5
Case 17 13
Case 73 65
0
-1