Competition and Negative Networks
The Origin, Dynamics, and Harmful Consequences of Negative Relations

A Concise Summary of the Research Program

Motivation

The origin of negative ties

Meanwhile the dynamics of positive ties, and in particular friendship relations, have been studied extensively, we know much less about *micro mechanisms* [36, 81-83, 152-153] that govern the dynamics of *negative ties*, such as hate and relational aggression [39, 87]. The ground-breaking nature of the proposed research is the systematic study of negative ties and networks, the characterization of their *origin*, the portrayal of their *dynamics*, and the better understanding of key social problems that arise or deepen as the *consequences* of negative relations.

> Our fundamental hypothesis of the proposed project is that negative relations are relevant because they are unavoidable consequences of competition that characterizes and fuels all aspects of social life.

Pupils compete for popularity, adults compete for social status, and politicians compete for power. Popularity, status, and power are relative (hierarchical) terms and they are attained in complex social processes [67]. Negativity is often the consequence of relative frustration [21], but negative ties could also be used as strategic tools in competition. Most important is, however, that all forms of negativity manifested in behavior are witnessed by relevant others, who sometimes take sides and sometimes mediate. Hence, negative ties and competition could not be studied properly outside the network context.
In educational settings, competition for popularity and status is a major source of different forms of negative relations [54]. These include gossiping [51], bullying [52, 87, 149, 175], mocking, and fighting [4, 66, 127]. In political competition, we know for long [112] that politicians use sophisticated strategies that include open criticism, accusations, lies, deceit, and forms of exclusion. Stakes, costs, and rules (the opportunity structure) determine who and how intensely will make use of the strategic tools of relational aggression. Too many competitors and too little chances make investments useless. Better opportunities for the concentration of power make the competition particularly tense, like in the case of power struggle in totalitarian regimes.

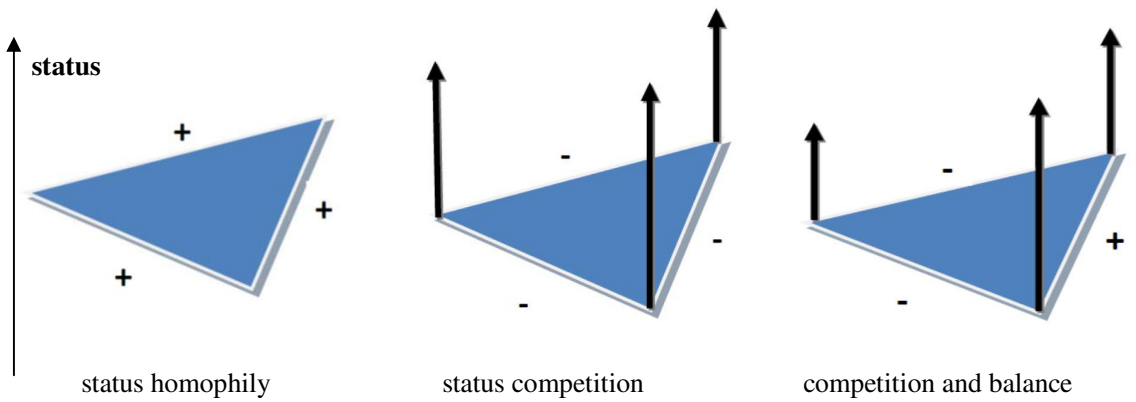
Micro mechanisms of the dynamics of negative ties and networks

A serious complication is that relational aggression towards an opponent is hardly a result of a pure economic calculation of costs and stakes. This is because rivalry for socially acquired limited resources, such as for social status or power, is never isolated. This implies that strategies are also not simple. First, direct competitors have similar status mostly with a similar background and similar opportunities. They could even be friends or close allies due to status based *homophily* [31, 106, 121]. Hence, the structure of social competition could be similar to *viscous competition* described by biologists [46, 68, 142, 164-165, 173, 182].
Second, easily utilizable strong ties do not necessarily help in status attainment. Same-status friends are unable to assist in climbing the status hierarchy higher. It is a better strategy to ally with status superiors, who can help to attain a position that is lower than theirs, but higher than the original [110]. Top status individuals are therefore in a very favorable situation as there is a competition for their grace. In exchange for alliance, group members will defend the top of status hierarchy and will be ready to demonstrate their loyalty by actively engaging in relational aggression towards any possible threat.
Ties that lead to status superiors are typically *weak ties* [69, 110]. Their direct relevance in the competition for status and for power means that successful strategists will utilize them extensively [23-24, 40, 94]. We

believe that weak and strong ties play also a different role in the negative domain. As a conceptual innovation, we introduce a distinction between *weak and strong negative ties*. We define weak negative links to have only an affective content, such as dislike [135]. In contrast, strong negative ties also include a behavioral element of *relational aggression* such as bullying, deception, physical aggression, and social exclusion. It is not of a necessity that the concept of weak and strong negative ties will result in such a theoretical breakthrough as the concept of weak ties did in the positive domain, but we believe that our conceptual innovation at least can partly correct for the empirical deficiencies of existing theories on signed networks [1, 25, 41, 88, 118, 178].

> Structural balance is a key micro mechanism underlying the dynamics of social networks if it is corrected for a distinction of strong and weak relationships, for the viscosity of competition, and for status inequalities.

Structural balance theory defines a triad to be balanced, if multiplying the signs of the three relations it is composed of gives a positive result [25, 77]. The most typical example for a balanced triad is the one that contains only positive relations. With *reciprocity* [88, 164, 186], *homophily*, and *balance* as the only mechanisms that govern network dynamics, all groups would end up in stable cliques containing only positive relations internally and negative relations externally [25, 63, 86, 114-115]. We believe that empirical research failed to confirm this prediction largely because *weak* negative ties do not cause large tensions in triads. For instance, a triad with only weak negative signs can remain stable.
Empirical research failed to confirm predictions of structural balance theory also because of the significant role of *status competition* in relationships. Human groups are characterized by a *competition for status* and can be described to have a complex and *hierarchical* structure [42-43, 53]. Hierarchical structures are often stabilized using relational aggression. It means that in contrary to the expectations of structural balance theory, *transitive triplets* will likely occur in empirical contexts and cyclical triads will not be likely.[1]



status homophily status competition competition and balance

Figure 1: Rival predictions for individuals with equal status (symmetric relations)

At the dyadic level, status considerations make relations asymmetric [20], because status differences forbid the interchange of roles in relational aggression [148]. Besides, in case of large status differences, *heterophobia* [61], which is a mirror image of homophily and describes disliking of dissimilar others, could also be asymmetric. Heterophobia can induce relational aggression towards a black sheep in the group with radically different characteristics than others [12], or towards a member of a low-status group [64, 95, 147],

[1] Technically, transitive triplet count is $\sum_j x_{ij} \sum_h x_{ih} x_{hj}$, and cyclical triads are $\sum_j x_{ji} \sum_h x_{ih} x_{hj}$; where x_{ij} is a binary variable that has a value of 1 if there is a directed tie from actor *i* to actor *j*.

while the victim could still have appreciations [38, 44, 159] or only weak negative ties towards popular peers that do not disturb legitimization of the existing status order [103, 109]. For instance, in a classical study [131], it was found that balanced attraction systems are stable considering positive within-group high attraction triads, but this stability varies with popularity, as attraction is more stable toward popular others. Hence, the competition for popularity (or status) interferes with balance arguments (see Figure 1).

The consequences of negative ties to major societal problems

Attaining high performance, avoiding conflict, and achieving integration are crucial for the well-being and stability of any human group or organization. Network ties are important for these problems because they are the primary source of social control that can stabilize norms of high performance [10, 27, 73, 123] and of cooperation [59-60, 80, 163]. It is also known that relations across subgroup boundaries reduce intergroup rivalry and violent conflict [154, 161-162]; largely facilitate solidarity [36] and integration [120].
In most social settings, negative ties are less frequent than positive ones [9, 26, 65], so why should we bother about them at all? We take this innovative path, because evidence confirms that negative ties might have a *stronger effect* on performance, cohesion, and integration than positive relations [103-104, 116, 125].
When investigating the impact of negative ties and networks, we will concentrate on three major societal problems:

1. Cooperation and performance;
2. Social exclusion;
3. Ethnic segregation.

Method and subprojects

In the proposed comprehensive research program, we select different empirical settings characterized by competition for popularity, social status, and power. This is because our general theoretical framework will need multiple tests at different levels of abstraction and in different empirical contexts. The proposed research will be structured in the following subprojects:

I. We use a*gent-based simulation* to illustrate how negative ties and networks could contribute to the evolution of cooperation and under which conditions they create serious problems of inefficiency.
II. We gather a large sample of classroom network data and test hypotheses about the interrelated dynamics of negative networks and status competition in *primary schools* and we analyze a large network panel gathered in *secondary schools*. In this context, we analyze how negative relations induced by intensified status competition could lower performance, lead to social exclusion, and to ethnic segregation.
III. We collect relational data about politicians in Hungary at the time of communist dictatorship and analyze the network dynamics related to power struggle.
IV. We use *laboratory experiments* to discover the best strategies of handling negative relations in small, newly created groups. We design controlled experiments to provide empirical test for interventions proposed by our analytical and empirical results.

These research objectives and subprojects will be elaborated in the following sections.

I. Agent-based simulation of the dynamics of networks, cooperation, and competition

I.1. The dynamics of negative ties and cooperation

First, we will examine how can cooperation be stable supported by structural balance mechanisms. Previous studies have demonstrated that cooperation is more likely to evolve in social dilemma games, such as the Prisoner's Dilemma, if played in networks [78-79, 107, 133, 151, 177]. Besides sparseness [132-133, 151], the structure of the network is also important because on top of direct ties, indirect relations also control

behavior and contribute to the establishment of cooperation through reputation mechanisms, such as image scoring [179]. In these studies, the network structure remains unchanged while behavior evolves [107, 133]. Studies that have relaxed this assumption used agent-based simulation to provide predictions about which conditions favor the emergence of cooperation [151, 184-185]. These studies, however, assumed only *positive* relations between the players.

Negative ties could also be accelerators of cooperation due to different mechanisms at the dyadic and triadic levels. At the *dyadic level*, vengeance and anger could be manifested as powerful trigger strategies [5-7, 169]. Another mechanism is selectivity that prescribes cooperation with those who are liked and defection with those who are disliked [58, 184]. At the *triadic level*, we hypothesize that structural balance could strengthen bonds and cooperation. For instance, if A and B are friends, and C is their common enemy, the presence of the negative ties towards C could strengthen cooperation between A and B. In general, balanced triads are guarantees for spreading appropriate reputational information.

> Different dyadic and triadic effects related to negative relations and structural balance increase cooperation in social dilemmas.

We plan to incorporate these dyadic and triadic mechanisms in an agent-based model in which the network of positive and negative relations and cooperation co-evolve. At the network level, our intuition is that the quicker structural balance reshapes relations, the better for the spread of cooperation. In practice, it would mean relatively more sign changes in the relations compared to the frequency of social dilemma interactions. Studies that examine the co-evolution of positive ties and cooperation anticipate this finding: they show that the time scale parameter that determines how frequently the network is updated compared to the update in the cooperation strategy is an important determinant of the extent of cooperation [151, 184-185].

I.2. Status competition and social exclusion

Second, we use simulation to study the interrelated dynamics of negative and positive ties and *status competition*. Resources and attributes at the outset are highly important for status dynamics [15-19, 176]. Efficient status signals stabilize the structure of group relations and help to avoid open conflicts [47, 136]. When these signals are inefficient or when the status order is not accepted, dyadic conflict might occur. Different theoretical arguments come to different conclusions on where in the social hierarchy the strongest negativity could be expected (Figure 2). On one hand, relational aggression towards vulnerable members does not imply severe costs, just signals strength and discipline. On the other hand, a fight with a direct rival is more costly, but it quickly clarifies the dominance hierarchy. In any case, bystanders of dyadic conflict read the outcome as a signal of strength, adjust their behavior towards the conflicting parties, and spread gossip accordingly [30, 48].

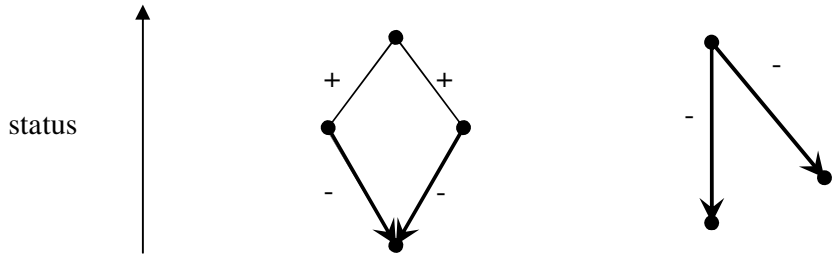


Figure 2: Relational aggression in rival theoretical perspectives: sub-top competition (left) and double attacks (right)

In one perspective, individuals below the top of the hierarchy, but with a window of possible advances will be in the frontline to apply relational aggression towards low-status group members in the hope of advancing their position [3, 130]. As competitors with a similar status compete by relational aggression towards low-status individuals, there might be no relative improvement in their situation, but leads to the *social exclusion* of victims.

In another perspective, status superiors might be directly interested to use relational aggression as strategic tools to maintain and legitimate the existing status order. "Double attacks", in which winners of aggressive encounters are more likely to attack a bystander, contribute efficiently to the quick establishment of a transitive hierarchy [28-30]. We could expect most relational aggression from individuals with highest sociometric status [183], especially in the early process of hierarchy formation. Even if relational attacks are costly, they can deter candidates or new entrants from competition. A high level of relational aggression and social exclusion of victims arises, if such signals need to be used extensively.

These rival explanations will be explored in agent based simulation and competing hypotheses will be derived for our empirical research (II.2).

II. Analysis of large network panel data from primary and secondary school classes

In schools, *negative relations* related to status competition are largely responsible for situations in which *low performance* is enforced [34-35], induce *social exclusion* [3, 108] and lead to ethnic *segregation* of relations [8, 74-76, 126, 128] probably more than in any other social setting. There are at least five practical advantages of the choice of school classes as a main empirical focus. First, school classes are quite closed communities with fixed boundaries. Second, norms and behavior are under development, and therefore interventions and prevention programs could be designed and implemented more successfully [150] than later in the life course. Third, network ties and status orders change more rapidly at this age than in adulthood. Fourth, we have good chances to capture the whole network, which is burdensome in other settings. Fifth, primary school classes are ideal choices for studying the problem of friendship segregation and ethnic exclusion.

II.1. Negative ties and academic performance

If general norms support high efforts, a dense group without major division lines ostracizes those who do not comply. Negativity that is manifested as punishment of low performers has a *positive impact on performance* [98]. A more disturbing example is when intensified competition leads to social exclusion of the best performing students and paradoxically *lowers overall performance*. In certain classrooms, similar to workplace environments, status can be attained by low performance and by advocating norms of performance lowering [34-35, 123]. If the large majority supports medium or low effort work, then best performers are likely to be punished and will be subjects of punishment [84]. Strikingly, social exclusion of best performers is observable also in the best schools [113]. In the latter case, if academic standards are shifted upwards, then social exclusion of best performers (geeks) could paradoxically be more likely. If standards of evaluation are linked to past performance, high performance poses a threat to the entire group, hardening to achieve the same grades due to higher standards.

Moreover, status orders do not necessarily reflect on academic achievement. Among others, status could be based on attractiveness, wealth, and sociability. If high status individuals tend to be low-performers, status competition could reward norms of low performance. Furthermore, stable sub-groups can maintain inefficient norms that limit achievement despite the presence of another sub-group in which achievement is approved [60, 163]. Therefore, it is of high importance which network topologies can contribute best to higher performance [9, 70-72]. We will analyze these structural conditions considering negative and positive relations in the school context.

II.2. Status competition and social exclusion

Status competition among pre-adolescents and adolescents is relatively intense [35]. It is not uncommon to see huge investments in strategic activities such as gossip, mediation, intervention, relational aggression, and sanctions on others for the sake of popularity and status [3, 49]. If everyone does so, we can observe a social dilemma situation: efforts invested are only sufficient to maintain or slightly modify the existing status order [67, 93].

We try to examine which actors use relational aggression to strengthen their status positions and how this contributes to social exclusion. We are going to test competing predictions derived in subproject I.2 by using exponential random graph models (ERGMs; [144-146, 156]), in particular *p** [144-146, 156] and *R-SIENA* models [155, 157] that allow us to control for social background and several psychological attributes and for the separation of selection and influence effects.

II.3. Structural balance, status generalization, and intergroup conflict

A further complexity of status competition arises from the fact that groups are *not homogenous*, and are typically fractured along salient demographic characteristics, gender and *ethnicity* in particular [8, 74-76, 126, 128, 143]. Even in integrated schools, friendship ties are highly segregated [62, 126]. Segregation of friendship ties could correlate with the emergence of subcultures that may oppose the objectives of schools and the educational system [181]. If friendship ties remain segregated in integrated classrooms, disadvantaged pupils will be not influenced by mainstream role models, and integrated education may reduce differences in scholastic performance to a lesser extent than desired.

Friendship segregation can arrive at an unexpectedly high level due to a self-reinforcing cascade that resembles the residential segregation dynamics described by Schelling [152]: we claim that few initial negative ties between members of different ethnic groups are sufficient to induce a *balancing mechanism*, in which positive ties will bind in-group members together and negativity will be the characteristic of out-group relations.

Status competition intensifies segregation as in-group members actively disapprove out-group members to strengthen their in-group ranks. A worst case scenario is when in-group members disapprove also the underlying norms of the out-group. The out-group can also be labeled to have completely opposite norms, in particular, with regard to school performance. Societal status relations contribute to determine which labels will be used by which ethnic group at the outset [13, 111]. In a self-reinforcing dynamics, members of the disadvantaged group will even enforce their members to an anti-school platform. In this subproject, we refine and test these hypotheses.

Furthermore, intergroup rivalry at the societal level could make dyadic relationships also painful and tense in the classroom. Even in less turbulent times, status differences between the groups could legitimize dyadic asymmetry and aggressive acts towards members of the lower status group. When relational aggression of this kind takes place to a remarkable extent, then intergroup status inequality is reinforced and could even grow. In a segregated social network full of sexist or ethnic tension, a viscous cycle might occur and larger status differences could potentially be observed than otherwise.

II.4. Measurement and data

Weak negative ties will be measured in the form of dislike and hate. For *strong negative ties*, we include multiple measurements and ask about outgoing and perceived incoming ties separately along the dimensions of harmful gossip, bullying, mocking, and fighting. Our focus requires also a clear-cut definition of *status*. A previously used in-degree measure [33] would not reflect on the *reputational character* of status [32, 37]. We therefore ask all respondents "who they think are considered *by others* having high status in the classroom". In-degree defined on this network approximates better the reputational character of status, thus, will be our operationalization of this concept.

We will gather new network panel data in *primary school classes*. Data gathering will start in the 6th grade and will contain three measurements till the 8th grade. Intentionally, classrooms with a larger proportion of Roma pupils will be over-represented in our sample. The main instrument in this data gathering is a self-administered in-class survey. Survey items will include network questions (negative, positive, and romantic), and questions on norms, performance, status, popularity, power, and several relevant controls including individual attributes and family background. Survey data will be supplemented with data on school characteristics, a questionnaire with teachers, background interviews with school management, grades, and competency test scores.

In addition, we use network panel data from 9th to 11th graders in *secondary school classes* we gathered with the support of the Hungarian Scientific Research Fund (OTKA K/81336). Data gathering in this project has started in 2010 in 44 *classrooms* (with 1439 respondents in the first wave) and ends in 2013. These data sets are basically the *very first network panel studies* truly focusing on different types of *negative relations* and *status competition*.

III. The structure of power struggle in the Rákosi era

III.1. Aim of the case study

In order to test how general our theoretical predictions are, we conduct a case study in a setting that is largely different from the educational context. For this purpose, we collect data about negativity and competition among politicians in Hungary from the time of communist dictatorship.

History teaches us that the struggle for power at the top of the society can be very cruel. Hungarian medieval history is full of torturing, quartering, dazzle, and burning rivals on an iron throne [11]. Hungarian medieval history is not unique in this aspect. Cruelty and killing of rivals is often the rule rather than the exception in intense political power struggle where the winner takes everything: typically, a rule of a life-time. Strikingly, such examples are not peculiarities of the distant past. The fact that we label these cases cruel tells us that our basic moral does not tolerate a high extent of cruelty and aggression in the quest for power [45].

We opt for a case study of dictatorship rather than a democracy because of the intensity of competition and because of a simpler analytical strategy: voters play a negligible role. We study the quest for power from 1949 till 1956 in Hungary from a network perspective. We describe the dynamics of political relations and power in this period and illustrate whether our theoretical claims about negative relations and competition are valid in this social setting.

III.2. Method

Our analytical strategy will include

a, a decision about the target population;
b, a selection of sources of relational information;
c, definition of power positions;
d, and operationalization and recording of relational aggression.

For each step of the analytical strategy, independent assistance will be used for coding and processing data. Information obtained in each step will be checked in expert interviews. For the target population, we restrict our interest with a position generator method that is typical in the sociological research on the elite [160]. Curricular data will be gathered about politicians who hold a position with significant power any time between 1949 and 1956 in Hungary. This list will be supplemented with politicians who did not hold office, but were identified as key political actors in expert interviews with historians.

For step b, we analyze CVs and determine co-occurrences before 1956. Most typical early co-occurrences are communist activity in 1919 in Hungary, participation in the Soviet Red Army, imprisonment in Hungary (if in the same prison), strike activity in Hungary (especially in the construction industry), membership in the illegal communist party, emigration time in the Soviet Union (or elsewhere), representation at the Comintern,

participation in the Spanish Civil War, partisan activity in World War II in Yugoslavia, in Hungary, or in the Soviet Union, membership in the Hungarian Front. More detailed CV information will be gathered for the period between 1945 and 1956. Some of these co-occurrences are co-incidental, but we will use them as relational indicators. That is, they partly measure potential friendship and alliance, and partly the effect of common background. In addition, to fill in missing gaps and to gain more insight, we code all positive and negative relational information from memoires [55-56, 117, 137, and memoires gathered by the '56 Institute[2]] and books written by historians [14, 57, 85, 89-91, 97, 99-100, 122, 138-141, 171, 174, and more]. In addition, we record directed criticism in documented speeches, self-criticism that is triggered by another politician ("I was wrong… as it has been justly highlighted by Comrade X"), and direct involvement in arrests and political trials.

IV. Laboratory experiments for the optimal handling of negativity

As discussed before, negative ties are unavoidable in any social setting and they might create a lot of trouble. We use laboratory experiments to assist problem solving in newly created groups in which negativity could have the most harmful consequences, in particular for segregation and group polarization. The interventions we focus on are relatively easy and cheap: they concern the scheduling of relationships. We design these interventions based on our theoretical and empirical findings and test their efficiency in our experiments. This approach is especially important for providing concrete practical solutions to the most difficult situations.

First we will identify what are the most troublesome initial situations. Most negativity in newly organized groups could be due to diversity and be the result of heterophobia. Previous studies in organizational research have claimed that while diversity increases performance as individual differences contribute to the emergence of innovative and creative ideas, it can also lead to conflicts that endanger group stability and performance [22, 50, 73, 105, 119, 124, 129, 134, 158, 167, 170, 172, 180]. The majority of previous research found that diversity leads to a decreased efficiency [2, 50, 92, 102, 124]. Furthermore, studies showed that cooperation suffers from the undesired consequences of diversity [96, 168]. Among diverse groups, the most problematic ones are those in which diversity is aligned with dislike due to other independent reasons.

Second, we help to provide guidelines that could assist efficient functioning of these most problematic groups. We investigate how the timing (scheduling) of contacts should be organized in order to avoid group polarization and stable aversions.

Work Plan for the First Year

Subproject	Design	Data gathering	Analysis	Publications
I.	model building	simulations	✓	1 paper submission
II.	sample, questionnaire	1st wave in primary schools, last wave in secondary schools	ERGMs	1 publication, 1 paper submission
III.	operationalization	document search, expert interviews		
IV.				1 publication (earlier related experiments)

Table 1: Overview of tasks of subprojects in 2012/2013

[2] Accessed from http://www.rev.hu/sulinet56/online/szerviz/oha/oha_lst.htm

Recruitment: One position will be advertised and filled competitively from September 2012 and two positions (only one from the project cost) from September 2013.
Supplementary funds: It will be our priority already in the first year to raise supplementary funds for the research program. We will apply for:

- the ERC Starting Independent Researcher Grant,
- the NF Grant of the Hungarian Scientific Research Fund,
- funding in the framework of the FuturICT Flagship Project of the European Union,
- and funding in the COST Actions of the European Union.

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