

<p>Social Influence in Dynamic Networks</p>	<p><b>European Collaborative Research Projects in the Social Sciences (ECRP) – ECRP VI (2010)</b></p> <p><b>Project Leader:</b> Prof Tom A.B. Snijders</p>
-------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------

**SECTION ONE: SUMMARY OF THE COLLABORATIVE RESEARCH PROJECT**

**1.1 Main aims of the Collaborative Research Project** *(Max. 5 aims/150 words)*

1. Extend the applicability of statistical models for the co-evolution of networks and behaviour by widening specification possibilities and procedures for model selection and model checking. Investigate the performance of these and other methods for assessing peer effects and delineate conditions and arguments determining when the various methods are preferable. Study and improve the usefulness of these models by applications to the following issues.
2. Elucidate the dynamics of negative and positive social interactions between adolescents and their effects on individual problem behaviour and well-being, including studies of delinquency, bullying, victimization, and self-harm.
3. Improve the understanding of how collaboration and coordination ties between organizations influence organizational performance, in particular in the health care sector.
4. Study the impact of R&D policy on collaboration between scientists and the relation between collaboration and performance.
5. Investigate how successful integration in society is related to dynamics of personal networks.

**1.2 Potential impacts (academic and non-academic) of the Collaborative Research Project** *(Max. 200 words)*

The ECRP will give essential contributions to establishing a methodology, based on a combination of statistical inference and network analysis, for studying social influence in networks. This is meant to transform recently developed models for assessing social influence in networks, and for studying the co-evolution of networks and behaviour, from a promising new approach to a well elaborated and extensively applied methodology, of which possibilities and limitations are relatively well understood. Applying these models, the ECRP will yield insights in the dynamics and results of several societal processes, insights which can be obtained only by employing a detailed relational perspective. These processes regard adolescents' externalizing and internalizing problem behaviors; collaboration and coordination between health care organizations, effects of health care policies, and their effects on health care performance; cooperation between scientists and the effects of research policy on scientific productivity; and integration of immigrants and of young adults in social networks and in employment and society. Utterior goals are better ways to deal with externalizing and internalizing problems in adolescent groups, and better understanding of policy effects with respect to health care organization, scientific research, successful social integration of immigrants and young adults.

**1.3 Added value of the multinational collaboration** *(Max. 200 words)*

The researchers collaborating in this ECRP constitute a rare combination of methodological and substantive social science expertise, combining knowledge and innovation in statistics, social network analysis, developmental psychology, sociology, anthropology, and organization science. To achieve scientific progress on this interface between statistical modeling and social science, and to achieve credibility for this new methodology for assessing social influence in networks by studying the co-evolution of networks and behaviour, a concerted international and multidisciplinary effort is indispensable. The legitimization and acceptance of new advanced methodology requires the kind of

international and multidisciplinary social science collaboration represented by this ECRP. The proposed joint research builds on existing collaborations, thereby ensuring the fruitful interaction and collaboration between the partners.

**1.4 Data handling aspects (if relevant): quality assurance, storage, access**  
(Max. 200 words)

Data will be collected and handled by the national teams according to established procedures ensuring quality and safety of data. If privacy issues arise when data are shared with partners, appropriate procedures will be followed to ensure confidentiality.

**SECTION TWO: DESCRIPTION OF THE COLLABORATIVE RESEARCH PROJECT**

The Project Leader should describe the collaboration using the structure below (Country Contributions will be described in detail in Section Three). (Max. 2500 words, excluding annexes. Entries exceeding 2500 words will not be accepted)

## ***Social Influence in Dynamic Networks***

### ***2.1 Introduction: Networks, Behaviour, Social Influence***

Social networks can be recognized in many social and economic situations. A network consists basically of a set of points and the ties between them. For instance, the points may be the pupils in a school while the set of ties refers to the friendship relations between them; or the points may be firms while the ties represent their collaborative links. In this research proposal we are concerned with networks where the points represent social or economic actors and the links are relations providing possibilities for exchange, influence, cooperation, etc.

Interest in social networks has grown strongly especially because networks are recognized as crucial social opportunities and constraints for behaviour, well-being, and performance of individuals and organizations in many social domains. Examples are work on social capital such as Burt (2005), Lin and Erickson (2008); research on networks in organizations reviewed by Brass et al. (2004); the work by Christakis and Fowler (2007 and later) about the importance of social contagion for obesity, smoking, and other health-related behaviours and complaints; research by economists, e.g., Jackson (2008); the special issue of *Journal of Abnormal Child Psychology* about peer effects on deviant behavior (Dishion and Dodge, 2005); the special issue on Social Networks and American Politics of *American Politics Research* (Heaney and McClurg, 2009).

Social networks shape and mediate many kinds of social influence, ranging from individuals influencing each others' health-related behaviours, through firms influencing each others' performance, to states influencing each others' security and level of democracy. Much of the scientific literature about such topics focuses on influence leading related actors to becoming increasingly similar, but social influence can lead to outcomes different from similarity: to psychological stress due to being bullied, higher performance due to better network position (Gulati and Gargiulo, 1999), etc. Social influence is also referred to as peer effects or contagion, often without using a specific network perspective. The contribution of the network perspective is the potential to express in detail who influences whom, and how influence may depend on position in the network, tie patterns, characteristics of connected actors, etc.; and a more stringent methodological approach.

The scientific study of social influence on social actors of any nature is complicated because of its reflexive nature – if *A* and *B* are friends then *A* may influence *B* but likewise *B* may influence *A* – and because of what economists call the endogeneity of social networks: social actors to some

extent choose their own social environment and then are influenced by it – perhaps they make the choice in order to be influenced. Manski (1993) called this the reflection problem: when I see myself moving in the mirror, how do I know that I cause my mirror image to move, and not the other way around? A variety of methods have been developed (e.g., see Mouw, 2006; Cohen-Cole and Fletcher, 2008; Steglich et al., 2010) and currently there still is much debate and development about this issue. A basic understanding is that there are the following three main schematic reasons potentially explaining similarity between socially connected social actors: tied actors may influence one another (“contagion”, see Valente, 1995); similar actors may choose each other to create or maintain social ties (“homophily”, see McPherson et al., 2001); and tied actors may be subject to the same external influences (e.g., Feld 1981). The analysis of these processes is further compounded by the consideration that social influence does not flow necessarily through direct ties but could be generated also, e.g., by being in a structurally similar position within the social network (Burt, 1987).

This research proposal is centered about a recently developed method for assessing and modeling social influence (Snijders et al., 2007; Steglich et al., 2010). The model is called the *stochastic actor-oriented (or actor-based) model (SAOM)* and represents the joint interdependent dynamics of network ties and individual attributes. These attributes may represent behavioural tendencies, attitudes, performance, or other individual outcome variables, and for the purpose of brevity are referred to here as “behaviour”. The term actor-oriented is used because changes in network ties and in actors’ behaviour are modeled from the point of view of the actors. The SAOM is an explicit stochastic model for the co-evolution of networks and behaviour in a given group. Data on networks and behaviour are assumed to be available at a few discrete observation moments, called the panel waves. It is assumed that networks as well as behaviour are potentially changing between the panel waves, but observed only at the moments of the panel waves. An explanation of the model can also be found in the tutorial paper Snijders et al. (2010). Statistical procedures for analyzing longitudinal data on networks and behaviour using this model are implemented in the freeware computer program *SIENA* (Simulation Investigation for Empirical Network Analysis), now available as the contributed package *RSiena* in the open source statistical software system R (Ripley and Snijders, 2010). The SAOM was developed, and still is being developed, by the research groups from Oxford and Groningen collaborating in this research proposal (project leader Tom Snijders). Information including published applications can be found at the website <http://www.stats.ox.ac.uk/~snijders/siena>.

This model and software are starting to be applied in a variety of disciplines. The following are a few examples. Several publications (see the mentioned website) have applied these techniques in investigations of peer influence between adolescents with respect to substance use, delinquency, etc.; e.g., Burk et al. (2007). De Klepper et al. (2010) studied the co-evolution of friendship with a variety of attitudes and behaviours in a college. Mercken et al. (2010) studied the development of smoking behaviour in mutual dependence with friendship dynamics in a large-scale international study. Berardo and Scholz (2010) studied the co-evolution of cooperation between organizations and their generalized trust.

Of the methods proposed in the literature for testing and assessing social influence, or peer effects, the SAOM is the only one that is formulated as an explicit probability model for the joint dynamics of one or more nodal variables (representing actor behaviour) and the tie structure in a network. This explicit modeling approach has a number of implications:

1. The model is flexible, and allows very detailed modeling of the process of changes in behavioural variables and in network ties. Several processes can be simultaneously modeled (as “control processes”, generalizing the concept of control variables).
2. It represents explicitly the dependence between network ties and between the behaviour of individuals in the same group; many other methods fail to do so, which may lead to model misspecification and unreliable results.
3. Fundamental tools of statistical inference can be used and elaborated, e.g., for model selection, model checking, model refinement, and interpretation of conclusions.
4. The model can be directly used to simulate the dynamic process, which allows theoretical analysis of properties of the model and checking of the fit of the model.

5. The endogeneity of the network can be analysed in an integrated fashion together with the influence process.
6. Conclusions depend on the approximate validity of the model for the process being investigated, or the robustness for the type of deviations between model and process that might occur. This approximate validity can be checked and, if necessary, improved by steps along the lines of point 3-4.

This contrasts with other methods for testing influence or peer effects, which usually are not based on an explicit probability model, or not integrated with a model for network dynamics (cf. the proposal for Subproject 2.) In this CRP, the strong points 1-5 are exploited and 6, a limitation, is investigated; it is fair to say that any method has limitations of this kind, and it is important to make such limitations explicit.

## *2.2 Aims and Objectives of the CRP*

This CRP aims to improve and apply the SAOM methodology for assessing social influence in networks; and by doing so to obtain scientific advances with respect to issues of social influence in various fields. The CRP builds upon the earlier CRP "*Dynamics of Actors and Networks across Levels*", which now has been concluded and in which initial development and first applications of this methodology took place. It is guided by the following combination of substantive and methodological research goals.

1. Extend the applicability of statistical models for the co-evolution of networks and behaviour, in particular the SAOM, by widening specification possibilities and procedures for model selection and model checking. Investigate the performance of these and other methods for assessing peer effects and delineate arguments and conditions with respect to research questions, study design, and statistical assumptions, determining when the various methods are preferable.

Study and improve the usefulness of these models by applications to the following issues.

2. Elucidate the dynamics of negative and positive social interactions between adolescents and their effects on individual problem behaviour and well-being, including studies of delinquency, bullying, victimization, and self-harm.
3. Improve the understanding of how collaboration and coordination ties between organizations influence organizational performance, in particular in the health care sector.
4. Study the impact of R&D policy on collaboration between scientists and the relation between collaboration and performance.
5. Investigate how successful integration in society is related to dynamics of personal networks.

The first goal is methodological in nature, the others substantive. The methodological goal must serve to better achieve the substantive goals, and the substantive goals must provide guidance as well as example material for the methodological goal.

This CRP is meant to transform the SAOM from a promising new approach for assessing social influence in networks to a well elaborated and extensively applied methodology, of which the main possibilities and limitations are understood. The insights that hopefully will be obtained in the dynamics and results of several societal processes can be realized only by employing a detailed relational perspective. This refers to questions such as: how is bullying and victimization influenced by individual characteristics and individual positions in networks of positive and negative interactions; which hospitals are more likely to collaborate in patient referrals, and how does this affect their performance; what is the joint effect of research policies, and collaboration culture in scientific disciplines, on changes in collaboration patterns and on productivity of scientists; for immigrants in Spain, how does the connectedness of Spanish individuals in their personal network affect the likelihood that the ties to these individuals are maintained, and how do such ties affect the successful integration into mainstream Spanish society.

### 2.3 Methods and design

The SAOM assumes that the network ties change depending on the network structure itself and on the behaviour, while also the behaviour changes depending on current behaviour as well as the network structure; thus, the network and the behaviour both are dependent variables. This represents the interdependent social influence and endogenous selection of ties in one encompassing model. The method is based upon a model for dynamics of networks proposed in Snijders (2001) and a model for the co-evolution of networks and behaviour proposed in Snijders et al. (2007). The co-evolution model is elaborated and compared with other methods for assessing network influence in Steglich et al. (2010).

### 2.4 Country contributions, added value of collaboration

The CRP comprises seven subprojects.

1. University of Oxford (UK). *Scope for stochastic actor-oriented models.*
2. University of Groningen (Netherlands). *Peer Influence in Social Networks: Comparing and Evaluating Methods across Domains.*
3. University of Örebro (Sweden). *The Role of Peers in Adolescent Development of Externalizing and Internalizing Problem Behaviors.*
4. University of Turku (Finland). *Bullying Networks across Classrooms.*
5. University of Lugano (Switzerland). *Network influence and organizational performance: Empirical evidence from a longitudinal study of an Italian community of hospital organizations*
6. University of Ljubljana (Slovenia). *Dynamics of scientific co-authorship networks.*
7. University Autonomous of Barcelona (Spain). *Personal networks over life transitions and integration into society.*

Projects 1-2 provide the methodological basis. The first develops the extensions of the SAOM that are most important for applications, the second studies the performance of this method, compares it to alternative methods, and formulates more precise arguments about the domain of appropriateness of the various methods. These teams also provide methodological support to the others. Project 7 develops methodology for the use of the SAOM for an important other data structure, personal networks in which respondents are asked about their relationships, and also information about the nominated others is collected. Projects 3-7 apply the SAOM methodology to studies of social influence in various fields: affective relations and social development of adolescents (3-4); organizational networks, both between (5) and within (6) organizations; scientific collaboration (6); immigrants and the labour market (7). For the good development of this methodology, suitability for a wide array of application areas is essential, and these projects cover major fields where social influence and peer effects are important. Projects 3-4 are about the same field but represent different important aspects in the CPR, viz., cyber networks and data sets consisting of many smaller networks (schools).

A research program like this is possible only internationally. Collecting prominent researchers in a diverse domain leads directly to requiring international collaboration. For the acceptance of new methodology, international coverage is important. In the domain of social network analysis European scholars have achieved an excellent international position, and this ECRP will contribute strongly to its maintainance and further improvement.

### 2.5 Management of multinational collaboration

The Project Leader (Snijders) will coordinate the collaboration between projects, assisted by a research assistant. Collaboration will be managed as simply as possible, and kept bilateral when this is appropriate. A protected website will be set up for communication, where CRP members can upload and download documents. There will be yearly meetings of the CRP, the first to be organized as soon as all or most projects have nominated their researchers (spring or early summer 2011). They will take place at locations of different CRP participants and include master

classes for students and young researchers working with *SIENA*. Bilateral meetings between Project Leader and CRP members will be arranged as necessary. The major social networks conferences will be used to arrange meetings of the attending CRP members. Total costs of coordination are € 74121.

### *2.6 Planned outputs*

The main outputs are the scientific publications mentioned in the project descriptions; the PhD dissertation for Project 2; and the improved *RSiena* package and documentation. The activities in the CRP will be reflected in the production of didactic vignettes in collaboration between methodological and substantive projects. Each vignette, accessible through the *SIENA* website, will consist of a small research question, data description, data set (real or simulated), explanation of the analysis, *RSiena* script, and interpretation of results. The CRP meetings will be accompanied by advanced *SIENA* user workshops, with open participation, organized in a self-funding way.

### *2.7 Requested funding*

The overall amount of funding requested is (Euros)

Oxford	605,139
Groningen	224,513
Orebro	306,400
Turku	287,197
Lugano	197,500
Ljubljana	236,028
Barcelona	90,200
Total:	1,958,405

- 2.1 Annexes (including no more than 1 side of A4 for references and no more than 2 sides of A4 for technical details, short bibliographies, etc., if appropriate).

### **Appendix 2.8.1. References**

- Brass, D.J., Galaskiewicz, J., Greve, H.R., and Tsai, W. (2004). Taking stock of networks and organizations: a multilevel perspective. *Academy of Management Journal*, 47, 795–817.
- Burt, R.S. (1987) Social contagion and innovation Cohesion versus structural equivalence. *American Journal of Sociology* 92, 1287-1335.
- Burt, R.S. (2005) *Brokerage and Closure*. Oxford: Oxford University Press.
- Christakis N.A., Fowler J.H. The spread of obesity in a large social network over 32 years. *New England Journal of Medicine* (2007) 357: 370-379.
- Cohen-Cole, E., & J.M. Fletcher. (2008a). Is Obesity Contagious? Social Networks vs. Environmental Factors in the Obesity Epidemic. *Journal of Health Economics* 27 (5):1382-1387
- Thomas J. Dishion and Kenneth A. Dodge (2005). Peer Contagion in Interventions for Children and Adolescents: Moving Towards an Understanding of the Ecology and Dynamics of Change. *Journal of Abnormal Child Psychology*, 33, 395–400
- Feld, S.L. (1981) The focused organization of social ties. *American Journal of Sociology*, 86, 1015-1035.
- Gulati, R., and Gargiulo, M. (1999) Where do interorganizational networks come from? *American Journal of Sociology*, 105, 177-231.
- Heaney, M.T., McClurg, S.D. (2009). Introduction to the Special Issue. *American Politics Research*, 37, 727-741.
- Jackson, M.O., 2008. *Social and Economic Network*. Princeton: Princeton University Press.
- Lin, N., and Ericson, B. (2008). *Social Capital*. Oxford: Oxford University Press.
- Manski, C. (1993) Identification of endogenous social effects: the reflection problem. *Review of Economic Studies*, 60: 531–542.
- McPherson, J.M., Smith-Lovin, L. and Cook, J.M. (2001). Birds of a Feather: Homophily in Social Networks. *Annual Review of Sociology* 27, 415-444.
- Mouw, T. (2006). Estimating the causal effect of social capital: A review of recent research. *Annual Review of Sociology*, 32, 79–102.
- Ripley, Ruth M., and Snijders, Tom A.B. 2010. Manual for SIENA version 4.0. Oxford: University of Oxford, Department of Statistics; Nuffield College. <http://www.stats.ox.ac.uk/siena/~snijders>
- Snijders, T.A.B. (2001) The statistical evaluation of social network dynamics. M.E. Sobel and M.P. Becker (eds.), *Sociological Methodology-2001*, 361-395. Boston and London: Basil Blackwell.
- Snijders, Tom A.B., Steglich, Christian E.G., and Schweinberger, Michael. 2007. Modeling the co-evolution of networks and behavior. In: *Longitudinal models in the behavioral and related sciences*, edited by Kees van Montfort, Han Oud and Albert Satorra, pp. 41–71. Mahwah, NJ: Lawrence Erlbaum.
- Snijders, T.A.B., Steglich, C.E.G., and van de Bunt, G.G. (2010). Introduction to actor-based models for network dynamics. *Social Networks*, 32, 44-60.
- Steglich, C.E.G., Snijders, T.A.B., Pearson, M. (2010) Dynamic networks and behavior: Separating selection from influence, *Sociological Methodology*, in press. <http://www.stats.ox.ac.uk/~snijders/siena/SteglichSnijdersPearson2009.pdf>
- Valente, T.W., 1995. *Network Models of the Diffusion of Innovations*. Hampton Press, Cresskill, NJ.

**Technical appendix 2.8.2. Stochastic actor-oriented statistical methodology for analysing the simultaneous dynamics of networks and behavior**

The data assumed to be available refers to a fixed group of  $n$  actors, and is represented as

$$\mathcal{Y}(t_m) = (X(t_m), Z_i(t_m)), \quad m = 1, \dots, M,$$

where  $X_i$  is a directed graph (adjacency matrix) on  $n$  nodes (the network),  $Z_i$  is an  $n$ -vector of changing attributes (the behavior), and  $t_1$  to  $t_M$  are the observation moments. Extensions to valued and/or multiple graphs, multiple attributes, exogenously changing node sets, have been made. There also can be exogenously determined covariates, but these will remain implicit in the notation.

The stochastic actor-oriented approach to the simultaneous dynamics of networks and behavior is based on the following principles (for more details see Snijders 1996, 2001, 2005; Steglich, Snijders, and Pearson 2010; Snijders, Steglich and Schweinberger 2007).

1. *Unobserved change in continuous time between the observation moments.*  
The outcomes are observations at discrete moments of a continuous-time Markov process  $\mathcal{Y}(t)$ ,  $t_1 \leq t \leq t_M$ .  
This assumption can be relaxed by allowing random effects. The values of the matrix, respectively vector, elements of  $X$  and  $Z$  are discrete ordinal (2 or more values).
2. Actors control their outgoing network ties and their behavior. These can be changed only in small steps. When a change is made, an actor can only change one outgoing tie variable, or one behavior variable, to a category adjacent to the present category.
3. At stochastically determined moments, actors get the opportunity to make changes in their network or in their behavior. The rates at which these opportunities happen can be exogenously or endogenously determined. If exogenous, the opportunities for actor  $i$  for changes in the network and in the behavior occur independently according to Poisson processes with rates  $\lambda_i^X$  and  $\lambda_i^Z$ , respectively. These rates can depend on covariates. The rates can also be endogenous (depending on  $\mathcal{Y}(t)$ ), for which suitable modifications in the definition must be made.
4. *Stochastic, myopic, optimization of the new network or behavior state.*  
When actor  $i$  has the opportunity to make a change, the choice made is to an adjacent value, or the current value; log-odds are proportional to  $f_i^X(x, z_0)$  or  $f_i^Z(x_0, z)$ , respectively, where  $f_i^X(y)$  and  $f_i^Z(y)$  are so-called objective functions for network and behavioral change, respectively; and  $x_0$  and  $z_0$  are the old and  $x$  and  $z$  the new values of network and behavior. The objective functions reflect the resultant of the short-term preferences of the actors and their costs and constraints. Extensions are possible by letting the objective functions depend not only on the newly obtained state but also on the current state. This allows to model the endowments obtained by being in a particular state (e.g., a network state that is valued relatively more highly than is reflected by the cost in reaching it).
5. The objective function is modeled as  $f_i^X(y) = \sum_k \beta_k^X s_{ki}^X(y)$ , where  $s_{ki}^X(y)$  are statistics that can be computed from the current network-behavioral configuration  $y = (x, z)$ , while  $\beta_k^X$  is a statistical parameter to be estimated from the data; and analogously for  $f_i^Z(y)$ . The substantive modeling effort focuses on the choice of the functions  $s_{ki}^X(y)$  and  $s_{ki}^Z(y)$ , on the basis of substantive theory and experience. E.g., these functions can reflect the degree of similarity between actors who are tied to each other; in that case the parameter  $\beta_k^Z$  would indicate the strength of social influence, and  $\beta_k^X$  the strength of behavior-dependent social selection.
6. There is no assumption of stationarity of the process. Connected to this, the first observation  $\mathcal{Y}(t_1)$  is itself not modeled but only used to condition on, as the starting point of the process.
7. These models are too complicated for explicit analytic calculations, but they can be implemented as stochastic simulation models. Statistical parameter estimation can be based on the method of moments implemented by stochastic approximation. The method

of moments implies that suitable statistics  $S = \mathcal{S}(Y(t_1), \dots, Y(t_M))$  are chosen and the parameter, denoted by  $\theta$ , (which includes the parameters  $\beta$  but also the parameters included in the functions  $\lambda$ ) is chosen so that the expected value of  $S$  under  $\theta$ , under suitable conditioning, is equal to the observed value.

The method of stochastic approximation uses iteration steps of the form

$$\theta^{(N+1)} = \theta^{(N)} - a_N (S^{(N)} - s) ,$$

where  $\theta^{(N)}$  and  $\theta^{(N+1)}$  are successive provisional parameter values,  $a_N$  is a deterministic positive sequence tending to 0,  $s$  is the observed outcome of  $S$ , and  $S^{(N)}$  is a simulated value of  $S$ , simulated for the provisional parameter value  $\theta^{(N)}$ . Methods for maximum likelihood estimation are presented in Snijders, Koskinen and Schweinberger (2010). Both methods can be regarded as frequentist Markov chain Monte Carlo methods.

For the analysis of data from multiple groups, which may be called a multilevel dynamic network analysis, the meta-analysis approach of Snijders and Baerveldt (2003) can be used, extended with group-level explanatory variables. Random effects approaches for multilevel dynamic network analysis are currently being developed.

<b>COUNTRY CONTRIBUTION 1</b> <i>Scope for stochastic actor-oriented models.</i>	<b>Principal Investigator:</b> <i>Tom A.B. Snijders</i>
	<b>Country:</b> <i>United Kingdom</i>
	<b>ECRP Funding Organisation:</b> <i>ESRC</i>
<b>3.1 Financial summary for Country Contribution 1</b>  The Principal Investigator should provide below a summary of the financial support sought from his/her national ECRP Funding Organisation.  Full financial details and any other supplementary information required by your national ECRP Funding Organisation should be supplied to them as instructed.	
	<b>TOTAL (EUROS)</b>
<b>3.1.1 Staff</b> (specify how many positions are sought) Principal Investigator (5%); Postdoctoral Researcher (100%); Programmer (30%); Research Assistant (20%)	<b>€265,169</b>
<b>3.1.2 Travel and subsistence</b>	<b>€22,000</b>
<b>3.1.3 Consumables</b>	<b>€0</b>
<b>3.1.4 Other items</b>	<b>€11,000</b>
<b>3.1.5 Overheads and other allowable costs</b>	<b>€306,970</b>
<b>3.1.6 GRAND TOTAL FOR INDIVIDUAL COUNTRY CONTRIBUTION 1</b>	<b>€605,139</b> <b>(£484,111)</b> <b>(80% FEC)</b>

### 3.2 Description of Country Contribution 1

#### *Scope for stochastic actor-oriented models*

##### 3.2.1 Specific competence and expertise of this team

The UK team is the leading team in the ECRP. The Project Leader is Prof Tom A.B. Snijders, the initiator and primary developer of the Stochastic Actor-Oriented Model for Network Dynamics and the *SIENA* program which implements this model. His work has yielded breakthroughs in longitudinal (Snijders, 2001; Snijders et al., 2007) as well as cross-sectional (Snijders, 2002; Snijders et al., 2006) statistical modeling of social networks. He is co-editor of *Social Networks* and associate editor of *Annals of Applied Statistics*, and the recipient of the 2010 *Simmel Award* of the International Network for Social Network Analysis (INSNA). He has a wide experience in collaborating with substantive social scientists, as testified by a large number of joint publications.

The researchers that are planned to be attracted for this research are Dr Johan Koskinen and Dr Ruth Ripley. Johan Koskinen is a statistician specializing in social network methods, who has made major contributions to Exponential Random Graph Models as well as Stochastic Actor-Oriented Models. He also is experienced in working with substantive social scientists. Ruth Ripley is a computational statistician with experience in various areas, and a high ability in programming of R,

the statistical software system. Both are now involved in another research project about Stochastic Actor-Oriented Models and the *SIENA* program.

### 3.2.2 Contribution to the overall work plan

#### *Background*

This project is concerned with the elaboration of the recently developed method for assessing and modeling social influence, described in Steglich et al. (2010) and implemented in the computer program *SIENA* (Ripley et al., 2010), and which is the methodological backbone of the ECRP. Social influence here is mostly concerned with effects springing from the network, or mediated by it, on actor-level variables which we indicate here in shorthand as behaviour, but which also may refer to performance, attitudes, etc. For drawing reliable scientific conclusions about such social influence it is essential to represent the network-related processes in an adequate way. The method in question is based on the construction of an explicit stochastic model for the co-evolution of networks and behaviour in a given group, called the *Stochastic Actor-Oriented Model for Network Dynamics*, also briefly referred to as the actor-oriented or actor-based model, and abbreviated to *SAOM*.

The SAOM is based on a stochastic model of actors embedded in networks, where networks as well as behaviour are potentially changing between the panel waves, influencing one another, but observed only at the moments of the panel waves (Steglich, Snijders and Pearson, 2010; Snijders, van de Bunt and Steglich, 2010). The term actor-oriented is used because changes in network ties and in actors' behaviour are modeled from the point of view of the actors. Corresponding statistical procedures are implemented in the computer program *SIENA* (Simulation Investigation for Empirical Network Analysis), now available as the contributed package *RSiena* in the statistical software system R (Ripley and Snijders, 2010). The method and program were developed, and still are being developed, by the research groups from Oxford and Groningen collaborating in this research proposal.

Very recently, the SAOM has been extended to more general data structures: non-directed networks, valued networks, multivariate networks, and bipartite networks. These extensions have been presented at conferences and are implemented in the newest version of *RSiena*. Articles presenting these extensions are in preparation. Substantive researchers have expressed their interest in these extensions, but practical experience with them still is very limited.

#### *Aims and objectives*

The general aim of this subproject is to extend the scope and usability of the stochastic actor-oriented model (SAOM) for the co-evolution of networks and behaviour.

Major assumptions of the currently available SAOM are the assumptions that the network and behaviour simultaneously develops as a Markov chain; and that all differences between actors with respect to rules for change are captured by observed covariates and current behaviour and network position. This leads to the first two specific goals.

1. Relax the assumptions of actor-oriented models for dynamics of networks and behaviour by developing extensions that allow unobserved heterogeneity between actors.
2. Relax the assumptions of actor-oriented models by developing extensions that allow more influences from the past.

Theories and tested scientific hypotheses are limited by the means available for expressing and testing them. Statistical models recently developed for network data such as the SAOM and also the Exponential Random Graph Model (e.g., Snijders et al., 2006) are very flexible in the network structures that may determine the probabilities of the model. This has led to new, as yet unrealized, possibilities for model specification which may be expected to lead to richer social sciences theories concerning influence in networks, and more detailed empirical tests of these

theories. Examples of new questions that may be posed are the following, set in the example of influence between adolescent friends in smoking initiation. Is the effective influence toward starting to smoke larger on adolescents having several smoking friends than on those having one smoking friend? Is the effective protection against not starting to smoke larger for adolescents having several non-smoking friends than for those having one non-smoking friend? More generally: what is the combined effect of number of friends and proportion of smokers among the friends on the likelihood of starting to smoke? Other questions are whether influence on adolescents depends on whether the focal individual occupies a peripheral or a central position in the network; and whether influence is stronger, or weaker, in tightly connected friendship groups compared to loose groups.

To better exploit this potential inherent in the SAOM, close collaboration is needed between statistical and substantive researchers. This collaboration will be realized in this ECPR, and leads to the following goal.

3. Elaborate specifications of actor-oriented models that allow researchers to model details of selection and influence processes: examples are influence moderated by network positions, influence from indirect ties (e.g., based on structural equivalence, cf. Burt, 1987), and selection favoring complementarity.

Finally, we wish to pursue general aims related to the main practical difficulties encountered in applying the SAOM. These difficulties are related to the lack of knowledge of many researchers about network analysis; to the feedback nature of this model where the dynamic framework allows changes in variables to be dependent on the past and simultaneously to be predictive of the future, seemingly blurring the distinction between dependent and explanatory variables; and to lack of knowledge about this new model.

4. Elaborate methods for model checking and model selection in the SAOM, in particular for newly developed models such as co-evolution of multivariate networks and multivariate behaviour, and co-evolution with two-mode networks.
5. Assist substantive social science researchers in understanding the SAOM and interpreting its results, and communicating these to a wider scientific audience.

### *Methods*

The five aims mentioned above will be pursued using the following approaches.

1. Actor heterogeneity will be modeled by using discrete actor-level random effects (latent class models), cf. Nagin (2005), Vermunt (2007). In these models actors are differentiated by unobserved categorical attributes that modify their network choices and/or behaviour changes, and which can represent, e.g., different behavioural trajectories. Such models for network data are promising, and now are being developed by Koskinen (Oxford) and Schweinberger (Penn State). Applications to empirical data sets and simulation studies are necessary to investigate their properties and develop suggestions as to how to specify them.
2. Consider an  $M$ -wave network panel data set. A simple way (for  $M \geq 3$ ) to allow influences from the past is to use, for the period between waves  $m$  and  $m+1$ , network observations of wave  $m-1$  and earlier as dyadic covariates, and positional measures (e.g., centrality) for earlier networks as actor covariates.  
A more elegant and flexible, but also more complicated way, is to extend the SAOM to a Hidden Markov Model (HMM; Cappé, Moulines, and Rydén, 2005). A HMM is a stochastic process  $(X_t, Y_t)$  where  $X_t$  is a Markov process and the conditional distribution of  $Y_t$  given  $\{(X_{t'}, Y_{t'}) \mid t' \leq t\}$  depends only on  $X_t$ ;  $Y_t$  is observed while  $X_t$  is unobserved or observed incompletely. This could be applied with  $Y_t$  (for observation moments  $t$ ) being the observed network and behaviour, and letting  $X_t$  be a resultant of the more distant past; e.g., how long an individual has been a smoker, etc. The use of HMMs will also allow combining the Markovian actor-oriented models with network evolution models based on events as in Butts (2007) and Brandes, Lerner and Snijders (2009).

3. The elaboration of more detailed specifications can be carried out within the confines of the currently available mathematical approach by relatively minor modifications of the *RSiena* code. The difficulty here is to find out what is useful from a theoretical and empirical social science perspective, and this will be achieved by means of close collaboration between this subproject and the other subprojects in the ECRP.  
 In collaboration with the projects in Sweden and Finland about bullying, models will be specified for relational influence, where one relation influences another relation; an example is a configuration where pupils defend their friends who are bullied by others – in this dynamic configuration the “causal” direction is from the friendship and bullying relations to the defending relation. The application to dynamics of personal networks in the Spanish project will lead to special considerations and may require specifications different from the usual application to complete networks.  
 Some more refined model specifications will be based on positional indicators that may interact with other effects. If these indicators are computationally simple, they can be computed within the model simulations. For choosing such computationally cheap positional indicators we shall collaborate with the group of Prof Ulrik Brandes of the Department of Computer Science, University of Konstanz. Positional indicators can also be derived from fitting blockmodels (Doreain, Batagelj, and Ferligoj, 2005); this will be done in collaboration with the Slovenian project.  
 The new option to analyze multivariate networks, together with the existing option to analyze multivariate dependent behaviour variables, opens rich possibilities for mediation analysis and path analysis, where the effect of one variable on another is mediated by another (cf. MacKinnon et al., 2007; Kuha and Goldthorpe, 2010).
4. Methods for model checking can be developed by utilising the fact that the *SIENA* methodology is based on computer simulation of the network evolution according to the estimated (or other) parameter values. This allows considering the fit between data and model for arbitrary statistics. These methods will be similar in principle to the simulation-based methods for checking cross-sectional network models presented in Hunter et al. (2008). Other possibilities are cross-validation by comparing results obtained when leaving out one or some intermediate panel waves; prediction of later panel waves; and the use of statistical procedures such as Schweinberger’s (2005) goodness of fit tests, likelihood-based tests and Bayesian model selection.
5. The collaboration with other social scientists will consist of collaboration within the ECRP on jointly written articles, and varied activities for dissemination of the methods studied and elaborated in the ECRP. The yearly meetings of the full ECRP will be combined with advanced *SIENA* user workshops, open to all interested experienced *SIENA* users.

#### *Work plan and outputs*

The planned duration is 4 years, starting March 1, 2011.

Collaboration with researchers in the other projects in applying the methodology to empirical data sets will take place throughout the duration of the ECRP. There will be yearly meetings of the ECRP, combined with advanced *SIENA* user workshops open for a larger audience. The website and documentation of *SIENA* will be improved and maintained, and extended by tutorial-like examples.

Methodological as well as expositional papers will be written, the latter in collaboration with other researchers in the ECRP.

A methodological paper on latent class models will be ready before the program starts. An expositional paper for a non-technical audience will be written in year 1. One or two methodological papers on HMMs will be written in years 1-2, and an expositional paper in year 2. A first paper on model checking will be written in year 1; a second paper, incorporating the new developments with respect to aims 1-3, in year 4. Extensions of model specifications (aim 3) will be developed and presented in papers co-authored with other researchers in the ECRP throughout years 1-4, and integrated in an overview paper in year 4.

These developments will also be included in an accessible form in the *SIENA* manual. They will be presented at relevant scientific conferences; e.g., the yearly Sunbelt International Social Networks conferences and other conferences on social networks; methodological conferences such as those of RC33 of the International Sociological Association and of the Psychometric Society; and other statistical conferences. The postdoctoral researcher and project leader will teach one- or multi-day workshops about the *SIENA* program at several of these meetings.

### 3.2.3 Justification of funding requested

Johan Koskinen, 100% FTE, 46.6 months, 15 April 2011 to 28 February 2015. Dr Koskinen will work full-time on this research project and will have close contacts with research teams in all countries, leading to methodological publications as well as to joint authorship on substantive publications. The salary is costed at National Spinal Point 33.

Ruth Ripley, 30% FTE, 35 months, 1 April 2012 to 28 February 2015. Dr Ripley, a computational statistician, will extend the current *RSiena* package and contribute to the documentation. The salary is costed at National Spinal Point 42.

Research Assistant, 20% FTE, 48 months, 1 March 2011 to 28 February 2015. A graduate student will be recruited to assist with data collection, organizing meetings and workshops, managing the *SIENA* website, and other research support (15% FTE) and contribute to coordination of the project (5% FTE). The salary is costed at National Spinal Point 27.

These grades and scales are commensurate with the University's grading structure and (for the first two) with current salary, experience and skills.

Travel and Subsistence – The project will require travel to partner countries for attending ECRP meetings and conferences for networking and dissemination purposes. To this end, funding is requested towards an allowance of £2,000 per year for Ripley (Years 2-4) and Koskinen (Years 1-4). A travel allowance of £2,000 per year for Snijders (Years 1-4) will be used in coordinating the ECRP as a whole.

Consultancy Fee - The consultant (to be recruited) will work alongside Ripley to extend the C/C++ code which is the computational core of the program.

Computer – The postdoctoral researcher will need a high-powered computer for analysis and development work. For the team as a whole, a high-end laptop will be needed for presentations and workshops.

Tom Snijders, 5% FTE for 48 months, Principal Investigator. He will manage and coordinate the ECRP, supervise the collaboration between methodologists and substantive researchers, take part in the development of statistical methods, supervise the extension of the *RSiena* program, line manage the research staff; and report to the ESRC. He will also commit an important part (15% FTE) of his regular research work to the project.

### 3.2.4 Annexes (including no more than 1 side of A4 for references and 2 sides of A4 for technical details, if appropriate). Insert brief CVs (no more than 1 side of A4) for each of the named researchers. CVs should include a list of no more than 10 relevant publications for each researcher.

### Annex 3.1 References

- Brandes, U., Lerner, J., & Snijders, T.A.B. (2009). Networks Evolving Step by Step: Statistical Analysis of Dyadic Event Data. *Proc. 2009 Intl. Conf. Advances in Social Network Analysis and Mining (ASONAM 2009)*, pp.200-205. IEEE Computer Society, 2009.
- Burt, R.S. (1987) Social contagion and innovation Cohesion versus structural equivalence. *American Journal of Sociology* 92, 1287-1335.
- Butts, C.T. (2007). A relational event framework for social action. *Sociological Methodology*, 38, 155–200.
- Cappé, O., Moulines, E., & Rydén, T. (2005). *Inference in Hidden Markov Models*. New York: Springer.
- Doreian, Patrick, Batagelj, Vladimir, Ferligoj, Anuška (2005). *Generalized blockmodeling*. Cambridge: Cambridge University Press.
- Hunter, D.R., Goodreau, S.M., and Handcock, M.S. (2008). Goodness of Fit of Social Network Models. *Journal of the American Statistical Association*, 103, 248-258
- Kuha, J., and Goldthorpe, J.H. (2010). Path analysis for discrete variables: the role of education in social mobility. *Journal of the Royal Statistical Society, A*, 173, 351-369.
- MacKinnon, D. P., Fairchild, A. J., & Fritz, M. S. (2007). Mediation analysis. *Annual Review of Psychology*, 58, 593–614.
- Nagin, D.S. (2005). *Group-based modeling of development*. Boston, MA: Harvard University Press.
- Ripley, Ruth M., and Snijders, Tom A.B. 2010. Manual for SIENA version 4.0. Oxford: University of Oxford, Department of Statistics; Nuffield College. <http://www.stats.ox.ac.uk/siena/~snijders>
- Schweinberger, M. (2005). Statistical modeling of network panel data: Goodness of fit. <http://www.stat.washington.edu/msch/goodness-of-fit.pdf>
- Snijders, T.A.B. (2001) The statistical evaluation of social network dynamics. M.E. Sobel and M.P. Becker (eds.), *Sociological Methodology-2001*, 361-395. Boston and London: Basil Blackwell.
- Snijders, Tom A.B., Pattison, Philippa E., Robins, Garry L., and Handcock, Mark S. (2006) New specifications for exponential random graph models. *Sociological Methodology*, 99-153.
- Snijders, Tom A.B., Steglich, Christian E.G., and Schweinberger, Michael. 2007. Modeling the co-evolution of networks and behavior. In: *Longitudinal models in the behavioral and related sciences*, edited by Kees van Montfort, Han Oud and Albert Satorra, pp. 41–71. Mahwah, NJ: Lawrence Erlbaum.
- Snijders, T.A.B., Steglich, C.E.G., and van de Bunt, G.G. (2010). Introduction to actor-based models for network dynamics. *Social Networks*, 32, 44-60.
- Steglich, C.E.G., Snijders, T.A.B., Pearson, M. (2010) Dynamic networks and behavior: Separating selection from influence, *Sociological Methodology*, in press.
- Vermunt, J.K. (2007). Growth models for categorical response variables: standard, latent-class, and hybrid approaches. K. van Montfort, H. Oud, and A. Satorra (Eds.). *Longitudinal models in the behavioral and related sciences*, 139-158. Mahwah, NJ: Erlbaum.

### Annex 3.2 Brief CV of Tom A.B. Snijders (1949)

PhD (mathematics) 1979, University of Groningen (*cum laude*), supervised by Willem Schaafsma.  
M.Sc. (mathematics) 1973, University of Groningen (*cum laude*)

#### Academic positions

From 2006 Professor of Statistics in the Social Sciences, University of Oxford; attached to Dept. of Politics and International Relations, Dept. of Statistics, and Dept. of Sociology; Fellow of Nuffield College (0.6 fte)  
From 2002 Professor of Methodology and Statistics, Dept. of Sociology, University of Groningen (since October 2006 0.2 fte)  
1992 - 2002 Professor of Stochastic Models for the Social and Behavioral Sciences, Dept. of Statistics and Measurement Theory, University of Groningen.  
1989 - 1992 Professor of Mathematical Sociology, University of Utrecht (half-time).  
1973 – 1992 Various positions in Depts. of Mathematics, Econometrics, and Statistics and Measurement Theory, University of Groningen.

#### Honors and awards, visiting appointments.

2008-2009 Honorary Francqui Chair, University of Leuven.  
2008-2013 Honorary Professorial Fellow, School of Behavioural Sciences, Univ. Melbourne  
April 2008 Visiting professor, Faculté Jean Monnet, Université de Paris-Sud  
since 2007 Correspondent of the Royal Netherlands Academy of Arts and Sciences.  
Sept 2005 Honorary doctorate in the Social Sciences, University of Stockholm  
May 2000 Visiting professor, Department of Sociology, Université de Lille - 1.  
since 1999 Elected member of the International Statistical Institute.

#### Main editorial functions

Co-editor, *Social Networks* (since 2006).  
Associate Editor, *Annals of Applied Statistics* (since 2006).  
Member Editorial Board, *Methodology* (since 2004).  
Associate Editor, *Social Networks* (2003-2006).  
Associate Editor, *Psychometrika* (1999–2004).  
Associate Editor, *J. of Social Structure* (since 1999).  
Contributing Editor, *Current Index to Statistics* (1997–2002).  
Intern. Consult. Editor, *American Journal of Sociology* (1992–1994).  
Associate Editor, *Journal of Educational and Behavioral Statistics* (1992–2004).  
Editor, *Statistica Neerlandica* (1986–1990).  
Associate editor, *Kwantitatieve Methoden* (1983 – 1986).

#### Key publications

Snijders, T.A.B., Koskinen, J.K., and Schweinberger, M. (2010)..Maximum Likelihood Estimation for Social Network Dynamics. *Annals of Applied Statistics*, in press.  
Steglich, C.E.G., Snijders, T.A.B., Pearson, M. (2010). Dynamic networks and behavior: separating selection from influence. *Sociological Methodology*, in press.  
Mercken, L., Snijders, T.A.B., Steglich, C.E.G., and de Vries, H. (2010). Dynamics of adolescent friendship networks and smoking behavior: *Social Science and Medicine* (2009), in press.  
Snijders, T.A.B., van de Bunt, G.G., and Steglich, C.E.G. (2010). Introduction to actor-based models for network dynamics. *Social Networks*, 32, 44-60.  
Snijders, T. A. B., Steglich, C., & Schweinberger, M. Modeling the co-evolution of networks and behavior. In K. van Montfort, H. Oud & A. Satorra (Eds.), *Longitudinal models in the behavioral and related sciences*, p. 41-71. Mahwah, NJ: Lawrence Erlbaum (2007).  
Snijders, T.A.B., Pattison, P.E., Robins, G.L., and Handcock, M.S. New specifications for exponential random graph models. *Sociological Methodology - 2006*, 99-153.  
Van der Gaag, M.P.J. and Snijders, T.A.B. The Resource Generator: Social capital quantification with concrete items. *Social Networks*, 27 (2005), 1-27.  
Snijders, T.A.B., The statistical evaluation of social network dynamics. M.E. Sobel and M.P. Becker (eds.), *Sociological Methodology-2001*, 361-395. Boston and London: Basil Blackwell.  
Snijders, T.A.B., and Bosker, R.J., *Multilevel analysis. An introduction to basic and advanced multilevel modeling*. London etc.: Sage Publications, 1999.  
Snijders, T.A.B. & Bosker, R.J., Standard errors and sample sizes for two-level research. *Journal of Educational Statistics* 18 (1993), 237-259.

### Annex 3.3 Brief CV of Johan Henrik Koskinen

PhD (Statistics) 2005, Stockholm University. Supervised by Ove Frank  
Licentiate of Philosophy (Statistics) 2003, Stockholm University

#### Academic positions

- 2009– Postdoctoral Fellow, Department of Politics and International Relations, University of Oxford.
- 2006–08 Postdoctoral Fellow, Department of Psychology, University of Melbourne.
- 2005–06 Researcher, SOFI, Stockholm University.
- 2004–05 Lecturer, Department of Statistics, Stockholm University.

#### Visits

- 2004 Research assistant, Department of Sociology, Stockholm University.
- 2009 Invited Visiting Statistician, CCSR, University of Manchester;
- 2005 Behavioural Science Honorary Visitor, Dep. Psychology, Univ. Melbourne;
- 2005 Visiting researcher, Dep. Prob. Theory & Math. Stats., St Petersburg State Univ.
- 2002 Visiting research student, Dep. Statistics, Univ. Groningen.

#### Some invited presentations

- 2010 Different forms of network dependence – some conceptual clarifications. Mitchell Centre for Social Network Analysis, University of Manchester
- 2010 Different levels of dependency.. Department of Psychology, Melbourne University.
- 2009 Different levels of homogeneity in longitudinal social networks. ARS'09, Università Degli Studi di Salerno, Salerno, Italy.
- 2009 Maximum Likelihood Estimation for Social Network Dynamics. Univ. College Dublin.
- 2008 Methodological implications of missing data in social network analysis - recent findings and future challenges, DSTO, Australia.
- 2007 Inferring structural dynamics from insufficiently observed social networks. The 4th workshop on Network Tomography, Adelaide, Australia.
- 2006 Aspects of Bayesian Inference for (Curved) Exponential Families of distributions for Graphs and Digraphs. Univ. Melbourne
- 2005 On Bayesian Inference for Dynamic Network Data (2005). 5<sup>th</sup> St. Petersburg Workshop on Simulation, St. Petersburg.

#### Key Publications

- Snijders, T.A.B., Koskinen, J.H., & Schweinberger, M. (2010). Maximum likelihood estimation for social network dynamics. *The Annals of Applied Statistics*. In press.
- Koskinen, J. H., Robins, G. L., and Pattison, P. E. (in press). Analysing Exponential Random Graph (p-star) Models with Missing Data Using Bayesian Data Augmentation. *Statistical Methodology*. DOI:10.1016/j.stamet.2009.09.007.
- Lusher, D., Koskinen, J., Robins, G., eds. (2010). *Exponential Random Graph Models for Social Networks: Theories, Methods and Applications*, (under contract with Cambridge University Press with planned publication in 2010).
- Koskinen, J. & Edling, C. (2010). The evolution of a bi-partite network - Peer referral in interlocking directorates. Accepted for publication in *Social Networks*.
- Ghilagaber, G. & Koskinen, J.H. (2009). Bayesian Adjustment of Anticipatory Covariates in the Analysis of Retrospective Data. *Mathematical Population Studies*, 16 (2) 105–130.
- Koskinen, J.H. (2009). Using latent variables to account for heterogeneity in exponential family random graph models. *Proc. 6th St. Petersburg Workshop on Simulation*, pp. 845-849.
- Koskinen, J.H. & Snijders, T.A.B. (2007). Bayesian Inference for Dynamic Social Network Data. *Journal of Statistical Planning and Inference*, Vol 137 (12) 3930-3938.
- Koskinen, J.H. (2005). On Bayesian Inference for Dynamic Network Data. *Proceedings of the 5<sup>th</sup> St. Petersburg Workshop on Simulation*, pp. 385-390.
- Koskinen, J.H., Jansson, I., & Spreen, M. (2002). The Role of Perceptual Data in Sampling Large Networks from Hidden Populations. Pp 56-73 in Hagberg (ed.), *Contributions to Social Network Analysis, Information Theory, and Other Topics in Statistics; Festschrift in honour of Ove Frank*. Stockholm: Dept. of Statistics, Stockholm University

### **Annex 3.4. Brief C.V. of Ruth M. Ripley.**

DPhil (information engineering) 1998, University of Oxford, supervised by Lionel Tarrasenko.  
MSc (statistics) 1973, Imperial College, University of London (with distinction)  
BA (mathematics) 1973, University of Cambridge (Class I)

#### **Academic positions**

- 2008- Scientific programmer, Department of Politics and International Relations, University of Oxford (0.6 fte)
- 2008- Departmental lecturer, Department of Statistics, University of Oxford (0.25 fte)
- 2007-08 (voluntary) Social network analysis programming work, in collaboration with Tom Snijders
- 2004-07 Occasional statistical research, consulting and tutoring in collaboration with Department of Statistics, University of Oxford
- 2002-03 Departmental lecturer, Department of Statistics, University of Oxford (0.8 fte)
- 1999-01 Statistical research, consulting and tutoring in collaboration with Department of Statistics, University of Oxford
- 1997-99 Researcher/Postdoctoral researcher, Department of Engineering Science, University of Oxford
- 1991-95 Researcher/programmer, Clinical Trials Service Unit, University of Oxford
- 1990-91 Researcher, Department of Statistics, University of Oxford
- 1989-90 Researcher, Department of Statistics and Modelling Science, University of Strathclyde

#### **Invited presentations**

- 2001 Looking for patterns in plainchant. Department of Statistics, University of Oxford.
- 1999 Linear and non-linear models (neural networks) for prognosis with censored data. Centre for Statistics in Medicine, University of Oxford.
- 1999 Neural network based non-linear survival methods with applications to breast cancer prognosis. Istituto Nazionale per lo Studio e la Cura dei Tumori, Milan.

#### **Key publications**

- Ripley, B. D. and Ripley, R. M. (2001a) Applications of R clients and servers. In *Proceedings of the 2nd International Workshop on Distributed Statistical Computing*, March 15–17, 2001, Technische Universitat Wien, Vienna (Eds K. Hornik and F. Leisch).
- Ripley, B. D. and Ripley, R. M. (2001b) Neural networks as statistical methods in survival analysis. In *Clinical Applications of Artificial Neural Networks* (Eds R. Dybowski and V. Gant). Cambridge University Press.
- Ripley, R. M., Harris, A. L. and Tarassenko, L. (1998) Neural network models for breast cancer prognosis. *Neural Computing and Applications*, 7, 367–375.
- Ripley, R. M., Harris, A. L. and Tarassenko, L. (2004) Non-linear survival analysis using neural networks. *Statistics in Medicine*, 23, 825–842.

#### **Software package**

- RSiena An R contributed package for longitudinal analysis of social networks (with Krists Boitmanis)
- survnnet An R contributed package for neural network based analyses of survival data (available at <http://www.stats.ox.ac.uk/pub/RWin/src/contrib/>)
- chant A Visual Basic application for analysis of medieval chant melodies. (available at <http://www.stats.ox.ac.uk/pub/ruth/>)

<b>COUNTRY CONTRIBUTION 2</b> <i>Peer Influence in Social Networks: Comparing and Evaluating Methods across Domains.</i>	<b>Principal Investigator:</b>	<i>Marijtje van Duijn</i>
	<b>Country:</b>	<i>Netherlands</i>
	<b>ECRP Funding Organisation:</b>	<i>NWO</i>
<b>3.1 Financial summary for Country Contribution 2</b>		
<p>The Principal Investigator should provide below a summary of the financial support sought from his/her national ECRP Funding Organisation.</p> <p>Full financial details and any other supplementary information required by your national ECRP Funding Organisation should be supplied to them as instructed.</p>		
		<b>TOTAL (EUROS)</b>
<b>3.1.1</b>	<b>Staff 1 Ph.D. candidate</b>	<b>200,013</b>
<b>3.1.2</b>	<b>Travel and subsistence</b>	<b>15,500</b>
<b>3.1.3</b>	<b>Consumables</b>	<b>4,000</b>
<b>3.1.4</b>	<b>Other items</b>	
<b>3.1.5</b>	<b>Overheads and other allowable costs</b>	<b>5,000</b>
<b>3.1.6</b>	<b>GRAND TOTAL FOR INDIVIDUAL COUNTRY CONTRIBUTION 2</b>	<b>224,513</b>

### 3.2 Description of Country Contribution 2 (*2112 words*)

#### 3.2.1. Specific competence and expertise of this team

The Dutch team will consist of Dr Marijtje van Duijn and Dr Christian Steglich, and a PhD student to be hired. Both team members have worked extensively with Project Leader Prof Tom Snijders on developing statistical models for the analysis of social network data. Christian Steglich is an expert in the stochastic actor-based models of the co-evolution of networks and behaviour. This has led to fruitful collaboration with substantive researchers, some of whom are participating in this proposal. Marijtje van Duijn's expertise is in statistical models for dependent data such as social networks and more generally clustered (multilevel) data. Her methodological experience in model comparison applied to simulated and empirical data fits very well with the objectives of the project proposal.

#### 3.2.2 Contribution to the overall work plan

##### *Background*

The publications by Nicholas Christakis and James Fowler on the Framingham Heart Study have attracted a lot of attention (e.g., Christakis & Fowler, 2007; Fowler & Christakis, 2008). The authors report on a unique data set with longitudinal data on health-related and psychological measures provided by several generations of inhabitants of Framingham, a town in Massachusetts (USA). Moreover, information on the kinship relations among the respondents is available that are used to explain individual outcomes. Health researchers were intrigued by the conclusion that individual characteristics and behaviour such as obesity, smoking and happiness, were found to spread through the social network, or, put differently, proved to be *contagious*. The findings, however, elicited criticism of methodologists and statisticians, most strongly voiced by Cohen-Cole and Fletcher (2008a; 2008b) who showed how easily unlikely results can be obtained using the methods applied by Christakis and Fowler. They argue convincingly that the applied models for longitudinal data do not take into account the contextual effects sufficiently. The selection of the

most appropriate analysis methods for social influence and contagion, and the demarcation of the conclusions that can reliably be drawn from such data, are still open questions. One other possibility is to use methods which incorporate the network characteristics and the network dynamics more explicitly in the model, an approach taken in the stochastic actor-based models of the co-evolution of networks and behaviour (Steglich, Snijders, & Pearson, 2010; Snijders, van de Bunt, & Steglich, 2010; see also Snijders, Steglich, and Schweinberger, 2007). Further investigation and comparison of these and other approaches is the topic of the present research proposal.

Not only in public health, but in many areas of research, the assessment of social relations, or peer effects, is a central research question. The notion of *peer influence* refers in general to any social process by which a behavior or attitude of a focal social actor is affected by the behavior and attitudes that are present among the peer contacts (or social ties) that act as reference points for this focal actor. Peer influence has mostly been studied as a process of contagion, by which actors gradually adopt their contacts' behavior, i.e., get more similar over time, as was also investigated by Christakis and Fowler. Typical examples are found in adolescence research (see proposals 3 and 4 in the ECRP), but also in organisation ecology (see proposal 5), sociology of science (see proposal 6) and (specific) group dynamics (see proposal 7). Other areas in which peer effects are prominent range from studies close to adolescence research, in educational economics (see, e.g., Hanushek, 2003) and criminology (see, e.g. Haynie & Osgood, 2005), to more general research in epidemiology/demography (see, e.g., Morris, 2004), and economics/investment banking (Shipilov & Li, 2008). See Mouw (2006) for more examples and discussion of analysis methods.

#### *Aims and objectives*

The assessment of peer effects in a dynamic social network context can be regarded as a domain-overarching methodological challenge in the social sciences. The aim of the Dutch contribution to the ECRP is to evaluate the different existing approaches to assess peer influence in dynamic social networks in a comparative framework under different conditions with respect to research question and study and/or network design. The comparison will be based both on results obtained with simulated data sets and with empirical data. Therefore, this contribution will depend crucially on data sets and disciplinary expertise of the researchers in the ECRP partner projects. Central in the comparison will be the approach of the Stochastic Actor-Oriented Model of the co-evolution of networks and behaviour (Steglich, et al., 2010; hereafter called the SAOM) which was developed in the Project Leader's research group, and over the last years has been successfully applied to peer influence research questions across a wide range of research domains (see, e.g., Burk, Steglich, & Snijders, 2007; Knecht, Snijders, Baerveldt, Steglich & Raub, 2010; Mercken, Snijders, Steglich & de Vries, 2010).

What distinguishes the SAOM approach most from other existing methods is the explicit modelling of network change in a co-evolution process occurring in mutual dependence with behaviour or attitude change. Steglich et al. (2010), addressing the more general task of assessing peer selection and peer influence effects simultaneously, identify the relative shortcomings of these other methods as issues of ignored network dependence, lack of control of alternative explanatory mechanisms (i.e., model misspecification), and incomplete observations (due to the discrete observations of a continuous process). While these issues are well understood in principle, it is not yet clear which biases in the results they imply for the other methods. Moreover, for the specific task of correctly assessing peer influence effects, the peer selection processes do not need to be accurately identified at all, but only controlled for. This is what other prominent methods that we will compare to the SAOM aim to achieve.

In a methodological review paper, Mouw (2006) summarises research on social capital effects, a special form of peer influence. He compares various models and methods to infer causal effects subject to different assumptions about the structural dependence in the data, and quasi-experimental and randomized designs. These approaches are not able to deal with all available data, i.e., the repeated observations of social networks and individual behaviour. They require data summarised at the individual (actor), or sometimes dyadic level so that conventional, but often

quite advanced, statistical techniques can be used in a next step. As Mouw (2006) points out, the assumptions underlying these techniques will usually be violated, due to the impossibility to adequately account for network effects and/or due to unobserved variables also related to the outcome variable (either network or behaviour). It is clear that both the data reduction and the violation of assumptions affect the results of the analysis. To which extent this is the case has, however, not been investigated so far, nor whether this would lead to substantially wrong conclusions. It seems reasonable to expect that the consequences of using an incomplete or imperfect model depend on the severity of the violations, which in its turn may depend on the context or domain of influence.

Moreover, the focus of the Dutch project on peer influence processes renders some of the identified issues potentially less important, notably model misspecification in the network component of the SAOM. Because this is a required component of the approach, this unique possibility offered by SAOM modelling might be a comparative disadvantage for assessing peer influence effects, as it forces researchers to be specific about how network relations change, if they are not primarily interested in network change or in fine details of who influences whom. A crucial question will be under what conditions such explicit modelling of network changes constitutes an analytical advantage over the more simple assumption of network stability in unobserved time periods, which underlies the literature summarised by Mouw (2006).

### *Methods*

After having obtained insight in the differences obtained with SAOM and conventional methods in different types of empirical data, a good way of providing more insight in the differences of the conventional models relative to the SAOM is to evaluate the performance of the different methods on simulated data, in which the occurrence of peer influence and potentially confounding mechanisms like peer selection can be controlled by the researcher. The SAOM is taken as a starting point or benchmark of the comparison, because, so far, this approach provides the most elaborate treatment of the mechanism of influence (on behaviour) and selection (of network ties). Generating data according to the SAOM provides the possibility to subsequent analysis with conventional methods, such as cross-lagged panel models (see, e.g. Simons-Morton & Chen, 2005), or longitudinal fixed effect models (see, e.g., Hanushek, 2003; Cohen-Cole & Fletcher, 2008b). The specification of the stochastic actor-oriented models used to generate the simulated data will be inspired by results from the analysis of empirical data available from the other participating projects. It is to be expected that the models and analytic results (and their interpretation) will be quite different for peer effects on bullying (projects 3 and 4) than for the collaboration influence on hospital performance (project 5). This will ensure that the simulation studies do not suffer from the lack of realism that often underlies such studies.

The different set-up in the data collection (for instance the different definitions of the network boundary in projects 3 and 4) is also expected to influence the results obtainable with SAOM and the conventional methods. The personal network data under study in project 7 will provide an excellent opportunity to test an unusual variant hereof.

In addition, the new SAOM model specification results from relaxing the earlier assumptions as proposed in project 1 will be used for a comparison both in simulated data (using the newly developed SAOM specifications) and in the empirical data provided by the other projects.

### *Workplan and planned outputs*

A PhD student is being requested for this project. The first year of the project will be devoted to making an inventory of the methods that are used in the research disciplines involved in the ECRP concerning peer influence, similar to Mouw (2006), but including the SAOM approach and focused on the domains in the present proposal. This may reveal 'blind spots' of certain research traditions. The domain-specific literature studies will be coupled with a diagnostic screening of the analytical methods concerning their ability to detect particular types of peer influence and their sensitivity to reasonable model violations. The findings will be reported in a paper (the first chapter of the PhD thesis).

In a next step, the SAOM will be applied to the data available from the partner-projects. Building on the insights from the first-year inventory, the results obtained with the SAOM will be compared to those obtained with other methods proposed in the literature. The comparison will take the greater part of the second year of the project, and will lead to a second methodological paper (the second chapter). The study will also involve investigation of the differences in substantive interpretation of different methods, in collaboration with the researchers of other projects. This is expected to lead to co-authored papers in domain-specific journals, with the secondary (yet important aim) to promote the dissemination of the SAOM in these domains, a process that has only just begun as a result of the concluded previous ECRP on "Dynamics of Networks and actors across Levels".

The inventory and application of the SAOM and other methods to available data will provide a good start of the simulation study to be carried out in the final part of the second year and the third year of the project, along the lines sketched above. The results will be the input for a methodological paper (the third chapter of the thesis).

In the fourth year, the results of project 1 will be incorporated in a new (extended) simulation study (to be reported as the fourth chapter).

The four-year project will be concluded by a Ph.D thesis for the candidate to be hired.

### **3.2.3 Justification of the funding requested**

The Ph.D. student will be supervised by the PI (Van Duijn) and Steglich, who both will spend approximately 4 hours each week on the project. The project leader (Snijders), who is partly based at the University of Groningen, will be involved in the project as well, and will serve as the promotor of the Ph.D. candidate. The Ph.D. student will be part of the graduate school ICS, the Interuniversity Centre for Social Science and Methodology, based in the Sociology Departments at the universities of Groningen, Utrecht and Nijmegen.

In addition to the financial support sought for the PhD candidate, in each of the four years a sum of €2000 is reserved for national travel and international traveling to meetings with the other European projects. In the second through fourth year, an extra amount of €1500 is intended for an international conference visit. In the third year, a sum of €3000 is set aside for a longer research visit, most likely to one of the participating project groups. The consumables cover a reservation for the purchase of software and yearly license costs.

### **3.2.4 Annexes**

### Annex 3.1 References

- Burk, W.J., Steglich, C. & Snijders, T.A.B. (2007.) Beyond dyadic interdependence: Actor-oriented models for co-evolving social networks and individual behaviors. *International Journal of Behavioral Development*, 31, 397-404.
- Christakis, N.A. & Fowler, J.H. (2007). The spread of obesity in a large social network over 32 years. *New England Journal of Medicine*, 357, 370-379.
- Cohen-Cole, E. & Fletcher, J.M. (2008a). Is obesity contagious? Social networks vs. environmental factors in the obesity epidemic. *Journal of Health Economics*, 27, 1382–1387.
- Cohen-Cole, E. & Fletcher, J.M. (2008b). Detecting implausible social network effects in acne, height, and headaches: Longitudinal analysis. *British Medical Journal*, 337, a2533.
- Ennett, Susan T., and Karl E. Bauman. 1994. The Contribution of Influence and Selection to Adolescent Peer Group Homogeneity: The Case of Adolescent Cigarette Smoking. *Journal of Personality and Social Psychology* 67: 653-63.
- Fowler, J. H, Christakis, N. A (2008). Dynamic spread of happiness in a large social network: Longitudinal analysis over 20 years in the Framingham Heart Study. *British Medical Journal*, 337, a2338.
- Hanushek, E.A., Kain, J.F., Markman, J.M., & Rivkin, S.G. (2003). Does peer ability affect student achievement? *Journal of Applied Econometrics*, 18, 527-544.
- Haynie, D.L. & Osgood, D.W. (2005). Reconsidering peers and delinquency: How do peers matter? *American Journal of Sociology* 106: 1013-57.
- Kandel, Denise B. 1978. Homophily, Selection, and Socialization in Adolescent Friendship Pairs. *Social Forces*, 84, 1109-1130.
- Knecht, A., Snijders, T.A.B., Baerveldt, C., Steglich, C.E.G., & Raub, W. (2010). "Friendship and delinquency: Selection and influence processes in early adolescence. *Social Development*, in press.
- Manski, Charles F. 1993. Identification of Endogenous Social Effects: The Reflection Problem. *The Review of Economic Studies* 60: 531-42.
- Mercken, L., Snijders, T.A.B., Steglich, C.E.G., and de Vries, H. (2010). Dynamics of adolescent friendship networks and smoking behavior: *Social Science and Medicine*, in press.
- Morris, M. (Ed.) (2004). *Network Epidemiology. A Handbook for Survey Design and Data Collection*. New York: Oxford University Press.
- Mouw, Ted. 2006. Estimating the Causal Effect of Social Capital: A Review of Recent Research. *Annual Review of Sociology* 32: 79-102.
- Shipilov, A.V., & Li, S.X. (2008). Can you have your cake and eat it too? Structure holes' influence on status accumulation and market performance in collaborative networks. *Administrative Science Quarterly*, 53, 73-108.
- Simons-Morton, B., & Chen, B.S. (2005). Over time relationships between early adolescent and peer substance use. *Addictive Behaviors*, 31, 1211-1223.
- Snijders, Tom A.B., Christian Steglich and Michael Schweinberger. 2007. Modeling the co-evolution of networks and behavior. Chapter 3 in K. van Montfort, H. Oud and A. Satorra (Eds.): *Longitudinal models in the behavioral and related sciences*. Mahwah NJ, Lawrence Erlbaum. pp.41-71.
- Snijders, T.A.B., van de Bunt, G.G., & Steglich, C.E.G. (2010). Introduction to stochastic actor-based models for network dynamics. *Social Networks*, 32,44-60.
- Steglich, C.E.G., Snijders, T.A.B., & Pearson, M. (2010). Dynamic networks and behavior: Separating selection from influence. *Sociological Methodology*, in press.

### Annex 3.2 Brief CV of Marijtje van Duijn

PhD (Social and behavioral sciences) 1993, University of Groningen, supervised by Tom Snijders, Ivo Molenaar and Margo Jansen.

MSC (Econometrics) 1988, University of Groningen (*cum laude*).

#### Academic positions

2007-present Associate professor, Dept. of Sociology, University of Groningen.

1998-2006 Assistant professor, Dept. of Statistics and Measurement Theory, University of Groningen

1993-1998 Postdoc at the Interuniversity Center of Social Science Theory and Methodology, University of Groningen.

#### Visiting appointments

2005-2006 Senior Fulbright scholar, Center for Statistics and the Social Sciences, University of Washington, Seattle, USA (1 year).

1995 Visiting lecturer in Multilevel Analysis, Department of Statistics, University of Stockholm, Sweden (6 weeks).

1993 Fulbright scholar, Department of Quantitative Psychology, University of Illinois at Urbana-Champaign, USA (7 months).

#### Key publications

Vermeij, L, Van Duijn, M.A.J., & Baerveldt, C. (2009). Ethnic segregation in context: Social discrimination among native Dutch pupils and their ethnic minority classmates. *Social Networks*, 31(4), 230-239.

Zijlstra, B.J.H., Van Duijn, M.A.J., & Snijders, T.A.B. (2009). MCMC estimation of the  $p_2$  network regression model with crossed random effects. *British Journal of Mathematical and Statistical Psychology*, 62(1), 143-166.

Van Duijn, M.A.J., Gile, K.J., & Handcock, M.S. (2009). A Framework for the comparison of maximum pseudo likelihood and maximum likelihood estimation of exponential family random graph models. *Social Networks*, 31(1), 52-62.

Van Duijn, M.A.J. (2007). Discussion of M.S. Handcock, A.E. Raftery. and J.M. Tantrum , "Model-based clustering for social networks. *Journal of the Royal Statistical Society - Series A*, 170, 335-336.

Baerveldt, C., Zijlstra, B.J.H., De Wolf, M., Van Rossem, R., Van Duijn, M.A.J. (2007). Ethnic boundaries in high school students' networks in Flanders and the Netherlands. *International Sociology*, 22, 701-720.

Van Duijn, M.A.J. & Vermunt, J.K. (2006). What is special about social network analysis. *Methodology*, 2, 2-6.

Huisman, M., & Van Duijn, M.A.J. Software for social network analysis. (2005). In: P.J. Carrington, J. Scott, & S. Wasserman, *Models and methods in social network analysis* (pp. 270-316). Cambridge: Cambridge University Press.

Van Duijn, M.A.J., Snijders, T.A.B., & Zijlstra, B.J.H. (2004).  $p_2$ : a random effects model with covariates for directed graphs. *Statistica Neerlandica*, 58, 234-254.

Van Duijn, M.A.J., Zeggelink, E.P.H., Huisman, M., Stokman, F.N., & Wasseur, F.W. (2003). Evolution of sociology freshmen into a friendship network. *Journal of Mathematical Sociology*, 27, 153-191.

Van Duijn, M.A.J., Van Busschbach, J.T., & Snijders, T.A.B. (1999). Multilevel analysis of personal networks as dependent variables, *Social Networks*, 21, 187-209.

### Annex 3.3 Brief CV of Christian Steglich (1968)

PhD (Social and behavioral sciences) 2003, University of Groningen, supervised by Siegwart Lindenberg and Tom Snijders.

MSc (Mathematics and information sciences) 1994, Technical University Berlin.

#### Academic positions

2006-present Researcher, Dept. of Sociology, University of Groningen.

2002-2006 Postdoc at the Interuniversity Center of Social Science Theory and Methodology, University of Groningen.

#### Research visits

2007 Cardiff Institute of Society, Health and Ethics, Cardiff University  
Faculty of Economics, University of Italian Switzerland, Lugano

2006 Department of Psychology, University of Melbourne

#### Key publications

Steglich, C.E.G., Snijders, T.A.B., & Pearson, M. (2010). Dynamic networks and behavior: Separating selection from influence. *Sociological Methodology*, in press.

Snijders, T.A.B., van de Bunt, G.G., & Steglich, C.E.G. (2010). Introduction to stochastic actor-based models for network dynamics. *Social Networks*, 32,44-60.

Dijkstra, J.K., Lindenberg, S., Veenstra, R. Steglich, C. Isaacs, J., Card, N.A., & Hodges, E.V.E. (2010). Influence and selection processes in weapon carrying during adolescence: The roles of status, aggression, and vulnerability. *Criminology*, in press.

Knecht, A., Snijders, T.A.B., Baerveldt, C., Steglich, C.E.G., & Raub, W. (2010). "Friendship and delinquency: Selection and influence processes in early adolescence. *Social Development*, in press.

Huisman, M., & Steglich, C. (2008). Treatment of non-response in longitudinal network studies. *Social Networks*, 30, 297-309.

Checkley, M., and Steglich, C. (2007). Partners in power: job mobility and dynamic deal-making." *European Management Review*, 4, 161-171.

Burk, W.J., Steglich, C. & Snijders, T.A.B. (2007.) Beyond dyadic interdependence: Actor-oriented models for co-evolving social networks and individual behaviors. *International Journal of Behavioral Development*, 31, 397-404.

Torlò, V.J., Steglich, C., Lomi, A. & Snijders, T.A.B. (2007.) Network structures, individual behavior and performance in organizations. In: G.T. Solomon (Ed.), *Proceedings of the Sixty-sixth Annual Meeting of the Academy of Management (CD)*, ISSN 1543-8643.

Snijders, T.A.B., Steglich, C., & Schweinberger, M. (2007). Modeling the co-evolution of networks and behavior. In: K. van Montfort, H. Oud and A. Satorra (Eds.), *Longitudinal models in the behavioral and related sciences*, pp. 41-71. Mahwah, NJ: Lawrence Erlbaum.

Steglich, C., Snijders, T.A.B. & West, P. (2006). Applying SIENA: An illustrative analysis of the coevolution of adolescents' friendship networks, taste in music, and alcohol consumption. *Methodology*, 2, 48-56.

<b>COUNTRY CONTRIBUTION 3</b> <i>The Role of Peers in Adolescent Development of Externalizing and Internalizing Problem Behaviors.</i>	<b>Principal Investigator:</b>	Prof. Margaret Kerr
	<b>Country:</b>	<i>Sweden</i>
	<b>ECRP Funding Organisation:</b>	<i>Vetenskapsrådet</i>

### 3.1 Financial summary for Country Contribution 3

The Principal Investigator should provide below a summary of the financial support sought from his/her national ECRP Funding Organisation.

Full financial details and any other supplementary information required by your national ECRP Funding Organisation should be supplied to them as instructed.

ALL CALCULATIONS ARE DONE OVER 4 YEARS *	TOTAL (EUROS)
<b>3.1.1 Staff</b>	<b>193 300</b>
<b>3.1.2 Travel and subsistence</b>	<b>16 500</b>
<b>3.1.3 Consumables</b>	-
<b>3.1.4 Other items</b>	-
<b>3.1.5 Overheads and other allowable costs</b>	<b>96 600</b>
<b>3.1.6 GRAND TOTAL FOR INDIVIDUAL COUNTRY CONTRIBUTION 3</b>	<b>306 400</b>

\* Funding is required for a 0.8 postdoc during 4 years. We calculate with a yearly cost of 312,000 Skr [32,078.43€]. To that is added 50% LKP = 156,000 Skr [16,039.22€]. The university overhead is 50% on salaries plus LKP, 234,000 [24,058.82€]. Total per year 702,000 Skr [72,176.47€]. Over 4 years, this is 2,808,000 Skr [288,705.88€]. We calculate with yearly travel costs of 40.000 Skr [4,112.62€]

### THE SWEDISH CONTRIBUTION

#### Competence and Expertise of the Team

The Swedish team consists of Professors Margaret Kerr and Håkan Stattin and Dr. Maarten Van Zalk-Selfhout. Kerr and Stattin are highly experienced in longitudinal research on adolescent development, and they have published work on social networks, friend influence, and parenting in highly visible international journals. Two of Kerr and Stattin's articles are among the top 1% most highly cited studies in psychology since 2000. Stattin is the past president of the European Association for Research on Adolescence, and Kerr is an associate editor for the *Journal of Research on Adolescence*. Kerr received an Excellent Researcher award from the Swedish Research Council in 2003. Van Zalk-Selfhout has published empirical articles using social network analyses and has hosted international workshops to teach this technique. Moreover, he published two articles using the social network technique in two of the three SSCI highest impact journals within the field of Social Psychology (i.e., *Journal of Personality*) and Developmental Psychology (i.e., *Developmental Psychology*). He received the award for Best National Dissertation from the Institute of the Study and Education of Human Development in the Netherlands.

## Swedish Contribution to the Overall Work Plan

### Aims and objectives

There are two overall aims of the Swedish contribution. One is to advance scientific knowledge about adolescent friendships and their roles in the development of adolescent problem behavior. The second is to further develop our collaboration with the other research teams, and particularly with Tom Snijders and his team. We were successful in accomplishing what we set out to do in our previous application. For example, the computational time for doing SIENA analyses today is a fraction of what it was originally, because of improvements prompted by our input and needs for handling large networks. Our previous contributions to the network have put us in a position to push the boundaries of knowledge and the capabilities of SIENA forward even further.

### Our databases and previous contributions

In 2001, Kerr and Stattin started a longitudinal study (funded by Vetenskapsrådet) that addressed several key limitations in research on the role of friends in adolescent problem behaviors. One key limitation was that prior research was based on data from friends within schools, even though a substantive part of adolescent friendships exist outside school (Persson, Kerr, Stattin, 2007; Kerr, et al., 2007). A second key limitation was that most studies focused on adolescents and their one, best friend. Adolescents commonly have multiple friends, together forming *social networks* (Snijders, 2001; 2005; 2006; Snijders, Steglich, & Van de Bunt, 2010; Steglich, Snijders, & Pearson, 2010). To address these issues, all youths between ages 10 and 18 in a whole community were included in the longitudinal study ( $N = 3200$ ). This database is unique internationally; independent reports from adolescents, their friends inside school, and their friends outside school were gathered over a period of five years. Thus, these data include ecologically valid friendship networks inside and outside of school. It was because of this dataset that we were invited to join the previously funded SIENA research network.

Previous funding has been used mainly for a postdoctoral research position. This position was occupied by Dr. William Burk and then later by Dr. Maarten Van Zalk-Selfhout. Both researchers have worked closely with Snijders to master SIENA, and a number of publications have resulted (Bešić, Van Zalk-Selfhout, Kerr, & Stattin, 2009; Burk, Stattin, & Kerr, 2008; Burk, Steglich, & Snijders, 2005; Van Zalk-Selfhout, Kerr, Branje, Stattin, & Meeus, in press). To highlight some key results, Van Zalk-Selfhout et al. (in press) showed that in order to understand to what extent friends may increase adolescent depression (i.e., *influence*), two alternative processes need to be controlled for: Selection and de-selection. Findings showed that depressive adolescents tend to select friends with similar depressive symptoms (i.e., *selection*). Additionally, adolescents tended to end friendships with those who had *dissimilar* depressive symptoms (*de-selection*). Thus, results demonstrated that selection and de-selection both need to be controlled for in order to prevent overestimation of influence processes for depression. This study is now in press in one of the highest impact developmental journals, *Developmental Psychology* (Van Zalk-Selfhout et al., in press). A follow-up study using SIENA to examine mechanisms of friends' influence on depression has been invited for resubmission to a high impact journal in clinical psychology, *Journal of Clinical Child and Adolescent Psychology*. Thus, being part of the Snijders network and applying SIENA to the 10-to-18 data has resulted in new knowledge about friends' influence on adolescents' externalizing and internalizing problems.

### Pushing the boundaries of knowledge further

Despite the highly innovative nature of the "10 to 18" project and its value for studying adolescent friendship networks, it has some limitations. First, the sample does not include many immigrants or youths experiencing particularly harsh conditions at home and school. To remedy these problems, we began a new study (funded by FAS) in 2005. The study, "7-Schools," takes place in seven schools in the city of Örebro, three of which were selected because they have large immigrant populations and problematic schools. With the 7-Schools data, we will be able to study friendship networks of immigrant adolescents and the possible moderating role of friendship networks for adolescents experiencing harsh conditions such as peer harassment or parental maltreatment.

A second limitation of the 10-to-18 study is that online friendships were not included. A national study conducted by Ungdomsstyrelsen (Nyman et al., 2009) and our piloting have shown

that between 34 to 57% of adolescent friendships are found only online. To capture these friendships as well, we started the project "ONLINE vs. OFFLINE WORLDS" (funded by Vetenskapsrådet). It is similar to 10-to-18 in that all early adolescents between ages 13 and 15 from a small Swedish community will participate. It will involve around 800 target adolescents, 400 friends inside school, 400 friends outside school, and 400 online friends. This project will be innovative because it will be the first in which online friends participate themselves.

### *Specific Research Questions*

The content-oriented part of our contribution to the network will focus on the role of multiple friends on adolescent problem behavior. The 10-to-18 and the 7-Schools databases are unique in that both have broad longitudinal information about externalizing problems (psychopathic traits, sensation seeking, thrill seeking, delinquency, violence, bullying, alcohol use, drug use) and internalizing problems (victimization, poor self-esteem, depression, failure expectation, bodily self-injury, poor emotional regulation), and both of them have information about the peer networks of youths. The Online-Offline project will also have this information, but has the extension that online peer networks and specific online problem behaviors will also be measured (such as online gambling and watching/downloading pornographic material). Hence, we have a wealth of possibilities to understand the roles of peer networks behind the development of externalizing and internalizing problems. Although we will focus on the whole range of externalizing and internalizing problem behaviors mentioned, we give examples below of specific questions about two problem behaviors.

*Bullying and harassment* take place in school and outside of school. Using the 10-to-18 data and SIENA, we will examine whether bullies select other bullies as friends, whether bullies de-select others who do not join in their bullying, and whether bullying is influenced by friends. We will examine whether in-school or out-of-school friends are more important influences on bullying and harassment behavior. The complete information about in- and out-of-school friendships in the 10-to-18 data will allow us to understand the role of friendships in bullying better than has ever been possible before. The same measures, but also including bullying and harassment because of being an immigrant, have been collected in 7-Schools, thus making possible cross-validation of the 10-to-18 findings and the extension to immigrant populations.

*Self-harm.* Self-harm is closely connected to peer harassment and poor parent-youth relations. Youth who self-harm tend to contact each other online: One cross-sectional study found that girls who harm themselves report spending time online with others who also self-harm (Whitlock, Powers, & Eckelrode, 2006). Nevertheless, whether these online friends influence girls into *increasing* their self-harm remains, to date, unclear. As with bullying and harassment, longitudinal studies are needed to examine the extent of this possible influence while controlling for alternative processes (i.e., selection and influence). In sum, the extent to which adolescents—particularly girls—are influenced by their friends into self-harming behaviors will be examined in this project.

*Combined influences.* A final innovative aspect of this project is that we will address the *combined* influences from several friends on the above-mentioned adolescent problem behaviors. This is based on the theoretical notion, "the whole is more than the sum of its parts" (Wasserman, 1979): problem behaviors of several friends together may be a greater risk factor for developing externalizing problems than behaviors of several friends separately. This principle may particularly hold when adolescents have problematic friends across *all* different contexts. For example, adolescents who have disruptive friends within school, delinquent friends outside school, and online friends who engage in cyberbullying and online gambling may particularly risk escalating in problematic behaviors. Data from both the "10-to-18" and "Online-Offline" projects contain information about externalizing problem behaviors across all peer contexts, and can, therefore, be used to address this issue.

### *Development of Collaboration with Other Research Teams*

A second overarching aim of this project is to continue and further develop our collaboration with other research teams, particularly with the Project Leader and his project (Contributions 1 and 2) and the Finnish team (Contribution 4). Below we specify how these collaborations are planned.

*Collaboration with Tom Snijders and colleagues (Contributions 1 and 2).* One aim of Tom Snijders and colleagues's team is to further develop analyses within the SIENA framework to study social influence in peer relationships. Several of these front-edge analyses will be tested in the data we have by our research team. For our team, new analyses and techniques are needed to answer our research questions on the role of influence, selection, and de-selection in problem behaviors. Our testing of their methodology in ecologically valid and large datasets provides unique opportunities to identify needed adjustments in the methodology. This collaboration has proven to be highly fruitful in the past. For instance, in a recently submitted study, Snijders and colleagues used data we provided on the distance that youths in the 10-to-18 study lived from each other. Residential distance is one example of the many factors that influence the likelihood of youths selecting each other as friends, but are not currently included in network analyses. Using our database, we will explore other issues with the Snijders group, and the postdoc will play a central role in this collaboration. Below are some specific issues to be addressed, but others will be added as they arise.

One issue that will be addressed in this collaboration regards the operationalization of combined influence effects of multiple friends. In the current version of SIENA, estimates of multiple friends' influences on adolescent problem behaviors are based on the *average* effect of adolescent friends, thereby ignoring the possible *interaction* effects between different friends' problem behaviors on adolescent problem behaviors. Thus, possibilities need to be created in SIENA where interactions between friends' influences can be modeled. As these effects have never before been modeled, our datasets will be highly useful to explore this type of modeling. Our findings will be reported back to the developers of SIENA, so that necessary adjustments in the software can be made. Thus, this collaboration will result in the development of techniques to test combined influences of multiple friends.

A second issue we will address is the operationalization of effect sizes in SIENA. Within the framework of SIENA, several different *types* of effects are estimated simultaneously. Because these effects can be considered qualitatively different, this has resulted in unstandardized effect sizes, which makes it hard to compare the relative importance of effect sizes. For this specific project as well as future applications of SIENA, this comparison of different effect sizes is often one of the central research questions. For example, in our project, we want to compare the effect of online friends' bullying with those of offline friends' bullying on subsequent adolescent bullying. Together with Snijders, we will develop and test standardized effect sizes with the data at hand.

*Collaboration with the Finnish team (Contribution 4).* We will also start collaborating with the Finnish team. As in our project, the Finnish team has independent reports on bullying and victimization of youths and their friends in school classrooms, thereby allowing for studying the role of selection and influence processes in these behaviors. Our data and data of the Finnish team will complement each other in at least two ways. In the Finnish project, mutual antipathies and perceived popularity are measured in addition to friendships. This allows for examining the relative and combined importance of different types of relationships in bullying and victimization. In our data, the larger peer networks are captured, including friends inside school, outside school, and online. Therefore, our data can provide more insight into bullying and victimization across different contexts and the roles of friends in influencing bullying behavior. In sum, our collaboration with the Finnish team will allow us to compare and integrate findings concerning the roles of different types of relationships in bullying across different contexts.

## Work plan

Funding will primarily go to support Dr. Maarten Van Zalk-Selfhout as a postdoctoral researcher. As shown by his CV, Van Zalk-Selfhout is an excellent fit to the requirements of this research project. He is already well acquainted with the 10-to-18 and 7-Schools databases and is a co-investigator in the Online-Offline study. His main task from the beginning of the project will be to pursue the aims and objectives of this proposal—writing and publishing empirical studies and engaging in the collaborative work. He will also play an active role in international conferences and workshops regarding research on friends and social network analyses, including the meetings of this network.

## Planned outputs

The studies written on the issues outlined above will be reported in high impact, peer-reviewed international journals. As shown by the prior publications of Van Zalk-Selfhout, findings with the social network technique can be published in journals with the highest impact within the field of Psychology. Findings from the collaboration will be reported at international conferences, such as the Society for Research on Child Development, Society for Research on Adolescents. Professors Stattin and Kerr will continue to host symposia on these issues. Furthermore, Dr. Van Zalk-Selfhout will continue to organize international workshops regarding social network analysis.

## Justification of funding requested

Funding is required for a 0.8 postdoctoral researcher during 4 years and travels for team member to attend network meetings and present the research at conferences. The work of the other team members will be financed by other sources. The postdoc will use the most recent developments in social network methodology present in order to study the research issues mentioned above. Regarding the collaboration, the postdoc will have regular meetings with Snijders and colleagues.

**Annexes** (including no more than 1 side of A4 for references and 2 sides of A4 for technical details, if appropriate). Insert brief CVs (no more than 1 side of A4) for each of the named researchers. CVs should include a list of no more than 10 relevant publications for each researcher.

- Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage Publications.
- Beran, T., & Li, Q. (2007). The relationship between cyberbullying and schoolbullying. *Journal of Student Wellbeing, 1*, 15-33.
- Bešić, N., Selfhout, M., Kerr, M., & Stattin, H. (2009). Shy Youths and Their Friends: Selection and Influence Processes Within Social Networks. *Manuscript resubmitted for publication in Journal of Personality*.
- Burk, W.J., Stattin, H., & Kerr, M. (2008). The co-evolution of early adolescent friendship networks, attitudes toward school, and delinquent behaviors. *Revue Française Sociologie, 49*, 499 - 522.
- East, P. L., & Rook, K. S. (1992). Compensatory patterns of support among children's peer relationships: A test using school friends, nonschool friends, and siblings. *Developmental Psychology, 28*, 163–172.
- Kerr, M., Stattin, H., & Kiesner, J. (2007). Peers and problem behavior: Have we missed something? In R. Engels, M. Kerr & H. Stattin (Eds.), *Friends, lovers, and groups: Who is important in adolescence and why?* (pp. 125–254). London: Wiley.
- Nyman, N., Bohlin, I., Serrano, C., Jacobson, E. (2009). *Se Mig: Unga om sex och Internet*. Stockholm: Ungdomsstyrelsen skriften.
- Wasserman, S., 1979. A stochastic model for directed graphs with transition rates determined by reciprocity. In: Schuessler, K.F. (Ed.), *Sociological Methodology 1980*, Jossey-Bass, San Francisco, pp. 392–412.

**BRIEF CV: MARGARET KERR****Positions & Functions**

- 2001- Professor, Örebro University, Sweden  
1998- Docent, Uppsala University, Sweden  
1995-97 Assistant Professor, Gannon University, U.S.A.  
1994-95 Postdoctoral Fellow: University of Montreal, Supervisor: Richard E. Tremblay  
1989-94 Ph.D. student: Cornell University, U.S.A., Supervisor: Daryl J. Bem

**Awards**

- 2004 Roberta Grodberg Simmons Prize Lecture, Society for Research on Adolescence (with H. Stattin)  
2003 Excellent Researcher Award, Swedish Research Council  
1990-94 Jacob K. Javits Graduate Fellowship, U.S. Department of Education  
1989-90 Sage Graduate Fellowship, Cornell University

**Main Editorial Functions**

- Associate editor for *Journal of Research on Adolescence*  
National editor for *Scandinavian Journal of Psychology*  
Co-editor for 2 special issues of *Journal of Adolescence*  
Frequent reviewer for *Developmental Psychology*, *Child Development*, *British Journal of Development*, *International Journal of Behavioral Development*, *Emotion*, *Scandinavian Journal of Psychology*, *Journal of Child Psychology and Psychiatry*

**Research Grants, Project Funding (past 5 years)**

- 2002-2006 "Hot Topics' In Developmental Research: A Conference Series to Facilitate Swedish-International Education and Research Cooperation," STINT, 1,600,000 SEK  
2004-2006 "Continuation of a longitudinal study: How are young criminals made?" Swedish Research Council, 1,860,000 SEK  
2004-2005 "Excellent researcher," Swedish Research Council, 1,300,000 SEK  
2006-2008 "Beyond parenting: Toward a general model of reciprocal parent-child relationships," Bank of Sweden Tercentenary Foundation, 2,100,000 SEK  
2009-2011 "Social networks of peers in adolescence and the development of adolescent problem behavior," Swedish Research Council, 1,284,000 SEK  
2010-2012 "ONLINE vs. OFFLINE WORLDS," Swedish Research Council, 1,095,000 SEK

**Key Publications**

- Van Zalk-Selfhout, M., Kerr, M., Branje, S., Stattin, H., & Meeus, W. (in press). It takes three: Selection, influence, and de-selection processes of depression in adolescent friendship networks. *Developmental Psychology*.
- Kerr, M., Stattin, H., & Burk, W. J. (in press). A reinterpretation of parental monitoring in longitudinal perspective. *Journal of Research on Adolescence*.
- Bešić, N. & Kerr, M. (2009). Punks, Goths, and other eye-catching peer crowds: Do they fulfill a function for shy youths? *Journal of Research on Adolescence*, 19, 113 – 121.
- Stattin, H. & Kerr, M. (2009). Neighborhood contexts of peer relationships and groups. In K. H. Rubin, W. Bukowski, & B. Laursen (Eds.). *Handbook of peer relationships. Peer interactions and groups*, (Ch. 23, pp. 414 – 431). New York: Wiley.
- Burk, W.J., Stattin, H., & Kerr, M. (2008). The co-evolution of early adolescent friendship networks, attitudes toward school, and delinquent behaviors. *Revue Française Sociologie*, 49, 499 - 522.
- Muñoz, L. C., Kerr, M., & Bešić, N. (2008). A matter of perspective: The peer relationships of youths with psychopathic personality traits. *Criminal Justice & Behavior*, 35, 212-227.
- Persson, A., Kerr, M., & Stattin, H. (2007). Staying in or moving away from structured activities: explanations involving parents and peers. *Developmental Psychology*, 43, 197-207.
- Kerr, M., Stattin, H., & Kiesner, J. (2007). Peers and problem behavior: Have we missed something? In R. C. M. E. Engels, M. Kerr, & H. Stattin (Ed.) *Friends, Lovers, and Groups: Key Relationships in Adolescence* (pp. 125 – 153) London: Wiley.
- Kiesner, J., Kerr, M., & Stattin, H. (2004). "Very Important Persons" In Adolescence: Going Beyond In-School, Single Friendships in the Study of Peer Homophily. *Journal of Adolescence*, 27, 545 – 560.
- Kerr, M., Stattin, H., Biesecker, G., & Ferrer-Wreder, L. (2003). Relationships with parents and peers in adolescence. In R. M. Lerner, M. A. Easterbrooks, J. Mistry (Eds.) *Comprehensive Handbook of Psychology (Volume 6: Developmental Psychology)* (pp. 395-422). Hoboken, NJ: John Wiley & Sons.

## **BRIEF CV: HÅKAN STATTIN**

### **Positions**

- 1995 Professor, Uppsala and Örebro University  
1988 Docent, Stockholm University  
1983 Ph.D. in psychology, Stockholm University

### **International Positions**

- 1989 Founding member of the European Association for Research on Adolescence (EARA). Elected member of the EARA organizing committee in 1990 and the executive committee 1992.  
2002-2004 President of EARA.  
2004 - Acquired funding and organized international summer schools for the Society for Research on Adolescence (SRA) and the European Association for Research on Adolescence (EARA): Marbach, Germany (2004); Antalya, Turkey (2006); Torino, Italy (2008), Vancouver, Canada (2009); Örebro, Sweden (2010); a North American location (2011). The SRA/EARA Summer Schools are the flagship doctoral training of the two organizations.  
2006-2010 At the Executive Council of the Society for Research on Adolescence (SRA), and Chairman of the International Committee of SRA  
2009 Swedish government expert in prevention research (Brussels, 2009)

### **Honors & Awards**

- Roberta Grodberg Simmons Prize Lecture, Society for Research on Adolescence, 2004  
Thompson Publisher Prize for two of the three studies among the 1% most highly cited studies in developmental psychology since 2000, received in 2005.

### **Research Grants**

- 2005 - External funding of 72 774,000 SEK for 12 research projects from Vetenskapsrådet, FAS, Riksbankens Jubileumsfond, EU, Sparbanksstiftelsen, and Socialstyrelsen

### **Main Editorial Functions**

- 1999-2002 Associate editor for *British Journal of Developmental Psychology*  
1999- Editorial board of the *International Journal of Behavioral Development*.  
2004- Associate editor for *Criminal Behaviour and Mental Health*  
2005- International Advisory Board of *European Journal of Criminology*

### **Key Publications**

- Van Zalk-Selfhout, M., Kerr, M., Branje, S., Stattin, H., & Meeus, W. (in press). It takes three: Selection, influence, and de-selection processes of depression in adolescent friendship networks. *Developmental Psychology*.  
Kerr, M., Stattin, H., & Burk, W. J. (in press). A reinterpretation of parental monitoring in longitudinal perspective. *Journal of Research on Adolescence*.  
Stattin, H., Persson, S., Burk, W. J., & Kerr, M. (in press). Adolescents' perceptions of the democratic functioning in their families. *European Psychologist*.  
Koutakis, N., Stattin, H., & Kerr, M. (2008). Reducing youth alcohol drinking through a parent-targeted intervention: the Örebro Prevention Program. *Addiction*, 103, 1629-1637.  
Magnusson, D., & Stattin, H. (2006). The person in the environment: Towards a general model for scientific inquiry. In R. M. Lerner (Ed.), *Theoretical models of human development. Volume 1 of Handbook of Child Psychology* (6th ed.). (pp. 400-464). New York: Wiley.  
Ferrer-Wreder, L., Stattin, H., Lorente, C. C., Tubman, J. G., & Adamson, L. (2004). *Successful Prevention and Youth Development Programs*. New York: Kluwer Academic / Plenum Publishers.  
Kerr, M. & Stattin, H. (2003). Parenting of adolescents: Action or reaction? In A. C. Crouter & A. Booth (Eds.), *Children's influence on family dynamics: The neglected side of family relationships*. (pp. 121-152). Mahwah: New Jersey: Lawrence Erlbaum.  
Kerr, M., Stattin, H., Biesecker, G., & Ferrer-Wreder, L. (2003). Relationships with parents and peers in adolescence. In R. M. Lerner, M. A. Easterbrooks, J. Mistry (Eds.) *Handbook of Psychology (Volume 6: Developmental Psychology)* (pp. 395-422). Hoboken, NJ: John Wiley & Sons.  
Kerr, M., & Stattin, H. (2000). What parents know, how they know it, and several forms of adolescent adjustment: Further evidence for a reinterpretation of monitoring. *Developmental Psychology*, 36, 366-380.  
Stattin, H., & Kerr, M. (2000). Parental monitoring: A reinterpretation. *Child Development*, 71, 1070-1083.

## **BRIEF CV: MAARTEN VAN ZALK-SELFHOUT**

### **Positions**

2009 Postdoctoral researcher, Örebro University, Sweden

2005 University teacher, Utrecht University, the Netherlands

### **Education**

Ph.D. (Honors): Utrecht University, Research Centre Adolescent Development, 2009

M.A. (Honors): Utrecht University, Developmental Psychology, the Netherlands, 2005 9.0/10.0 GPA

### **Honors & Awards**

Best National Dissertation, Institute for the Study and Education of Human Development, the Netherlands, 2009

Best International Article, Institute for the Study and Education of Human Development, the Netherlands, 2008

Best National Article, Institute for the Study and Education of Human Development, the Netherlands, 2007

International Travel Award, The Netherlands Organization for Scientific Research, 2005

### **Key Publications**

- (1) Van Zalk-Selfhout, M., Branje, S., Kerr, M., Stattin, H., & Meeus (in press). It Takes Three: Selection, Influence, and De-selection Processes of Depression in Adolescent Friend Networks. *Developmental Psychology*.
- (2) Van Zalk-Selfhout, M., Burk, W., Branje, S., Denissen, J. J. A., Van Aken, M. A. G., & Meeus, W. (in press). Emerging late adolescent friendship networks and Big Five personality traits: A dynamic social network perspective. *Journal of Personality*.
- (3) Selfhout, M., Denissen, J., Branje, S., & Meeus, W. (2009). In the eye of the beholder: Perceived, actual, and friend-rated similarity in personality, communication, and friendship intensity during the acquaintanceship process. *Journal of Personality and Social Psychology*, *96*, 1152-1165.
- (4) Selfhout, M., Branje, S., Ter Bogt, T., Delsing, M., & Meeus, W. (2009). Different types of Internet use, depression, and social anxiety: The role of perceived friendship quality. *Journal of Adolescence*, *32*, 819-833.
- (5) Selfhout, M., Branje, S., & Meeus, W. (2009). Developmental trajectories of perceived friendship intimacy, constructive problem solving, and depression from early to late adolescence. *Journal of Abnormal Child Psychology*, *37*, 251-264.
- (6) Selfhout, M., Branje, S., Ter Bogt, T., & Meeus, W. (2009). The role of music preferences in the formation and stability of friend relationships. *Journal of Adolescence*, *32*, 95-107.
- (7) Selfhout, M., Branje, S., & Meeus, W. (2008). The development of delinquency and perceived friendship quality in friendship dyads. *Journal of Abnormal Child Psychology*, *36*, 471-485.
- (8) Selfhout, M., Delsing, M., Meeus, W., & Ter Bogt, T. (2008). Heavy metal and hip-hop style preferences and externalizing problem behavior: A two-wave longitudinal study. *Youth & Society*, *39*, 435-452.
- (9) Denissen, J., Geenen, R., Selfhout, M., & Van Aken, M. (2008). Single-item Big Five ratings in a social network design. *European Journal of Personality*, *22*, 37-54.
- (10) Selfhout, M., Branje, S., Raaijmakers, Q., & Meeus, W. (2007). Similarity in adolescent friend relationships: the role of gender. *Netherlands Journal of Psychology*, *63*, 50-57.

<b>COUNTRY CONTRIBUTION 4</b> <i>Bullying networks across classrooms</i>	<b>Principal Investigator:</b> Christina Salmivalli
	<b>Country:</b> Finland
	<b>ECRP Funding Organisation:</b> The Academy of Finland
<b>6.1 Financial summary for Country Contribution 4</b>  The Principal Investigator should provide below a summary of the financial support sought from his/her national ECRP Funding Organisation.  Full financial details and any other supplementary information required by your national ECRP Funding Organisation should be supplied to them as instructed.	
	<b>TOTAL (EUROS)</b>
<b>6.1.1 Staff</b> (specify how many positions are sought) 1 post-doc, 46 months (March 2011-December 2014)	<b>107 855</b>
<b>6.1.2 Travel and subsistence</b>	<b>9 600</b>
<b>6.1.3 Consumables</b>	
<b>6.1.4 Other items</b>	
<b>6.1.5 Overheads and other allowable costs</b>	<b>169 742</b>
<b>6.1.6 GRAND TOTAL FOR INDIVIDUAL COUNTRY CONTRIBUTION 4</b>	<b>287 197</b>

**Note.** The funding applied from the Academy of Finland is 287 197 euros. The overall funding of the country contribution is 358 996 eur, of which the University of Turku covers 20%, i.e. 71 799 euros.

## 6.2 Description of Country Contribution 4

### 6.2.1 Describe the specific competence and expertise of your country team with regard to the overall collaboration.

The Finnish team consists of Professor Christina Salmivalli (University of Turku), Professor René Veenstra (University of Groningen, visiting professor at the University of Turku) and PhD Noona Kiuru (University of Jyväskylä).

Professor Christina Salmivalli is an internationally recognized scholar in the field of children's peer relations, especially bullying and victimization among peers at school. She is currently the leader of the KiVa intervention project funded by the Finnish Ministry of Education and the head of the National Graduate School of Psychology in Finland. She has been leading four research projects funded by the Academy of Finland (1999-2003, 2003-2006, 2008-2011, and 2010-2013). She has published numerous well-cited peer-reviewed research articles, many of them in top-tier journals, and numerous chapters in edited volumes.

Professor René Veenstra has been collaborating with the KiVa project since its beginning. He has published on a variety of topics (bullying and victimization, prosocial and antisocial behavior, social network analysis, temperament-by-environment interactions) in major scientific journals including *Child Development*, *Developmental Psychology*, *International Journal of Behavioral Development*, and *Journal of Research on Adolescence*. His work has been widely cited in the last five years (300 citations). He is Associate Editor of the *Journal of Research on Adolescence* for the period 2010-2015. Together with Christian Steglich (University of Groningen) he has written a chapter for the forthcoming *Handbook of Developmental Research Methods* (editors: Brett Laursen, Todd D. Little, & Noel A. Card) on "Actor-Based Models for Network and Behavior Dynamics."

Noona Kiuru received her PhD in April 2008. In addition, she has a degree of M.A of Science (statistics as main subject). She currently works at the University of Jyväskylä as a post-doctoral researcher funded by the Academy of Finland. A central focus of her post-doctoral work is an investigation of peer network processes by using process-oriented and dynamic research methodologies, such as Siena program (Snijders et al., 2007).

## 6.2.2 Describe thoroughly your country team's contribution to the overall work plan,

The Finnish Ministry of Education has funded the development and initial evaluation of a new bullying intervention program, KiVa Koulu (2006–2009). The initial evaluation of KiVa included the main effects of the program after five and ten months of program implementation. The results have so far been a remarkable success. According to the meta-analysis by Ttofi et al. (2008), KiVa seems to be the most effective intervention program evaluated with a stringent randomized control design, reducing both victimization and bullying significantly. The first article based on the results (Kärnä et al., 2008) is forthcoming in *Child Development*, one of the leading journals in developmental psychology.

The proposed project will utilize the longitudinal network data collected in the context of the evaluation of the KiVa program. The data is unique in the world, involving more than 30 000 students (grades 1–9) from over 1000 classes in 234 schools representing all five provinces in the mainland Finland. During the evaluation study, the schools were randomly assigned to intervention (117 schools) and control (117 schools) conditions. KiVa data includes three assessment points during a one-year period: the pre-test, the evaluation after five months of intervention, and the evaluation after ten months of the intervention. Most importantly for the present project, the questionnaire used involved dyadic questions about bullying and being bullied, about support and defending relationships during bullying incidents, about most and least liked classmates, and about most popular classmates. Network data that can be derived from students' answers to these questions enables completely new research questions to be answered, both in bullying research in general and in the area of bullying interventions.

The proposed project will make important contributions to the overall project, to research on bullying, as well as to intervention research.

### *Contributions to the overall ECRP project*

We will contribute to the overall project by proposing (on the basis of our specific objectives) and testing new developments of the Siena program developed by the Snijders team (Snijders, 2001, 2005, 2009). In addition, we will collaborate closely with the Swedish team whose proposal comes content-wise close to the topics we are investigating. We are focusing on bullying/victimization in many schools, whereas the Swedish team is examining bullying both in and outside school (including the internet). The integration of findings from both projects will gain a better insight into bullying across diverse contexts.

### *Contributions to bullying research*

Bullying is a subtype of aggressive behaviour which includes 1) intent to harm, 2) repetition over time, and 3) a power differential, that is, the victim finds it difficult to defend him- or herself against the perpetrator. A key feature that differentiates bullying from conflicts, quarrels, or fights, is thus the imbalance of power between the perpetrator and the victim (Olweus, 1991; Salmivalli & Peets, 2009). Another key feature of bullying is that it is fundamentally a *relational phenomenon*. Rather than consisting of single aggressive attacks, bullying represents a rather stable relationship between children in the bully-victim -dyad (Veenstra et al., 2007), which is further embedded in a larger peer setting. Peers are usually present when bullying takes place (O'Connell et al., 1999). Some of the peer bystanders tend to provide reinforcement and social rewards to the bully, whereas others support and defend the victimized children (Salmivalli et al., 1996).

Although the group nature of bullying has been much discussed during the last decade (for a review, see Salmivalli, 2010), there has been a lack of powerful tools to examine empirically the social mechanisms involved in the emergence and maintenance of bullying. Multilevel modelling has enabled to investigate the impact of classroom- and peer clique level characteristics on bullying and victimization (e.g., Espelage et al., 2003; Kärnä et al., in press; Salmivalli & Voeten, 2004), and methods such as p2 have provided the possibility to analyze the characteristics of bully-victim dyads (Veenstra et al., 2007). However, new methods for analyzing *network data*, such as SIENA (Snijders et al., 2007, 2010) open up completely new avenues for research on bullying.

In addition to information gained by traditional research methods, network analyses enable to combine individual characteristics and network position of individuals to predict who bullies whom, to identify different types of classrooms based on the network dynamics of bullying, and to analyze changes in the networks over time. Network analyses also provide innovative ways to investigate the effects of bullying prevention/intervention programs which have so far mainly focused on the prevalence of bullies and victims before and after the intervention.

### *Contributions to intervention research*

As bullying constitutes a serious risk for the psychosocial development of both victims (Isaacs et al., 2008; Olweus, 1994; Salmivalli & Isaacs, 2005) and bullies (Kaltiala-Heino et al., 2000; Nansel et al., 2004), there is a pressing need for effective interventions. During the past decades, numerous intervention programs have been developed to reduce bullying (for meta-analyses, see Ferguson et al., 2007; Smith et al., 2004; Ttofi et al., 2008; Vreeman & Carroll, 2007). At present, it seems that these programs can, at best, reduce bullying and victimization by 50% or more (Kärnä et al., in press; Olweus, 1991). However, most intervention evaluations have focused on the prevalence estimates of bullies and victims before and after the intervention(s), sometimes showing controversial patterns (for instance, the number of victims remains the same whereas the number of bullies seems to decrease, or vice versa). It is clear that not enough is known about the patterns and mechanisms of change during a successful intervention, and network analyses provide the possibility to get a more detailed view of what happens during a successful intervention, and whether some kinds of classrooms are more resistant to change than others.

An intervention might result, for instance, in a decrease of incoming bullying ties for some victims (i.e., the victims being bullied by fewer classmates), in a decrease of outgoing bullying ties (the number of children bullying their classmates being lower), or in an increase in defending ties, indicating that the victims, although still harassed by some classmates, get more support from the peer group. Furthermore, ties indicating affection (liking) might be more evenly distributed across actors in the network after a successful intervention.

In summary, there might be different types of positive intervention effects that have not been distinguished in previous research. Some of these effects might contribute to the well-being of victims as well other students in the school class more than others. Moreover, the likelihood of positive intervention effects might depend on the initial network position of the bullies and victims, or on the structural characteristics of the social networks at the classroom level.

### *Aims and objectives*

The Finnish project will focus on three topics: A) the balance and influence processes involved in bullying and defending, B) the impact of classroom-level network characteristics (bullying and defending networks, affiliation networks, antipathy networks) on the adjustment of victims and their perpetrators, and C) the effects of an extensive anti-bullying intervention on the bullying, defending, affiliation and popularity networks in classrooms. More specific research questions include the following:

#### A. Balance and influence processes involved in bullying and defending

A1. How do the bullies choose the victims they are targeting? We will be looking at the impact of victims' as well as bullies' individual characteristics (e.g., self-esteem), dyadic characteristics (e.g., power imbalance, mutual antipathy) and classroom characteristics (e.g., bullying-related norms) on their choice of targets. A question of special interest is whether liked peers have an impact on target selection, in other words, do children and adolescents become more similar over time with their liked peers with respect to their bullying behavior as well as their choice of targets? Furthermore, based on balance theory (Cartwright & Harary, 1956), we expect that intransitive relations – where bullies' choice of victims diverge – likely create emotional tensions, leading individuals to change their perceptions or relations in order to restore balance. In addition to the influence of affiliative ties, we will investigate whether there is an influence of popular classmates with respect to bullying behavior and target selection (e.g., student X starts to harass the victim who is already bullied by a classmate whom student X perceives as highly popular). Finally, our data enables to investigate the extent to which antipathies, identified by like least -nominations, have opposite effects, such as students starting to provide support to peers who are bullied by their least liked classmates.

A2. What are the individual, dyadic and network determinants of choosing the peers that one supports and defends? In analogy with the questions posed about bullies, we will examine whether children become increasingly similar with their liked classmates over time with respect to defending behavior (influence similarity) and with respect to choosing the victims they provide with support (similarity in outgoing ties). A further question is how the social network position of the bully (social acceptance, perceived popularity) influences the likelihood of the victim to get support.

#### B. The impact of classroom-level network characteristics on the adjustment of victims and bullies

B1. What kind of bullying networks appear across classrooms? Classrooms can be hypothesized to differ from each other at least with respect to two network parameters, namely, density (the number of bully-victim ties) and centrality (the degree to which bullying is targeted at specific victims). We will contribute to the work in this area (e.g., Huitsing et al., in review) by systematically searching for patterns enabling to classify classrooms on the basis of the density and centrality of multiple networks (e.g., bullying, defending, affection, antipathies).

B2. How do the above network characteristics influence the intrapersonal and interpersonal adjustment (including social network position) of the victims and bullies? We hypothesize that the network characteristics of classrooms influence the adjustment of victims, as well as the social status of the bullies. For instance, victims are likely to be more maladjusted (more depressed, lower self-esteem) in classrooms with a combination of high centrality of bullying networks and low density of defending networks.

B3. How is the victims' adjustment influenced by whether (s)he is bullied by a liked vs. a disliked classmate, and by the social status of the perpetrator (*social acceptance*, reflected in large number of like most-nominations, and *perceived popularity*, reflected in a large number of nominations for being popular)

### C. Intervention effects on bullying, defending, and friendship networks

C1. How are changes in the bullying, defending, and friendship networks over time influenced by an extensive anti-bullying program implemented in 50% of the classrooms involved in the KiVa data set? What kinds of changes are most likely to contribute to the well-being of the former victims in positive ways?

C2. How are changes in one network of interest (e.g., defending, affiliation, popularity) during the intervention reflected in changes in another network (e.g., bullying)?

C3. What kind of bullying networks are most resistant to change? Related to question B1 above, we will investigate whether the network characteristics of classrooms influence the likelihood of the intervention being successful in reducing bullying and victimization. This is important as it will provide educators insight into kinds of classrooms where extra efforts are likely to be needed when intervening bullying.

### *Work plan*

The post-doc position will be announced internationally and the chosen post-doc researcher (preferably already familiar with Siena methodology) will start in the project in March, 2011. Under the supervision of the senior researchers in the group, (s)he will start the first analyses during 2011 and submits the first research article within a year. The other researchers in the team include Professor Christina Salmivalli, Professor René Veenstra, and PhD Noona Kiuru.

Table 1. The preliminary work plan

Study	Data	Writing &	Revising,	Responsible
	analysissubmitting	resubmitting	researchers	
	papers	papers		
Studies A1-A2	2011	2011–2012	2013	N.N.; Kiuru
Studies B1-B3	2011-2012	2012–2013	2013	N.N.;Veenstra
Studies C1-C3	2012-2013	2012–2014	2014	N.N.,Salmivalli

*Note.* N.N. = the post-doctoral researcher recruited to the project.

### Planned outputs.

So far network data has rarely been utilized in bullying research, and it has never before been used in intervention studies. The studies will thus contribute to the understanding of the classroom dynamics involved in bullying and the changes taking place during a successful intervention. The findings from the proposed studies will be reported in top-tier international journals and in scientific conferences. Besides scientific contributions, substantial practical value from the project will be expected, as the

findings will enable developing new (classroom-level) diagnostic tools for school personnel, based on the bullying-related networks in classrooms, and will help school personnel finding more effective ways to tackle bully-victim problems in schools.

**6.2.3 Justify the funding requested (including time commitments for all team members).**

Funding is required for one post-doctoral researcher for the period of four years. The postdoc will utilize the Siena program to examine the research questions presented above, in collaboration with other members of the Finnish team and in the Collaborative Research Project. The senior researchers will contribute 10-20 % of their total working time to the project.

**6.2.4. Annexes**

## References

- Burk, W. J., Steglich, C. E. G., & Snijders, T. A. B. (2007). Beyond dyadic interdependence: Actor-oriented models for co-evolving social networks and individual behaviours. *International Journal of Behavioral Development, 31*, 397-404.
- Cartwright, D., & Harary, F. (1956). Structural balance: a generalization of Heider's theory. *Psychological Review, 63*, 277-293
- Ferguson, C., San Miguel, C., Kilburn, J., & Sanchez, P. (2007). The effectiveness of school-based anti-bullying programs: A meta-analytic review. *Criminal Justice Review, 32*, 401-414.
- Isaacs, J., Hodges, E., & Salmivalli, C. (2008). Long-term consequences of victimization: A follow-up from adolescence to young adulthood. *European Journal of Developmental Science, 2*, 387-397.
- Kaltiala-Heino, R., Rimpelä, M., Rantanen, P., & Rimpelä, A. (2000). Bullying at school — an indicator of adolescents at risk for mental disorders. *Journal of Adolescence, 23*, 661-674.
- Kärnä, A., Voeten, M., Little, T., Poskiparta, E., Kaljonen, A., & Salmivalli, C. (in press). A large-scale evaluation of the KiVa anti-bullying program. *Child Development*.
- Nansel, T. R., Craig, W., Overpeck, M. D., Saluja, G., Ruan, W. J., & the Health Behavior in School-Aged Children Bullying Analyses Working Group. (2004). Cross-national consistency in the relationship between bullying behaviors and psychosocial adjustment. *Archives of Pediatrics & Adolescent Medicine, 158*, 730-736.
- Olweus, D. (1991). Bully/victim problems among schoolchildren: Basic facts and effects of a school-based intervention program. In D. Pepler & K. Rubin (Eds.), *The development and treatment of childhood aggression* (pp. 411-448). Hillsdale, NJ: Erlbaum.
- Olweus, D. (1994). Bullying at school: Long-term outcomes for the victims and an effective school-based intervention program. In L. R. Huesmann (Ed.), *Aggressive behavior: Current perspectives*. (pp. 97-130). New York: Plenum Press.
- Salmivalli, C., & Isaacs, J. (2005). Prospective relations among victimization, rejection, friendlessness, and children's self- and peer-perceptions. *Child Development, 76*, 1161-1171.
- Salmivalli, C., & Peets, K. (2008). Bullies, victims, and bully-victim relationships. In K. Rubin, W. Bukowski, & B. Laursen (Eds.), *Handbook of Peer Interactions, Relationships, and Groups*. Guilford Press, pp. 322-340.
- Smith, J. D., Schneider, B. H., Smith, P. K., & Ananiadou, K. (2004). The effectiveness of whole-school antibullying programs: A synthesis of evaluation research. *School Psychology Review, 33*, 547-560.
- Snijders, T. A. B. (2001). The statistical evaluation of social network dynamics. In M. E. Sobel & M. P. Becker (Eds.), *Sociological Methodology - 2001* (pp. 361-395), Boston: Basil Blackwell.
- Snijders, T. A. B. (2005). Models for longitudinal network data. In P. Carrington, J. Scott, & S. Wasserman (Eds.), *Models and Methods in Social Network Analysis*. New York: Cambridge University Press.
- Snijders, T. A. B. (2009). Analyzing the joint dynamics of several networks. Presentation at the XXIX Sunbelt Social Networks Conference, San Diego, March 10, 2009.
- Snijders, T. A. B. (2009). [Longitudinal Methods of Network Analysis](#). In B. Meyers (Ed.). In [Encyclopedia of Complexity and System Science](#), part of the *Social Networks* section (section Ed. J. Scott) (pp. 5998-6013). Verlag: Springer.
- Snijders, T. A. B., Baerveldt, C. (2003). A multi-level study of the effects of delinquent behavior on friendship evolution. *Journal of Mathematical Sociology, 27*, 123-151.
- Snijders, T. A. B., Steglich, C. E. G., Schweinberger, M. & Huisman, M. (2007). Manual for SIENA version 3.1. University of Groningen & University of Oxford, Netherlands and UK.
- Snijders, T.A.B., Steglich, C.E.G., and van de Bunt, G.G. (2010). Introduction to actor-based models for network dynamics. *Social Networks, 32*, 44-60.
- Steglich, C., Snijders, T. A. B., & Pearson, M. (in press). Dynamic networks and behavior: Separating selection from influence. *Sociological Methodology*.
- Ttöfi, M., Farrington, D.P., & Baldry, A.C. (2008). *Effectiveness of programmes to reduce school bullying: A systematic review*. The Swedish National Council for Crime Prevention. Västerås: Edita Norstedts.
- Veenstra, R., Lindenberg, S., Oldehinkel, A. J., De Winter, A. F., Verhulst, F. C., & Ormel, J. (2005). Bullying and victimization in elementary schools: A comparison of bullies, victims, Bully/Victims, and uninvolved preadolescents. *Developmental Psychology, 41*, 672-682.
- Vreeman, R. C., & Carroll, A. E. (2007). A systematic review of school-based interventions to prevent bullying. *Archives of Pediatrics & Adolescent Medicine, 161* 78-88.

**Short Curriculum Vitae: Christina Salmivalli (born 1967)**

**Academic Positions and Functions**

- 1995 Doctoral student, National Graduate School of Psychology
- 1999 Post-doctoral research fellow of the Academy of Finland
- 2002 Acting assistant professor, University of Turku
- 2003 Academy of Finland Research Fellow at the University of Turku
- 2003 Professor-II at the University of Stavanger (ongoing)
- 2004 Professor of Psychology at the University of Turku (ongoing)
- 2006 Leader of the KiVa Intervention Project (ongoing)

**Awards**

- 1998 Award for an outstanding doctoral thesis, The Finnish Academy of Sciences
- 2003 National Award for Dissemination of Knowledge
- 2008 The Humanist Act of the Year, University of Turku; Award to the KiVa program
- 2009 Psychologist of the year in Finland
- 2009 European Crime Prevention Award to the KiVa program

**Research Grants, Project Funding (past 5 years)**

- 2003-2006 Project "Relational schemas, social goals, and social behavior in childhood and in adolescence", Academy of Finland, 262 500 eur
- 2006-2009 KiVa Koulu -project, the Finnish Ministry of Education, 1,9 million eur.
- 2009-2010 KiVa Koulu -project, the Finnish Ministry of Education, 2,6 million eur.
- 2008-2011 Project "Aggressive and prosocial behavior: Considering the contexts in which they occur", 377 000 eur
- 2010-2013 Project "School Bullying: Intervention Effects and Their Mechanisms at the Individual, Dyadic, Classroom, and School Levels", 420 000 eur

**Main Editorial Functions**

Editorial Board, *European Journal of Developmental Science*; Consulting Editor, *Aggressive Behavior*; Frequent ad hoc reviewer for *Child Development*, *Developmental Psychology*, *International Journal of Behavioral Development*, *Merrill-Palmer Quarterly*, *Social Development*, etc.

**Key Publications**

- Salmivalli, C., Lagerspetz, K., Björkqvist, K., Österman, K. & Kaukiainen, A. (1996). Bullying as a Group Process: Participant Roles and Their Relations to Social Status within the Group. *Aggressive Behavior*, 22, 1-15.
- Salmivalli, C., & Voeten, M. (2004). Connections between attitudes, group norms, and behaviors associated with bullying in schools. *International Journal of Behavioral Development*, 28,246-258.
- Salmivalli, C., Ojanen, T., Haanpää, J., & Peets, K. (2005). "I'm O.K. but you're not" and other peer-relational schemas. Explaining individual differences in children's social goals. *Developmental Psychology*, 41, 363-375.
- Salmivalli, C., & Isaacs, J. (2005). Prospective relations among victimization, rejection, friendlessness, and children's self- and peer-perceptions. *Child Development*, 76, 1161-1171.
- Peets, K., Hodges, E., Kikas, E., & Salmivalli, C. (2007). Hostile attributions and behavioral strategies in children: Does relationship type matter? *Developmental Psychology*, 43, 889-900.
- Peets, K., Hodges, E., & Salmivalli, C. (2008). Affect-congruent social-cognitive evaluations and behaviors. *Child Development*, 79, 170-185.
- Kärnä, A., Voeten, M., Poskiparta, E., & Salmivalli, C. (2010). Vulnerable children in varying classroom contexts: Bystanders' behaviors moderate the effects of risk factors on victimization. *Merrill-Palmer Quarterly*.
- Kärnä, A., Voeten, M., Little, T., Poskiparta, E., Kaljonen, A., & Salmivalli, C. (in press). A large-scale evaluation of the KiVa anti-bullying program. *Child Development*.
- Salmivalli, C., & Peets, K. (2008). Bullies, victims, and bully-victim relationships. In K. Rubin, W. Bukowski, & B. Laursen (Eds.), *Handbook of Peer Interactions, Relationships, and Groups*. Guilford Press, pp. 322-340.
- Salmivalli, C., Kärnä, A., & Poskiparta, E. (2009). From peer putdowns to peer support: A theoretical model and how it translated into a national anti-bullying program. In S. R. Jimerson, S. M. Swearer, & D. L. Espelage (Eds.). *Handbook of Bullying in Schools: An International Perspective* (pp. 441-454). New York: Routledge.

## Short Curriculum Vitae: René Veenstra (born 1969)

### Academic Positions and Functions

1994 – 1999	PhD Student
1997 – 1999	Lecturer (fixed-term, 0.3 fte)
1999	Educational researcher for OECD-project (fixed-term, 0.7 fte)
2000 – 2005	Data manager TRAILS, Social Psychiatry, University Medical Center Groningen (fixed-term, 0.5 fte)
2000 – 2005	Postdoc, Sociology, University of Groningen (fixed-term, 0.5 fte)
2001 – now	Member of Research School ICS, Interuniversity Center for Social Science Theory and Methodology
2005 – 2007	Assistant Professor, Sociology, University of Groningen (tenured, 1.0 fte)
2007 – now	Visiting Professor, Psychology, University of Turku, Finland
2008 – now	Associate Professor, Sociology, University of Groningen (tenured, 1.0 fte)
2009 – now	Member of Management Team TRAILS

### Research Grants, Project Funding (past 5 years)

2004-2008	Project "Does it run in the family? Dysfunctional families and problematic behavior of adolescents and emerging adults." NWO (Dutch Scientific Organization) € 162.500.
2008-2012	Project "Targeting the group? A social network perspective on bullying." NWO (Dutch Scientific Organization) € 180.000.

### Main Editorial Functions

Associate Editor, *Journal of Research on Adolescence*; Frequent ad hoc reviewer for various journals, including *Child Development*, *International Journal of Behavioral Development*; *Journal of Abnormal Child Psychology*, *Social Networks*, *Sociology of Education*.

### Key Publications

- Veenstra, R., Lindenberg, S., Oldehinkel, A. J., De Winter, A. F., Verhulst, F. C., & Ormel, J. (2005). Bullying and victimization in elementary schools: A comparison of bullies, victims, bully/victims, and uninvolved preadolescents. *Developmental Psychology*, *41*, 672-682.
- Veenstra, R., Lindenberg, S., Oldehinkel, A. J., De Winter, A. F., & Ormel, J. (2006). Temperament, environment, and antisocial behavior in a population sample of preadolescent boys and girls. *International Journal of Behavioral Development*, *30*, 422-432.
- Veenstra, R., Lindenberg, S., Zijlstra, B. J. H., De Winter, A. F., Verhulst, F. C., & Ormel, J. (2007). The dyadic nature of bullying and victimization: Testing a dual-perspective theory. *Child Development*, *78*, 1843-1854.
- Dijkstra, J. K., Lindenberg, S., & Veenstra, R. (2007). Same-gender and cross-gender peer acceptance and peer rejection and their relation to bullying and helping among preadolescents: Comparing predictions from gender-homophily and goal-framing approaches. *Developmental Psychology*, *43*, 1377-1389.
- Sentse, M., Veenstra, R., Lindenberg, S., Verhulst, F. C., & Ormel, J. (2009). Buffers and risks in temperament and family for early adolescent psychopathology: Generic, conditional, or domain-specific effects? *Developmental Psychology*, *45*, 419-430.
- Veenstra, R., Lindenberg, S., Verhulst, F. C., & Ormel, J. (2009). Childhood-limited versus persistent antisocial behavior: Why do some recover and others do not? *Journal of Early Adolescence*, *29*, 718-742.
- Veenstra, R., Lindenberg, S., Munniksma, A., & Dijkstra, J. K. (2010). The complex relation between bullying, victimization, acceptance, and rejection: Giving special attention to status, affection, and sex differences. *Child Development*, *81*, 510-516.
- Dijkstra, J. K., Lindenberg, S., Veenstra, R., Steglich, C., Isaacs, J., Card, N. A. & Hodges, E. V. E. (2010). Influence and selection processes in weapon carrying during adolescence: The roles of status, aggression, and vulnerability. *Criminology*, *48*, 187-220.
- Sijtsema, J. J., Veenstra, R., Lindenberg, S., Van Roon, A. M., Verhulst, F. C., Ormel, J., & Riese, H. (2010). Mediation of sensation seeking and behavioral inhibition on the longitudinal relationship between heart rate and antisocial behavior. The TRAILS Study. *Journal of the American Academy of Child and Adolescent Psychiatry* (in press).
- Veenstra, R. & Steglich, C. E. G. (2011). Actor-Based Models for Network and Behavior Dynamics: A Tool to Examine Selection and Influence Processes. In B. Laursen, T. D. Little, & N. A. Card (eds.), *Handbook of Developmental Research Methods*. New York: Guilford (forthcoming).

## Short Curriculum Vitae: Noona Kiuru (born 1979)

### Academic Degrees

- 31.5.1998 Matriculation examination, Etelä-Tapiolan lukio, Espoo  
11.12.2003 M.A of Psychology, Department of Psychology, University of Jyväskylä  
28.12.2007 M.A of Science (statistics as main subject), Department of Mathematics and Statistics  
10.4.2008 ph.D of Psychology, Department of Psychology, University of Jyväskylä

### Academic Positions and Functions

- 1.1.2004-31.7.2007 PhD student (ph.D Degree 10<sup>th</sup> April, 2008)  
1.8.2007-31.7.2009 Assistant professor, University of Jyväskylä  
1.8.2009-31.12.2009 Post-doctoral researcher, Center of Excellence for Learning and Motivation Research  
1.1.2010-31.12.2010 Post-doctoral researcher, Academy of Finland

### Personal Research Grants, Project Funding (past 5 years)

- 1.7.2005-30.6.2006 Grant from Finnish cultural foundation for ph.D work (16000 eur)  
1.7.2006-31.7.2007 Doctoral student position in National Graduate School of Psychology  
1.1.2010-31.12.2012 Post-doctoral research project funded by Academy of Finland "Examining the development of academic performance and adaptation in the context of interpersonal relations: Peers, parents, and teachers" (256 410 eur)

### Key Publications

- Kiuru, N., Aunola K., Vuori, J., & Nurmi, J.-E. (2007). The role of peer groups in adolescents' educational expectations and adjustment. *Journal of Youth and Adolescence*, 36, 995-1009.
- Kiuru, N., Burk, W., Laursen, B., Salmela-Aro, K., & Nurmi, J.-E. (accepted with minor revisions). Pressure to drink but not to smoking: Disentangling selection and socialization in adolescent peer networks and peer groups. *Journal of Adolescence*.
- Kiuru, N., Aunola, K., Nurmi, J.-E., Leskinen, E., & Salmela-Aro, K. (2008). Peer group influence and selection in adolescents' school burnout: A longitudinal study. *Merrill-Palmer Quarterly*, 54, 23-55.
- Kiuru, N., Koivisto, P., Mutanen, P., Vuori, J., & Nurmi, J.-E., (in press). How do efforts to enhance career preparation affect peer groups? *Journal of Research on Adolescence*.
- Kiuru, N., Nurmi, J.-E., Aunola, K., & Salmela-Aro, K. (2009). Peer group homogeneity in adolescents' school adjustment varies according to peer group type and gender. *International Journal of Behavioral Development*, 33, 65-76.
- Laursen, B., Bukowski, W. M., Nurmi, J.-E., Marion, D., Salmela-Aro, K., & Kiuru, N. (in press). Opposites detract: Middle school peer group antipathies. *Journal of Experimental Child Psychology*.
- Pakarinen, E., Lerkkanen, M.-K., Poikkeus, A.-M., Kiuru, N., Siekkinen, M., Rasku-Puttonen, H., & Nurmi, J.-E. (2010). A validation of the classroom assessment -scoring system in Finnish kindergartens. *Early Education and Development*, 21, 95-124.
- Pakarinen, P., Kiuru, N., Lerkkanen, M.-K., Poikkeus, A.-M., Siekkinen, M., & Nurmi, J.-E. (in press). Classroom organization and teaching stress predict learning motivation in kindergarten children. *European Journal of Psychology of Education*.
- Salmela-Aro, K., Kiuru, N., & Nurmi, J.-E. (2008). The role of educational track in adolescents' school burnout. *British Journal of Educational Psychology*, 78, 663-689.
- Salmela-Aro, K., Kiuru, N., Leskinen, E., & Nurmi, J.-E. (2009). School-Burnout Inventory (SBI) - Reliability and Validity. *European Journal of Psychological Assessment*, 25, 48-57.

<b>COUNTRY CONTRIBUTION:</b> <i>Network influence and organizational performance: Empirical evidence from a longitudinal study of an Italian community of hospital organizations</i>	<b>Principal Investigator:</b>	Alessandro Lomi
	<b>Country:</b>	Switzerland
	<b>ECRP Funding Organisation:</b>	<i>Swiss National Science Foundation</i>
<b>7.1 Financial summary for Country Contribution 5</b>		
The Principal Investigator should provide below a summary of the financial support sought from his/her national ECRP Funding Organisation.		
Full financial details and any other supplementary information required by your national ECRP Funding Organisation should be supplied to them as instructed.		
		<b>TOTAL (EUROS)</b>
<b>7.1.1 Staff</b> 1 full time post-doctoral position for three years	<b>160,000</b> (gross salary) <b>22,500</b> (social security charges)	
<b>7.1.2 Travel and subsistence</b>	<b>15,000</b>	
<b>7.1.3 Consumables</b>	<b>0</b>	
<b>7.1.4 Other items</b>	<b>0</b>	
<b>7.1.5 Overheads and other allowable costs</b>	<b>0</b>	
<b>7.1.6 GRAND TOTAL FOR INDIVIDUAL COUNTRY CONTRIBUTION 5 (Switzerland)</b>	<b>197,500</b>	

**7.2 Description of Country Contribution** (*1500-2500 words, excluding annexes. Entries exceeding 2500 words will not be accepted*)

**7.2.1 Specific competence and expertise of your country team with regard to the overall collaboration.**

The research project will be carried out in the context of the research activities of the Organization and Management Theory group (<http://www.core.eco.usi.ch/omt.htm>) of the **Center for Organizational Research (CORE)** established at the University of Lugano (<http://www.core.eco.usi.ch/>). The complete list of project currently included in the CORE project portfolio can be found at the following address: <http://www.core.eco.usi.ch/progetti.htm>. **Alessandro Lomi** is founder and current director of the CORE. His main research interests are in the area of social networks within and between organizations, and in demographic models of industrial evolution and corporate change. On these and related topics he has published three books and a number of articles in leading international journals.

In the recent past Alessandro Lomi has contributed to two major research projects on topics that are directly related to those of the current proposal. The first was an ESF-ECRP research project directed by Professor Tom Snijders on the "Dynamics of Actors & Networks across Levels." This project ended in 2009 and is the precursor to the current proposal. The second project was a four-year research project on "Models and Methods for Representing Organizational Knowledge" supported by the Italian Ministry of University and Scientific Research (MURST).

During the period 2009-2012 Alessandro Lomi is *Principal Overseas Co-investigator* in the project "Network dynamics and field evolution: hubs, clusters and interorganisational ties in biotechnology" supported by the Australian Research Council (ARC). During the same period he is *Principal Investigator* in the project "Niches, Networks and the Propensity of Organizations to Collaborate" supported by the *Schweizerscher Nationalfonds zur Förderung*.

With Professor Tom Snijders, Alessandro Lomi is currently a Honorary Fellow in the MelNet group, School of Behavioral Sciences, University of Melbourne (Australia) – an internationally recognized research group focusing on the analysis of social networks with specific focus on models for exponential random graphs (<http://www.sna.unimelb.edu.au/>).

## 7.2.2 Country team's contribution

### *(7.2.2.a) Aims and objectives*

A longstanding empirical question in the sociology of markets and organizations concerns the extent to which dimensions of organizational performance, however measured, might be modified by relations that organizations develop with partners, and with actual or potential competitors (Ahuja, 2000; Walker, Kogut and Shan, 1997; Uzzi, 1996). The reason why specifying how interorganizational networks influence individual performance is important is that we would like to understand (i) why organizations perform differently; (ii) what factors affect the likelihood of observing such differences; (iii) when such differences matter, and (iv) what forces erode or amplify them. Extant research has focused on explanations based on differences in competitive positions vis-à-vis market forces, and on differences in idiosyncratic organization-specific resources. Less developed are explanations that recognize that organizations may compete in groups, rather than individually (Rowley et al., 2004), and that organizational performance depends crucially on the identity of network partners and, therefore, on the composition of interorganizational networks (Baum et al., 2000; Sorenson and Stuart, 2008). The reason why building a more complete understanding of how network ties influence organizational performance is difficult, is that network influence is partly endogenous to the matching process that generates observed patterns of interorganizational association. As a consequence observational data typically do not allow for clean separation between the effects of influence on performance generated by network ties, and the effects of partner selection. The presence of systematic network connections between partners is probably one of the major sources of endogeneity that are almost unavoidable in research on organizational effectiveness and performance (March and Sutton, 1997). For this reason, extant research that has used the presence of network ties to predict the level of individual performance has produced important insight, but has not yet provided a compelling demonstration of the existence of network influence (Stuart, Hoang, and Hybels, 1999; Stuart, 2000). To clarify this matter, this study starts from the following basic proposition: if effects of network influence on organizational performance exist, then the difference between the performance of two organizations connected by network ties should be smaller than if there were no influence (Falk and Ichino, 2006). We expect this to be the case because network ties provide opportunities for learning and mutual adjustment – two of the most powerful endogenous influence mechanisms responsible for similarity in organizational practices and behavioral orientations (Denrell, 2003). To establish the empirical validity of this proposition we examine the two main sources of confounding factors identified by Manski (1993). The first source is generated by the possibility that similarity in performance between two organizations is determined by similarity in environmental conditions, institutional factors, and competitive resource dependencies that they jointly face. The second source is generated by the possibility that two organizations attain similar levels of performance because they have similar characteristics that make them behave similarly even in the absence of mutual contact. We address these theoretical and methodological issues in the context of the health care industry, an institutional setting in which competition coexists with clear and well documented patterns of relational coordination and collaboration between providers of health care services. Similarly to other organizations operating in knowledge-intensive fields (Whittington et al., 2009) network-based learning and influence processes are likely to play a central role in explaining interorganizational differences and similarities in organizational performance.

### *(7.2.2.b) Research Design and Methods*

We are collecting network panel data on a regional community of hospital organizations during the period 2006-2008. The interorganizational community is located in Lazio, one of the largest regions in Central Italy which includes 110 hospitals serving a population of more than six million residents and treating more than one million patients per year. We are currently in the process of completing the data collection. We are exploring the possibility to extend the observation period back in time to 2003 and we are discussing the matter with the Italian regional health agencies that have accepted to provide the data. Using the region as a sampling criterion is meaningful because: (i) The production and organization of health care services in Italy (as well as in other

countries) is decentralized at the regional level, and (ii) Geographical regions are fairly closed health care systems (i.e., inter-regional mobility of patients is very low). The sample includes information on: (i) Relations of collaboration and coordination established between hospitals via patient transfer decisions (patient mobility); (ii) Variables that describe activities and resources that are specific to individual hospitals (e.g., capacity, range of services offered), and (iii) Variables that define hospitals competitive position in terms of overlap in patient pools (demand) and services offered (supply). We are also collecting information on: (iv) Variables that capture important institutional differences between hospitals such as, for example, differences in type of governance, legal form and administrative structure. Finally we are collecting data that will allow us to define reliable indicators of hospital performance – the basic dependent variable of our study. More specifically we are focusing on two specific dimensions of performance that are considered meaningful in the health care literature. The first is the comparative performance index (CPI) which is based on the international Diagnosis-Related Groups (DRG) system and that is used to assess efficiency of hospitals in terms of average length of stay (ALOS) weighted by case mix to account for hospital-specific differences in clinical complexity of the cases treated. The second is the Weighted Productivity Index (WPI) – a fundamental index of adjusted hospital productivity reconstructed as the case flow weighed by the case mix. In the empirical part of the study we consider hospital performance as the main target of social influence processes flowing through interorganizational networks. To analyze the network panel data we will be specifying and estimating dynamic statistical models for social networks to examine the extent to which hospitals connected by network ties attain similar levels of performance – controlling for a variety of other institutional, economic and organization-specific factors that may affect interorganizational performance similarity. The analytical approach that we adopt is introduced by Snijders (2001), and developed further by Steglich, Snijders and Pearson (2010). An application to interorganizational relations is discussed by van de Bunt and Groenewegen (2007).

*(7.2.2.c) Work plan*

The project unfolds over three years. The research activities will be organized in eight partially overlapping stages. To simplify exposition, each stage may be viewed as a relatively self-contained but interdependent set of activities. The first stage (S1) is dedicated to conceptualization and theory development to link our sample to central issues in the analysis of network influence on organizational performance. The second stage (S2) is dedicated to gathering qualitative information through interviews with medical doctors and hospital executives working in some of the hospitals in our sample. We have already developed an extensive network of personal contacts that would allow to access expert knowledge relatively directly. This will be particularly important in the contextual interpretation of the meaning of the performance measures we adopt. The third stage (S3) is dedicated to data collection and coding. We have developed a very productive working relation with the regional public health agencies that ensures access to the official databases containing most of the information needed for the study. The fourth stage (S4) is dedicated Data Quality Control to ensure that the subsequent analysis may be proceed unencumbered. The fifth stage (S5) involves the application of exploratory network data analysis to understand better the relational structure of the sample, the distribution of the (dependent) performance variables, and the possible role of control covariates. The sixth stage (S6) is dedicated to model specification and to the development of causal connections between the data and the theoretically relevant concepts. The activities in S6 are consistent with the third objective of the UK Team to elaborate more detailed specifications that are both inspired by theory and coherent with extant empirical results. The seventh stage (S7) is dedicated to model estimation. Stochastic models for dynamic networks are becoming easier to specify and estimate, but the model-building and estimation process remains rather laborious with convergence of larger models requiring a significant amount of time even on the fastest computers available. The final stage (S8) is dedicated mostly to writing activities and to preparation of manuscripts for submission. The deadlines for submission of papers for presentation to the relevant international conferences typically fall within the period December 15-January 15. The following table summarizes the various activities and the duration and articulation of the various stages.

(S1)									
(S2)									
(S3)									
(S4)									
(S5)									

(S6)									
(S7)									
(S8)									
	Y1_Q1	Y1_Q2	Y1_Q3	Y1_Q4	Y2_Q1	Y2_Q2	Y2_Q3	Y2_Q4	
	MARCH 2011				MARCH 2012				

Examples of relevant yearly conferences include the Academy of Management Meeting, the EGOS Colloquium, the INSNA Sunbelt conference, and the conference of the American Sociological Association. Actual conferences are typically in July and August. Under the working assumption of March 2011 as a starting date, there will be three main conference submission rounds at the end of the fourth quarters of year 1 (Y1\_Q4), year 2 (Y2\_Q4), and year 3 (Y3\_Q4).

*(7.2.2.d) Planned outputs*

Our main objective is to submit at least three papers to the best international academic journals publishing research work in the broadly defined areas of organization theory, economic sociology, strategic management, and social science research methods. Specific target outlets include Organization Science, Administrative Science Quarterly, European Sociological Review, Strategic Management Journal, Academy of Management Journal, Social Networks, Social Science Research, and Sociological Methods and Research. Ideally, Prof. Tom Snijders would be involved as a co-author in at least two of these papers together with members of the Groningen and Oxford teams. At least other two papers will be submitted to more focused journals addressing audiences interested in the sociology, economics of health care organizations. Examples of such outlets include Health Care Services Research, Journal of Health Economics, and Social Science and Medicine. The methods-oriented publications will be developed in close contact with the Groningen and the Oxford teams in order to test the performance of different analytical approaches to assess the implications of influence on organizational performance. The more substantive papers may benefit from direct interaction with the Slovenian team whose research objectives also involve assessment of the effects of networks on performance.

**7.2.3 Justify the funding requested.**

An overall amount of Euros 197,500 is requested for three years. The human resources needed to carry out the project consist of a post-doctoral fellow to employed full time for the duration of the project. The gross salary (Euros 160,000) is established according to the Swiss salary scale for Post-Doctoral researchers working in Swiss Universities. The PI will dedicate to the project approximately one full day per week. The level of social security contributions (Euros 22,500) is established by Swiss employment laws. The ideal candidate has a recent Doctoral Degree in relevant disciplines granted by a reputable doctoral program. He or she has an active interest in developing empirical and methodological contributions to the analysis of network-based social influence processes in organizational fields, communities and populations. The ideal candidate has a perfect command of spoken and written English. Knowledge of a second European language is an asset. Some knowledge of Italian may be useful, but not essential. A selection criterion that will be strictly enforced is that the candidate be interested in an academic career with the more specific objective of taking on a junior faculty position at the end of the project. Additional Euros 15,000 are requested to cover travel costs. This amount should cover the costs of the following project-related yearly events:

	Number of individuals	Estimated yearly cost
One coordination meeting with representatives of the European projects	Two	800
Two field trips to Italy (Rome) for data collection and interviews with Medical doctors and hospital executives	One	700
One conference in the US (including conference fees) (For Example: Academy of Management Meeting: <a href="http://www.aomonline.org/aom.asp?ID=4">http://www.aomonline.org/aom.asp?ID=4</a> )	Two	2,000
One conference in Europe (For Example: EGOS Colloquium: <a href="http://www.egosnet.org/jart/prj3/egosnet/main.jart">http://www.egosnet.org/jart/prj3/egosnet/main.jart</a> )	Two	1,500
<b>Estimated yearly travel costs (Euros)</b>		<b>5,000</b>

#### 7.2.4 Annexes

Please refer to annexes 1 and 2 included as integral parts to the present application:

- Annex 1 – Abridged CV of Principal investigator and related publications of Principal investigator
- Annex 2. References quoted in the document

## Abridged bio-sketch

**ALESSANDRO LOMI** is Professor in Organization Theory and Behavior in the Faculty of Economics at the University of Lugano (Switzerland), and Professor of Management (on leave) in the Department of Management Sciences at the University of Bologna (Italy). Since 2007 he directs the Center of Organizational Research (CORe) at the University of Lugano. In 2008 he was nominated *Conseiller a la Recherche* in the Human and Social Sciences Division of the *Conseil national de la recherche Suisse* (Swiss NSF). In 2008 he was *Jemolo Research Fellow at* Nuffield College, University of Oxford (U.K.). From 2007 he is Senior Research Fellow in the School of Behavioral Science at the University of Melbourne (Australia).

Between 2003 and 2006 Alessandro Lomi was Honorary Visiting Professor at the Cass Business School, City University (London). In 2002 he was NATO Senior Research Fellow at the Santa Fe Institute (New Mexico). In 2001 he was Researcher in Residence at the Santa Fe institute (New Mexico). In the past he was an Assistant Professor at the London Business School (University of London), a Visiting Professor at the Haas School of Business (University of California, Berkeley), a Post-Doctoral Fellow at the London Business School (University of London), a NATO Advanced Science Fellow at Syracuse University (New York), and CNR Junior Research Fellow at the New York University (New York, NY).

His research interests include the analysis of social networks within and between organizations, computational models of organizational and economic processes, and demographic models of industrial and corporate change. On these themes he has published three books and a number of articles in leading international journals. His recent work "Dynamics of organizations" co-edited with Erik has been published jointly by the MIT Press and the American Association for Artificial Intelligence (AAAI). He received his M.Sc. and Ph.D. degrees from Cornell University (Ithaca, New York). He holds a BA in Economics from the University of Bologna (Italy).

In the year 2011 he will be visiting at Universidad Carlos III, Madrid (Spain) where he has been awarded the *Banco Santander Cátedra de Excelencia*.

## Related publications

### **Currently under submission**

Lomi, A., Pallotti, F. (2010) "Uncertainty, network mechanisms, and the propensity of organizations to collaborate: An empirical examination of patient transfer relations in a community of hospital organizations." Under submission (Second Revision), *Organization Science*.

Lomi, A., Pallotti, F. (2010) "Relational Collaboration Among Spatial Multipoint Competitors." Under submission, *Social Networks*.

### **Forthcoming**

Lomi, A., Pallotti, F. (2010) "How to Close a Hole: Exploring Alternative Closure Mechanisms in Inter-organizational Networks" (With F. Pallotti). In Dean Lusher, Johan Koskinen, and Garry Robins (Eds.) *Exponential Random Graph Models for Social Networks: Theories, Models and Applications*. Structural Analysis in the Social Sciences Series. New York. Cambridge University Press.

Lomi, A., and Boukhris, M. (2011) "An Evolutionary Model of Partner Selection and Organizational Performance." Forthcoming in Tom A.B. Snijders and Christian E.G. Steglich(Eds.). Actor-based Models for Analyzing Network Dynamics.

Pallotti, F., Mascia, D., and Lomi, A. (2011). "The network dynamics of collaboration between multipoint competitors: An empirical test of the Mutual Forbearance Hypothesis." Forthcoming in Tom A.B. Snijders and Christian E.G. Steglich (Eds.). Actor-based Models for Analyzing Network Dynamics.

### **Recently Published**

Mascia, D., Pallotti, F., Lomi, A and Cicchetti, A. 2009. "*Cooperazione competizione o cooptazione? Evidenze empiriche del settore sanità*". *Studi Organizzativi*, 11(1):5-30. (In Italian).

Lomi, A., Negro, G, Fonti, F. (2008) "Evolutionary Perspectives on Interorganizational Networks." (With Giacomo Negro and Fabio Fonti) In Steve Cropper, Mark Ebers, Chris Huxham, and Peter Smith Ring (Eds.): *Oxford Handbook of Inter-Organizational Relations*. Pp. 313-338 Oxford (UK). Oxford University Press.

Lomi, A., Pattison, P. (2006) "Manufacturing relations: An empirical study of the organization of production across multiple networks. " (With P. Pattison). *Organization Science*, Vol. 17(3): 313-332.

Lomi, A., Pattison, P. (2004) "Introduction". In A. Lomi and P. Pattison (Eds.) Computational and Mathematical Organization Theory. Special Issue on mathematical representations and models for the analysis of social networks within and between organizations. May. Vol. 10(1): 5-15.

## References quoted in the text of the proposal

- Baum, J., Calabrese, T., and Silverman, B. (2000) "Don't go it alone: Alliance network composition and startups' performance in Canadian biotechnology." *Strategic Management Journal*, 21: 267–294.
- Denrell, J. (2003) . "Vicarious learning, undersampling of failure and the myths of management." *Organization Science*, 14(3): 227-243.
- Falk, A., and Ichino, A. (2006) "Clean Evidence on Peer Effects." *Journal of Labor Economics*, 24(1): 39-59.
- Manski, C. (1993) "Identification of endogenous social effects: the reflection problem." *Review of Economic Studies*, 60: 531–542.
- March, J.G., and Sutton, R.I. (1997) " Organizational Performance as a Dependent Variable." *Organization Science*, 8 (6): 698-706.
- Rowley, T., Baum, J., Shipilov, A., Greve, H., and Rao, H. (2004). Competing in Groups." *Managerial and Decision Economics*, 25: 453–471.
- Shan, W., Walker, G., and Kogut, B. (1997) "Interfirm Cooperation and Startup Innovation in the Biotechnology Industry." *Strategic Management Journal*, 15(5) 387-394.
- Snijders, T.A.B. (2001) "The statistical evaluation of social network dynamics." M.E. Sobel and M.P. Becker (eds.) *Sociological Methodology*: 361-395. Boston and London: Basil Blackwell.
- Sorenson, O., and Stuart, T.E. (2008) "Bringing the context back in: Settings and the search for syndicate partners in venture capital investing." *Administrative Science Quarterly*, 53: 266-294.
- Steglich, C.E.G., Snijders, T.A.B., and Pearson, M. (2010) "Dynamic networks and behavior: Separating selection from influence," *Sociological Methodology*, in press.
- Stuart, T. (2000) "Organizational Alliances and the Performance of Firms: A Study of Growth and Innovation Rates in a High-Technology Industry." *Strategic Management Journal*, 21 (8):791-811
- Stuart, T. E., Hoang, H., and Hybels, R. C. (1999) "Interorganizational endorsements and the performance of entrepreneurial ventures." *Administrative Science Quarterly*, 44: 315–349.
- Uzzi B. (1996) "The sources and consequences of embeddedness for the economic performance of organizations: The network effect." *American Sociological Review*, 61: 674–698.
- van de Bunt, G., and Groenewegen, P. (2007) "An Actor-Oriented Dynamic Network Approach: The Case of interorganizational network evolution." *Organizational Research Methods*, 10; 463-482.
- Whittington, K., Owen-Smith, J., and Powell, W. (2009) "Networks, Propinquity, and Innovation in Knowledge-intensive Industries." *Administrative Science Quarterly*, 54: 90-122.

<b>COUNTRY CONTRIBUTION 6</b> <i>Dynamics of scientific co-authorship networks.</i>	Principal Investigator:	Prof. Anuska Ferligoj
	Country:	<i>SLOVENIA</i>
	ECRP Funding Organisation:	<i>Slovenian Research Agency</i>
<b>8.1 Financial summary for Country Contribution 6</b>  The Principal Investigator should provide below a summary of the financial support sought from his/her national ECRP Funding Organisation. Full financial details and any other supplementary information required by your national ECRP Funding Organisation should be supplied to them as instructed.		
		<b>TOTAL (EUROS)</b>
<b>8.1.1</b>	<b>Staff</b> (specify how many positions are sought) 1.3 FTE	<b>137.638,80 €</b>
<b>8.1.2</b>	<b>Travel and subsistence</b>	<b>17.000,00 €</b>
<b>8.1.3</b>	<b>Consumables</b>	<b>17.281,50 €</b>
<b>8.1.4</b>	<b>Other items</b>	<b>64.107,70 €</b>
<b>8.1.5</b>	<b>Overheads and other allowable costs</b>	-
<b>8.1.6</b>	<b>GRAND TOTAL FOR INDIVIDUAL COUNTRY CONTRIBUTION 6</b>	<b>236.028,00 €</b>

**8.2 Description of Country Contribution 6** (*1500-2500 words, excluding annexes. Entries exceeding 2500 words will not be accepted*)

**8.2.1 Competence and expertise**

Anuska Ferligoj is professor of statistics at University of Ljubljana (Slovenia), head of the Centre of Methodology and Informatics, and head of the Graduate Programme on Statistics at University of Ljubljana. She is an internationally recognized expert in social science methodology, specialising in multivariate analysis and social network analysis. In the last 20 years she developed an internationally known research group which is working on several topics of social network analysis (e.g., network measurement, blockmodeling, development of the programme Pajek). In the proposed project Ferligoj will collaborate with interdisciplinary team of researchers who have the necessary scientific competencies, such as social networks analysis and sociology of science.

Franc Mali is professor for sociology and epistemology of science at the University of Ljubljana (Slovenia). His recent research is focused on the science and technology indicators for R&D policy and the problems of the social and ethical regulation of modern technologies. From 1999 – 2007 he was the board member of SSTNET (The Sociology of Sociology and Technology Research Network) at the European Sociological Association (ESA).

**8.2.2 Contribution to the overall work plan**

In 2009 Ferligoj as principal investigator started a 3-year project financed by Slovenian Research Agency on longitudinal study of coauthorship networks in Slovenia. Here, the network is defined by all researchers registered to work in the fields of biotechnology, mathematics, physics, or sociology in Slovenia and a tie between two researchers is measured by coauthorship of relevant scientific publications. In the second year of this project it became clear that several extensions to the aims and objectives of the project can be specified. So far the results of the longitudinal analysis of scientific coauthorship networks in Slovenia for 1986 - 2005 (Kronegger, Ferligoj, Doreian 2010) indicate different coauthoring cultures in different scientific disciplines (four scientific disciplines were treated: biotechnology, mathematics, physics and sociology). However, these cultures changed over time in

Slovenia. The number of coauthored publications grew much faster than solo authored productions, especially after independence in 1991 and the integration of Slovenian science into broader EU systems. Trajectories of types of coauthorship differed across the disciplines. These types of findings are neither novel nor scarce in sociological or bibliometrical literature. However, bibliometric analyses are sometimes too much oriented only to statistical analysis of authorship patterns in the publishing output of science. The intention of our longitudinal study of coauthorship networks in Slovenia has been to reveal the internal social dynamics of scientific collaboration in the investigated example of scientific disciplines as well. The analysis of co-authored publication patterns in various scientific fields (disciplines) is the good indication of the underlying processes of formation and organization of social networks in science.

Using blockmodeling (Doreian P, Batagelj V, Ferligoj A 2005), we show how coauthorship structures change in all disciplines. The most frequent form was a core-periphery structure with multiple simple cores, a periphery and a semi-periphery (Ferligoj, Kronegger 2009). The next most frequent form had this structure but with bridging cores which connect two or more other cores. Bridging cores consolidate the center of a discipline by giving it greater coherence. These consolidated structures appeared at different times in different disciplines, appearing earliest in physics and latest in biotechnology. In 2005, biotechnology had the most consolidated center followed by physics and sociology. All coauthorship networks expanded over time. By far, new recruits went into either the semi-periphery or the periphery in all fields. Two "lab" fields, biotechnology and physics, have larger semi-peripheries than peripheries. The reverse holds for mathematics and sociology, two "office" disciplines. Institutional affiliations and shared interests all impact the structure of collaboration in subtle ways. We will consider these and other mechanisms at the level of actors in the SIENA models to test hypotheses statistically.

#### Aims and Objectives of proposed project:

The aim of the proposed project is to give insights into the impact of R&D policy measures (with an emphasis on the R&D evaluation system) on the increased process of collaboration of the scientists in Slovenia. Namely, Slovenian R&D policy faces big challenges stemming from adaptive structural changes, including the ever growing demand to create the new forms of scientific networks. Here, we will seek to follow these processes through the time. The new challenges of R&D development in the world requires from Slovenian R&D policy not only to remove the most visible structural constraints from the past (fragmentation and isolation of scientific community) but also requires some substantive adjustments to the new forms of knowledge production.

Scientific collaboration and scientific networks are key mechanism of modern scientific practice. In science, as a complex system, the interactions among scientists bring a lot of benefits in the forms of both inputs and outputs. Recently, in sociology of science various arguments have been advanced that the value of scientific collaboration lies through the enhancement scientific productivity and scientific impact. Moreover, recent analyses in sociology of science point to the positive influence of collaborative structures on human creativity in all human intellectual activities. The focus of our interest will be the collaboration in science. Namely, a lot of bibliometric analyses have uncovered the positive effects of scientific collaboration on research performance (in terms of published output and impact). Therefore, our basic project aim is to provide models to indicate collaborative structures that influence the scientific performance at large and to be useful for evaluation of research policies and programs.

Therefore, in this ECPR proposal the research group plans to upgrade the aims and objectives of the currently running research project in several directions:

- Analyse how strong the co-authored publications vary with the regard to the cognitive and the (internal and external) sociological factors;

- The extension of the included scientific disciplines that will represent all six basic scientific fields (natural sciences and mathematics, engineering sciences and technologies, medical sciences, biotechnological sciences, social sciences, humanities). Now, we have only a few representatives of the basic scientific fields.

- In the current project the data up to 2005 are analysed. The obtained core-periphery structure stabilized in the last period. The hypothesis is that there should not be drastic changes in the structure in the next five-year period. Therefore, the extension of the time period (2006-2010) is

planned.

In the current project we have not planned to study the effects of scientific collaboration on the scientific productivity of scientists. Here, we plan to search for the indicators of scientific performance of scientists of the considered disciplines and to study the effects of scientific collaboration on the performance of scientists. One of the hypotheses that we plan to test is based on the results obtained by Zihlerl, Igljic and Ferligoj (2006). They studied the relationship between cooperation ties among researchers in their research teams and the publication performance of the young researchers working in these groups. The performance was the weakest if the researchers in the group were the most weakly connected. Also in the most connected research groups the performance of the young researchers was below average. The best performance was in the groups with moderate strength of the cooperation ties. In this perspective our hypothesis is that scientists in the periphery will perform the worse and the ones in the semi-periphery the best. Scientists in the core groups are expected to have also below average scientific performance.

The inclusion of additional indicators on affiliation of researchers, formal organization, roles and competences.

The specification of SIENA model that will include the dynamic blockmodeling structure.

Data and methods:

The data set used in the proposed research is obtained from two commonly connected sources in Slovenia: (i) the Current Research Information System (SICRIS) which includes the information on all active researchers registered at the Slovenian Research Agency and (ii) the Co-operative On-Line Bibliographic System & Services (COBISS) which contains a database of all publications available in Slovenian libraries. Connecting these systems gives a unique officially maintained database of complete personal bibliographies of all researchers registered in Slovenia. SICRIS provides additional information on the education, positions and employment of researchers, information on the research groups and the institutions as well as information on both the projects and programs involving Slovenian researchers. Both systems are technically maintained by the Institute of Information Science in Maribor (IZUM).

All researchers registered to work in the considered scientific fields in Slovenia who are listed in SICRIS will be included in this study. Collaboration between the researchers is operationalised by coauthorship of publications. A symmetric tie between two researchers is measured by coauthorship of relevant scientific contribution. The data set analysed is based on all publications issued in the years from 1986 to 2010. The construction of the network differs from similar studies (e.g., Newman 2004) since the key information for the analysed scientific field about authors and topics is available from the SICRIS database and not in keywords or topic tags of the articles which is usually available bibliographic databases.

Analysis and visualization of co-authorship networks through time will be conducted using blockmodeling and other methods and models implemented in the PAJEK program. The dynamics of networks will be analysed with actor-oriented models implemented in the SIENA program. The results will be combined as described in aims and objectives.

Workplan:

- 1<sup>st</sup> year. State of the art report, data preparation and network construction.
- 2<sup>nd</sup> year. Descriptive longitudinal network analysis and evolution of blockmodeling structure for each scientific discipline. The analysis of the effects of individual, institutional and organizational characteristics on coauthorship network dynamics.
- 3<sup>rd</sup> year. To study the possibilities of implementing dynamic blockmodeling structures into SIENA models.

Planned outputs:

The main deliverables of the project are publications in scientific journals and a chapter in collective volume produced by the CRP. Apart from contribution to the basic science, there is also applicative value: our findings can be used as a basis for shaping research policies in Slovenia. The obtained experience in the application of the SIENA program contributes to new ideas for further development of the program.

**8.2.3 Justify the funding requested** (including time commitments for all team members).

Funding of 1 FTE is required for two post-doctoral researchers for the period of three years (each part-time, jointly 1 FTE). One post-doctoral researcher will be involved with data coding and database management activities, and extensive experimentation with a novel analytical framework for relational data. The other post-doctoral student will work on specific topics of sociology of science that are important for the problem definitions, the interpretation and qualitative evaluation of the obtained results. The senior researchers (Ferligoj and Mali) will supervise both post-doctoral researchers and will contribute 0.15 FTE each for the development, implementation and evaluation of new methods. Expert on sociology of science prof. Franc Mali, will analyse the context of the research and prepare the theoretical background for forming the proper models. The expert will also provide proper interpretations of the results.

Student helpers (0.3 FTE in total) are needed for the implementation and various smaller tasks. Travel expenses are calculated on the bases of annual meetings of the coordinated project and short visits to collaborating sites. A significant amount of expenses is provided to disseminate findings of the research on the conferences.

▪ **Annexes:**

## Short Curriculum Vitae of Anuska Ferligoj (born 1947)

### Academic Degrees

- 1979 M.Sc. in Operational Research, University of Ljubljana (UL)  
1983 Ph.D. in Information Science, University of Ljubljana

### Academic Positions and Functions

- 1983 – 1991 Head of Department of Methodology, Faculty of Social Sciences (FSS), UL  
1983 – 1985 Vice dean of Faculty of Social Sciences, UL  
1989 – 1993 Associate professor, Faculty of Social Sciences, UL  
Since 1990 Elected member of the International Statistical Institute  
1990 – 1991 Fulbright scholar, University of Pittsburgh  
1991 – 1993 Head of the Department of Sociology, Faculty of Social Sciences, UL  
Since 1992 Head of Centre of Methodology and Informatics, FSS, UL  
Since 1994 Full professor of statistics, Faculty of Social Sciences, UL  
Since 2002 Head of Graduate program on statistics, UL  
2003 – 2005 Dean of Faculty of Social Sciences, UL  
Since 2007 President of the Statistical Council of the Statistical Office of the R Slovenia  
Since 2007 Elected member of European Academy of Sociology  
2009 – 2010 Guest professor, University of Vienna

### Main Editorial Functions

- 1987 – 2010 Editor of Metodološki zvezki (till 2003 series, after 2004 journal)  
1993 – 2008 Member of editorial board, Journal of Mathematical Sociology  
1996 – 2005 Member of editorial board, Statistical Theory and Method Abstracts  
Since 2001 Member of editorial board, Journal of Classification  
Since 2003 Member of editorial board, Social Networks  
Since 2005 Member of editorial board, Methodology  
Since 2005 Member of editorial board, Structure and Dynamics  
Since 2007 Member of editorial board, Advances in Data Analysis and Classification  
Since 2010 Member of editorial board, BMS  
Supervision or co-supervision of 16 PhDs. Many invited lectures, organization of conferences and conference sessions.

### Key Publications

- KRONEGGER, Luka, FERLIGOJ, Anuska, Patrick Doreian. Collaboration structures in Slovenian scientific communities. *i.* 2010 (in press)  
FERLIGOJ, Anuska, KRONEGGER, Luka. Clustering of attribute and/or relational data. *Metodološki Zvezki*, 6 (2009), 135-153.  
DOREIAN, Patrick, BATAGELJ, Vladimir, FERLIGOJ, Anuska. *Generalized blockmodeling*, Cambridge: Cambridge University Press, 2005.  
KOGOVSEK, Tina, FERLIGOJ, Anuska. Effects on reliability and validity of egocentered network measurements. *Social Networks* 27 (2005), 205-229.  
DOREIAN, Patrick, BATAGELJ, Vladimir, FERLIGOJ, Anuska. Generalized blockmodeling of two-mode network data. *Social Networks* 26 (2004), 29-53.  
KOGOVSEK, Tina, FERLIGOJ, Anuska, SARIS, Willem S., COENDERS, Germa. Estimating the reliability and validity of personal support measures: full information ML estimation with planned incomplete data. *Social Networks* 24 (2002), 1-20.  
FERLIGOJ, Anuska, HLEBEC, Valentina. Evaluation of social network measurement instruments. *Social Networks* 21 (1999), 111-130.  
BATAGELJ, Vladimir, FERLIGOJ, Anuska, DOREIAN, Patrick. An optimizational approach to regular equivalence. *Social Networks* 14 (1992), 121-135.  
FERLIGOJ, Anuska, BATAGELJ, Vladimir. Some types of clustering with relational constraints. *Psychometrika*, 48 (1983), 541-552.  
FERLIGOJ, Anuska, BATAGELJ, Vladimir. Clustering with relational constraint. *Psychometrika*. 47 (1982), 413-426.

## Short Curriculum Vitae of Franc Mali (born 1955)

### Academic Degrees

- 1989 M.Sc. in Sociology of Science, University of Ljubljana (UL)  
1993 Ph.D. in Sociology of Science, University of Ljubljana

### Academic Positions and Functions

- 1995 – 2003 Assistant professor, Faculty of Social Sciences (FSS), UL  
2003 – 2009 Associate professor, Faculty of Social Sciences, UL  
since 2009 Full professor of sociology, Faculty of Social Sciences, UL  
since 1996 Head of Center for Social Studies of Science, FSS, UL  
2002 – 2004 Head of Department for Cultural Studies, Faculty of Social Sciences, UL  
1998 DAAD fellowship (University Bielefeld)  
1998 – 2007 Member of Executive committee of SSTNET (Sociology of Sociology and Technology Research Network at the European Sociological Association)  
2004 – 2007 Member of Executive committee of Sociological Association in Slovenia

### Main Editorial Functions

- 2002-2008 Member of editorial board, *Družboslovne razprave*, Slovenia  
1994-2002 Member of editorial board, *Revija za raziskovalno in inovacijsko politiko*, Slovenia  
Supervision or co-supervision of 4 Ph.D., 4 invited lectures abroad;

### Key Publications

- MALI, Franc: Bringing converging technologies closer to civil society: the role of the precautionary principle. *Innovation*, Mar. 2009, vol. 22, no. 1, pp. 53-75.
- MALI, Franc: Science and technology studies in Slovenia. In: *Governing sociotechnical change in Southeastern Europe: contributions from a science & technology studies perspective*. Sofia: East-West Publishers, 2007, 60-67.
- MALI, Franc: Some challenges for R&D policy-making in the newcomer EU countries. In: BAMMÉ, Arno, GETZINGER, Günter, WIESER, Bernhard (eds.). *Yearbook 2006 of the Institute for Advanced Studies on Science, Technology and Society*, (Technik- und Wissenschaftsforschung, Vol. 54). München; Wien: Profil, cop. 2006, 193-210.
- MALI, Franc. The new challenges of university system in the recent processes of commodification of scientific knowledge. *Teor. vědy*, 2004, vol. 26, no. 1, 67-78.
- MALI, Franc. Socio-economic transition and new challenges for the science and technology policy in Slovenia. V: BIEGELBAUER, Peter, BORRÁS, Susana (eds.). *Innovation policies in Europe and the US : the new agenda*. Aldershot; Burlington: Ashgate, 2003, 211-321.
- MALI, Franc. Sociology in Slovenia: the challenge of transition. V: KEEN, Mike Forrest, MUCHA, Janusz (eds.). *Sociology in Central and Eastern Europe: transformation at the dawn of a new millenium*, (Contributions in sociology, no. 139). Westport, Conn.: Praeger, 2003, 165-174.

## List of references:

- Barabási AL, Jeong H, Neda Z, Ravasz E, Schubert A, Vicsek T (2002) Evolution of the social network of scientific collaborations. *Physica A: Statistical Mechanics and its Applications* 311(3-4):590–614
- Batagelj V, Mrvar A (2003) Analysis and visualization of large networks. In: Jünger M, Mutzel P (eds) *Graph Drawing Software*, Springer, Berlin, Berlin,77–103
- Brandes, U., Lerner, J., Snijders, T.A.B. (2009). Networks Evolving Step by Step: Statistical Analysis of Dyadic Event Data. *Proc. 2009 Intl. Conf. Advances in Social Network Analysis and Mining* (ASONAM 2009), IEEE Computer Society, 200-205.
- Corley EA, Boardman PC, Bozeman B (2006) Design and management of multiinstitutional research collaborations: Theoretical implications from two case studies. *Research Policy* 35:975–993
- Crane D (1972) *Invisible colleges: Diffusion of knowledge in scientific communities*. University of Chicago Press, Chicago
- de Nooy W, Mrvar A, Batagelj V (2005) *Exploratory Social Network Analysis with Pajek*. Cambridge University Press, Cambridge
- Doreian P, Batagelj V, Ferligoj A (2005) *Generalized Blockmodeling*. Cambridge University Press, Cambridge
- Erjavec T, Ignat C, Pouliquen B, Steinberger R (2005) Massive multi-lingual corpus compilation: Acquis communautaire and totale. In: *Proceedings of the 2nd Language & Technology Conference*, Poznan, Poland, 32–36
- Ferligoj A, Kronegger L (2009) Clustering of attribute and/or relational data. *Metodološki Zvezki* (Advances in Methodology and Statistics) 6(2):135–153
- Ferligoj A, Doreian P, Batagelj V (2010) Positions and roles. In: Scott J, Carrington P (eds) *Sage Handbook of Social Network Analysis*, Newbury Park: Sage Publications. (Forthcoming)
- Garfield E (1979) *Citation indexing: Its theory and application in science, technology, and humanities*. Philadelphia: ISI Press
- Gómez I, Fernández MT, Sebastián J (1999) Analysis of the structure of international scientific cooperation networks through bibliometric indicators. *Scientometrics* 44(3):441–457
- Hicks DM, Katz JS (1996) Where is science going? *Science Technology Human Values* 21(4):379–406
- Kretschmer H (1997) Patterns of behaviour in coauthorship networks of invisible colleges. *Scientometrics* 40(3):579–591
- Kretschmer H (1999) A new model of scientific collaboration Part 1. Theoretical approach. *Scientometrics* 46(3):501–518
- Kretschmer H, Hoffmann U, Kretschmer T (2006) Collaboration structures between german immunology institutions, and gender visibility, as reflected in the web. *Research Evaluation* 15(2):117–126
- Kuhn TS (1962) *The Structure of Scientific Revolutions*. University Of Chicago Press, Chicago
- Kundra R, Kretschmer H (1999) A new model of scientific collaboration Part 2. Collaboration of patterns in Indiana medicine. *Scientometrics* 46(3):519–528
- Lambiotte R, Panzarasa P (2009) Communities, knowledge creation, and information diffusion. *Journal of Informetrics* 3(3):180–190
- Laudel G (2001) Collaboration, creativity and rewards: why and how scientists collaborate. *International Journal of Technology Management* 22:762–781
- Newman MEJ (2004) Coauthorship networks and patterns of scientific collaboration. *Proceedings of the National Academy of Sciences of the United States of America* 101(Suppl 1):5200–5205
- Perianes-Rodríguez A, Olmeda-Gómez C, Moya-Anegón F (2010) Detecting, identifying and visualizing research groups in co-authorship networks. *Scientometrics* 82(2):307–319
- Price DS (1963) *Little Science, Big Science and Beyond*. Columbia University Press, New York
- Price DS (1965) Networks of Scientific Papers. *Science* 149:510–515
- Wagner C, Leydesdorff L (2005) Network structure, self-organization, and the growth of international collaboration in science. *Research Policy* 34(10):1608–1618
- Yasuhiro Y, Yoshiko O (2006) Patterns of scientific collaboration between Japan and France. Inter-sectoral Analysis Using Probabilistic Partnership Index. *Scientometrics* 68:303–324
- Zihel P, Igljic H, Ferligoj A (2006) Research groups' social capital: a clustering approach. *Metodološki Zvezki* 3: 217-237

<b>COUNTRY CONTRIBUTION 7</b> <i>Personal networks over life transitions and integration into society.</i>	<b>Principal Investigator:</b> Dr. José Luis Molina
	<b>Country:</b> <i>Spain</i>
	<b>ECRP Funding Organisation:</b> <i>Ministry of Science and Innovation (MICINN)</i>
<b>9.1 Financial summary for Country Contribution 7</b>  The Principal Investigator should provide below a summary of the financial support sought from his/her national ECRP Funding Organisation.  Full financial details and any other supplementary information required by your national ECRP Funding Organisation should be supplied to them as instructed.	
	<b>TOTAL (EUROS)</b>
<b>9.1.1 Staff</b> (specify how many positions are sought) 1 full-time position for 2 years	<b>71.000</b>
<b>9.1.2 Travel and subsistence</b>	<b>12.000</b>
<b>9.1.3 Consumables</b>	
<b>9.1.4 Other items</b>	<b>7.200</b>
<b>9.1.5 Overheads and other allowable costs</b>	
<b>9.1.6 GRAND TOTAL FOR INDIVIDUAL COUNTRY CONTRIBUTION 7</b>	<b>90.200</b>

**9.2 Description of Country Contribution 2** (*1500-2500 words, excluding annexes. Entries exceeding 2500 words will not be accepted*)

9.2.1 Competence and expertise

Principal Investigator is Dr. José Luis Molina, professor in Social and Cultural Anthropology at the Autonomous University of Barcelona (UAB) and director of the Laboratory of Personal Networks and Communities of the UAB. He has a long-standing expertise in social network analysis, specializing in methods and tools for the collection of (dynamic) personal network data and in substantive studies concerning personal networks. He has published three books and many articles in major scientific journals (e.g., *Social Networks*, *Field Methods*, *International Sociology*, *Social Science and Medicine*, *Journal of Applied Behavioral Science*). He also organizes the annual *Summer Course in Social Network Analysis* at the UAB.

Co-applicants are Dr. Miranda Lubbers, postdoctoral research fellow at the UAB and coordinator of the *Observatory of Personal Networks*, Dr. Isidro Maya Jariego, professor in Social Psychology at the University of Seville and coordinator of the *Laboratory of Social Networks and Communities*, and Dr. Ainhoa de Federico de la Rúa, associate member of the Department of Sociology of the University of Malaga and editor of the Spanish Journal of Social Network Analysis *REDES*. All have ample expertise in social network analysis and actor-based modelling, with specific competence in personal networks. Their expertise is reflected, among others, in publications in high-standing journals (e.g., *Social Networks*, *American Journal of Community Psychology*, *International Journal of Intercultural Relations*, *International Sociology*, *European Journal of Social Psychology*).

9.2.2 Contribution to overall work plan

9.2.2.1. Aims and objectives

*This project contributes to the overall work plan by (1) developing an analytic framework for the dynamics of personal networks in the line of stochastic actor-oriented modelling (goal 1), and (2) generating substantive knowledge about personal network dynamics (goal 5).*

Social network dynamics are commonly investigated within contained groups that are bounded by organizational structures (e.g., schools, work groups). This "sociocentric" approach is valuable for investigating the dynamics of social relationships within a group, as well as their recurrent influence on a behaviour of its members for which the organizational boundary is relevant (e.g., pupils' peer relationships at school and their academic performance). However, this perspective does not accurately get to the dynamics of real-life personal networks that are drawn from specific, but varied sources, and not just single organisations (Louch, 2002). Scholars who are interested in predicting individual outcomes that are not primarily produced within a single context, such as social well-being, health, or integration of immigrants, need to consider all social circles in which persons move.

In these cases, an "egocentric" or "personal" network approach is adopted. A personal network is the set of social relationships surrounding a focal individual, which are drawn from diverse settings (e.g., family, neighbourhood, workplace, association). It represents an individual's social context, the intermediate level between the individual and society (Degenne & Forsé, 2004). Past studies into personal networks, however, tended to capture only a small part of this social context, by measuring only a person's 5-10 most intimate and supportive relationships. Nonetheless, "weak" ties, for being more numerous, more heterogeneous and less connected to one's other ties, give access to a greater variety of information, which also affects individual outcomes (e.g., finding housing or employment; e.g., Granovetter, 1995, Lin, 2001). Second, the structure of relationships *among* network members affects an individual's possibility to mobilize social support (Lin, 1999), and the conformity of opinions and identifications in his or her network (e.g., McFarland and Pals, 2005), which can have consequences for individual outcomes. To better understand the impact that the social context has on individual outcomes, various researchers started to measure personal networks more elaborately, by eliciting lists of up to 45 network members per respondent and by completely observing the network (i.e., also relationships among network members; McCarty, 2002). Empirical data of this type are accumulating, and more recently, longitudinal data of this type are also collected (e.g., Degenne & Lebeaux, 2005; Llopis, 2008; Maya Jariago & Holgado, 2009; Molina, Lerner & Gómez Mestres, 2008). These longitudinal data give insight into processes of socialization and social integration, and the accelerating or disrupting effects of life events on such processes.

Investigating the dynamics of completely observed personal networks is complex, however, due to the existence of three meaningful units of analysis: (1) the relationship between a respondent ("ego") and a network member ("alter"), (2) the relationship among two network members, and (3) the overall network. Change occurs at each level. At the ego-alter relationship level, existing ties can be broken, they can gradually fade away or be temporarily lost out of sight, become stronger, change in contents, or remain stable over time, and new ties are also acquired. At the alter-alter relationship level, we can also observe the formation, maintenance and termination of ties. As a result of these tie-level dynamics, networks change in size, composition and structure at the aggregate level. The dynamics at the three levels are obviously interrelated, but so far, there is no integrated method for analysing these dynamics (Lubbers et al., 2009). This obscures an understanding of the complexity of network dynamics. For example, it is assumed that ties that are structurally embedded in dense clusters are cognitively and time-wise easier to maintain (e.g., Roberts, Dunbar, Pollet & Kuppens, 2009), yet it has never been tested whether changes in alters' embeddedness truly affect the stability of ego-alter ties.

The **first aim** of our contribution is to elaborate a model for personal network dynamics that integrates the three levels of analysis described above, based on the core analytic framework of this ECRP (Stochastic Actor-Oriented Modelling, SAOM, see Section 2; Snijders, 2001; Snijders, Steglich & Schweinberger, 2007). The model can be formulated as follows:

(1) In each network, the relations between the dynamics of ties among alters and those of ties between ego and alters can be modelled by conceptualising them, in terms of SAOM, as a "co-evolution of networks and behaviour" (see Section 2). The relations among alters form a "network" that changes over time. For analytical purposes, the strength or supportiveness of the tie that ego has with alter can be regarded as "behaviour" of alters. The term "behaviour" refers to a time-variable attribute of network members that can be assumed to co-evolve with the network. This conceptualisation allows us to investigate, for example, whether changes in network structure affect changes in the supportiveness of ego-alter ties, or (vice versa) whether alters with whom ego feels closer over time become more embedded in their networks.

(2) To analyze all networks simultaneously and to model the relation between the network level and the two relationship dynamics, we adopt a multilevel application of SAOM. This will be represented as random coefficient multilevel versions of SAOM, and implemented in SIENA. It enables us to use characteristics of respondents and of their overall networks as predictors of the dynamics at the two tie levels and of their recurrent relations. We will also model the link between the relationship dynamics and their aggregate outcomes.

(3) Apart from *changes in the strength or supportiveness* of ego-alter relationships (see point 1), researchers are also interested in predicting the *stability* of ego-alter relationships. Modelling changes in network constitution as endogenous to the network allows us to predict the termination of ego-alter ties by (time-constant or varying) alter characteristics, ego-alter characteristics, the structure of the network, periodic effects, ego characteristics (in a multilevel application) and interactions.

(4) An added feature is the development of a module for data manipulation that facilitates the very time-consuming transformation of personal network data for SIENA.

The model will be tested on empirical data, to observe how it behaves under varying data conditions (e.g., varying levels of density, stability and missing data) and to identify and specify potentially important predictors and control variables for personal network dynamics. Two data sets will be used for this aim, which are described below. We propose to extend both with a third wave of data. Apart from the substantive interest, this is necessary to fully develop the analytic framework.

Our **second aim** is substantive, namely to extend the empirical research about personal network dynamics we started in the previous ECRP. This concerns two studies:

*(1) Personal network dynamics in immigrant communities in Barcelona (Argentineans, Dominicans, Moroccans, and Senegalese). Wave 1 (2004-2006; sample of NSF study): N = 294; Wave 2 (2007-2008): N = 77. We propose to collect a third wave in this ECRP (2011, aiming at N = 75).*

This study investigated whether changes in the personal networks of immigrants over time reflected a tendency toward social integration in the host society, and which underlying (relational) processes were responsible for observed tendencies. We interviewed 77 immigrants twice over a two-year interval. In each wave, respondents provided lists of 45 persons they knew and with whom they had contact. Subsequently, they responded to questions about these persons and the relationships they had with them (e.g., country of origin, country of residence, setting, tie strength) and about relationships among these persons.

Observed changes in individual networks reflected subtle, segmented processes of social integration in or separation from the host society. Various mechanisms explained the direction of change. For example, migrants met Spanish people primarily through transitivity (meeting "friends of friends") and at the workplace. Consequently, migrants who entered dense, homogeneous networks of fellow migrants upon arrival in Spain and who found jobs in the lower segments of the labour market through these contacts had fewer opportunities to meet Spaniards.

On average, there was no tendency toward a larger integration in the host society (e.g., no average increase in the number of Spanish alters, tie strength with Spanish alters, structural embeddedness of Spanish alters, or interrelations among Spanish alters and fellow migrants). Rather, some respondents became more integrated in, or even assimilated to the host society, while others became more separated from it, or moved into ethnic enclaves. This seems to support segmented assimilation theory (Portes & Zhou, 1993). However, results also emphasized that social integration is not a linear process and that in the short run, temporal instability explains a considerable part of the dynamics in social relationships. Analyses of qualitative data showed that the observed changes were in line with changes in respondents' attitudes toward Spain, ethnic identifications and remigration intentions. So, changes were meaningful to the respondents, but they may represent temporal fluctuations rather than long-term tendencies.

We aim to extend this research with a third wave of data to study processes of social integration over a longer time-span (six years). The comparison between short-term and intermediate-term dynamics strengthens the original research. Second, the analytic framework we develop will allow us to answer more complex research questions (e.g., Under what conditions are contacts among ethnic groups in personal networks established? Which characteristics of respondents, alters, and networks explain whether ties with Spanish alters become stronger over time?), while controlling appropriately for the dependence structure.

*(2) Personal network dynamics in a local cohort of secondary school students over the transition to university. Wave 1 (2007): N = 69; Wave 2 (2009): N = 59. We propose to collect a third wave in this ECRP (2011; aiming at N = 69).*

This study follows pupils who were in the highest grade of pre-university education in 2007, in a small town near Seville. Their personal networks were measured in the academic years before and after the transition to university, and so was the sociocentric network of all pupils in the grade. Sixty percent of the pupils went to the University of Seville after the transition, which implied daily commuting and an introduction to a more metropolitan lifestyle. We distinguished two groups of students: those whose personal networks were disrupted by the transition, with large losses of school-related ties and decreases in density, and those who largely maintained their school-related ties and remained very active in the school network. We propose to collect a third wave of data, three years after Wave 1, to investigate whether the processes in the groups consolidated over time, or whether the second group set in a process of change at a later time point. The proposed analytic framework also allows us to test which aspects distinguish the two groups (e.g., whether the network structure conditions the maintenance or termination of school-related ties). Also, we will investigate how students replaced the support functions of the lost ties in the longer run.

#### *9.2.2.2. Methods*

For Study 1, we propose to re-interview 75 immigrants in 2011-2012, approximately six years after Wave 1. We intend to include as many participants of Wave 2 as we can trace, and to complement this group with respondents who only participated in Wave 1. Similar to previous waves, computer-assisted personal interviews will be held, to delineate the personal networks, characteristics of network members and the relationships respondents have with them, and the perceived relationships among network members (e.g., Lubbers et al., 2009). Subsequently, qualitative interviews about the observed changes in networks are held, which are used for the validation and interpretation of findings. The three sets of respondents (participants in all waves, in Waves 1 and 2, and in Waves 1 and 3) can be analysed jointly with the proposed analytic framework, described in Section 9.2.2.1.

For Study 2, all students of the initial sample will be approached ( $N = 69$ ). Similar to previous waves, networks of up to 25 alters will be delineated, followed by questions about alters, the relationships respondents have with alters, and perceived relationships among alters. A sociocentric questionnaire regarding the relationships among former schoolmates will also be administered.

#### *9.2.2.3 Work plan*

Year 1: Data collection, control and preparation; Development and testing of methodology with first waves; Organisation of seminar.

Year 2: Data analysis; Organisation of workshop; Substantive articles.

Year 3: Substantive articles and book.

#### *9.2.2.4 Planned results*

Results will be published in high-standing academic journals and a book on personal network dynamics. Furthermore, we plan to organize an international seminar about theories of personal network dynamics and an international workshop for disseminating the analytic framework developed in this project. The workshop will be held in collaboration with the Observatory of Personal Networks, a virtual archive for extended network data supported by the Spanish Ministry of Science and Innovation (CSO2009-07965-E). The data collected in this research will be deposited in the Observatory.

### 9.2.3 Justification of requested funding

Funding is requested for a full-time postdoctoral position during two years. The candidate, Dr. Lubbers, will develop the analytic framework, test it on the data, and organize the workshop and seminar. The other applicants will dedicate 50% of their research time to this ECRP for the duration of the project. All applicants will be involved in data collection, theory development and publication (Study 1: Dr. Molina and Dr. Lubbers; Study 2: Dr. Maya Jariego and Dr. De Federico). We also request funding for complementary data collection in two settings (immigrant communities and

students,  $N = 144$ ), as explained above. Travel expenses are calculated on the basis of annual meetings of the CRP and travels between Spanish team members. The workshop will be self-supporting and the seminar paid by other means.

Word count: 2,499

#### 9.2.4 Annexes

#### References

- Degenne, A., & Forsé, M. (2004). *Les Réseaux Sociaux*. A. Colin, Paris (2004).
- Degenne, A., & Lebeaux, M.-O. (2005). The dynamics of personal networks at the time of entry into adult life. *Social Networks*, 27, 337–358.
- Flap, H., (2004). Creation and returns of social capital. In: Flap, H., Völker, B. (Eds.), *Creation and Returns of Social Capital*. Routledge, London, pp. 3–24.
- Granovetter, M. (1995). *Getting a Job: A Study of Contacts and Careers*, 2nd Edition. University of Chicago Press, Chicago.
- Lin, N. (1999). Building a network theory of social capital. *Connections*, 22, 28–51.
- Lin, N. (2001). *Social Capital. A theory of social structure and action*. Cambridge University Press, New York.
- Louch, H. (2000). Personal network integration: transitivity and homophily in strong tie relations. *Social Networks*, 22, 45–64.
- Llopis, J. (2008). *Redes sociales y salud. Una aplicación práctica*. Paper presented at the XI Conference of Anthropology - Theoretical challenges and new practices, FAAEE, Donostia, Spain.
- Lubbers, M. J., J. L. Molina, J. Lerner, U. Brandes, J. Ávila, & C. McCarty (2009). Longitudinal analysis of personal networks. The case of Argentinean migrants in Spain. *Social Networks*, 32, 91-104.
- Maya Jariego, I. & Holgado, D. (2009). *Geographical mobility and personal transitions: Covariation of personal networks and social networks data*. European Research Collaborative Project Meeting on Dynamic Analysis of Networks and Behaviours. Oxford, June 30, 2009.
- McCarty, C. (2002). Structure in personal networks. *Journal of Social Structure*, 3, 1275 (1), <http://www.cmu.edu/joss/content/articles/volume3/McCarty.html> (visited: 1276 1-11-07).
- McFarland, D., & Pals, H. (2005). Motives and contexts of identity change: a case for network effects. *Social Psychology Quarterly*, 68, 289–315.
- Molina, J. L., Lerner, J., & Gómez Mestres, S. (2008). "Patrones de cambio de las redes personales de inmigrantes en Cataluña", *REDES-Revista hispana para el análisis de redes sociales, Volumen 15 #4* (36-60).
- Portes, A., & Zhou, M. (1993). The new second generation: segmented assimilation and its variants among post-1965 immigrant youth. *Annals of the American Academy of Political and Social Sciences*, 530, 74–98.
- Roberts, S. G., Dunbar, R. I., Pollet, T. V., & Kuppens, T. (2009). Exploring variation in active network size: Constraints and ego characteristics. *Social Networks*, 31, 138-146.
- Snijders, T.A.B. (2001) The statistical evaluation of social network dynamics. M.E. Sobel and M.P. Becker (eds.), *Sociological Methodology-2001*, 361-395. Boston and London: Basil Blackwell.
- Snijders, T.A.B., Steglich, C.E.G., & Schweinberger, M. (2007). Modeling the co-evolution of networks and behavior. In: *Longitudinal models in the behavioral and related sciences*, edited by Kees van Montfort, Han Oud and Albert Satorra, pp. 41–71. Mahwah, NJ: Lawrence Erlbaum.

### Short Curriculum Vitae of José Luis Molina (born 1961)

webpage <http://pagines.uab.cat/joseluismolina/>, e-mail: JoseLuis.Molina@uab.es

#### Academic degrees

- Ph.D. in Social Anthropology, Autonomous University of Barcelona (UAB), 2000.
- Master in Applied Anthropology, UAB, 1991.

#### Current academic positions and functions

- Full professor of the Department of Social and Cultural Anthropology, UAB.
- Coordinator of the Graduate Program on Social and Cultural Anthropology, UAB.
- Coordinator of the Laboratory of Social Networks and Communities, UAB.
- Member of the Ethics Committee on Human and Animal Research at the UAB.

#### Main editorial functions

Editorial Board, Revista REDES. Revista hispana para el análisis de Redes sociales.

Editorial Board, AIBR. Revista De Antropología Iberoamericana.

Editorial Board, Periferia. Revista de formació i investigació en antropología.

#### Selected publications

Molina, J. L. (2001). *El análisis de redes sociales. Una introducción*. Barcelona: Editorial Bellaterra.

Borgatti, S. P., Molina, J. L. (2003). "Ethical and Strategic Issues in Organizational Social Network Analysis", *Journal of Applied Behavioral Science*, vol. 39, 9-27.

Molina, J. L. (2007). "The development of social network analysis in the Spanish-speaking world: A Spanish chronicle", *Social Networks*, 29, 2, 324-329.

Molina, J. L., Fernández, R., Llopis, J., & C. McCarty (2007). "El apoyo social desde la perspectiva de las redes personales". In Zúñiga, M., *Redes sociales y Salud Pública*. Monterrey, México. Universidad Autónoma de Nuevo León. pp. 73-98. ISBN: 970-694-694-404-4.

Lubbers, M. J., Molina, J. L., & C. McCarty (2007). "Personal networks and ethnic identifications: The case of migrants in Spain", *International Sociology*, 22, 6, 720-740.

Brandes, U., J. Lerner, M. J. Lubbers, C. McCarty & J. L. Molina (2008). "Visual Statistics for Collections of Clustered Graphs", *Proceedings of the 2008 IEEE Pacific Visualization Symposium*, March 5-7, Kyoto, Japan.

Reyes-García, V., Molina J.L., Broesch J., Calvet, L., Huanca, T., Leonard, W.R., McDade, T.W., Saus, J., Tanner, S. (2008). "Do the aged and knowledgeable men enjoy more prestige? A test of predictions from the prestige-bias model of cultural transmission", *Evolution and Human Behavior*, 29, 275-281.

Lozano, S., Borge, J., Arenas, À. & J. L. Molina (2008). "Beyond Nadel's Paradox. A computational approach to structural and cultural dimensions of social cohesion", *arXiv:0807.2880v1* [physics.soc-ph].

Molina, J. L., Lerner, J., & S. Gómez Mestres (2008). "Patrones de cambio de las redes personales de inmigrantes en Cataluña", *REDES-Revista hispana para el análisis de redes sociales*, Volumen 15 #4 (36-60).

Lubbers, M. J., J. L. Molina, J. Lerner, U. Brandes, J. Ávila, & C. McCarty (2009). Longitudinal analysis of personal networks. The case of Argentinean migrants in Spain. *Social Networks*, 32, 91-104.

**Short Curriculum Vitae of Miranda Lubbers** (born 1973)  
e-mail: MirandaJessica.Lubbers@uab.es

**Academic degrees**

- Ph.D. in Social Sciences, University of Groningen, The Netherlands, 2004.
- M.Sc in Sociology, University of Groningen, The Netherlands, 1998.

**Academic positions and functions**

2008 - present: Postdoctoral researcher (Beatriu de Pinós fellow), Department of Social and Cultural Anthropology, Autonomous University of Barcelona, Spain.  
2007 - 2008: Assistant professor University Rovira i Virgili, Department of Management Studies, Tarragona, Spain.  
2006 - 2007: Postdoctoral researcher (Rubicon fellow of the Netherlands Organisation for Scientific Research), Department of Social and Cultural Anthropology, Autonomous University of Barcelona, Spain  
2004 - 2006: Postdoctoral researcher at the Groningen Institute for Educational Research, The Netherlands

**Selected publications**

- M. J. Lubbers, T. A. B. Snijders & M. P. C. Van Der Werf (2010). Changes in group composition and social networks of students across the first two years of junior high school. In press at the *Journal of Research on Adolescence*.
- M. J. Lubbers, J. L. Molina, J. Lerner, U. Brandes, J. Ávila, & C. McCarty (2009). Longitudinal analysis of personal networks. The case of Argentinean migrants in Spain. *Social Networks*, 32, 91-104.
- M. J. Lubbers, H. Kuyper, & M. P. C. Van Der Werf (2009). Social comparison with friends versus non-friends. *European Journal of Social Psychology*, 39, 52-68.
- U. Brandes, J. Lerner, M. J. Lubbers, C. McCarty, & J. L. Molina (2008). Visual statistics for collections of clustered graphs. *Proceedings of the 2008 IEEE Pacific Visualization Symposium*, March 5-7, Kyoto, Japan.
- M. J. Lubbers & T. A. B. Snijders (2007). A comparison of various approaches to the Exponential Random Graph Model: A reanalysis of 102 student networks in school classes. *Social Networks*, 29, 489-507.
- M. J. Lubbers, J. L. Molina, & C. McCarty (2007). Personal networks and ethnic identifications: The case of migrants in Spain. *International Sociology*, 22, 720-740.
- M. J. Lubbers, M. P. C. Van Der Werf, T. A. B. Snijders, B. P. M. Creemers & H. Kuyper (2006). The impact of peer relations on academic progress in junior high. *Journal of School Psychology*, 44, 491-512.
- M. J. Lubbers, M. P. C. Van Der Werf, H. Kuyper, & G. J. Offringa (2006). Predicting peer acceptance in Dutch youth: A multilevel analysis. *Journal of Early Adolescence*, 26, 4 – 35.
- M. J. Lubbers (2003). Group composition and network structure in school classes. A multilevel application of the  $p^*$  model. *Social Networks*, 25, 309 – 332.

**Short Curriculum Vitae of Isidro Maya Jariego** (born 1969)  
webpage <http://personal.us.es/isidromj/php/>

**Academic degrees**

Ph.D. on Social Psychology, USE, 1999.  
Master in Human Resources Management, USE, 1992.

**Current positions**

Full professor of the Department of Social Psychology, University of Seville.  
Coordinator of the Laboratory of Social Networks and Communities, University of Seville.  
Vice dean of Technological Transfer and International Programs.

**Main editorial functions**

Editorial Board, Revista REDES. Revista hispana para el análisis de Redes sociales.

**Key Publications**

- Domínguez, S., & Maya Jariego, I. (2008). Acculturation of Host Individuals: Immigrants and Personal Networks. *American Journal of Community Psychology*, 42, 309-327.
- Maya Jariego, I., & Armitage, N. (2007). Multiple Senses of Community in Migration and Commuting: The Interplay between Time, Space and Relations. *International Sociology*, 22 (6), 743-766.
- Maya Jariego, I. & Holgado, D. (2005). Lazos fuertes y proveedores múltiples de apoyo: comparación de dos formas de representación gráfica de las redes personales. *Empiria. Revista de metodología de ciencias sociales*, 10, 107-127.
- Araya, R., & Maya Jariego, I. (2005). Los puentes interlocales: las redes personales de los universitarios alcazareños en Sevilla. En Porrás, J. I. & Espinoza, V. (Eds.). *Redes. Enfoques y aplicaciones del análisis de redes sociales*, pp. 183-213. Universidad Santiago de Chile y Universidad Bolivariana. Santiago de Chile, Chile.
- Maya Jariego, I. (2004). La formación de comunidades de inmigrantes: desplazamiento en cadena y contexto de recepción. *Araucaria. Revista Iberoamericana de Filosofía, Política y Humanidades*, 6 (12), 83-91.
- Maya Jariego, I. (2003). Internet, amigos y bacterias: la alargada sombra de Stanley Milgram. *Araucaria. Revista Iberoamericana de Filosofía, Política y Humanidades*, 5 (10), 3-14.
- Martínez, M. F., García, M., y Maya Jariego, I. (2002). Social support and locus of control as predictors of psychological well-being in Moroccan and Peruvian immigrant women in Spain. *International Journal of Intercultural Relations*, 26 (3), 287-310.
- Martínez, M. F., García, M., y Maya Jariego, I. (2001). Una tipología analítica de las redes de apoyo social en inmigrantes africanos en Andalucía. *Revista Española de Investigaciones Sociológicas*, 95, 99-125. ISSN: 0210-5233
- Martínez, M. F., García, M., y Maya Jariego, I. (2001). El efecto amortiguador del apoyo social sobre la depresión en un colectivo de inmigrantes. *Psicothema*, 13 (4), 605-610. ISSN: 0214-9915
- Martínez, M. F., García, M., y Maya Jariego, I. (2001). El rol del apoyo social y las actitudes hacia el empleo en el emplazamiento laboral de inmigrantes. *Anuario de Psicología*, 32 (3), 51-65. ISSN: 0066-5126

## Short Curriculum Vitae of Ainhoa de Federico de la Rúa (born 1973)

e-mail: ainhoa.defederico@univ-tlse2.fr

### Academic degrees

- 2003: Joint Ph.D. in sociology, Univ. de Lille 1 and Univ. Pública de Navarra, summa cum laude. PhD. Awarded with the First price for the best dissertation in Sociology in Spain (2003) and for the best dissertation in Humanities and Social Sciences at the Univ. Pública de Navarra (2008).
- 1999: MA in Sociology, Univ. Pública de Navarra, Spain.
- 1998: MA in Sociology, Univ. de Lille 1, France. First in the promotion.
- 1996: Bachelor in Sociology, Univ. Pública de Navarra, Spain.

### Academic positions and functions

- 2007-to date: Associated Researcher of the research group *Social networks and structures* of the Sociology Department of the University of Malaga, Spain.
- 2008- to date: Associate Professor at the Univ. Toulouse II le Mirail, France.
- 2008: Visiting Scholar at the Autonomous University of Barcelona, Spain (3 months).
- 2007: Visiting Professor at the Autonomous University of Barcelona, Spain (4 months).
- 2004-2008: Associate Professor at University of Lille 1 - USTL, France.
- 2003-2002: Assistant professor at University of Lille 3 - Charles de Gaulle, France.
- 2002-2003: Marie Curie Fellow, ICS, University of Groningen, The Netherlands.
- 2000-2002: Assistant professor University of Lille 1 - USTL, France.

### Main editorial functions

- 2010-to date Main editor of the journal REDES. Revista hispana para el análisis de redes sociales.
- 2004-to date Member of the editorial board of International Sociology.
- 2002-to date Member of the editorial board of REDES specialized in Social Network Analysis.
- Many invited lectures, organizations of seminars and conference sessions

### Recent publications

- (2009) « El interaccionismo estructural en el análisis de redes sociales » (On structural interactionism in social network analysis) *REDES. Revista hispana para el análisis de redes sociales*. Vol. 17#12, 14 p.
- (2008) « Análisis de redes sociales y trabajo social » (Social network analysis and social work) *Portularia. Revista de Trabajo Social / Journal of social work* 8(1): 9-21.
- (2007) « Networks and Identifications. Towards a relational approach of social identity » in de Federico de la Rúa, A. (editor) (2007) Networks and Identifications. Special Issue. *International Sociology*. 22(6): 683-699.
- (2006) « Amistad e identificación. Las micro fundaciones de las pertenencias macro. Amigos europeos e identidad europea. » (Friendship and identification. Micro foundations of macro belongings) in Molina, J. L., Maya Jariego, I. Lozares Colina, C. and de Federico de la Rúa, A. (editors) *REDES. Revista hispana para el análisis de redes sociales*. Volumen especial. Universidad Autónoma de Barcelona: Barcelona, Spain. p.16-50.
- (2005) « Friendship networks and European identification. Transnational networks and identities of Erasmus students » in Oscar Santacreu (editor) *European Union Social Changes: Migrations, Participation and Democracy*. OBETS, Universidad de Alicante, pp. 191-226.
- With Ferrand, A. (2005) « Methods of social network analysis. » in Graziella Caselli, Jaques Vallin and Guillaume Wunsch (editors) *Demography: Analysis and Synthesis. A treatise in population*. Volume IV, Section II Observation auxiliary methods, teaching and research. Elsevier, Academic Press, pp. 745-781.
- (2004) « Los espacios sociales de la transnacionalidad. Una tipología de los modos de integración relacional de los migrantes » (The social spaces of transnationality. A typology of relational integration of migrants). *Araucaria. Revista Iberoamericana de Filosofía, Política y Humanidades* « Redes personales y determinación de estructuras meso en comunidades inmigradas » 6 (12): 120-140.
- (2004) « L'analyse longitudinale de réseaux sociaux totaux avec SIENA. Méthode, discussion et application. » (Longitudinal social network analysis with SIENA. Method, discussion and application) *Bulletin de Méthodologie Sociologique*. N° 84, octobre, pp. 5-39.