

Registration form (basic details)

1a. Details of applicant

-Name, title(s): Andreas Flache, dr., ma. computer science (dipl. inf).
-Male/female: Male
-Address for correspondence: ICS, RUG
Grote Rozenstraat 31
9712 TG Groningen

-Preference for English correspondence: no
-Telephone: 050-3636214 (sec: 050-3636220, home: 050-5251477)
-Fax: 050-3636226
-E-mail: a.flache@ppsw.rug.nl
-Website (optional): www.ppsw.rug.nl/~flache

-Doctorate (date): 19. 12. 1996
-Use of extension clause (see Notes): no
(if 'yes', give reasons and calculation)

1b. Title of research proposal

The importance of timing and structure: modelling effects of interpersonal contacts on social cohesion in diverse groups.

1c. Summary of research proposal

The way policy-makers and social scientists think about social cohesion is strongly influenced by the contact hypothesis: contacts between culturally different people improve their interpersonal relationships and thus foster social cohesion. A prominent example is the policy to assign schoolchildren from so-called "black-neighborhoods" to mixed schools. However, empirical tests of the contact hypothesis in various realms show a complex picture.

Various research lines study under which conditions contacts may foster cohesion. We aim to innovate this research through a systematic integration of three hitherto unrelated fields. Due to this integration we can identify previously unrecognized conditions under which contacts may foster cohesion in different empirical realms. In particular, we suggest that cohesion may be a matter of *timing* and *network structure of contacts*, conditions that can be utilized for policy design. We draw on *formal computational models of social differentiation* to generate precise predictions about the conditions and dynamics of social cohesion. Our innovations in this research line will be a systematic combination of positive and negative effects of social contact (assimilation and rejection) and an empirical test of underlying micro-level assumptions. We employ for the empirical test recently developed statistical techniques and datasets from *studies of intercultural friendship networks*. We aim to advance these studies by feeding their results about micro-level processes back into our formal analysis of the structural determinants of social cohesion. Finally, we incorporate a condition for group cohesion that was suggested by recent *research on subgroup formation in work teams* but has been overlooked by the other lines of study: so-called "faultlines" caused by clustering of members' demographic attributes. Our new theory will first be tested in controlled group discussion experiments. Subsequently, field tests will be conducted on intercultural friendship networks in schools and on culturally diverse work groups.

Keywords:

contact hypothesis, computational modelling, social network dynamics, intercultural relationships, social cohesion

1d. NWO Council area Social and behavioral sciences (MaGW)

1e. Host institution (if applicable) RUG

Research proposal

2. Description of the proposed research

2a. Research topic

Maintaining social cohesion in demographically and culturally diverse groups is a challenge for modern societies. The corresponding scientific question is why diverse groups differ in cohesiveness, that is: in the extent to which group members are tied to each other by good interpersonal relationships (MW03). It is well known that people may feel attracted towards each other when they are similar in demographic characteristics (e.g. age, ethnicity) or embrace similar social norms, e.g. a similar dress code or religious denomination (Byr71;Ne63). But when might demographically diverse people come to agree on social norms? Contact is widely seen as an important part of the answer. The corresponding contact hypothesis (Pet98;All54) – with roots in classical sociology (Du64) – suggests that contacts between diverse people improve interpersonal relations (Pet98;For97) and thus group cohesion. Contacts – such as sharing the same neighbourhood, school class or work team – expose people to each other and entail at least some communication and interaction. Such contacts have been found to increase intermarriage between ethnic groups (BS97;Bla77) and formation of other cross-group social relationships (QC03;Mar90; HS85). This view resonates prominently in the recent debate in the Netherlands whether schoolchildren from so-called “black-neighborhoods” should be sent to mixed schools.

Effects of contacts on cohesion are complex, however. Common membership in sports clubs has been found to promote agreement between culturally different people (Eri96), but people also often reject others’ cultural preferences (e.g. music, fashion) in contacts (Mar03;Bou84). In studies of inter-ethnic relations, some found contact to improve attitudes about other ethnicities (PE95;EP94) but others showed that mixing of ethnic groups in schools may result in stronger preferences for same-ethnicity friendships (Mo01), particularly for small minorities (QC03). Recently, this has also been observed in Dutch schools (Baerveldt, personal communication). Finally, organization research showed that mixing employees from different nationalities or disciplinary backgrounds in work teams often results in conflict rather than cooperation (TJZ03;WD01;EM00;JNN99).

There are known conditions under which contacts successfully foster cohesion (cf. Pet98). Examples are common goals for the group as a whole (Bre96;She66), extracurricular activities in multiethnic schools (QC03;Mo01;QGF96) or management strategies that emphasize team identity and group goals in diverse teams (GV03;VVO03;EM00;Veg98). Formal theories of social differentiation suggest that information technologies and geographical mobility foster cultural convergence, because they facilitate contacts across large geographical and social distance (Ax97;Mar98a).

These are clearly important findings. However, we argue that previous research overlooked important conditions that modify how contacts affect cohesion. In particular, we propose a new research topic: effects of the *specific timing and the specific network structure of contacts*, that is: who is when brought into contact with whom. Effects of timing and network structure on the dynamics of social cohesion in diverse groups have hitherto not been analyzed systematically, but could clearly be important for interventions, for example for forming school classes or for work team composition. To adequately study this topic we will integrate three widely disconnected fields of study that all address effects of contacts on cohesion, but that are separated by diverse frameworks and empirical realms, notably *formal models of social differentiation* (FM04;MKF03;Mar03,Mar98a,b;HFM00;Ax97; LN97;StZ96;Zeg95; Car91,Car86; NSL90), *studies of the cultural segregation of friendship networks* (QC03;Vdu03;Mo01;BS94; HW87;HS85), and *research on subgroup formation in work teams* (Sha04;TJZ03; GV03;EM00;LM98;PMN98). Two additional innovations follow from the proposed integration. First, we develop a formal explanatory model that integrates for the first time microlevel mechanisms that were hitherto not systematically combined, notably positive (“assimilation”) and negative (“rejection”) effects of interpersonal contacts. Second, due to this integration, we can identify previously unrecognized conditions under which “us vs. them” divisions may arise from negative effects of contacts in diverse groups.

We aim to combine complementary strengths of the research lines in order to contribute to the advancement of each. We derive from *formal models of social differentiation* explicit quantitative assumptions about the micromechanisms through which interpersonal contacts affect interactants' norms. We discuss these micromechanisms in 2.b. These models generate predictions about effects of frequency and range of contacts in a population on cultural convergence (cf. Mar98a;Ax97). However, hitherto the specific timing and the network structure of contacts were neglected. We argue in 2.b that by advancing previous models we can address timing and network structure. Moreover, research in this line provided no reliable tests of hypothesized dynamics, because it fails to use longitudinal data. Finally, despite ample empirical evidence that cultural dynamics are driven by both positive influence (assimilation) and negative influence (rejection), researchers have mainly focused on the positive side and not integrated both mechanisms theoretically. As a consequence, their models overlook conditions under which contacts may be detrimental for cohesion. We will use insights from recent *research on intercultural friendship networks* to improve formal social differentiation studies in these respects. First, we use recently developed methods (Sn03;SB03;QC03;VDu03;Sn01) and data (QC03;Mo01) that allow to disentangle empirically the interrelated micromechanisms that according to social differentiation models underly individual norms and social relationships. Second, we incorporate into formal models of social differentiation the theoretical insight from school research that both positive *and* negative effects of contacts may underly segregation of friendship networks (QC03;BS94). At the same time, we aim to advance research on intercultural friendship formation. Hitherto this research fails to use its empirical insights on microlevel processes for predictions of dynamics and conditions of group cohesion. We use our computational models to derive and test on available school data such predictions, notably about effects of the timing and network structure of contacts.

Finally, we integrate into our research an important insight from studies of subgroup formation in work teams. It has been overlooked by the other research lines that highly correlated dimensions of demographic diversity (like for example in a team consisting of two young female western europeans and two elderly moroccan men) may cause "faultlines" (LM98) that are detrimental for group cohesion. However, hitherto faultline research focuses empirically on the distribution of *demographic* attributes, such as gender or ethnicity. As a consequence, division lines may be overlooked that are unrelated to demographic differences (like in an interdepartmental project team that is demographically homogenous but divided by differences in opinions between team members). We believe we can considerably advance the analysis of faultline dynamics by our formal explication and empirical analysis of underlying micro processes, based on experiments, school data and data from work settings (see 2.b).

To summarize, the proposed research addresses effects of contact between diverse people on group cohesion. We aim to derive and test previously unrecognized conditions that shape the effect of contacts on cohesion, notably the timing and the network structure of contacts. For this, we develop a formal model that integrates micromechanisms identified in hitherto widely unrelated research lines. Predictions will be tested in group discussion experiments and in the empirical realms of intercultural friendships in schools and diverse work teams.

2b. Approach

Theoretical approach / theoretical subproject

Our starting point is a conceptualization of cohesion that is suitable for diverse groups. We adapt a recent suggestion by Moody and White (2003), and assess group cohesion via the minimum number of members that are needed to hold a group together, i.e. that would need to be removed from a network to split the group in subgroups between which there are not positive social relations or no normative commonalities (cf. MW03 for a graph theoretical elaboration). This implies in particular that in a cohesive group not all group members need to like each other or agree with each other on everything. For example, when A agrees with B on fashion and B with C on music, then the group can still be *normatively cohesive* even without agreement between A and C. Similarly, a group is *structurally cohesive* to the extent that every two members are connected at least indirectly through chains of good social relations, e.g. friends of friends of friends. A group is cohesive to the extent that it is both normatively and structurally cohesive.

All three research lines address effects of contacts on cohesion, despite different frameworks. In formal theories of social differentiation contacts affect the similarity of “symbols” (Mar98a;Car91), “cultural forms” (Mar03;Mar98b) or “culture” (Ax97), including social norms. Studies of intercultural friendship formation focus on the degree to which friendship choices connect culturally different subgroups. Finally, research on team diversity explains effects of demographic diversity on team performance partly through effects on team cohesion (GV03;EM00;JNN99). Some studies directly test effects on interpersonal attraction and cohesion (cf. WO98).

How then do contacts between people affect mutual attraction and similarity of norms? Despite diverse perspectives, answers within the three research lines point to four fundamental micro-level mechanisms, homophily, social influence, rejection and heterophobia. We take these mechanisms as the basis of our analysis. While other combinations of microlevel mechanisms have also been proposed to model interpersonal contacts (Pet98), we argue in the following that these four mechanisms correspond well to dynamics observed in a variety of different empirical realms.

Homophily is attraction towards similar others, or “birds of a feather flock together” (MSC01; MS87;Byr71;Ne63). In most groups, interpersonal similarity depends on multiple topics and demographic characteristics simultaneously. Accordingly, we model attraction as resultant of the overall similarity between interactants across a range of individual attributes (cf. Mar98a;Ax97). Demographic characteristics are modelled as stable, but individual norms may change. Most social differentiation models derive homophily from a symbolic interactionist perspective (Mar98a,b;Car91,Car86). People who interpret ‘symbols’ similarly also communicate better and thus come to share more common interpretations. Studies of intercultural friendships sometimes attribute homophily to need for social support from same-ethnicity friends (Tat99), or simply refer to ample evidence for homophilious friendship choices (Mo01). Students of team diversity draw on social identity theory (Taj82;TT86) and self-categorization theory (Tur87). They argue that people who are similar in salient characteristics see each other in the same positively evaluated social category, which in turn fosters mutual attraction (GV03;EM01;Veg98).

The mirror image of homophily is *heterophobia*, negative evaluation of dissimilar others. These two mechanisms are fundamentally different. Under homophily, dissimilarity does not entail antipathy, it only implies less attraction. However, with both heterophobia and homophily, attraction may turn into antipathy when dissimilarity becomes too large. Social differentiation models recognize heterophobia (Mar03), but do not combine it with homophily. In research on friendship networks, heterophobia is seen as consequence of perceived threats from outgroups that entail avoidance of outgroup friendships (QC03;Mo01;BS94). In studies on team diversity, heterophobia, like homophily, is derived from social identity and social categorization processes. For example, Earley and Mosakovski (2003) argue that similarities are “contrast[ed] with the perceived dissimilarity of outsiders to enhance self-construals and worth” (28).

Social influence is the tendency to adopt norms of attractive others (MF93;Frd84;CZ68;FSB50). *Rejection* is the opposite, the tendency to change individual norms such that one differs more from negatively evaluated others (ML72;Ber66). Researchers mostly derive social influence and rejection from the same theories than homphily and heterophobia. Social differentiation studies and friendship research suggest in addition that rejection may result from actors’ desire to affirm their social identity under perceived threat from outgroups, referred to as “cultural rejection” (Mar03) or “profiling” (BS94), respectively.

This evidence suggests that an adequate theory of the effects of contacts on cohesion needs to incorporate all four micro-level mechanisms. However, in diverse groups the corresponding dynamics may occur between all group members simultaneously within the patterns of given contact possibilities. To grapple with this theoretical complexity, we use agent-based computational modelling (MW02;FM96; MF95) and advance previous models of social differentiation (Mar03,98a,98b;Ax97;StZ96;Zeg95;Car91) for our purposes. Previous modelling work recognized a self-reinforcing feedback loop between homophily and social influence (similarity fosters attraction, attraction fosters similarity), but neglected the corresponding dynamic implied by heterophobia and rejection (dissimilarity leads to heterophobia, heterophobia increases dissimilarity). We follow instead recent work of Flache and Macy (2004) and Macy, Kitts, Flache and Benard (2003) who combined all four mechanisms. In contrast with previous work, they found that contacts between initially diverse people may undermine social cohesion. Initially diverse but moderately cohesive groups may tend to fall apart in polarized

subgroups that negatively evaluate each other and are opposed on a number of normative issues. The reason is that with all mechanisms operating simultaneously, increasing convergence in norms between some subgroups due to homophily, social influence and small initial similarities may develop alongside with increasing differences and disliking towards other groups – due to heterophobia, rejection and small initial dissimilarities (FM04;MKF03).

This modelling work (FM04;MKF03) suggests that the effect of contacts on cohesion may decisively depend upon the extent to which individuals' relational and normative choices exhibit heterophobia and rejection. Moreover, these mechanisms may interact with timing and network structure of contact opportunities. In contact opportunities, such as school classes or work teams, people are exposed to each other and need to interact to some extent, so that they learn others' demographic characteristics and norms. The timing of contacts defines the point in time and the sequence in which particular group members come into contact. The network structure of contacts shapes who has contact with whom (WF94). In the proposed research we apply formal techniques (see further below) to derive specific hypotheses about effects of timing and network structure of contacts. We give here illustrative hypotheses and underlying intuitions based on our theoretical approach. The first hypothesis follows directly from our recent work (FM04;MKF03) and relates the mix of mechanisms at the microlevel to effects of contacts on group cohesion.

Hypothesis 1: The more heterophobia and rejection individuals' relational choices and norm choices exhibit, the more will increased contact opportunities tend to reduce rather than foster social cohesion in initially diverse groups.

For the next hypothesis we extend Lau and Murnighan's analysis (1998) of demographic "faultlines". We argue that demographic faultlines are only detrimental to the extent that heterophobia and rejection translate them into emergent normative and relational divisions. We use as operationalization of faultlines the concept of "subgroup strength" (GV03), which indicates the extent to which a group is separated in subgroups with demographic differences on multiple dimensions (cf. Sha04;TJZ03).

Hypothesis 2: The more heterophobia and rejection individuals' relational choices and norm choices exhibit, and the higher the subgroup strength of the demographic distribution of individual characteristics, the more will increased contact opportunities tend to reduce social cohesion and foster group polarization in norms.

Our theory also suggests effects of the timing of contacts: when a diverse set of people is brought into contact immediately, then a tendency towards polarization may arise and split the group. However, when initially only small relatively homogenous subsets of members are in contact, then these subgroups may each develop a local consensus, but each on different norms. Particularly in a large highly diverse group, this may imply that this distribution of norms remains stable when subsequently all subgroups are brought into contact. The reason is that there are sufficiently many subgroups so that most normative positions are represented by some subgroup. When this happens, members may stick to their specific positions, because for every normative issue multiple pressures from social influence and rejection outweigh each other. This balance in turn preserves cohesion despite diversity, because normative as well as relational overlap between subgroups is retained (cf. FM04;MKF03).

Compare two different contact schedules for a large, highly diverse group.

- Schedule 1: relatively homogenous subgroups are formed. Then interaction takes place within these subgroups. Subsequently, all group members are brought into contact with each other and interaction takes place in the group as a whole.
- Schedule 2: All group members are immediately brought into contact with each other and interaction takes place in the group as a whole.

Hypothesis 3: In schedule 1, the group will develop a higher level of social cohesion than in schedule 2, *cet par.* The difference between schedule 1 and schedule 2 will be the larger, the more individuals' behavior exhibits heterophobia and rejection.

Finally, in a similar vein, we expect that the network structure in combination with the timing of contact opportunities may decisively affect social cohesion. Here follows an illustrative hypothesis.

Compare two sequences of contact networks between homogenous subgroups in a relatively small, diverse group.

- Sequence 1: Every subgroup is first brought into contact with two similar other subgroups. Subsequently, all group members are brought into contact.
- Sequence 2: Every subgroup is first brought into contact with two dissimilar (and also mutually dissimilar) subgroups. Subsequently, all group members are brought into contact.

Hypothesis 4: In sequence 1, social cohesion will become lower than in sequence 2. The difference between the sequences will be the larger, the more individuals' behavior exhibits heterophobia and rejection.

To give an intuition for hypothesis 4, in sequence 1, the similar subgroups tend to converge on a consensus due to homophily and social influence. As a consequence, few different norm profiles remain in the group. Accordingly, it is unlikely that pressures to stay and to change always balance in the second phase. Thus, when all subgroups come into contact some may further converge towards similar norms, due to homophily and social influence. Due to heterophobia and rejection, they tend in the process to distance themselves from initially dissimilar outgroups, which eventually results in lack of normative and relational overlap, thus: low cohesion. In sequence 2, however, it is more likely that each subgroups' position remains stable in the first phase, due to balanced counterpressures from the two dissimilar other groups. As a consequence, most positions in the opinion space are still occupied when all subgroups come into contact. The overall distribution of norms likely remains diverse and norm profiles overlap, due to a balance of attracting and rejecting pressures from every subgroups' perspective.

Methods of theory elaboration

We begin our analysis with attractor neural networks (ANN) (Hop82;NV97). With ANN's we model homophily, heterophobia, social influence and rejection as follows. To the extent that two agents i and j have the same demographic characteristics and embrace the same norms at the same time, the social relationship between them will be increasingly positive. Conversely, to the extent that the two agents i and j are different, their relationship becomes increasingly negative. Whether agents evaluate a given level of similarity as positive or negative is depends on an aspiration level. Individual nodes (group members) seek to minimize "energy", or: dissonance (Fe57), across relations by iteratively adjusting social relations and their individual norms to maintain agreement with "friends" and disagreement with "enemies". Technically, ANN's implement this with a Hebbian learning rule (Heb49; cf. FM04;MKF03;KMF99;NV97).

In later stages of theory elaboration, we aim to endogenize theoretically the relative strength of the four micro mechanisms. For this, we model individual decisions explicitly in terms of boundedly rational maximization of social goals (Lin01;Sim82). To briefly illustrate: we expect for example to derive that agents who are more central in the contact network exhibit less heterophobia and rejection, because they have more alternative sources of peer approval from similar others. Technically, we will draw here on previous work of the applicant on adaptive learning models (MF02;FM02), and social control in networks (Fla02;KMF99;Fla96;FM96). Finally, we seek to derive general theorems analytically, based on Markov chain models (You98) and game theoretical analyses of Nash equilibria in network dynamics (Goy03;Jac03;BG00).

Empirical approach

In the first empirical project we choose controlled experiments to test hypotheses with high reliability. The second, subsequent, empirical project addresses field implications for friendship networks in schools and diverse work groups.

In the *experimental subproject* the dependent variables are measures of normative and structural group cohesion, based on subjects' choices in repeated rounds of group discussion. Subjects discuss via email simultaneously a number of salient and sufficiently controversial issues selected in pilot studies (cf. Frd99). We use subjects' initial opinions to manipulate initial group composition (see hypotheses 3 and 4). Via the email access structure we manipulate timing and network structure of contacts. Throughout discussion rounds, subjects record repeatedly their opinions and liking of each other. To control for "cheap talk" we will also explore measurements of liking based on costly rewards or punishments (FG00,Fla96), and we will test effects of subject payment schemes that induce micro level incentives (e.g. rewards for agreement with positively evaluated others to induce homophily). To disentangle in the data analysis the relative strength of the micro-mechanisms and effects of the manipulations, we employ recently developed actor-oriented statistics methods (Sn03,Sn01,Sn96). Hitherto, these methods have only been applied for network change with fixed actor attributes (cf. SB03;Sn01, Sn96). Extensions for changing actor attributes become soon available (Sn03). As a spin-off, our experimental data will help to further develop the statistical technique with a high quality data-set of repeated actor and network change under controlled context conditions.

Field subproject. In a first phase, the field project addresses ethnically and culturally diverse school settings. In a second phase, diverse work teams are addressed.

We aim to use two datasets on friendship formation in ethnically diverse schools for this project. We have access to data from the National Longitudinal Study of Adolescent Health (Add Health), a nationally representative sample of most public and private high schools in the United States. This is a data set of unique size and quality that contains longitudinal data about networks, demographic pupil characteristics and attitudes in a large number of school classes. The other dataset contains repeated measurements of networks and norms in dutch school classes and is currently collected in the NWO-financed project "The Dynamics of Networks and Behavior" (NWO/ESR Snijders). We plan to use both data sets to test predictions of changes in social cohesion based on observed microlevel mechanisms. Furthermore, hypotheses about network structure and timing of contacts will be tested on basis of information about tracks and classes within schools.

Two data sets are available for work settings. One has been collected on project teams in a one-year research project at a dutch university. It contains about thirty complete peer evaluation networks and repeated measurements of both demographic and attitudinal individual attributes. The second data set will be newly collected in collaboration with the applicant in a dutch forensic hospital. Due to reorganization, the frequency of work contacts between members from subdepartments with different organizational subcultures will increase in the course of the study. Consent has been obtained to conduct repeated measurements on a representative sample of organization members, including individual assessment of relational segmentation of the organization and a range of attitudinal and demographic questions. This allows to assess dynamics of structural and normative cohesion. We explore currently how indicators for timing and network structure of contacts between subdepartments can be obtained.

2.c Innovation

We discussed the innovations that we expect from the proposed research in sections 2.a and 2.b.

To summarize:

- We derive and test empirically, both in experiments and in the field, hypotheses about effects of the timing and the network structure of contacts on social cohesion in a diverse group. This is a new topic.
- We develop for this purpose a formal analysis that integrates for the first time positive and negative effects of contacts. This highlights potentials for group polarization overlooked by previous models.
- We relate the concept of demographic faultlines ("subgroup strength") to the distribution of non-demographic attributes, notably norms. We will test both on school data and work group data whether non-demographic faultlines can be used to predict negative effects of contacts on cohesion.
- We test empirically on longitudinal data micro assumptions of formal models of social differentiation, both

in experiments and in field research. We use for this recent advances in actor oriented statistics that have previously not been applied to disentangle micromechanisms empirically.

2.d Plan of work

Year	Subproject		
	Theoretical (applicant)	Experimental (postdoc)	Field (Ph.D student)
2005	model development, preparation experiments		
2006	preparation school study, supervision experiments, preparation workplace studies	elaboration experimental method, experiments	Theoretical preparation design field studies
2007	publication results experiments, supervision field studies, theory development	data analysis publication	Analyze school and team data
2008	Publication school and team results, theory development		publication results school and team study, Analyze organization data
2009	Publication organization results, theory development		Dissertation Further publications

International collaborators:

- Macy, Cornell
 - Kitts, Washington State
 - Takacs, Budapest
 - Moody, Ohio State (Add Health data)
- Furthermore, contact will sought with
- Mark, Stanford
 - Axelrod, Michigan

2e. Literature references

- [Ax97] Axelrod, R. 1997. The Dissemination of Culture: A Model with Local Convergence and Global Polarization. *Journal of Conflict Resolution* 41:203-226.
- [All54] Allport, G. W. 1954. *The Nature of Prejudice*. Cambridge, Mass.: Addison-Wesley.
- [BS94] Baerveldt, C., T.A.B. Snijders. 1994. Influences on and from the segmentation of networks: hypotheses and tests. *Social Networks* 16:213-232.
- [BG00] Bala, V., S. Goyal. 2000. A non-cooperative model of network formation. *Econometrica* 68:1181-1230.
- [Ber66] Berscheid, E. 1966. Opinion change and communicator-communicatee similarity and dissimilarity. *Journal of Personality and Social Psychology* 4: 670-680.
- [Bla77] Blau, P. M. 1977. *Inequality and Heterogeneity: A Primitive Theory of Social Structure*. New York: Free Press.
- [BS97] Blau, P.M., Schwartz, J. 1997. *Crosscutting Social Circles*. New Brunswick, NJ: Transaction Press.
- [Bou84] Bourdieu, P. [1979] 1984. *Distinction: A Social Critique of Judgement of Taste*. Translated by R. Nice. Reprint, Cambridge, MA: Harvard University Press.
- [Bre96] Brewer, M. B. 1996. When Contact is not Enough: Social Identity and Intergroup Cooperation. *International Journal of Intercultural Relations* 20:291-303.
- [Byr71] Byrne, D. E. 1971. *The Attraction Paradigm*. New York: Academic Press.
- [Car91] Carley, K. 1991. A theory of group stability. *American Sociological Review* 56:331-354.

-
- [Car86] Carley, K. 1986. An Approach for Relating Social Structure to Cognitive Structure. *Journal of Mathematical Sociology* 12:137-189.
- [CZ68] Cartwright, D., A. Zander. 1968. Pressures to uniformity in groups: An introduction. Pp. 139-151 in *Group Dynamics: Research and Theory*, edited by Cartwright, D., A. Zander. New York, NY: Harper & Row.
- [Du64] Durkheim, E. 1964 [1893]. *The Division of Labor in Society*. New York: Free Press.
- [EM00] Earley, P. C., E. Mosakowski. 2000. Creating Hybrid Team Cultures: An Empirical Test of Transnational Team Functioning. *Academy of Management Journal* 43.1:26-49.
- [EP94] Ellison C.G., D.A. Powers 1994. The contact hypothesis and racial attitudes among black-americans. *Social Science Quarterly* 75.2: 385-400.
- [Eri96] Erickson, B. 1996. Culture, Class and Connections. *American Journal of Sociology* 102:217-251.
- [FG00] Fehr, E. S. Gächter. 2000. Cooperation and Punishment in Public Goods Experiments. *American Economic Review* 90:980-994.
- [Fe57] Festinger, L. 1962. *A Theory of Cognitive Dissonance*. Evanston, Ill., Row, Peterson.
- [FSB50] Festinger, L, S. Schachter, K. Back. 1950. *Social Pressures in Informal Groups*. New York, NY: Harper.
- [FM04] Flache, A., M.W. Macy. 2004. Culture Wars and Dynamic Networks: A Hopfield Model of Emergent Structure. Paper submitted for presentation at the 2004 Annual Meeting of the American Sociological Association. Manuscript available from http://www.ppsw.rug.nl/~flache/publications_e.htm
- [FM02] Flache, A., M.W. Macy. 2002. Stochastic Collusion and the Power Law of Learning: A General Reinforcement Learning Model of Cooperation. *Journal of Conflict Resolution* 46.5:629-653.
- [FM96] Flache, A., M.W. Macy 1996. The Weakness of Strong Ties: Collective action failure in a highly cohesive group. *Journal of Mathematical Sociology* 21:3-28.
- [Fla02] Flache A. 2002. The Rational Weakness of Strong Ties. Failure of Group Solidarity in a Highly Cohesive Group of Rational Agents. *Journal of Mathematical Sociology* 26:189-216.
- [Fla96] Flache, A. 1996. *The Double Edge of Networks. An Analysis of the Effect of Informal Networks on Cooperation in Social Dilemmas*. Amsterdam: Thesis Publishers.
- [For97] Forbes, H. D. 1997. *Ethnic conflict: Commerce, culture and the contact hypothesis*. New Haven (CT)/ London: Yale University Press.
- [Frd84] Friedkin, N. E. 1984. Structural cohesion and equivalence explanations of social homogeneity. *Sociological Methods & Research* 12:235-261.
- [Frd99] Friedkin, N.E. 1999. Choice Shift and Group Polarization. *American Sociological Review* 64.6:856-875.
- [GV03] Gibson, C., F. Vermeulen. A healthy divide. Subgroups as a Stimulus for Team Learning Behavior. *Administrative Science Quarterly* 48: 202-239.
- [Goy03] Goyal, S. 2003. Learning in Networks. 2003. Forthcoming in Demange, G., M. Wooders (eds). *Group Formation in Economics: Networks, Clubs and Coalitions*. Cambridge: Cambridge University Press.
- [HW87] Hallinan, M. T., R. A. Williams. 1987. The Stability of Students' Interracial Friendships. *American Sociological Review* 52:653-664.
- [HS85] Hallinan, M. T., S. S. Smith. 1985. The Effects of Classroom Racial Composition on Student's Interracial Friendliness. *Social Psychological Quarterly* 48:3-16.
- [Heb49] Hebb, D. O. 1949. *The Organisation of Behavior: A Neuropsychological Approach*. John Wiley and Sons, New York, NY.
- [HFM00] Heggemann, R, A. Flache, V. Möller, 2000. Cellular Automata Models as Modelling Tool. pp. 151-178 in: Suleiman R., K.G. Troitzsch, N. Gilbert (eds.) *Tools and Techniques for Social Science Simulation*. Heidelberg: Physica.
- [Hop82] Hopfield, J.J. 1982. Neural networks and physical systems with emergent collective computational abilities. *Proceedings of the National Academy of Sciences U.S.A.* 79:2554-2558.
- [Jac03] Jackson, M. O. 2003. A Survey of Models of Network Formation: Stability and Efficiency. Forthcoming in Demange, G., M. Wooders (eds). *Group Formation in Economics: Networks, Clubs and Coalitions*. Cambridge: Cambridge University Press.

-
- [JNN99] Jehn, K.E., G.B. Northcraft, M.A. Neale. 1999. Why differences make a difference: A field study of diversity, conflict, and performance in work groups. *Administrative Science Quarterly* 44:741-763.
- [KMF99] Kitts, J., M.W. Macy, A. Flache, 1999. Structural Learning: Conformity and Social Control in Task-Oriented Groups. *Computational and Mathematical Organization Theory* 5:2:129-145.
- [LM98] Lau, D. C., J. K. Murnighan. 1998. Demographic Diversity and Faultlines: The Compositional Dynamics of Organizational Groups. *Academy of Management Review* 23: 325-340.
- [LN97] Latané, B., A. Nowak 1997. Self-Organizing Social Systems: Necessary and sufficient conditions for the emergence of clustering, consolidation and continuing diversity. Pp 43-74 in: Barnet, G., F. Boster (eds.): *Progress in communication science: Persuasion*. Norwood, NJ. Ablex.
- [Lin01] Lindenberg, S.M. 2001. Social Rationality versus Rational Egoism. Pp. 635-668 in: Turner, J.H. *Handbook of Sociological Theory*. New York: Kluwer.
- [MKF03] Macy, M.W., J. Kitts, A. Flache, S. Benard. 2003. Polarization in Dynamic Networks: A Hopfield model of emergent structure. Pp 162-173 in: Ronald Breiger, Kathleen Carley and Philippa Pattison (eds). *Dynamic Social Network Modelling and Analysis: Workshop Summary and Papers*. Washington: The National Academies Press.
- [MF02] Macy, M.W., A. Flache. 2002. Learning Dynamics in Social Dilemmas. *Proceedings of the National Academy of Sciences U S A*. May 14;99.10:7229-36.
- [MF95] Macy, M.W., A. Flache. 1995. Beyond Rationality in Models of Choice. *Annual Review of Sociology* 21:73-91.
- [MW02] Macy, M., R. Willer. 2002. From Factors to Actors: Computational Sociology and Agent-Based Modelling. *Annual Review of Sociology* 28:143-66.
- [Mar03] Mark, N. 2003. Culture and Competition: Homophily and Distancing Explanations for Cultural Niches. *American Sociological Review* 68:319-345.
- [Mar98a] Mark, N. 1998a. Beyond individual differences: Social differentiation from first principles. *American Sociological Review* 63:309-330.
- [Mar98b] Mark, N. 1998b. Birds of a Feather Sing Together. *Social Forces* 77:453-485.
- [MF93] Marsden, P.V. and N. E. Friedkin. 1993. Network studies of social influence. *Sociological Methods & Research* 22:127-151.
- [Mar90] Marsden, P.V. 1990. Network diversity, substructures and opportunities for contact. Pp 397-410 in: Calhoun, C., M. Meyer, R.S. Scott. *Structures of Power and Constraint: Papers in Honor of Peter Blau*. New York: Cambridge
- [ML72] Mazen, R., H. Leventhal. 1972. The influence of communicator-recipient similarity upon the beliefs and behavior of pregnant women. *Journal of Experimental Social Psychology* 8:289-302
- [MSC01] McPherson, M., L. Smith-Lovin, J.M. Cook. 2001. Homophily in social networks. *Annual Review of Sociology* 27:415-444.
- [MS87] McPherson, J. M., L. Smith-Lovin. 1987. Homophily in voluntary organizations: Status distance and the composition of face-to-face groups. *American Sociological Review* 52:370-379.
- [MW03] Moody, J., D.R. White. 2003. Structural cohesion and embeddedness: A hierarchical Concept of Social Groups. *American Sociological Review* 68:103-127.
- [Mo01] Moody, J. 2001. Race, School Integration, and Friendship Segregation in America. *American Journal of Sociology* 107.3:679-716.
- [Ne63] Newcomb, T.M. 1963. Stabilities underlying changes in interpersonal attraction. *Journal of Abnormal and Social Psychology* 66:376-386.
- [NV97] Nowak, A., R. Vallacher. 1997. Computational social psychology: Cellular automata and neural network models of interpersonal dynamics. In Read, S., L. Miller (eds.). *Connectionist Models of Social Reasoning and Social Behavior*. Mahwah, NJ: Lawrence Erlbaum.
- [NSL90] Nowak, A., J. Szamrej, B. Latané 1990. From Private Attitude to Public Opinion — Dynamic Theory of Social Impact. *Psychological Review* 97: 362–376.
- [Pet98] Pettigrew, T. F. 1998. Intergroup contact theory. *Annual Review of Psychology* 49:65-85.
- [PMN98] Polzer, J. T., E. A. Mannix, M.A. Neale. 1998. Interest Alignment and Coalitions in Multiparty Negotiation. *Academy of Management Journal* 41:42-54.

- [PE95] Powers, D.A., C.G. Ellison. 1995. Interracial contact and Black Racial Attitudes - The Contact Hypothesis And Selectivity Bias. *Social Forces*. 74.1: 205-226.
- [QC03] Quillian, L., M. E. Campbell. 2003. Beyond black and white: The present and future of multiracial friendship segregation. *American Sociological Review* 68:540-566.
- [QGF03] Quiroz, P. A., N. F. Gonzalez, K. A. Frank. 1996. Carving a Niche in the High School Social Structure: Formal and Informal Constraints on Participation in the Extracurriculum. *Research in Sociology of Education* 11:93-120.
- [Sha04] Shaw, J. B. 2004. The Development and Analysis of a Measure of Group Faultlines. *Organizational Research Methods* 7.1:66-102.
- [She66] Sherif, M. 1966. *Group Conflict and Cooperation*. London, Routledge and Kegan Paul.
- [Sim82] Simon, H.A. 1982. [1955]. A Behavioral Model of Rational Choice. In: Simon, H.A. *Models of Bounded Rationality: Behavioral Economics and Business Organization* 2:239-258.
- [SB03] Snijders, T.A.B., C. Baerveldt. 2003. A Multilevel Network Study of the Effects of Delinquent Behavior on Friendship Evolution. *Journal of Mathematical Sociology* 27:123-151.
- [Sn03] Snijders, T.A.B. 2003. Studying the mutual influence between relations and behaviour. Paper presented at the SUNBELT XXIII *International Sunbelt Social Network Conference*, 12-16 February, Cancun, Mexico.
- [Sn01] Snijders, T. A.B. 2001. The Statistical Evaluation of Social Network Dynamics. Pp. 361-395 in *Sociological Methodology -2001*, edited by M.E. Sobel and M.P. Becker. Boston and London: Basil Blackwell.
- [Sn96] Snijders, T.A.B., 1996. Stochastic actor-oriented dynamic network analysis. *Journal of Mathematical Sociology* 21:149-172.
- [StZ96] Stokman, F. N., E. P.H. Zeggelink. 1996. Self-organizing Friendship Networks. Pp 385-418 in: W.B.G. Liebrand, D. M. Messick (eds). *Frontiers in Social Dilemmas Research*, Berlin: Springer.
- [Taj82] Tajfel, H. 1982. Social Psychology of Intergroup Relations. *Annual Review of Psychology* 33:1-39.
- [TT86] Tajfel, H., J. C. Turner. 1986. The Social Identity Theory of Intergroup Behavior. In: Worchel, S., W.G. Austin (eds.): *The Social Psychology of Intergroup Relations*. Chicago, Nelson-Hall.
- [Tat99] Tatum, B.D. 1999. *Why are all the Black Kids Sitting Together in the Cafeteria?* New York: Basic Books.
- [TJZ03] Thatcher, S. M.B, K. A. Jehn, E. Zanutto. 2003. Cracks in Diversity Research : The Effects of Diversity Faultlines on Conflict and Performance. *Group Decision and Negotiation* 12. 3: 217-241.
- [Tur87] Turner, J.C. 1987. *Rediscovering the Social Group: A Self-Categorization Theory*. Oxford:Basic Blackwell.
- [VVO03] Van der Vegt, G.S., E. Van de Vliert, A. Oosterhof. (2003). Informational Dissimilarity and Organizational Citizenship Behavior: The Role of Intra-team Interdependence and Team Identification. *Academy of Management Journal* 46.6:715-728.
- [Veg98] Van der Vegt, G. 1998. *Patterns of Interdependence in Work Teams. A cross-level examination of the relation with satisfaction and commitment*. Groningen: Dissertatiereeks KLI.
- [Vdu03] Van Duijn, M.A.J., M. Huisman, F.N. Stokman, F.W. Wasseur, E.P.H. Zeggelink. 2003. Evolution of sociology freshmen into a friendship network. *Journal of Mathematical Sociology* 27:153-191.
- [WF94] Wasserman, S., K. Faust. 1994. *Social Network Analysis*. Cambridge: Cambridge University Press.
- [WD01] Webber, S.S., L.M. Donahue. 2001. Impact of highly and less job-related diversity on work group cohesion and performance: A meta-analysis. *Journal of Management* 27:141-162.
- [WO98] Williams, K. & O'Reilly, C. 1998. The complexity of diversity: A review of forty years of research. *Research in Organizational Behavior* 20:77-140.
- [You98] Young, H. P. 1998. *Individual Strategy and Social Structure. An Evolutionary Theory of Institutions*. Princeton: Princeton University Press.
- [Zeg95] Zeggelink, E. 1995. Evolving friendship networks: an individual oriented approach implementing similarity. *Social Networks* 17:83-110.

[2f. Utilisation paragraph: Only required for proposals to be submitted to Technical Sciences, see Notes]

Cost estimates

3a. Budget

	2005	2006	2007	2008	2009	TOTAL
Staff costs: (in k€)	21.50	158.6	178.47	100.12	106.77	565.46
Applicant	21.50	22.48	29.22	30.87	32.64	136.71
Post-doc	0	84	89.25	0	0	173.25
PhD student	0	52.125	55.00	64.25	69.13	240.50
Support staff	0	0	5	5	5	15
Non staff costs: (k€)	0	2	11	11	11	35.00
Equipment	0	0	2	2	2	6.00
Consumables	0	0	2	2	2	6.00
Travel and subsistence	0	2	7	5	5	19.00
Other	0	0	2	2	0	4.00
TOTAL						600.46

Explanations:

- At start of the project in 2005, applicant will hold permanent 1.0 fte assistant professorship at RUG, which will in 7/2006 be upgraded into associate professorship given positive evaluation.
- Accordingly, salary costs of applicant in the budget cover only 25% of his employment, the remaining 75% are paid by the RUG. The 25% included in the budget cover costs of additional research time for applicant, so that in total 0.75fte of the applicant's work time will be devoted to the proposed research.
- Personal grant to applicant from his faculty (see 3.b) will be used to cover in period 2005-2006 purchase of equipment, applicant's bench fee, travel costs, subject payment and salaries for support staff.
- From 2007-2009, support staff, bench fee and travel costs of the applicant are included in the budget above.
- For phd and postdoc, a benchfee of 25% is assumed from which most travel expenses should be covered. For postdoc additional travel budget is planned of 2k€ / year.

3b. Have you requested any additional grants for this project either from NWO or from any other institution? yes/no (If 'yes', see Notes)

The faculty of Psychological, Pedagogical and Sociological Sciences of the University of Gronigen provided a personal grant of 80 k€ to the applicant that will be used in the period 2005-2006 to cover the applicants' bench fee and additional material costs.

Curriculum vitae

4a. Personal details

Title(s), initial(s), first name, surname: dr. Andreas Flache
Male/female: male
Date and place of birth: 12. 05. 1963, Einbeck, Germany
Nationality: German
Native country parents¹: Germany

4b. Master's ('Doctoraal')

University/College of Higher Education: University of Koblenz-Landau, Germany
Date: August 1991 (cum laude)
Main subject: A software tool for the empirical analysis of chaotical dynamics

4c. Doctorate

University/College of Higher Education: University of Groningen
Date: 19 December 1996 (cum laude)
Supervisor ('Promotor'): W.B.G. Liebrand (RUG), W. Raub (UU), F.N. Stokman (RUG)
Title of thesis: The double edge of networks. An Analysis of the Effect of Informal Networks on Cooperation in Social Dilemmas.

4d. Work experience since graduating

(per appointment: fte, tenured term ('vast') / fixed-term ('tijdelijk')

1/1997-5/1999. *Fixed term.* 1.0 fte. Postdoc at the Department for Philosophy, University of Bayreuth, Germany.
Research Project: "The dynamics of social-dilemma situations", financed by the German Science Foundation (DFG).

7/1999-7/2002. *Fixed term.* 1.0 fte. Research fellow of the Royal Netherlands Academy of Arts and Sciences, postdoc at the ICS, University of Groningen. Research project: "Network embeddedness and group solidarity: when do they come together?".

7/2002-present. *Fixed term.* 1.0 fte. Senior research fellow of the Royal Netherlands Academy of Arts and Sciences, postdoc at the ICS, University of Groningen. Prolongation of project granted in 7/2002 until 7/2004: "Network embeddedness and group solidarity at work".

Since 2000, member of supervision committee of 4 Ph.D. projects in the ICS program.

4e. Man-years of research

5 years, 7 month (based on 0.8 fte research in all academic positions specified under 4.d)

4f. Brief summary of research over last five years

Flache's previous research was directed at two main topics, 1) adverse effects of social networks on group cooperation, and 2) cooperation based on learning behavior. Beyond that, the applicant has addressed with formal methods and partly in collaboration with moral philosophers (Hegselmann), various theoretical issues in sociology and social philosophy. In particular, Flache studied the consequences of different rationality assumptions on social support (Flache 2001; Flache&Hegselmann 1999a,b,1998), cooperation (Flache,Macy,Raub 2001; Hegselmann&Flache 2001) and instability of group decision making (Flache&Torenvlied,*conditionally accepted*). In the study of adverse effects of social networks, the applicant further developed the counterintuitive and innovative hypothesis that a dense network of informal relations may undermine cooperation in a group (Flache 1996; Flache&Macy 1996). In subsequent research, hypotheses were elaborated about the conditions under which strong ties may be detrimental for cooperation, notably task-uncertainty

¹ NWO monitors the inflow of new staff into the research field on the basis of criteria set out in the Wet SAMEN (Employment of Minorities (Promotion) Act). Information will be used only for the purpose for which it is provided. For more information about this legislation (in Dutch only), please visit www.wetsamen.nl

(Flache 2002) and bounded rationality (Flache, Macy, Raub 2001). In subsequent empirical work the applicant collaborated with researchers of the NWO-financed project "Solidarity at Work" (Sanders, NWO-9817), to collect data on informal networks and organizational cooperation in a large sample of dutch employees. First empirical tests tend to support the expected adverse network effects (Flache 2003). Further publications based on these data are in preparation. With respect to cooperation and learning, the applicant generalized in collaboration with Macy (Cornell University) previous studies and showed in a high impact publication (Macy&Flache 2002) that actors' aspiration level is a decisive condition for cooperation between learning players across a range of different social dilemma situations. In a subsequent study, Flache and Macy (2002) integrated and compared two specifications of reinforcement learning from the sociological and the economics literature, respectively. They identified previously unnoticed differences between these models. Based on his interest in mechanisms of social control in informal networks, the applicant started recently to address in collaboration with Kitts (U Washington), Macy and Benard (Cornell) the question how informal networks and subgroups may evolve in the first place. With the proposed research the applicant aims to move a decisive step further into this new topic on his research agenda, using models and methods developed in previous work.

4g. International activities

Research visits of applicant

- 1993 Kellogg Graduate School of Management, Northwestern University, Evanston, Illinois. 2 Month. Host: Prof. David Messick.
1994 Department of Sociology, Brandeis University, Waltham, Massachusetts. 3 Month. Host: Prof. M.W. Macy.
1996 CNR, Department of Cognitive Sciences, University of Rome. 1 Month. Host: Prof. R. Conte.
2001 Department of Sociology, Cornell University, Ithaca, N.Y. 3 Month. Host: Prof. M.W. Macy

Research visits of international guests hosted by applicant

- 2003 Ma. J. Pujol, University of Barcelona, Artificial Intelligence Department. 6 month.
2003 Prof. Macy, Cornell University. 3 month.
2002 Prof. Macy, Cornell University. 0.5 month.

4h. Other academic activities

- Member of organizational committee of the *First Conference of the European Social Simulation Association*. Groningen, The Netherlands, September 18-21, 2003. Together with: Jager, W., Zoethout, K. (RUG), Janssen M., Indiana University.
- Organizer *First International Workshop on Solidarity and Prosocial Dispositions*, Schiermonnikoog, The Netherlands, March 2002. Together with Veenstra, R. (RUG).
- Member editorial board *Journal of Artificial Societies and Social Simulation* since 2001.
- Reviewer for international peer reviewed journals
American Journal of Sociology, Sociology of Education, Rationality and Society, Journal of Mathematical Sociology, Journal of Mathematical Psychology, Journal of Artificial Societies and Social Simulation, SCS Transactions - Applications of Modeling and Computer Simulation
- Since 2002 in total 4 presentations as *invited speaker* at international conferences (see details under 5. Publications / other).

4i. Scholarships and prizes

- Research fellowship of the Royal Netherlands Academy of Arts and Sciences 1999-2002, ca. 300 K€.
- Prolongation research fellowship of the Royal Netherlands Academy of Arts and Sciences 2002-2004, ca. 300 K€.
- Personal grant to applicant from strategic personell fund of the faculty of Psychological, Pedagogical and Sociological Sciences, RUG. 80 K€.

List of publications

5. Publications:

Impact factors and assessment of overall impact in research field

Where available, ISI 2002 impact factors are indicated.

In terms of impact factors, the most important publications of the applicant are:

- Macy, Flache 2002. *Proceedings of the National Academy of Sciences U.S.A.* Impact 10.7 (for comparison: highest impact in sociology ASR=2.85)
- Flache, Macy 2002. *Journal of Conflict Resolution.* Impact 1.253, ranked 4th in Political Sciences.
- Macy, Flache. 1995. *Annual Review of Sociology.* Impact 2.745, ranked 2nd in Sociology.

-International (refereed) journals

1. **Flache, A., R. Torenvlied.** *Conditionally accepted.* When do they ever make up their mind? The social structure of instability in decision making dynamics. *Journal of Mathematical Sociology.* (ISI 2002 Impact = 0.5)
2. Wittek, R.P.M., **A. Flache.** 2003. Rational Choice und Organisationstheorie. In: Allmendinger, J., T. Hinz. Organisationssoziologie. *Kölner Zeitschrift für Soziologie und Sozialpsychologie.* Sonderheft 42:55-87. (in German). (ISI 2002 Impact = 0.614)
3. **Flache, A., M.W. Macy.** 2002. Stochastic Collusion and the Power Law of Learning: A General Reinforcement Learning Model of Cooperation. *Journal of Conflict Resolution* 46(5):629-653. S. (ISI 2002 Impact = 1.253)
4. **Flache, A.** 2002. The Rational Weakness of Strong Ties. Failure of Group Solidarity in a Highly Cohesive Group of Rational Agents. *Journal of Mathematical Sociology* 26:189-216. S. (ISI 2002 Impact = 0.5)
5. Macy, M.W., **A. Flache.** 2002. Learning Dynamics in Social Dilemmas. *Proceedings of the National Academy of Sciences U S A.* May 14;99(10):7229-36. S. (ISI 2002 Impact = 10.7)
6. **Flache, A., R. Hegselmann.** 2001. Do Irregular Grids make a Difference? Relaxing the Spatial Regularity Assumption in Cellular Models of Social Dynamics. *Journal of Artificial Societies and Social Simulation* 4 (4). <http://jasss.soc.surrey.ac.uk/4/4/6.html>
7. **Flache, A.** 2001. Individual Risk Preferences and Collective Outcomes in the Evolution of Exchange Networks. *Rationality and Society* 13 (3):304-348. (ISI 2002 Impact = 0.529)
8. Hegselmann, R., **A. Flache,** 2000. Rational and Adaptive Playing. A comparative analysis for all possible Prisoner's Dilemmas. pp. 75-97 in: *Analyse & Kritik* 22 (1). (Both authors contributed equally).
9. **Flache, A., R. Hegselmann,** 1999a. Altruism vs. Self-Interest in Social Support. Computer simulations of social support networks in cellular worlds. In: *Advances in Group Processes* 16:61-97.
10. **Flache, A., R. Hegselmann,** 1999b. Rationality vs. Learning in the Evolution of Solidarity Networks: A Theoretical Comparison. *Computational and Mathematical Organization Theory* 5:2:97-127. S
11. Kitts, J., M.W. Macy, **A. Flache,** 1999. Structural Learning: Conformity and Social Control in Task-Oriented Groups. *Computational and Mathematical Organization Theory* 5:2:129-145. S
12. Hegselmann, R., **A. Flache,** 1998. Understanding Complex Social Dynamics: A Plea For Cellular AutomataBased Modelling. *Journal of Artificial Societies and Social Simulation* 1: <http://www.soc.surrey.ac.uk/JASSS/1/3/1.html>
13. **Flache, A., M.W. Macy** 1996. The Weakness of Strong Ties: Collective action failure in a highly cohesive group. *Journal of Mathematical Sociology* 21:3-28. S (ISI 2002 Impact = 0.529)
14. Macy, M.W., **A. Flache** 1995. Beyond Rationality in Models of Choice. *Annual Review of Sociology* 21:73-91. S (ISI 2002 Impact = 2.745).

-National (refereed) journals

Flache, A. 2003. "Je vrienden val je niet af". De negatieve effecten van informele netwerken op groepsolidariteit in werkgroepen. *Gedrag & Organisatie* 2003-16.3: 179-200.

-Books, or contributions to books

1. **Flache, A. Forthcoming.** Stylized solutions for environmental dilemmas in a cellular world. In: Suleiman, R., D. Budescu, D. Messick, I. Fischer. *Contemporary approaches to social dilemma research*. Cambridge: Cambridge University Press.
2. Macy, M.W., J. Kitts, **A. Flache**, S. Benard. 2003. Polarization in Dynamic Networks: A Hopfield model of emergent structure. Pp 162-173 in: Ronald Breiger, Kathleen Carley and Philippa Pattison. *Dynamic Social Network Modelling and Analysis: Workshop Summary and Papers*. Washington: The National Academies Press. S
3. **Flache, A.** 2002. De zwakke kant van hechte netwerken. Pp.35-40 in: Hackeng, T., H. Veenhof (eds.). *Over de grenzen van het weten. Jaarboek 2001. Vereniging van Akademie-onderzoekers*. Amsterdam: KNAW.
4. Van Veen, K., **A. Flache**, J. Kratzer, R. Wittek. 2001. Sociale netwerkanalyse voor kennismangement: de blinde vlekken van wetenschap en praktijk. Pp. 263-277 in: Van Baalen, P., M. Weggeman, M., A. Witteveen (eds.). *Kennis en Management*. Schiedam: Scriptum.
5. Wittek, R. and **A. Flache**. 2001. Solidarität am Arbeitsplatz. Pp. 149-182 in: Bierhoff, H.W. and D. Fetchenhauer (eds.). *Solidarität. Konflikt, Umwelt und Dritte Welt*. Opladen: Leske und Budrich. (in German).
6. **Flache, A.**, M.W. Macy, W. Raub, 2000. Do company towns solve free rider problems? A sensitivity analysis of a rational-choice explanation. In: Raub, W., J. Weesie (eds.). *The Management of Durable Relations: Theoretical and Empirical Models for Households and Organizations*. Amsterdam: Thela Thesis.
7. Hegselmann, R, **A. Flache**, V. Möller, 2000. Cellular Automata Models as Modelling Tool. pp. 151-178 in: Suleiman R., K.G. Troitzsch, N. Gilbert (eds.) *Tools and Techniques for Social Science Simulation*. Heidelberg: Physica.
8. **Flache, A.**, R. Hegselmann 1998. Rational vs. adaptive egoism in support networks: How different micro foundations shape different macro hypotheses, in: Leinfellner, W., E. Köhler (eds), *Game Theory, Experience, Rationality. Foundations of Social Sciences, Economics and Ethics. In Honor of John C. Harsanyi* [Yearbook of the Institute Vienna Circle 5] 261-275. Dordrecht: Kluver.
9. **Flache, A.** 1996. *The Double Edge of Networks*. Amsterdam: Thesis Publishers.
10. **Flache, A.** 1992. Empacs: A Softwaretool for the Empirical Analysis of Chaotic Systems, in: Faulbaum, F. (ed.) *SoftStat '91. Advances in Statistical Software 3* 169-176. Stuttgart: Gustav Fischer.
11. **Flache, A.**, V. Schmidt 1991. Programmsystem IPMOS - Computersimulation beliebiger Weidlich-Haag-Modelle, in: Kreutz, H., J. Bacher. *Disziplin und Kreativität. Sozialwissenschaftliche Computersimulationen: theoretische Experimente und praktische Anwendung* 160-178. Opladen: Leske+Budrich.
12. **Flache, A.**, V. Schmidt 1990. IPMOS - A Software Tool for Modeling and Analysis of Interacting Populations, in: Troitzsch, K.G.T, J. Gladitz. *Computer Aided Sociological Research* 339-351. Berlin (Ost): Akademie Verlag.
13. **Flache, A.**, V. Schmidt 1989. IPMOS - Ein Softwarewerkzeug zur Mikromodellierung und Simulation interagierender Populationen, in: Faulbaum, F., R. Haux, K. Jöckel (Hrsg.) *Softstat '89. Fortschritte der Statistik Software 2, 5. Konferenz über die wissenschaftliche Anwendung von Statistik-Software, Heidelberg, 1989*. 426-433. Stuttgart: Gustav Fischer.

-Other

Selection of invited presentations

1. Flache, A. 2003. How may virtual communication shape cooperation in a work team? A formal model based on social exchange theory. Invited paper presented at the Zif-Workshop "Trust and Community on the Internet", July 31 – August 2, 2003, Bielefeld, Germany.
2. Flache, A. 2003. When social control may fail to solve cooperation problems: Theoretical mechanisms and empirical evidence. Invited paper presented at the Japanese European Conference on Social Networks, Utrecht, May 2003.
3. Flache, A. 2003. Which informal networks foster which organizational solidarity? Invited paper presented at the International Conference on Rational Choice and Social Institutions, Fukuoka, Japan, September 2003.

4. Flache, A. 2002. When Social Control May Fail to Solve Cooperation Problems. Theoretical Mechanisms and Empirical Evidence. Invited presentation in the section “*Solidarity and Social Norms – Models and Mechanisms*” at the 31. Kongress der Deutschen Gesellschaft für Soziologie in Leipzig 7.-11. Oktober 2002.
5. Flache, A. 2002. The weak side of social control. Models and Empirical Evidence. Invited presentation at the NIAS conference “*Social Networks, Norms and Solidarity – New Approaches to Cooperation*”. June 9-11, 2002. Wassenaar, The Netherlands.
6. Flache, A. 2002. Why Social Cohesion may undermine Collective Action: Models and Experiments. Invited Lecture in *Research on Monday Seminar Series*. May 6, 2002. Faculty of Economics of the Erasmus University Rotterdam and the Tinbergen Institute.

Working papers

1. Macy, M.W., Flache, A. (2001). “Learning to Cooperate in Social Dilemmas”. ISCORE discussion paper no. 190. 49 pages. Institute for the Study of Cooperative Relations. Department of Sociology. University of Utrecht.
2. Flache, A., Macy, M.W. (2001). “Stochastic Collusion and the Power Law of Learning”. ISCORE discussion paper no 189. 53 pages. Institute for the Study of Cooperative Relations. Department of Sociology. University of Utrecht.
3. Flache, A. (2001). “The Rational Weakness of Strong Ties. Failure of Group Solidarity in a Highly Cohesive Group of Rational Agents.” ISCORE discussion paper no. 182. 66 pages. Institute for the Study of Cooperative Relations. Department of Sociology. University of Utrecht.
4. Flache, A. (2001). “Individual Risk Preferences and Collective Outcomes in the Evolution of Exchange Networks”. ISCORE discussion paper no. 181. 65 pages. Institute for the Study of Cooperative Relations. Department of Sociology. University of Utrecht. [Reprinted from *Rationality and Society* 13 (2001): 304-348.]
5. Flache, A., R. Hegselmann 2000. Abschlussbericht zum DFG Projekt “Dynamik sozialer Dilemma-Situationen” (Research report for the German Science Foundation). University of Bayreuth, Department of Philosophie (350 p, in German).