What Binds Us *When* With *Whom*?
Content and Structure in Social Network Analysis

By

Frans N. Stokman

ICS

University of Groningen

The Netherlands

December 2004

Extended version of keynote at the SUNBELT XXIV International Social Network Conference, Portorož (Slovenia) May 13, 2004

Social network analysis[1] studies the behavior of the individual[2] at the micro level, the pattern of relationships (network structure) at the macro level, and the interactions between the two. The analysis of the interaction structures that is involved in social network analysis is an important element in the analysis of the macro-micro-macro link, the way in which individual behavior and collective phenomena are connected with one another. In this perspective, social networks are both the cause of and the result of individual behavior. Social networks provide and limit opportunities of individual choices, whereas at the same time individuals initiate, construct, maintain, and break up relationships and by so doing determine the global structure of the network. However, individuals seldom consciously construct network structures beyond their own relationships. The overall network structures are often the 'unintended' effect of individual actions and can as such be called a "spontaneous order" (see e.g. Hayek 1973). Within this context, the main object of social network research is more or less durable relationships among individuals. Communication, advice, influence, friendship, and trust relationships are probably the most frequently studied relationships. Social network researchers are interested both in the evolution of such networks, their overall structure, and their effects on individual behavior and group performance.

The article aims to provide a heuristic for the elaboration of microfoundations for social network analysis that can be helpful for the choice of the social relationships to be studied and for the selection of structural aspects that are expected to be of importance. Such a theoretical grounding is too often lacking, resulting in ad hoc selections of the types of relationships studied and of ad hoc focus on certain structural aspects in the networks studied. Moreover, the heuristic shows ways to integrate current approaches in social network analysis and to specify an array of conditions under which they are appropriate or not. Elaboration of microfoundations involves an analysis of the dominant goals of individuals and social actors in different contexts and the instrumental value of the different types of social relationships for the realization of their goals. Similarly, which structures and positions in such networks create strong opportunities or strong constraints also depends on their instrumental value for goal realization at stake.

Section 1 introduces the reader to the concept of social capital and the different exchange approaches in social network analysis. Exchange approaches make explicit that there is always both cooperation and competition in and between relationships as well as between networks. In Section 2 we review a number of social network studies that are focused on the role of social networks in production. We argue that these studies focus too much on structure and neglect the content of relationships. In Section 3, the heuristic is elaborated based on the analytic primacy of the realization of goals that cannot be realized in isolation: joint production and sharing. Such goals not only include material gain, but also include hedonic goals ('feeling good'), and normative goals ('behaving

[1] I thank Tom Snijders, Stefan Thau, Rafael Wittek, Jacob Dijkstra, Bruce Bueno de Mesquita, Marcel Van Assen , David Willer and particularly Siegwart Lindenberg for their comments on earlier drafts of this text. Their comments considerably clarified my thoughts. Within a broader context, ideas in this article were developed in close collaboration with many persons of whom I particularly would like to mention Jelle Van der Knoop, Robert Mokken, and Reinier Van Oosten.

[2] Wherever we speak of individuals or individual behavior, both persons and social actors, like organizations or organizational units, are implied.

appropriately'). Sections 4 and 5 illustrate how this heuristic can be applied in two completely different contexts: policy networks and friendship networks.

1. Social capital and social exchanges

Social capital is the opportunity structure created by social relationships (Lin 1982, Flap and de Graaf 1986; Coleman 1988, Burt 1992). Social capital gives the individual access to resources of others that can be used for the realization of his[3] goals. The amount of social capital depends on the quantity of these resources, their value for the goal realization of the individual, and the willingness of others to grant them (Flap 1999). The idea of social capital and the access to resources of others is closely linked with exchange theories. Following Emerson (1981), Cook (1995), Molm (1997) and Lawler (2001), we distinguish between four fundamental types of exchanges with different network effects, namely (1) negotiated exchange, *i.e.* exchanges based on an explicit and binding agreement (*e.g.* business negotiations and negotiations about salary and promotion conditions); (2) productive exchange, *i.e.* exchanges aiming to combine resources for the generation of joint goods (*e.g.* work teams pursue a common product; a group of friends preparing a party or holiday); (3) reciprocal exchange, *i.e.* tacit, non-negotiated exchanges (*e.g.* helping a co-worker in completing his task assuming that the other will reciprocate in the future without being sure whether or when he will reciprocate); and (4) generalized exchange, *i.e.* providing resources to some members of a group while receiving other resources from other group members (*e.g.* helping a co-worker or friend completing his task and obtaining assistance from other team mates or friends).

If individuals valuate resources differently, they can improve outcomes for themselves and others by exchanging resources. Individuals can then be seen as *interdependent* as the value of the outcome depends on joint behavior of the individual and others. In exchange situations, individuals have typically both *common interests* and *opposed interests*. The common interests result from the fact that an exchange leads to better outcomes for the exchange partners, whereas the division of the gains over the partners results in opposed interests. This is most clearly the case in *negotiated exchange* where bargaining between the exchange partners lead to *simultaneous* agreement on the terms of the exchange by both partners (Cook and Yamagishi 1992; Cook 1995; Molm 1997; Molm et al 2000). *Cooperative game theory* aims to predict the terms of the exchange under the assumption that the agreements are strictly binding. *Network Exchange Theory* (NET) specifically investigates the effects of network structures on the choice between alternative exchanges and on the outcomes of the negotiations, i.e. the negotiated exchange rate (Willer 1999). NET has, both theoretically and in experiments, demonstrated that in particular possibilities to exclude others create disproportionately better outcomes for individuals. Subjects can exchange if and only if they possess certain endowments (resources) and attach different relative utility to the endowments. NET almost always represents such an exchange in a reduced form, namely by letting subjects split a common pool. Such a representation is illustrated in Figure 1. In Figure 1a, A and B can split a common pool of 24 points, as A and C can do. If two individuals come to an

[3] Wherever he or his is used, the female form is also implied.

agreement, each individual gains the number of points agreed upon, otherwise the points vanish. If each individual is allowed to make only one exchange, A can play B and C against each other by demanding a better deal than the other offers, resulting in a split close to 23 points for A and 1 point for one of the other individuals. In Figure 1b, the strong power position of B is weakened if two of the A's can make an exchange with each other as well. In that case, exchanges not involving B become an alternative, strongly reducing B's power position.

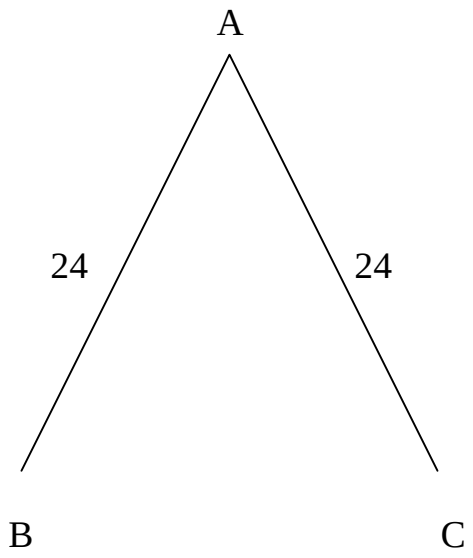

Figure 1a: A strong power exchange network

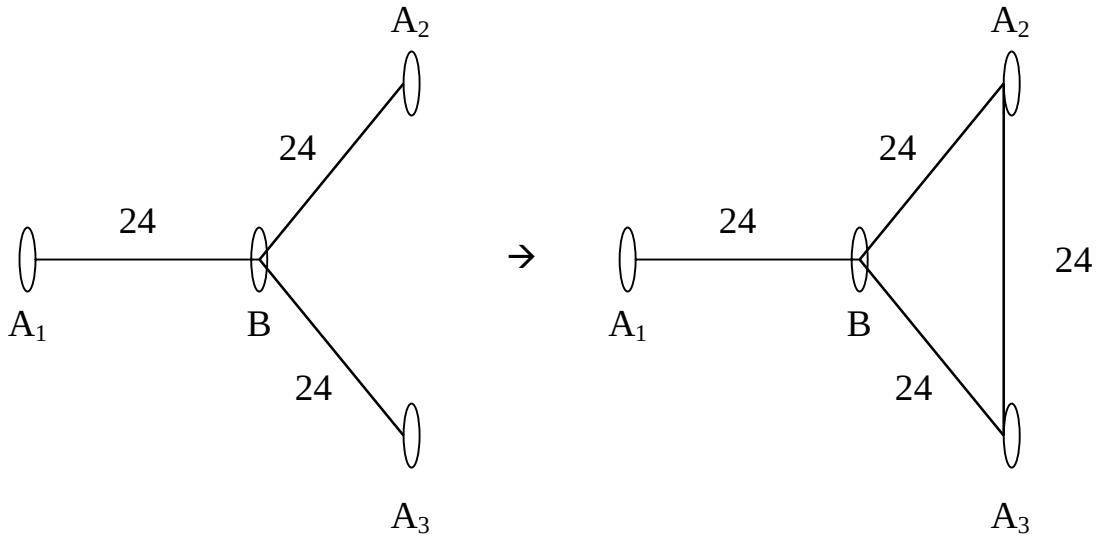

Figure 1b: From a strong to a weak power exchange network

An important insight gained from NET is that effects of network structures are context sensitive and cannot be generalized without taking the context and the type of negotiated resource into account. An almost trivial example is a change in the number of

exchanges an individual is allowed to make. The power advantage of A in Figure 1a vanishes completely if A is allowed to make two exchanges and is even weaker than those of B and C if A has to make both exchanges to gain. Context comes in as well if we do not confine our attention to isolated transactions, but recognize that transactions are embedded in longer lasting dyadic relationships and embedded in relationships with third individuals. Experiments have shown that individuals soon prefer less profitable exchanges with exchange partners they negotiated with earlier, than with unknown, newly assigned partners (Kollock 1994). Finally, context comes in because only material resources are exchanged in NET studies. Individuals are fully and purposively framed towards material gain only.[4] Notwithstanding the insights NET has yielded, the theory is therefore strongly limited to situations where transactions are isolated (interaction partners are strangers) and individual goals are fully focused on material gain.

In the other three types of exchanges, transactions are much more interlinked with each other in longer lasting relationships. In *productive exchange*, longer lasting interdependencies result from the fact that individuals have to combine resources for the generation of joint goods that otherwise cannot be produced or have to be produced at a higher cost. In *reciprocal* and *generalized exchange* situations, transactions within long lasting relationships are even more intertwined, as offers are made without being sure whether, when, or to what degree the other (or in generalized exchange another) will reciprocate. In such situations, cooperation of exchange partners is uncertain and free riding a problem. *Non-cooperative game theory* aims to specify the conditions under which cooperation can or cannot be expected. Network studies usually emphasize the information and control possibilities of networks to enhance cooperation (Raub and Weesie 1990; Flache and Macy 1996; Bienenstock and Bonacich 1992; Weesie et al 1997; Buskens and Raub 2004). In contrast to NET, longer lasting relationships and interdependencies are explicitly modeled and other goals than material gain are taken into account.

2. Networks and production

Management studies investigate the conditions for performance in production settings. Their studies show that outcome and task interdependencies should be embedded in clear institutional rules, salary and promotion systems, but also require Organizational Citizenship Behavior[5] or extra role behavior. We can easily see the network implications of institutional rules for power networks, salary and promotion systems for negotiated exchange networks and OCB and extra role behavior for reciprocal and generalized exchange and informal norms that generate such exchanges.

[4] Even in that situation, a split of a common pool has shown not to be the right representation of a real exchange, notwithstanding the years-long claim of the NET researchers (Van Assen 2001). Starting from the incentive structures of the individuals and representing exchanges fully by subjects with endowments and varying utilities for the endowments is particularly a prerequisite for the study of evolution of exchange networks and of effects of exchanges with positive and/or negative externalities for others (Van Assen et al 2003).

[5] Organizational Citizenship Behavior or OCB for short (Organ, 1988) is the most frequently studied form of cooperative behavior in management studies. It consists of employee behaviors that have an overall positive effect on the functioning of the organization, but cannot be contractually enforced.

These approaches are not integrated, however, nor focused on their specific contribution to production. The most well-known network approach that is specifically focused on production is Burt's brokers theory.[6] I therefore will first consider that approach before giving an integrative framework where all major network approaches can be related to each other.

In his 2000 review article 'The Network Structure of Social Capital' Burt gives ample evidence of the competitive advantage of broker positions in information networks. Brokers are able to combine information from different groups in an efficient way to develop creative solutions to problems, whereas in dense networks the same information is repeated time and time again. Later studies indicate that success of a team not only depends on open external networks, but also on a dense information network within the team, establishing common norms and good coordination facilities.
Burt's arguments are based on structural characteristics irrespective of the content of the information spread. It is likely due to this lack of interest in the content of the relationships that he wrongly lists the power advantage of broker positions in *negotiated exchange* networks as an indicator for the success of broker positions in *information* networks (Burt 2000, 357). The first is based on *exclusion*, as we have seen above, whereas the latter is based on *inclusion*. NET showed that the more exchanges have to be included, the less powerful the central actor is.

The opposite type of network position is a position within a dense network, at the local level represented by a triad in which all possible ties are present. Simmel (1950) gives much thought to the triad versus the dyad. The triad is special only if the other relationship is not completely united, shows both common and opposed interests. Only then, the third person can profit from his connections with the other two (*tertius gaudens* – the third who profits). That any relationship is a mixture of common and opposed interests is precisely why the triad is important for norm generation and trust: through reputation and control it confines the behavior of the two. It was an important contribution of Krackhardt (1999) that he identified Simmelian brokers, persons in different dense networks, as a special category that is likely to experience norm conflicts.

Whereas Burt's and Krackhardt's arguments are mainly structural, Podolny and Baron (1997) show that the competitiveness of brokers is dependent on which network is being considered. They show that brokers are beneficial in networks that conduit resources in position-to-position ties (like task advice and performance feedback), but disadvantageous in networks of affective person-to-person ties (like organizational gossip and social support). This implies that not only structure counts, but content as well.

In summary, I conclude that there is at present very strong evidence that social networks matter in joint production and the formation of norms and trust. The arguments are predominantly structural, however, and content plays a subordinate role. In addition, we have extensive social network research on the different types of network exchanges, but their importance can only be understood if they are studied in relation to each other. Again, this has not been done. In order to link different types of network exchanges, I will argue that it is necessary to give analytic primacy to goals that cannot be realized in isolation and thus lead to joint production and sharing. These are goals not only in the context of material gain, but also hedonic ('feeling good') and normative goals

[6] See Borgatti and Foster (2003) for a broader review of network studies in organizational research.

('behaving appropriately') (see Lindenberg 2001). What we need is a heuristic to select the *combination* of processes and corresponding ties that matter in the given setting. It implies reflection on *what* is produced by *which* network under *which* structural conditions and *why.* The heuristic presented below is based on the group theory of Lindenberg in his 1997 article on Grounding Groups in Theory.

3. Heuristic to derive networks for joint production

In reviewing the literature on group theory, Lindenberg shows that different approaches emphasize three types of interdependencies, namely functional, structural, and cognitive interdependencies. Functional interdependencies consist of outcome and task interdependencies that are connected to joint production. The cognitive interdependencies consist not only of the cognitively mediated functional interdependencies, but particularly also of external cues about what is and is not appropriate behavior. The structural interdependencies concern the more or less stable ties between the individuals and the interdependencies that result from the pattern of ties. In the middle of the last century, Lewinian field theory (of which Sherif and Festinger and their group dynamics program are the most well-known representatives) recognized all three interdependencies but tools for a real integration of the three lacked at that time, resulting in subsequent rival approaches that focused on just one of them. Lindenberg attributed the failure of field theory to the fact that it repeatedly defined groups in terms of functional interdependencies, but focused mostly on the cognitively mediated consequences of functional interdependencies (such as conformity pressures), resulting in very little direct focus on functional interdependence in group dynamics (Lindenberg 1997 p.287). Integration of functional, cognitive, and structural interdependencies was furthermore hampered by the strong dyadic orientation in theories that started from the perspective of social exchange (Lindenberg 1997 p.312). I agree with Lindenberg that joint production should be the starting point and that such a perspective facilitates the theoretical integration of different exchange theories by specifying their own specific contributions to joint production. The heuristic therefore gives the analytic primacy to functional interdependencies between the individuals: their outcome and task interdependencies. A profound analysis of these interdependencies comes first. Outcome and task interdependencies determine the functional structure: with whom do we have to communicate, coordinate, exchange resources, in which sequence for the realization of the common goal at stake? The functional structure is one of the important determinants of relationships and the structural interdependencies associated with them. Both functional interdependencies and structural interdependencies create cognitive interdependencies. The corresponding cognitive structure is the second major determinant of structural interdependencies.

It is important to realize that the ties social network analysis usually studies normally serve several simultaneous functional interdependencies in a production-oriented organization. In our universities we have different functional interdependencies for teaching, research and administration. Each of these functional interdependencies gives rise to different relationships and these relationships may or may not coincide with the same tie. The colleagues with whom we have to coordinate our teaching only partially overlap with our colleagues with whom we are involved in joint research projects. Different functional interdependencies therefore lead to only partially overlapping

relationship structures and may well lead to conflicting cognitive structures, of which different perceptions of priorities among the many tasks to be performed is just one of them. This is illustrated in Figure 2 from the perspective of one focal individual. His different functional interdependencies for joint production determine both his cognitive and structural interdependencies, the two interacting with each other. The single arrows from functional interdependencies to cognitive and structural ones do not imply that existing cognitive and structural interdependencies cannot be used to build related or new functional interdependencies. On the contrary, networks and joint norms can be exploited for other functional interdependencies than the original ones from which they emerged. In such situations it are however again the new functional interdependencies that subsequently codetermine the cognitive and structural interdependencies.

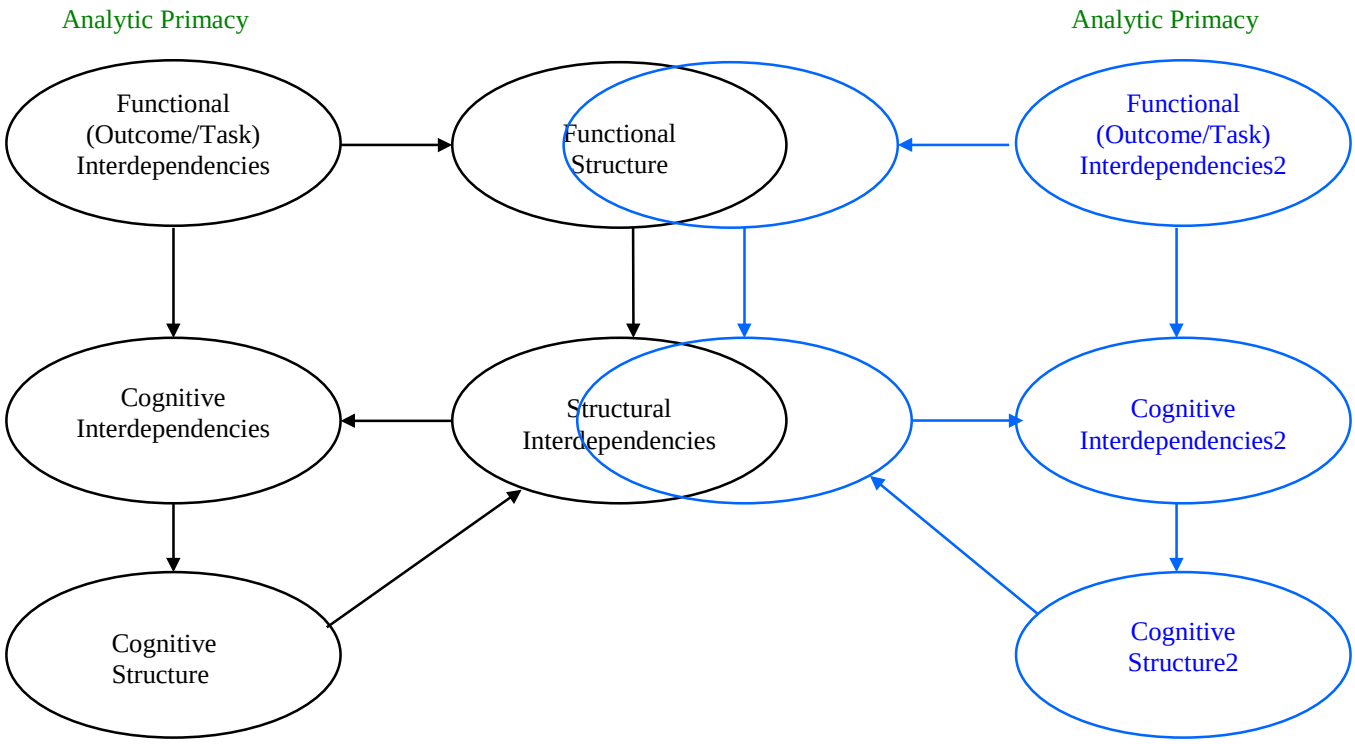

Figure 2: Heuristic

The analysis of functional interdependencies is not confined to gain oriented activities. We are also functionally interdependent with others to realize all kinds of settings and activities in which we can 'feel good' (drinks, friendships, sports etc). And the best we can obtain is to 'feel good' with all or some colleagues with whom we have to collaborate in our work situation.

We may therefore conclude that most of our ties with our colleagues are multifunctional, related to functional interdependencies that are steered by the

organizational objectives as well by interdependencies outside the organization. Such ties may well be used for gain purposes and hedonic aims. Each of these aims may well generate different cognitive interdependencies with different and even conflicting norms about how to behave. Social network analysis should focus on which structures are important for which goals and on the conditions under which the different functional interdependencies coalesce and under which conditions they hinder each other. *This requires designs in which different social ties are analyzed simultaneously and relationships can be decomposed in terms of the functional and cognitive interdependencies they serve.*

As said before, the strong message social network analysis has given and shown, is that social relationships and certain social structures are indispensable both for successful production and for the generation of common norms. The analytic primacy of functional interdependencies also leads to the conclusion that social relationships are *dependent* rather than *independent* variable. This is the weak side of informal relationships: if functional interdependencies become vague and multi-interpretable, *e.g.* due to institutional changes, relational cues become unclear ('are you helping me or do you show off your knowledge?') and informal relationships tend to break down.

We also may expect problems if cognitive and structural interdependencies do not match with functional interdependencies. That the functional and cognitive interdependencies can be in conflict with each other can be well illustrated by what happened at the finish of the 200-kilometer ice skating competition in Friesland (The Netherlands) in 1956. As in cycle racing, informal teams may well work together to bring the best racer in a winning position (and it is difficult to win the competition without a highly solidary and competent team), but in the end each individual is expected to compete for the winning position. In 1956, in the 11th 'Eleven Cities skating competition' of the last century (in the whole century only 15 were held), five men operated during the whole match as an informal team (with a sixth person) and succeeded to pass the finish in a winning position. To the disgust of the public and the organizers, they decided to pass the finish as a team. The organization decided to give no medals to anybody in that year. Whereas all winners of the other 14 competitions in the former century became heroes for the rest of their lives, these men never received any honor and were never invited to any official ceremony. It's a nice example of how strong solidarity can be incompatible with a competitive setting and that strong solidarity can be counterproductive, as Flache and Macy showed in their simulation studies and experiments (Flache and Macy 1996).

Problems may not just arise because of conflicting or vague functional interdependencies or non-matching functional and cognitive interdependencies. Problems are also likely to arise if pairs of persons perceive different cognitive interdependencies, *e.g.* when one person perceives the other as his friend, whereas the other perceives the first as his business partner. Problems may finally arise if the cognitive and structural interdependencies do not match with one another and, as a consequence of that, do not support one another.[7]

[7] Social network researchers repeatedly showed that cognitive structures may well fundamentally deviate from the actual interaction structures (Killworth and Bernard 1976; 1979; Freeman et al 1987; Kumbasar 1994), but the behavioral consequences received less attention.

Just as we expect important differences in universities in functional interdependencies for research, teaching and administration, we expect important differences in functional interdependencies in Research and Development teams in the conceptualization phase versus the commercialization phase. In the first, creative solutions based on different sources of information determine success, whereas in the second close coordination is likely to be determining. In a similar way, we expect the functional interdependencies of account managers (*e.g.* in banking products) to differ fundamentally between the specification phase of Taylor-made products for clients and the implementation phase. In both situations we expect open networks in the specification phase to contribute to individual performance, whereas careful coordination in the implementation requires closed networks. First evidence confirming these expectations was indeed found in David Dekker's network study among 57 persons in a banking account managers department and four service departments. We expected that the best performing persons have *simultaneously* a low constraint (open) network in specification activities and a high constraint (dense) network in service delivery activities. Indeed, the best performing persons combine a low constraint network in specification with a high constraint network in delivery (Dekker 2001; Dekker et al forthcoming) and the least performing persons have opposite networks in both. In other words, contrary to Burt's assessment, the important message is not: low constraint outside one's own group and high constraint within ons's own team, but even in one's own group open networks in one activity and closed ones in another, depending on the functional interdependencies in the two activities.

Above we claimed that not only functional interdependencies determine structural interdependencies, but that there is an interaction between cognitive and structural interdependencies as well. As cognitive interdependencies consist of norms on appropriate behavior, and trust strongly depends on past experience of appropriate behavior, we claim that cognitive interdependencies can best be studied on the basis of *trust* networks. In contrast to brokers in certain information networks, we expect that brokers in a trust network experience role ambiguity because they are under pressure from different groups with different norms. And such role ambiguity is expected to reduce performance, as is corroborated in the study of Dekker.

Can we infer specific contributions of different social exchange theories to joint production from this heuristic? When negotiated exchange theory succeeds to cross the border of experimental studies into the real world, it may become relevant for the investigation of legal labor contracts without which enforcement of long-term contributions to joint production is difficult to realize. Such contracts connect joint production with external sanction (legal) systems to enforce cooperation. Similarly, legal regulations help to embed functional interdependencies in institutional arrangements. More importantly, such legal labor contracts and institutional embedding are preconditions to build trust that non-cooperative individuals can effectively be sanctioned or even fired (see Lindenberg 2000). The generation of trust and the concomitant generation of common norms and expectations are important preconditions for individuals to engage in reciprocal and generalized exchanges where individuals risk exploitation because efforts of others cannot be enforced legally, but such exchanges are essential for joint production. Reciprocal and generalized exchange is therefore more directly connected with cognitive interdependencies. Trust and reciprocal norms may

even imply that the legal sanction possibilities never or seldom have to be used (see Ellickson 1991). It can even be stated that trust and common norms are likely to be undermined each time the external sanctioning systems have to be used. Consequently, the contribution of different forms of social exchange to joint production can only be understood in their interaction effects. Such studies are missing at present. In a similar vein, if social networks are not carefully linked to functional and cognitive interdependencies, we may miss important network determinants for individual contributions to joint goods. Still, hardly any social network study has investigated moderating conditions on the relationship between network structure and outcomes, such as performance. Most studies more or less assume that the effect of networks on behavior is context-independent.

4. First Illustration of heuristic: Policy Networks

The necessity to arrive at a collective outcome can be seen as a special case of functional interdependence and joint production. There is a *common interest* to arrive at an outcome, there are *opposite interests*, as each of the stakeholders want an outcome as close as possible to their own position. Consequently, we can use the heuristic given. Collective decision making is not confined to politics. Most of the processes within organizations can be seen as collective decision making processes as well: which strategy should the organization follow, how should different production processes be designed, how can we design processes and salary systems in such a way that we get the right mix of competition and solidarity? I will show that three types of networks are at stake, related to three fundamental processes through which collective outcomes are produced. All three need to be studied simultaneously. I will specify the conditions which one is likely to dominate in the decision making.

At present, we see four nonintegrated approaches, three of them network approaches, and the fourth a game theoretic approach, not based on networks.

The first are network influence models that model social influence on individual opinions and attitudes. These so-called contagion models (Friedkin and Johnsen 1990; 1997; 1999; Marsden and Friedkin 1993; Leenders 1995; 2002) assume that opinions and attitudes of actors in a social system only partially depend on individual characteristics but are also shaped by social influence. The social influence part is represented in an influence network, reflecting the dyadic influence of actors on each other. Technically, spatial autocorrelation algorithms are used to capture such processes. In the social influence part of the model, the opinions or attitudes of persons are modeled as the weighted mean of the opinions or attitudes of the persons who have an influence relationship to the person. In the literature, a large variety of weights have been proposed, as Leenders (2002) has shown.

The second are network extensions of Coleman's exchange model (1972; 1990). Coleman assumed that actors have interest in some events and control others. By exchanging control over events in which they are less interested for control over events in which they are more interested, mutually beneficial outcomes can be achieved. The major mechanism in this model is that of a market. The model is able to predict the division of control over the actors in equilibrium. Power (and value of the events) are derived from the model and are not ad hoc introduced. Whereas the original Coleman model assumed

unrestricted exchange possibilities, later models introduced unequal exchange opportunities by connecting Coleman's exchange model to networks (Marsden and Laumann 1977; Laumann et al 1987; König 1997; Pappi and Henning 1998). In these models, structural constraints force actors to exchange with particular others. Moreover, the models were adapted to predict outcomes on dichotomous yes/no decisions. Coleman's model became thus extended to outcomes of collective decision making processes.

The third are the Network Exchange Models we introduced above. Whereas Coleman's model is based on global equilibria, Network Exchange Models focus on network effects upon exchange rates between pairs of actors. Power arises primarily because of the possibility to exclude others from exchange and is defined in terms of shifts of exchange rates in one's own advantage.

The fourth is the approach of Bueno de Mesquita (Bueno de Mesquita et al 1985; Bueno de Mesquita 1994). He stresses that the nature of politics is conflict resolution in which power dominates over arguments or exchange. In situations of conflicts of interests between actors, reflected in different positions regarding the desired outcome of political decisions, collective outcomes arrive through a process in which actors challenge each other's positions. In such challenge processes differences in power and salience play an important role. To the degree that the salience for the issue is lower and the power dominance for the other position is larger, the actor will be inclined to give up his own position. It saves unnecessary costs to uphold a position on an issue that is only marginally related to one's own interests. The process is therefore represented by a non-cooperative game.

It is unclear under which conditions which approach is appropriate. It seems only of marginal concern to the authors; they even hardly cite each other. Two of the four approaches make predictions only at the local level: individual opinions in the contagion models and exchange rates in dyads in the Network Exchange Models.

Understanding the interdependencies that arise in collective decision making requires a clear distinction between ultimate goals and instrumental goals. Instrumental goals can be considered as means through which ultimate goals can be realized. Utility functions for ultimate goals are usually monotonically increasing or decreasing. Ultimate goals dominate in political discussions, but controversial decisions usually concern instrumental goals. Instrumental goals typically have an optimum: too much is as bad as too little. The preferred optimum typically depends on the weighting of the different ultimate goals. As the weighting will depend on the constraints of an actor, different actors will likely support different optima. Moreover, as ultimate goals of certain actors are more affected by such a measure than of others, actors differ in their interest in the outcome. On the basis of this reasoning we model collective decision making as decision making about controversial issues with single peaked preference functions. Solutions of problems may well require simultaneous decisions on several issues. Different issues should represent rather independent controversial elements of the solution and as a set should cover the full range of possible outcomes.

Figure 3 gives an example of a fishery infrastructure problem the European Commission (EC) wanted to solve with its COM (98) 728 proposal.[8] The proposal is related to at least two ultimate goals: long-term survival of fish and maintaining a competitive European fishery industry. Experts identified two controversial issues in the EC proposal about which a decision had to be taken. The first concerned the size of the scrap-build penalty. The actors in favor of a high scrap-build penalty thought this would restrict the demand for subsidies to renew the fleet. This would mean that newer, more efficient, boats with higher "killing power" would be introduced at a slower pace. In the proposal, the European Commission called for a scrap-build penalty of 130 tonnes for each new ship of 100 tonnes. The UK favored the most extreme position, a scrap-build penalty of 150 to 180 tonnes of old ship for each new ship of 100 tonnes. On our scale we scored that position 100. The other extreme, scored as 0, was the status quo position at that time, requiring a penalty of 100 tonnes for every new 100 tonnes. Most member states took the status quo as their initial position. According to the expert, the Commission's most favored outcome on this issue (a scrap build penalty of 130 tonnes) should be scored as 90 on our scale, much closer to the UK's position than to the status quo. Two member states, Denmark and Austria, were scored in between 90 and the most extreme score (See Figure 3).

The second controversial element was the proposed linkage of the subsidy with the annual and final objectives of a member state within the context of a Multi Annual Guidance Program (MAGP). These objectives are designed to restrict the size of the fishing fleet. The specific policy question addressed here was the extent to which member states should have to achieve their objectives, as defined by the MAGP, to qualify for the subsidy. Most member states have some difficulty meeting the MAGP objectives. Introducing strict adherence to these objectives as a necessary condition for obtaining subsidy for building new boats would have negative financial consequences for the sector. The European Commission took the position that strict adherence to all MAGP objectives should be condition for receiving subsidy for fleet renewal. This position was scored as 100 on our scale. The Netherlands was said to have most difficulty meeting the MAGP objectives, which caused the Dutch to take the most extreme position on the other side. They would have preferred no linkage at all (the status quo position at that time). Most other member states took intermediate positions (See Figure 3).

The final decision on the two issues is 0 on the Scrap-building issue (a penalty of 100 ton for every new 100 ton), and 70 on the Linkage issue (linkage with annual objectives). The Netherlands and the UK abstained in the final vote, while all other actors voted in favor.

[8] The proposal is part of a larger study on EU decision making by an international project group. On the basis of interviews with experts and analysis of documents 162 controversial issues were identified in 66 European Commission proposals in the period 1996-2000. Issues were specified in such a way that all positions, the actual outcome, and (whenever applicable) the status quo could be located on a scale ranging from 0 to 100. The saliences of the issues for the actors were measured on a scale from 0 (no salience at all) to 1 (highest possible salience). Again, experts were interviewed to obtain the initial positions and saliences of all EU Member States, the European Commission and the common position of the European Parliament for each of the 162 issues. The relative capabilities of the actors were based on their score on the Shapley-Shubik index. See Stokman and Thomson 2004 and Thomson et al 2005 for more details. The example is also used in Van Assen et al 2002.

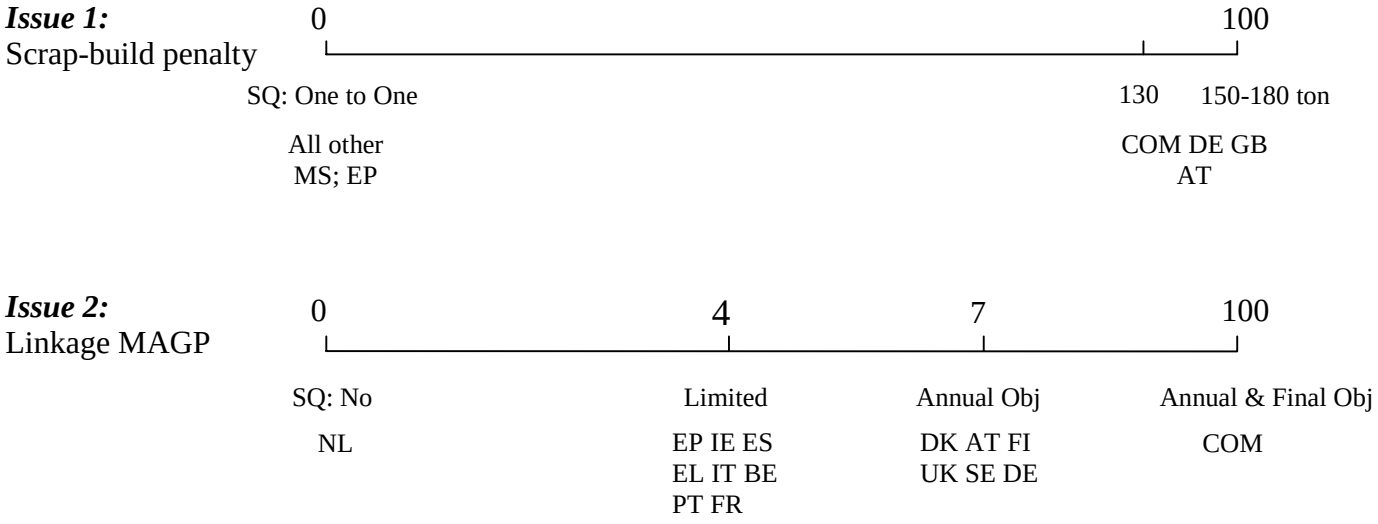

Figure 3: Two issues in COM(98) 728 on fishery infrastructure

The dynamics in the decision making process results from the fact that each actor, with different intensity and potential, tries to realize his position whereas only one outcome can be chosen. In a complex situation and if many actors are involved, actors will try to build a coalition as large as possible behind their initial positions or behind a position that is as close as possible to theirs. In that way, actors hope to affect the positions of the final decision makers in order to reach a collective outcome that reflects their interests as much as possible. The dynamics of decision making is therefore primarily based on processes through which other actors are willing or forced to change their positions. Three fundamental processes can result in such shifts in positions: *persuasion, logrolling, and enforcement* and each of them is associated with its own specific interdependencies. Table 1 gives an overview of these three processes, the types of networks associated with these processes, which approaches are associated with which process and the conditions under which each of the processes is expected to dominate collective decision making. These bargaining processes can be seen as to precede formal decision-making and affect the final positions of the actors in the decision-making[9].

[9] In his sociological critique of economic models of politics, Udehn (1996) derives the same three fundamental processes from the literature.

Table 1: Fundamental Processes, Dominant Networks, Approaches, Conditions for processes to dominate

Fundamental Processes	*Dominant Networks*	*Present Not-integrated Approaches*	*Integrated Approach*	*Conditions for process to dominate*
Persuasion	Information Networks	1. Contagion Models 2. Reciprocal Exchange Networks	Cooperative Nash Bargaining Solution for all relevant actors	1. Reversal point very unattractive 2. Overall coalition possible/sub coalitions difficult to form 3. Risk averse actors
Logrolling	Negotiated Exchange Networks	3. Coleman Exchange Model 4. Network Exchange Theory	Voting position exchange model (Cooperative solutions for subsets of actors with positive and/or negative externalities for others)	Opposite positions and complementary interests
Enforcement	Hierarchical/ Power Networks	5. Non-cooperative Models	(Non-cooperative) Challenge model	Opposite positions and non-complementary interests

Through *persuasion*, actors aim at changing each other's initial positions as well as the salience of these positions (Stokman et al 2000). The mechanism by which this is achieved is through convincing information. Common interests, based on functional interdependencies, can be argued to be stronger than diversity of interests. The conditions under which this is likely to happen are as follows (see Table 1). Not arriving at an overall agreement, involving all relevant actors, is seen as very undesirable because of the prevalence of the common interests. This facilitates the feasibility of the grand coalition of all actors, particularly when smaller coalitions are difficult to form. The latter is typically the case when coalitions change from issue to issue and stable coalitions do not exist over time.[10] Such conditions can only be reached when the actors are embedded in a dense trust network or severely punished when they deviate. Actors need to be confident that the information given is sincere and not strategically manipulated. Pursuing one's own personal gains is allowed as long as it does not inflict harm on others and as long as personal gains are compatible with common interests. Within this context, actors can be confident that present concessions to actors who have a high interest in present issues will be compensated in a future situation when their own interests are at higher stake. Reciprocal and generalized exchanges are therefore integral part of decision making by persuasion (and not of decision making by logrolling as their name may suggest).

Logrolling and enforcement typically do not affect initial positions and saliences. Logrolling can be seen as a process of negotiated exchanges. The result is that actors are willing to support another position on an issue that is of relatively less importance to them in exchange for support of another actor for the issue that is relatively more important to them. In a similar vein, actors can feel enforced to support another position under the pressure of power. These two processes are primarily likely if initial positions fundamentally differ because of other weighting of ultimate goals. In such situations, arguments do not help to bring initial positions closer to one another, so coalitions can be built only through processes that affect the final or voting positions of actors. Whereas information and trust networks dominate under persuasion, negotiated exchange networks determine the exchange possibilities under *logrolling*. Network Exchange Theory studies given and static networks. In contrast, we derive exchange networks from the distribution of positions and saliences of the stakeholders on the issues (see Figure 4).[11] Profits and losses connected to position shifts are determined on the basis of the shifts in outcomes on the two issues that result from such shifts.[12] Actors from two groups with opposing positions can profit from position exchange if the relative salience of the two issues for

[10] Under these conditions and assuming quadratic loss functions on the issue continua (implying risk averse actors), Achen (2005) showed that the average of the policy positions, weighted by the product of each actor's power and salience, is a first-order approximation of the cooperative Nash Bargain Solution (NBS).
[11] The Coleman exchange model has serious disadvantages as a model of collective decision making (see Stokman and Van Oosten 1994). The most important one is that the Coleman model is based on exchange of control. Utility of control is assumed to be monotonically increasing and, consequently, has more features of an ultimate goal rather than of an instrumental goal.
[12] The utility loss of an outcome on an issue for an actor is assumed to be equal to the distance between the policy position of that actor and the outcome on the issue continuum, weighted by the salience of the actor for the issue. In addition, the model assumes that the actors' initial expectations of outcomes are equal to the mean of the initial positions of the *n* actors, weighted by their capability times salience (see note 10).

each of them is different (see Table 1) (Stokman and van Oosten 1994). A position exchange is then profitable for both, but also has important side or externality effects on others' utility. This can clearly be seen in Figure 4. Assume an actor of type *D* attaches relatively more salience to issue 1 than to issue 2 if we compare his saliences with those of an actor of type *A*. Then issue 1 is *D*'s demand issue and *A*'s supply issue. Position exchange between *A* and *D* implies that *A* is willing to shift his position on issue 1 in the direction of *D*, whereas *D* does the same on issue 2. If they do, they both shift away from *B* in the direction of *C* on both issues. In that case, *B* is punished doubly and *C* rewarded doubly, while none of the two is engaged in the exchange. Positive and negative externalities emerge also within the *A* and *D* group, if *A* and/or *D* consist of more actors. An exchange of two actors from the *A* and *D* group will have positive externalities for other members in the *A* and/or *D* group if the relative saliences within each group are relative homogeneous. Otherwise, such an exchange may well have negative externalities within the *A* and *D* group as well. In the most extreme case, one *A* member may want to use issue 1 as its supply issue whereas another *A* member may want to use that issue as its demand issue.

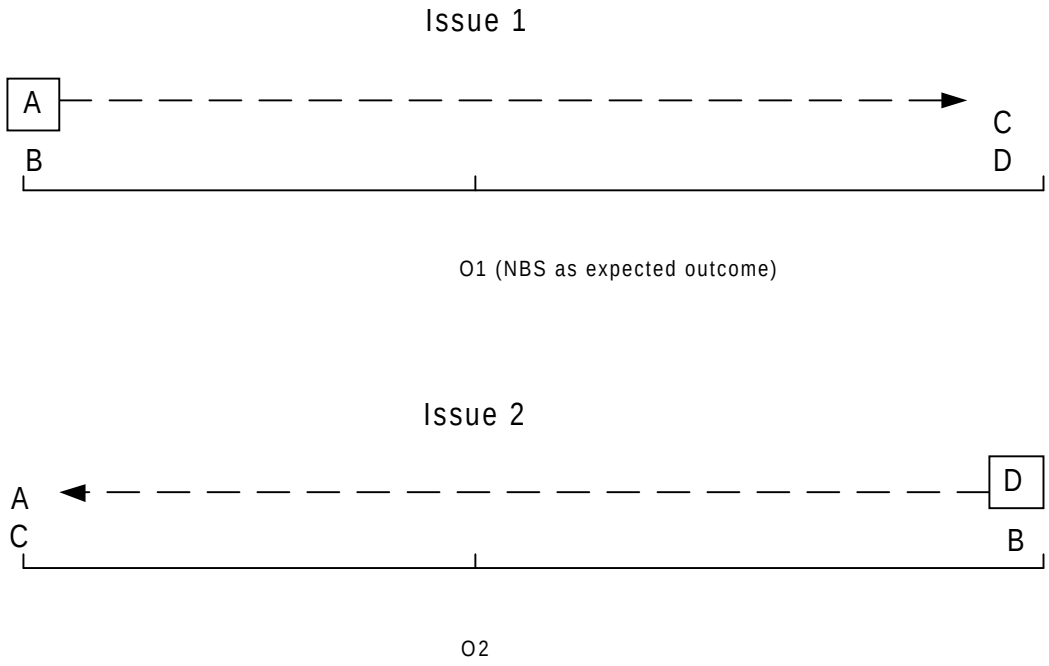

Figure 4: Effects of an exchange between actors of type A and type D

Figure 5 gives the division of the Member States, the European Commission and Parliament into the four groups for the two issues in COM(98) 728 on fishery

infrastructure. Figure 5 shows that group *C* is empty, precluding exchanges for the group *B* due to lack of exchange partners. Group *A* consists of 8 actors and group *D* of four. This results in an exchange network with 32 possible exchanges, but one of them is excluded as the European Parliament and Great Britain have the same relative saliences for the two issues.[13] As all members of group *D* have a higher relative salience for the MAGP issue than all members of group *A*, the first issue is the supply issue for the group *D* (in contrast to Figure 4 where the first issue was *D*'s demand issue) and all exchanges go in the same direction: the initial position of the group *B.* The final outcome nicely corresponds with the initial positions of the group *B* members.

		Linkage to Multi-Annual Guidance Program	
		No or Limited Linkage	*Linkage to Annual and/or Final Objectives*
Scrap-Build Penalty	*One to One*	*A*: EP IE ES EL IT BE PT FR	*B*: DE SE FI
	Destroy 130 or More	*C*: *EMPTY*	*D*: COM DE AU UK

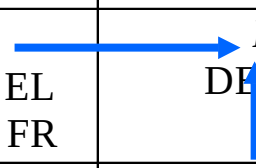

Figure 5: An exchange with positive externalities only in COM(98) 728

We can now specify under which conditions logrolling based on bilateral exchanges will be compatible with cognitive interdependencies based on persuasion and consensus building. The following three conditions should hold simultaneously:

1. One of the four groups should be empty. Without loss of generality, let us assume that group *C* is empty (as is the case in Figure 5).
2. The relative saliences in the two groups that can exchange is such that the exchange is going in the direction of the non-empty group (In the example of Figure 5, the *A*-*D* exchange is going in the direction of the *B* group).
3. The relative saliences in the two groups that can exchange are such that there are no negative externalities within their own group. This occurs under the following

[13] NET would predict high power for the group *D* as it can exclude members of the group *A*. Due to the fact that all actors are affected by the shifts of the outcomes due to bilateral exchanges, this is not true, however.

condition. Without loss of generality, let us assume that an actor in the *A* group has the highest relative salience for issue 1 compared to all other actors in the *A*-*D* group. No negative externalities occur if the exchange rate is lower than the relative salience of the *A* actor with the lowest relative salience for issue 1 and higher than the relative salience of the *D* actor with the highest relative salience for issue 1. This implies that negative externalities within the own group are unavoidable when actors of the one group embed some actors of the other group in the ordering.

In all other cases, negative externalities of bilateral exchanges over pairs of issues will harm consensus building, unless actors with negative externalities are compensated on the basis of third issues.[14]

In the context of the European Union, the distribution of positions and saliences on the fishery infrastructure is an exception rather than the rule among the 66 controversial European Commission proposals studied. Overall the negative externalities of model-predicted bilateral exchanges are about twice as high as the positive externalities, showing that bilateral exchanges in these proposals tend *not* to contribute to consensus building. Persuasion and logrolling are here apparently in conflict with one another (Arregui et al 2005).

Enforcement, not persuasion, characterizes the power process in collective decision making (see Table 1). Stakeholders try to build as large a coalition as possible behind their own position regarding the desired outcome by showing that they have sufficient power to enforce a decision and/or to block other alternatives. Solutions to substantive problems are not sought by arguments but by showing that there is sufficient support to enforce the decision on the basis of the formal procedures and/or informal power arguments. Compliance to solutions dominates over endorsement of solutions. Outcomes of decisions can be seen as the result of a non-cooperative game in which no binding agreements are made (Bueno de Mesquita et al 1985; Bueno de Mesquita 1994). If enforcement dominates decision making about organizational policies, hierarchy dominates over arguments also in the preparatory stage of decision making. In such a situation, the goals of the organization are likely not primarily seen as common goals, but as the goals of and set by the top of the organization. Such a setting leads to a cognitive interdependence model in which personal relationships are primarily seen in the light of their hierarchical place and ordering. In other words, power networks dominate the outcomes of collective decision making processes.

Again, as bilateral negotiated exchanges may well be compatible with consensus or even enhance consensus building (in the presence of large positive and the absence of negative externalities), it is unlikely that persuasion on the basis of high common interests will long survive without clear institutional rules and clear responsibilities that are derived from them. They connect joint production with external sanction (legal) systems to enforce cooperation, resulting in sufficient trust that non-cooperative

[14] Van Assen et al (2003) define measures with which the positive and negative externalities of bilateral exchanges for other stakeholders can be computed. In their approach, exchange is considered as a *cooperative two-person game*. That is, in the derivation and the calculation of the measures it is assumed that actors not involved in the exchange do not affect the exchange rate of the exchange under consideration.

individuals can effectively be sanctioned or even fired. If cognitive interdependencies are linked to norms that decisions should be based on consensus, institutional rules work like legal contracts (see Section 3). They provide safeguards to actors in case fundamental problems arise or other actors misbehave, but the more often you have to fall back on them, the more the norm of consensus building will be under pressure. As going to the court to enforce a contract usually results in the end of the relationship, a frequent use of formal rules is likely to undermine the perception that the common interests are so high that the actors are expected to compromise for the sake of consensus. The mere existence of the rules should give sufficient constraints to enforce agreement and compliance.

It is interesting to study and model transitions from one dominant process of decision making to another. This is subject of future research in which both Lindenberg's theory about frame switches (Lindenberg and Frey 1993; Lindenberg 1998; 2000) can be helpful as well as Esser's model building on shifts in the definition of situations (Esser 1997; 2000).

The dominance of the three types of networks (persuasion, exchange, power) in the context of the European Union was evaluated on the basis of the accuracy of three corresponding models. The accuracy of a model is determined by the distance between the model predicted outcomes and the actual outcomes on the issue scales (Stokman and Thomson 2004 p.19). Models based on cooperative solutions that include the positions of all EU decision makers give the best predictions. *Unanimity, wherever possible*, is a very strong norm in the EU, even when decision outcomes supported by only a qualified majority of actors are possible (see also Mattila and Lane, 2001). Decision outcomes in the EU tend to take into account actors' essential interests, wherever possible, and actors avoid harming the essential interests of others. This implies that persuasion networks dominate in the European context. Above we have seen that negotiated exchange networks do not often support consensus building in the European Union because of the high negative externalities involved. Given the dominant norm of consensus building, this type of network is not dominant in the European context as shown by its worse predictions than the persuasion model. The same holds for the power networks: non-cooperative bargaining models do even worse. [15] We therefore conclude that also in the European context procedures do not determine behavior, but set the boundaries within which action takes place. The reader should be aware that we can make these inferences about European Union decision making only by the comparative analysis of the three processes and corresponding networks.[16]

5. Second illustration of heuristic: Structure and evolution of friendship networks

Notwithstanding ambiguity, people agree on the fact that a friend gives support, can be trusted, shows respect and real interest, is verbally open, and is a comrade.

[15] This is also the case for the procedural models. They simply assume that outcomes of decisions are the result of the interaction of institutional rules and preferences of actors, neglecting the informal bargaining processes and associated networks.

[16]This approach has not only been validated in scientific research but is also applied in commercial projects as a successful tool for strategic intervention in decision making to arrive at decisions close to the client's position with sufficient support to be viable. See www.decide.nl for more details.

Friendships are therefore associated with hedonic goals. In the literature, friendships are particularly seen as instrumental to obtain self-confirmation and social approval. To the extent that they are successful in this respect, they produce social well-being (Cramer 1998; Lindenberg 1990; Ormel et al 1997). The *shape* of the friendship is characterized by voluntariness, privateness, mutuality, durability, frequency of contact and dynamics (Fehr 1996; Bell 1981; Duck 1977, 1988, 1991; Dykstra 1990; Fischer 1982). In the literature, attraction is seen as the main driving force behind friendships. Different attraction forces are mentioned. The most prevalent determinant is similarity. Individuals prefer friends who share their attitudes, values, and beliefs (among others: Urberg et al 1998; Leenders 1995; Duck 1991; Hallinan and Teixeira 1987; Brehm 1985; Dahlbäck 1982; Werner and Parmelee 1979). Other attraction forces, however, may promote friendships among dissimilar individuals. Davison and Jones (1976), for example, report a generally observed attraction to higher status individuals.

If we approach friendship from the perspective of the heuristic, we should ask by which functional interdependencies friendships are generated and with which other functional interdependencies it is likely connected. Approached from the last perspective, it is important to realize that friendship can develop only among individuals that had an opportunity to interact (Newcomb 1956; McPherson et al 2001; Van de Bunt 1999; Van Duijn et al 2003). Meeting precedes mating and meeting is strongly associated with opportunity structures generated by other functional interdependencies and spatial proximity. Friendships emerge, therefore, almost always in contexts where individuals do other things together (enhancing the multifunctionality of relationships). An interesting question is then which other functional interdependencies promote development of friendships, or in social network language, under which conditions informal ties are or aren't likely to flourish. There is empirical evidence that very strong common interests create strong lifetime friendships, particularly in life threatening situations. In other words, the stronger the common interests within a group of individuals, the more likely friendly relationships seem to develop. Approached from the first perspective (by which functional interdependencies friendship is generated), we should investigate whether we deal with only one type of relationships or more. There is empirical evidence that friendly relationships (denoted friends) serve other functional interdependencies than the few strong friendship relationships that develop on top of that. I consider first friendly relationships. They seem to be related to three functional interdependencies (the need for behavioral confirmation, for status, and for stimulation) and I propose a general model in which the three are integrated as follows.

Notwithstanding a general need to have friends, individuals differ in the number of friends they are happy with, among others because of differences in personality and time constraints. Moreover, individuals differ in their preferences regarding the desired characteristics of their friends. These differences are twofold. First, a characteristic or dimension considered important by one individual might well be irrelevant for another individual. For example, some individuals attach high importance to the fact that their friends are in a certain age range or have certain political views, whereas other individuals do not care about age or political views of their friends. We call the importance of a dimension for an individual the salience of that dimension for that individual. Second, for a certain dimension, like age, individuals differ in the preferred value their friends should have on that dimension. Some individuals prefer friends of

their own age; others prefer friends that are older or younger than they are. We call such a preferred value for their friends the individual's ideal-friend-value on the dimension. As this example shows, the ideal-friend-value may be equal to the individual's own value on the dimension but that is not necessarily the case. It is crucial, however, that differences exist among individuals in the saliences attached to them and in the positioning of self and others on these dimensions. And due to these differences, individuals may face differences in scarcity of desired friends within their opportunity set.

These observations lead to the conclusion that the basic process of friendship formation can be modeled on the basis of several one-dimensional issues where individuals have single peaked preferences around their ideal-friend-value on that dimension. The larger the distance between the actual value of a (potential) friend and the individual's ideal-friend-value on a dimension, the less attractive that individual is to establish or maintain a friendship with. The higher the individual's salience for the dimension, the higher such a distance weights. This corresponds to Jones' (1982) suggestion to model the strength of a similarity-attraction relationship as an inverse function of distance between the implicit ideal point of an individual and the other's value on the relevant dimension. This implies, maybe surprisingly enough for most readers, that we have a similar incentive structure as in our previous illustration on policy networks. The basic processes and associated networks are, however, fundamentally different as the joint production is not a collective outcome that is binding for all, but a number of individuals with whom we have reciprocal friendship relationships; friends with characteristics that are sufficiently close to our ideal-friend-values on salient dimensions to find behavioral (self) confirmation. Particularly of interest in this context are therefore which dimensions are of importance, which types of ideal-friend-values are we dealing with, and what are their effects on structure and evolution of friendship networks. On the basis of past research, we can distinguish three main bases for ideal-friend-values on underlying dimensions. These are associated with three fundamental attraction forces (Stokman and Zeggelink 1996): *similarity*, ideal-friend-values close to our own values on the relevant dimensions and associated with the desire to get behavioral confirmation from friends; *aspiration*, ideal-friend-values close to characteristics of status and reference groups we want to belong to (Festinger 1954); and *complementarity*, ideal-friend-values with clearly different characteristics associated with the desire to get stimulation from our friends. Complementary friendship relations seem to survive only if reciprocal status differences are involved, where an individual's higher status on one dimension compensates the other's higher status on the other dimension (Tesser 1988; 2000). Behavioral confirmation driven friendship networks will likely have high transitivity as behavioral confirmation is particularly generated within groups. The other attraction forces likely generate more layered networks.

There is evidence that strong friendship relationships fundamentally differ from the friendship relationships described above, as they are not transitive (Van de Bunt 1999). Strong friendship relationships are dyadic relationships linked with strong multifunctionality and joint production of memory and identity (Lindenberg 2001). They are likely to develop within friendly settings, but have a separate functional interdependence.

Whereas, game theoretical and process simulation models were particularly helpful for the analysis of policy networks, new statistical models are particularly helpful for the analysis of the evolution and the resulting structure of friendship networks.

Most recent statistical models start from the assumption that the relationship between any two points A and B can be described by four states: a reciprocal choice, an asymmetric choice from *A* to *B*, an asymmetric choice from *B* to *A*, and no choice. The four states can be seen as a realization of a stochastic process. The p_1 model estimates for each point a sender (activity) and a receiver (popularity) parameter and for the network as a whole a density and a reciprocity parameter (Holland and Leinhardt 1981; Wasserman and Weaver 1985). A type of logistic regression allows explaining variation of these parameters over individuals and subgroups (the so called p_2 model; see Lazega and Van Duijn 1997; Van Duijn et al 2004). For example, assume girls (sex equals 1) tend to make more friendship choices than boys (sex equals 0). A positive sender effect of sex implies a larger probability of a relationship from a high scoring point on that variable (a girl) than from a low scoring point (boy) to some other point. Density and reciprocity effects are often defined by the (absolute) differences of the scores of the points on the variable. If boys and girls tend to make more friendship choices within their own groups, we find a negative effect of the absolute difference of the sex scores on the density parameter. The so called p^*-models also include the estimation of higher order parameters, like triadic dependencies as e.g. transitivity (Wasserman and Pattison 1996), associated with the idea that transitivity of friendships emerge because of opportunity structures and the desire to have a group of friends rather than a set of mutually unconnected friends.[17]

Holland and Leinhardt (1977) introduced Markov processes as general framework for stochastic models of network evolution. The basic idea of Markov models is to conceive the social network structure as changing from one state into another over time. The unit of analysis is usually the dyad with its four possible states (see above under p_1 models). The parameters that govern the process concern the likelihood of transition from one of these four states into another. The original Markov models assume stationarity of the parameters over the whole process and population homogeneity (Wasserman 1980). Recent models have considerably increased the analytic possibilities of Markov models by eliminating these strongly limiting assumptions. Now, change parameters may well be dependent on the stage of network development and different for pairs within and between subgroups (Leenders 1995; 1996). These models, however, were still restricted by the fact that dyads were assumed to be independent. Quite general dependencies between dyads are allowed by Snijders' (1996, 2001, 2005) integration of Markov models with random utility models, which realize a much stronger link between theory and statistical testing. In these models, random utility modeling is used to derive which network characteristics or interactions between individual and network characteristics are likely to produce high utility and thus are likely to govern network change. For each of these utility components, parameters are estimated indicating their strength. Van de Bunt (1999; Van de Bunt et al 1999) and Van Duijn et al (2003) provide illustrations of the approach in studies of friendship networks, within organizations and among sociology

[17] The strong dependencies between different ties in the network lead to problems with the estimation methods proposed originally for the *p** model. These problems were resolved by new estimation methods combined with new specifications of the *p** model, as proposed in Snijders et al. (forthcoming).

freshmen. Van Duijn et al show that similarity on two visible dimensions (gender and track) strongly determine the overall structure of the freshmen' friendship network from the very beginning and that particularly network opportunities explain further evolution of friendships within these boundaries.

In network evolution, two processes take place simultaneously. On the one hand, social actors shape the network by initiating, constructing, maintaining, and breaking up relationships. On the other hand, attributes (behavior, opinions, attitudes) of social actors are partly shaped by their relationships. Integration of the two processes requires further integration of theory and statistical testing. The first steps in this direction have been taken. As we have seen above, spatial auto-correlation models are often used to model the influence process. Spatial auto-correlation models lack the close link to theory, as Snijders was able to develop for Markov models. Efforts to link theory with social influence and to separate selection and influence effects can be found in the dynamic friendship models developed by Zeggelink and Stokman (Zeggelink 1993; 1994; Stokman and Zeggelink 1996; Stokman 2004), and Steglich et al (forthcoming). [18]

6. Conclusions

Over the last decades, social network analysis has generated many new insights and opened completely new lines of research that are fundamental for our insights in social phenomena. Social network analysis particularly has provided an impressive toolbox for empirical analysis of social network structures and their relevance for opportunities and behavioral choices of persons. Particularly impressive are recent developments in statistical network models that can be used for the estimation of fundamental network parameters, at the level of the network, the positions in the network, the local structures in the network, and for the reliable detection of subgroups in networks. Were earlier methods mainly focused on the analysis of static networks, new advanced techniques rapidly are being developed for complex analyses of network dynamics, enabling the analysis of network evolution and facilitating the analysis of complex interactions between different networks, and their interactions with the evolution of individual behavior. All these developments have contributed to the important fact that we are now able to investigate the relationships between networks and behavior empirically and that the social network concept has developed from a metaphor into a concept with a clear empirical reference. It is precisely these developments that enable researchers to investigate more complex relationships between structures as well as between structures and behavior. At the same time, however, it has seduced many social network researchers to concentrate their attention to structure and to neglect the interaction between structure and content. It is for that reason that I devoted so much attention to substantive questions. Precisely because the present social network methodology is able to handle complex questions, we need to give more attention to questions which relationships matter in which contexts and which structural characteristics create opportunities in which contexts and in which not. Such questions can only be answered by a thorough analysis of the microfoundations of social networks.

[18] The statistical models introduced in this section are available in the statistical package StOCNET (Huisman and Van Duijn 2003, 2005; Snijders and Huisman 2003).

Of course, I am aware that already many studies take microfoundations seriously, but I hope to have shown that still many insights can be obtained by extending the microfoundations fundamentally in different directions:

- By including other goals than gain, particularly 'behaving appropriately' and 'feeling good';
- By explicitly deriving the relationships to be considered in the different contexts on the basis of the main processes at stake;
- By focusing on the interactions between different types of relationships and network structures;
- By dealing explicitly with the balance between cooperation and competition: at the level of the relationship itself; between relationships; and between clusters and/or networks.

The main aim of the article was to provide researchers with a heuristic for such an analysis. The heuristic starts with the analytic primacy of the realization of goals that cannot be realized in isolation: joint production and sharing. Moreover, it is based on the fact that most relationships are multifunctional, related to the simultaneous fulfillment of different goals. I found these starting points in Lindenberg's group theory with, on the one hand, its analytic primacy in functional interdependencies, the outcome and task interdependencies connected with efforts to realize the different personal goals, and, on the other, the mutual interdependencies between functional, cognitive and structural interdependencies.

Three examples showed that the heuristic resulted in fundamental new insights. In the context of joint production within labor organizations, we qualified the conclusion of Burt that the best performance tends to be delivered by persons who combine open information networks outside their team with dense networks within their teams. By looking more carefully to different tasks and functional interdependencies, we found evidence that good performing persons need open *and* dense networks simultaneously, also within their own team, depending on the tasks to be fulfilled. In the second example, we showed in the context of policy networks how the heuristic enabled us to specify three fundamental processes of collective decision making (contagion based on information and trust networks, negotiated exchange based on exchange networks, and enforcement based on power networks) and to indicate the conditions under which the one or the other process is likely to be dominant. Moreover, we were able to specify a number of conditions under which exchange and power processes were compatible with and supportive for contagion as dominant decision making process and when not. In my view, these results are an important step forward compared to the different unrelated policy network approaches we have at the moment.

Within the context of friendship, finally, the heuristic resulted in the distinction of two friendship relationships, friends versus strong friends, connected with different functional interdependencies. Three well-known attraction forces for friends could be derived from an incentive structure that was very similar to that in policy networks, namely single peaked preference functions around ideal-friend-values on salient dimensions.

References

Achen C H 2005 Chapter 4. Institutional realism and bargaining models. In: Thomson R, Stokman F N, Achen C, König (eds.) *The European Union Decides.* Cambridge: Cambridge University Press

Arregui, J, Stokman F N, Thomson R 2005 Chapter 5. Exchange and Compromise in the European Union. In: Thomson R, Stokman F N, Achen C, König (eds.) *The European Union Decides.* Cambridge: Cambridge University Press

Bell R R 1981 *Worlds of friendship.* Beverly Hills: Sage Publications.

Bienenstock E J, Bonacich P 1992 The core as a solution to exclusionary networks. *Social Networks* 14: 231-244.

Borgatti S P, Foster P C 2003 The network paradigm in organizational research: A review and typology, *Journal of Management* 29, 991-1013

Brehm S S 1985 *Intimate relationships*. New York: McGraw-Hill.

Bueno de Mesquita B, Newman D, Rabushka A 1985 *Forecasting Political Events, The Future of Hong Kong*. New Haven: Yale University Press.

Bueno de Mesquita B 1994 Political Forecasting: An Expected Utility Method In: Bueno de Mesquita B, Stokman F N (eds) *European Community Decision Making. Models, Comparisons, and Applications.* Yale Univ Press. pp. 71-104

Burt R S 2000 The network structure of social capital. *Research in Organizational Behaviour* 22: 345-423

Burt R S 1992 *Structural Holes: The Social Structure of Competition*. Cambridge: Harvard Univ Press

Buskens V, Raub W 2004 Soziale Mechanismen rationalen Vertrauens. Eine theoretische Skizze und Resultate aus empirischen Studien. In: Diekmann A, Voss T. (eds*.), Rational Choice Theorie in den Sozialwisschenschaften. Anwendungen und Probleme - Festschrift für Rolf Ziegler*, München: Oldenbourg, 2004. pp 183-216

Coleman J S 1972 Systems of social exchange. *Journal of Mathematical Sociology* 2: 145-163

Coleman J S 1988 Social capital in the creation of human capital. *American Journal of Sociology* 94:95-120

Coleman J S 1990 *Foundations of Social Theory*. Cambridge: The Belknap Press

Cook K S 1995 Social relationships and group processes. In Cook K S, Fine G A, House J S (eds) *Sociological perspectives on social psychology.* Boston MA: Allyn and Bacon 203-235

Cook K S, Yamagishi T 1992 Power in exchange networks: a power-dependence formulation. *Social Networks* 14: 245-265.

Cramer D 1998 *Close relationships: the study of love and friendship*. London: Arnold.

Dahlbäck O 1982 Choices of contact, attraction and social relations: A study of peer relations among school children. *Project Metropolitan Research.* Report no. 19, Stockholm.

Davison M L, Jones L E 1976 A similarity-attraction model for predicting sociometric choice from perceived group structure. *Journal of Personality and Social Psychology*, *33*, 601- 612.

Dekker D J 2001 *Network Perspectives on Tasks in Account Management.* Rotterdam: Tinbergen Institute Research Series no 259

Dekker, D, Stokman, F, Franses P H forthcoming Effectiveness of brokering within management organizations. Submitted for publication

Duck S W 1977 *The study of acquaintance*. Westmead: Saxon House.

Duck S W 1988 *Handbook of personal relationships: theory, research, and interventions.* Chichester, Wiley.

Duck S W 1991 *Friends, for life: the psychology of personal relationships. Second (revised) Edition*. New York: Harvester.

Dykstra P A 1990 *Next of (non)kin: the importance of primary relationships for older adults' well being*. Amsterdam: Swets and Zeitlinger.

Ellickson R C 1991. *Order without law*. Cambridge, MA: Harvard University Press

Emerson R.M. 1981 Social exchange theory. In Rosenberg, M, Turner R H (eds.) *Social psychology: sociological perspectives.* New York: Basic Books 30-65

Esser H 1997 Die “Definition” der Situation und die Rationalität des Handelns. In Melegny T, Niederzu H J, Preglau M, Traxler F, Scheikal B (eds) *Soziologie im Konzert der Wissenschaften.* Westdeutscher Verlag 69-90

Esser H 2000 Normen als Frames: Das Problem der “Unbedingtheit” des normativen Handelns. In Metze R, Mühler K and Opp K D *Normen und Institutionen: Entstehung und Wirkungen.* Leipzig: Leipziger Universitätsverlag 137-155

Fehr B 1996 *Friendship processes*. Thousans Oaks, California: Sage.

Festinger L 1954 A theory of social comparison processes. *Human Relations* 7, 117-140

Fischer C S 1982 What do we mean by 'friend'?: an inductive study. *Social Networks* 3, 287-306.

Flap H D, Graaf N D de 1986 Social capital and attained occupational status. *The Netherlands Journal of Sociology* 22, 145-161

Flap H D 1999 Creation and returns of social capital. A new research program. *La Revue Tocqueville* 20, 1-22

Flache A., Macy M W 1996 The weakness of strong ties: Collective action failure in highly cohesive groups. *Journal of Mathematical Sociology* 21: 3-28

Freeman L C, Romney A K, Freeman S C 1987 Cognitive structure and informant accuracy. *American Anthropologist* 89, 310-325

Friedkin N E, Johnsen E C 1990 Social influence and opinions. *Journal of Mathematical Sociology* 15: 193-205.

Friedkin N E, Johnsen E C 1997 Social positions in influence networks. *Social Networks* 19: 209-222.

Friedkin, N E, Johnsen E C 1999 Social influence networks and opinion change. *Advances in Group Processes* 16: 1-29.

Hallinan M T, Teixeira R A 1987 Opportunities and constraints: black-white differences in the formation of interracial friendships. *Child Development* 58, 1358-1371.

Hayek F A 1973 *Law, Legislation and Liberty*. Chicago: Univeristy of Chicago Press

Holland P W, Leinhardt S 1977 A dynamic model for social networks. *Journal of Mathematical Sociology* 5: 5-20.

Holland P W, Leinhardt S 1981 An exponential family of probability distributions for directed graphs. *Journal of the American Statistical Association* 77, 33-50

Huisman M, Van Duijn M A J 2003 StOCNET: Software for the statistical analysis of social networks. *Connections* 25(1), 7-26.

Huisman M, Van Duijn M A J 2005 Software for Social Network Analysis. In: Carrington P, Scott J, Wasserman S (Eds.), *Models and methods in social network analysis*. New York: Cambridge University Press (in press).

Jones L E 1982 Construal of social environments: multidimensional models of interpersonal perception and attraction. In Hirschberg N, Humphreys L G (Eds.), *Multivariate Applications in the Social Sciences*. Hillsdale, NJ: Erlbaum.

Killworth P D, Bernard H R 1976 Informant accuracy in social network data. *Human Organization* 35, 269-286

Killworth P D, Bernard H R 1976 Informant accuracy in social network data III: A comparison of triadic structure in behavioral and cognitive data. *Social Networks* 12, 289-312

Kollock P 1994 The emergence of exchange structures: An experimental study of uncertainty, commitment, and trust, *American Journal of Sociology* 100: 313-45

König T 1997 *Europa auf dem Weg zum Mehrheitssystem. Gründe und Konsequenzen nationaler und parlamentarischer Integration*. Opladen: Westdeutscher Verlag

Krackhardt David 1999 The ties that torture: Simmelian tie analysis in organizations, *Research in the Sociology of Organizations* 16 183-210

Kumbasar E A 1994 Systematic biases in social perception. *American Journal of Sociology* 100, 477-505

Laumann E O, Knoke D, Kim Y H 1987 Event outcomes In: Laumann E O, Knoke D *The Organizational State. Social Choice in National Policy Domains*. Madison: The university of Wisconsin Press.

Lawler E J 2001 An affect theory of social exchange. *American Journal of Sociology* 107 321-352

Lazega E, Van Duijn M 1997 Position in formal structure, personal characteristics and choices of advisors in a law firm: A logistic regression model for dyadic network data. *Social Networks* 19: 375-397

Leenders R Th A J 1995 *Structure and Influence. Statistical Models for the Dynamics of Actor Attributes, Network Structure and their Interdependence*. Amsterdam: Thela Thesis Publishers

Leenders R Th A J 1996 Evolution of friendship and best friendship choices. *Journal of Mathematical Sociology* 21: 133-148

Leenders R Th A J 2002 Modeling social influence through network autocorrelation: constructing the weight matrix. *Social Networks* 24: 21-48

Lin N 1982 Social resources and instrumental action. In: Marsden P V, Lin N (eds) *Social Structure and Network Analysis*. London: Sage

Lindenberg S 2001 Social Rationality versus rational egoism. In: Turner J H (ed), *Handbook of Social Theory*. New York: Kluwer Academic/Plenum Publishers

Lindenberg S 2000 It takes both trust and lack of mistrust: The working of solidarity and relational signaling in contractual relationships. *Journal of Management and Governance* 4: 11-33

Lindenberg S 1998 Solidarity: Its microfoundations and marco dependence: A framing approach. In: Doreian P, Fararo T J (eds) *The Problem of Solidarity: Theories and Models*. Amsterdam: Gordon and Breach

Lindenberg S 1997 Grounding groups in theory, *Advances in Group Processes* 14 281-331

Lindenberg S, Frey, B 1993 Alternatives, frames, and relative prices: A broader view of rational choice. *Acta Sociologica* 36 191-205

Lindenberg S 1990 Homo Socio-oeconomicus: The emergence of a general model of man in the social sciences. *Journal of Institutional and Theoretical Economics (JITE), 146*: 727-48

Marsden P V, Friedkin N E 1993 Network studies of social influence. *Sociological Methods & Research* 22, 127-151

Marsden P V, Laumann E O 1977 Collective action in a community elite: Exchange, influence, resources and issue resolution. In: Liebert R J, Imershein A W (eds.) *Power, Paradigms, and Community Research*. London: Sage

Mattila M, Lane J-E 2001 Why Unanimity in the Council? A Roll Call Analysis of Council Voting',. *European Union Politics* 2(1): 31-52.

McPherson M, Smith-Lovin L, Cook J M 2001 BIRDS OF A FEATHER: Homophily in Social Networks. *Annual Review of Sociology* 27, 415-444

Molm L D, Takahashi N, Peterson G 2000 Risk and trust in social exchange: an experimental test of a classical proposition *American Journal of Sociology* 105, 1396-1427

Molm L D 1997 *Coercive power in social exchange.* Cambridge: Cambridge University Press

Newcomb T M 1956 The prediction of interpersonal attraction. *The American Psychologist* 11, 575-581.

Ormel J, Lindenberg S, Steverink N, Vonkorff M 1997 Quality of life and social production functions: A framework for understanding health effects. *Social Science and Medicine*, *45*: 1051-1063

Pappi F U, Henning C H C A 1998 Policy networks: More than a metaphor? *Journal of Theoretical Politics* 10: 553-575.

Podolny J M, Baron, J N 1997 Resources and relationships: Social networks and mobility in the workplace, *American Sociological Review* 62 673-693

Raub W, Weesie J, 1990 Reputation and efficiency in social interactions: An example of network effects. *American Journal of Sociology* 96: 626-654

Seidman S B 1983 Internal Cohesion of *LS* Sets in Graphs. *Social Networks* 5: 97-107

Simmel Georg [1923]1950 *The Sociology of Georg Simmel*. New York: Free Press

Snijders T A B 1996. Stochastic actor-oriented models for network change. *Journal of Mathematical Sociology* 21: 149-172

Snijders T A B 2001 The statistical evaluation of social network dynamics. In: Sobel M E, Becker M P (eds.), *Sociological Methodology-2001*. Boston and London: Basil Blackwell, 361-395

Snijders T A B 2005 Models for Longitudinal Network Data. In: Carrington P, Scott J, Wasserman S (Eds.), *Models and methods in social network analysis*. New York: Cambridge University Press (in press).

Snijders T A B, Pattison P E, Robins G L, Handcock M S forthcoming. New specifications for exponential random graph models.

Steglich C E G, Snijders T A B, Pearson M. forthcoming. Dynamic Networks and Behavior: Separating Selection from Influence.

Stokman F N, Van den Bos J M M 1992 A two-stage model of policy making: With an empirical test in the U.S. energy policy domain. In: Moore G, Whitt J A(eds.) *The Political Consequences of Social Networks. Volume 4 of Research and Society*. Greenwich, Conn: JAI Press

Stokman F N, Van Oosten R 1994 The exchange of voting postions: An object-oriented model of policy networks. In Bueno de Mesquita B, Stokman F N (eds.). *European community decision making. Models, comparisons, and applications* (pp. 105-127). New Haven, CT: Yale University Press.

Stokman F N, Zeggelink E P H 1996 'Self-organizing' friendship networks. In: Liebrand W B G, Messick D M (eds), *Frontiers in social dilemmas research.* Berlin: Springer

Stokman F N, Van Assen M A L M, Van der Knoop J, Van Oosten R C H 2000 Strategic decision making. *Advances in Group processes* 17: 131-153

Stokman F N 2004 Frame dependent modeling of influence processes. In: Diekmann A, Voss T (eds) *Rational-Choice-Theorie in den Sozailwissenschaften. Anwendungen und Probleme*. München: Oldenbourg Verlag, 113-127

Stokman F N, Thomson R 2004 Winners and losers in the European Union. *European Union Politics* 5: 5-23

Tesser A 1988 Toward a self-evaluation maintenance model of social behavior. In: Berkowitz L (Ed.), Advances in Experimental Social Psychology (Vol. 21). New York: Academic Press, 181-227.

Tesser A 2000 On the confluence of self-esteem maintenance mechanisms. *Personality and Social Psychology Review* 4, 290-299.

Thomson R, Stokman F N, Achen C, König (eds.) 2005 *The European Union Decides.* Cambridge: Cambridge University Press

Udehn L 1996 *The Limits of Public Choice: A Sociological Critique of the Economic Theory of Politics*. London: Routledge

Urberg K A, Degirmencioglu S M, Tolson J M 1998 Adolescent friendship selection and termination: the role of similarity. *Journal of Social and Personal Relationships* 15:703-710.

Van Assen M A L M 2001 *Essays on Actor Models in Exchange Networks and Social Dilemmas*. Amsterdam: Thela Thesis

Van Assen M A L M, Stokman F N, Van Oosten R 2003 Conflict Measures in Cooperative Exchange Models of Collective Decision Making, *Rationality and Society 15*, 85-112

Van de Bunt G G 1999 *Friends by Choice. An Actor-Oriented Statistical Network Model for Friendship Networks through Time*. Amsterdam: Thela Thesis

Van de Bunt G G, Van Duijn M A J, Snijders T A B 1999 Friendship networks through time: An actor-oriented dynamic statistical network model. *Computational and Mathematical Organization Theory*, 5, 167-192.

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

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

Wasserman S S 1980 Analyzing Social Networks as Stochastic Processes. *Journal of the American Statistical Association* 75, 280–294.

Wasserman S, Weaver S O 1985 Statistical analysis of binary relational data: Parameter estimation. *Journal of Mathematical Psychology* 29: 406-427

Wasserman S, Pattison P 1996 Logit models and logistic regressions for social networks. I. An introduction to Markov graphs and *p**. *Psychometrika* 61: 401-425

Weesie J, Buskens V, Raub W 1997 The management of trust relations via institutional and structural embeddedness. In: Doreian P, Fararo T J (eds) *The Problem of Solidarity: Theories and Models*. Amsterdam: Gordon and Breach

Werner C M, Parmelee P 1979 Similarity of Activity Preferences among Friends: Those Who Play Together Stay Together. *Social Psychology Quarterly* 42: 62-66.

Willer D (ed.) 1999 *Network exchange theory*. Westport: Praeger

Zeggelink E P H 1993 *Strangers into Friends; The Evolution of Friendship Networks Using an Individual Oriented Approach*. Amsterdam: Thela Thesis Publishers

Zeggelink E P H 1994 Dynamics of structure: An individual oriented approach. *Social Networks* 16: 295-333