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BETWEEN THE RIGHT AND THE COMMON. HOW GROUPS REACT TO SOCIALLY UNDESIRABLE BEHAVIOUR

Abstract. The aim of the paper is to analyse the relationship between group characteristics and the scope of reaction of the group to socially undesirable behaviour. Sometimes small groups or communities fail to react to undesirable or violent behaviour and their apathy can have devastating consequences. Such a situation can occur among co-workers witnessing workplace mobbing, or neighbours who do not react to a suspicion of domestic violence. Reasons for their inaction are diverse and can include fear, doubts concerning the necessity of such a reaction, and also conformity. In the paper I examine a seemingly favourable situation: I assume that reaction is costless and all the members of the group would like to react (internalised norm), but they also want to conform. In order to analyse the factors that can influence the scope of group reaction, a structurally embedded sequential coordination game was played for different initial conditions. Computer simulations were conducted for networks of a specific type (Erdös-Rényi random graph). The main aim of the analysis was to identify non-structural and structural features of the group that can impede or even block the intervention of the group. There is a positive relationship between the scope of group reaction and the strength of the internalized norm, whereas the level of conformity affects the chances of group intervention in a negative way. Heterogeneity of the group is an important factor – the scope of reaction is higher when members of the group have different levels of norm internalisation and conformity. There is a non-linear relationship between network density and the scope of reaction. Both low and high density can make it harder for people to act.

Keywords: rational choice theory, game theory, social network analysis, bystander behaviour, diffusion, conformity.

Introduction

Sometimes small groups or communities fail to react to undesirable or violent behaviour or a suspicion of such. Co-workers witnessing workplace mobbing or bystanders of bullying obviously watch but they seem not to see anything. Medical staff in hospitals do not report that someone is working under the influence of alcohol, although it puts patients in mortal peril. Neighbours who suspect domestic abuse do nothing, although appropriate institutions that could investigate the issue are only a phone-call away (after such a phone-call the testimony of other neighbours would be desirable as well). Reasons for the passivity of bystanders are diverse. In some cases people are afraid of retribution, sometimes they fear that their reaction would not help at all or would make the situation even worse. And maybe sometimes they simply do not care. But what if they do care and even feel obliged to react, and the only reason they are not sure whether to react is the fact that others have not?

The aim of this paper is to show that even when we make such an optimistic assumption and we have a crowd of potential "heroes" at hand, there are different structural and non-structural barriers that can block a reaction[1]. In the paper I analyse group characteristics that can enable or hinder the chances of group intervention when faced with the undesirable behaviour of one of its members or somebody known to the group. In order to analyse the factors that can influence the scope of group reaction, a structurally embedded sequential coordination game was played for different initial conditions. In the paper I examine a seemingly favourable situation: I assume that reaction is costless and all the members of the group would like to react (internalised norm), but they also want to conform. Depending on the levels of norm internalisation and conformity every player can be characterised by a parameter called a threshold. In short, the threshold level describes players' attitude towards the issue. Any player would intervene if a certain fraction of his or her friends have already done so. The assumptions of the model could be seen as "optimistic" with no threshold higher than $\frac{1}{2}$. In addition, for all simulations some initiators were chosen randomly from the group. The main dependent variable is the scope of diffusion, which is an indicator based on the number of those bystanders who finally joined in the intervention. The factors influencing the scope of reaction are both of a non-structural and structural character.

Since the widely publicised case of the murder of Kitty Genevese, which was witnessed by 38 people who did not call the police, the question of bystander apathy has been a topic of various studies. The most prominent study was carried out by Darley and Latane in 1968 and they were the first to describe the paradoxical phenomenon called a bystander effect, which is a negative relationship between the number of witnesses and the chance of intervention. In other words, the more people who are present at an emergency, the smaller the chance of any intervention. The phenomenon has been studied in various contexts and with different modifications and it is now known that the bystander effect is weaker when an emergency is perceived as dangerous (compared with non-dangerous), when perpetrators are present (compared with non-present), and the costs of intervention are more physical than non-physical (Fischer et al., 2011). The problem of bystander apathy has been described in game-theoretical terms by Palfrey and Rosenthal (1984) who treated the effect of intervention as a discrete public good. In general, if bystanders take into account mainly the costs and possible benefits of their actions (or inaction), different public-good models can help analyse their behaviour (e.g. Komendant-Brodowska, 2009). In the model described below, I analyse the behaviour of people witnessing violence or aggression from a different angle, not as a result of a calculation of costs and benefits concerning the effects of intervention but rather as a social action.

First of all, I assume that people feel an internalised norm to react. There is also no clear "good" that can be produced by their intervention. In other words, no matter how many people have reacted, others can still join in. E.g. even if one person informs the police that their neighbour abuses his family, other neighbours can still act, by providing testimony, showing support to the victims etc. In addition, I assume their reaction is costless. At first glance, it seems that in such conditions people will surely react, but there is another factor to take into account.

One of the reasons for bystander inaction is conformity. If my friend hasn't done anything when our fellow student is being mocked and beaten by a school bully, why should I do something? Conformity is a tendency to adjust one's behaviour to others. Social psychologists describe two different needs that can result in conformist behaviour: a desire to be correct (informational influence) or a desire to "fit in" or to be liked (normative influence) (e.g. Deutsch, Gerard, 1955, according to: Aronson, Wilson and Akert, 2006). In the first case the behaviour of the other members of the group serves as an indicator of the proper way to act in a certain situation, e.g. when we park our car the same way the others did. In the latter case, we do not want to disagree with the others because it creates a tension (even when those others are complete strangers to us and we are sure they are all wrong, as in Ash's famous experiment). Those two kinds of social pressure can also operate at the same time. In addition, the tendency to conform is stronger when the social pressure is coming from people who we like, love, and trust, because we don't want to lose their approval and respect (Aronson, Wilson, and Akert, 2006). So, I assume that members of small groups and communities, whose behaviour is analysed in this paper, observe what their friends or neighbours have done and want to act accordingly. In addition, while bystanders adjust their behaviour to what their friends are doing, the latter are doing exactly the same thing.

Whether the members of the group witness an obvious act of aggression or just suspect some malpractice, there is this first moment when nobody has intervened. So, initially, nobody reacts. Then, if potential or real victims are fortunate enough, somebody intervenes, and then other witnesses can join the intervention. Therefore, we can analyse the problem of intervention as a specific example of diffusion. The question of diffusion of innovations has been studied by scholars from different domains (e.g. classical studies of hybrid corn by Ryan and Gross, 1950; studies about tetracycline – Coleman, Katz and Menzel, 1957). Sometimes the same problem is also referred to as "contagion", especially when the innovation in question is not particularly beneficial for the units analysed. One of the main results of various studies of the issue that have been published since the 1950s is the fact that different structural conditions and also characteristics of the innovation itself have a tremendous effect on the dynamics and scope of diffusion (for a comprehensive summary see: Rogers, 2010). The model described below is a specific model of diffusion as I use a different basic game, not a pure coordination game as usually used in such studies. Therefore, it is worth underlining that the aim of the paper is to analyse a specific social problem, not diffusion in general.

Method

In order to analyse different group characteristics that can impede or block a reaction of the group, I used a modified structurally embedded coordination game, which is played sequentially. As stated before, I assume that conformist behaviour can sometimes suppress our good intentions and that the game starts with a vast majority of people being passive (except for the initiators).

These are the basic assumptions of the model:

- Dichotomous choice between not reacting (B) and reacting (R).
- Players feel an internalised norm to react (α_i).
- Reaction is costless.
- Players want to conform – to adjust to what their neighbours (friends) are doing (conformity level β_i).
- Players are embedded in a network of symmetrical relations (acquaintances, friends, neighbours, family members).

- There is no common knowledge about the others' preferences (pluralistic ignorance, i.e. players don't know that all members of the group share a norm that tells them to react).
- Players cannot perform the action in a hidden manner – if they choose to do it, their action is seen at least by those they have a relation to.
- Players react to the actions they can observe.
- Majority of players start the game by not reacting. Some players (e.g. chosen randomly) initiate the intervention.
- Outsiders (players who don't have any relations with other members of the group) do not act unless they are initiators themselves. Their action does not affect what the others are doing.

In other words, I assume that everyone in a small group knows that they should intervene or at least "say something", but they don't know what the others will think. They start with everyone being silent and they don't want to act differently than their friends or relatives, or neighbours. I use a simple model of a structurally embedded modified coordination game to analyse the characteristics of the group that may impede the diffusion of what is right among the indifferent majority (for a more specific description of the model: Komendant-Brodowska, 2013, 2014a, 2014b).

Players are embedded in a network of symmetrical relations. Depending on the type of small group or community we consider, we should consider different kinds of relations. In the model it is assumed that they are symmetrical and they are significant for the players. So, when player i is related to player j, she wants to behave similarly to player j, and in reverse, player j wants to act the same way as player i. In addition, there are no significant relations that connect the members of the group to the suspected perpetrator. E.g. if we consider a situation in a hospital, and the medical staff who think about reporting a doctor to the manager, we assume that those staff members are not direct subordinates of this doctor, because then the assumption that the reaction is costless would not hold. It is worth underlining that by assuming that there is no relation between the witnesses and the perpetrator we can show how the structure of the group of witnesses itself can impede on the intervention. In real-life situations group reaction can be inhibited even further by the perpetrator him- or herself and by other factors.

Players, involved in the relations of friendship and taking these relationships into consideration in their decisions as previously mentioned, have a choice of only two behaviours: reaction (R) and passivity (B). Players' utility functions and the choice of a particular behaviour at a given point in the game are in the form:

$$u_i(B) = \beta_i p_{iB}$$

$$u_i(R) = \alpha_i + \beta_i p_{iR}$$

where:

α_i – an increase of *player* i's utility because his or her behaviour is in accordance with the internalised norm (norm internalisation parameter)

β_i – an increase of *player* i's utility because his or her behaviour is in accordance with the behaviour of his or her friends (conformity level parameter)

p_{iR} – the percentage of *player* i's friends who are reacting (R) (number of i's friends who are reacting divided by the sum of *player* i's friends)

$p_{iB} = 1 - p_{iR}$ – the percentage of *player* i's friends who are passive (B)

I assume that if a player is indifferent between the two behaviours, he or she selects the behaviour from the starting point of the game, namely passivity (B), and only if choosing the reaction (R) gives him or her an increase in utility, will it encourage them to respond. This procedure reflects the fact that there is a clear starting point in this game and in order to break the *status quo* players need to benefit, at least minimally, from changing their behaviour.

$$u(R) > u(B) \text{ if and only if } \alpha_i + \beta_i p_{iR} > \beta_i p_{iB}$$

$$\alpha_i + \beta_i p_{iR} > \beta_i (1 - p_{iR})$$

Therefore,

$$p_{iR} > \frac{1}{2} - \frac{\alpha_i}{2\beta_i}$$

For each player, it is possible to designate one key parameter indicating the response threshold $t_i^* = 1/2 - \alpha_i/2\beta_i$ (wider description: Komendant-Brodowska, 2013, p. 85). The player will react when the proportion of responders among his or her friends exceeds this value. The threshold is lower, when the degree of norm internalisation is higher, and the conformity level is lower.

Analysis of selected network structures and utility functions allows us to formulate some preliminary conclusions on the group conditions of the behaviour of witnesses of violence (Komendant-Brodowska, 2013). When it comes to non-structural parameters, it's pretty clear that the stronger the degree of norm internalisation and the lower the level of conformity, we can expect a broader response of the group to the violence they are witnessing. The relationship between these two parameters also influences the number of initiators of the reaction in the group. Such initiators (for whom the threshold level is lower than zero) are crucial to break the group passivity. According to the assumptions of the model only when a player initiates a reaction, may others join him. In this article I will not, however, pay more attention to the initiators of reaction, because the subject of my interest will primarily be group characteristics, and the presence of the initiators of them does not depend on those characteristics. The number of initiators randomly selected from the group will be treated as one of the parameters describing the initial conditions of the game.

First of all, as far as the structural characteristics of the group are concerned, one should mention the concept of blocking clusters, well known in social network analysis (e.g. Easley, Kleinberg, 2010). These are the subsets of players (with the exception of the initiators) with threshold values t_i^*, among which all have at least $1 - t_i^*$ friends in the set. The presence of such structures in the network of relationships prevents the dissemination of behaviour that – if it were universal – would give players a higher payout than the behaviour chosen by them at the beginning of the game. In other words, if there are such subgroups in the group, with strong internal connections and a small number of connections with the rest of the group, players from these subgroups will not join the intervention. The whole group except for the initiators may also form a blocking cluster. In such cases, only the initiators, who are the most motivated players – able to act independently of what their friends do – would react. The presence of blocking clusters depends on different group characteristics, which will be discussed further in the article.

Simulations

Simulations were conducted in order to analyse the factors that may be associated with the process of witnesses' intervention. The game begins with the almost universal "code of silence", i.e. all members of the group know that something is wrong and they feel they ought to react, but they do not, because their friends also are passive. Then, at least one initiator breaks this "conspiracy of silence" and reacts to the problem. The simulations were used to analyse what would happen next. The factors supporting and blocking the diffusion of intervention would be analysed based on the results of simulations. For this purpose, a model of the game in NetLogo environment and an additional program in Java[2] (which allowed us to perform multiple simulations using the parameters from specified ranges) were constructed. Firstly I will explain briefly the initial conditions of the game, and then the results of the simulation data (a more detailed description of the simulation procedure can be found in: Komendant-Brodowska, 2014).

It should be noted that the simulations described below only allow us to analyse a limited number of selected factors contributing to the diffusion of socially desirable behaviour and only in certain conditions. The analysis presented here is largely of an exploratory character. I will describe some examples of directions in further research that seem to be worth exploring in the section of the article about the possible modifications and extensions of the model.

Initial conditions – non-structural parameters

As the size of the group was not a factor to be analysed and as the major research question concerned situations that happen in small groups, a fixed size of groups (20 players) was used. The parameters describing the degree of internalization α_i and the level of conformity β_i were assigned to players by the investigator. It should be noted that from the point of view of the game it is not so much the absolute values of these parameters that are important, but the relationship between them, as it determines the threshold level. In total, 72,900 simulations were carried out for groups of homogeneous thresholds. In the simulations nine levels of $\alpha \in \langle 10.90 \rangle$ were used for a fixed-size $\beta = 100$, which corresponds to the range of thresholds $t_i^* \in \{0.05; 0.1; 0.15; 0.2; 0.25; 0.3; 0.35; 0.4; 0.45\}$.

Simulations were also carried out in groups of heterogeneous thresholds (36000 simulations). In order to obtain different thresholds, the values of the parameter α were randomly assigned to the players, based on a normal distribution with assigned parameters m_{t^*} (mean) and δ_{t^*} (standard deviation). The simulations were performed for the expected average value of the threshold $m_{t^*} = 0.25$ and of the expected standard deviation of thresholds $\delta_{t^*} \in \{0.05; 0.1; 0.15; 0.2; 0.25\}$ and for comparison in homogeneous groups with the same response threshold value ($\delta_{t^*} = 0$). For each player the same value $\beta = 100$ was assigned.

Both in homogenous and heterogeneous groups initiators were randomly selected from the group, for whom $\alpha_i > \beta_i$. In different variants of the simulation there were one, three, or five, initiators in the group chosen randomly. In heterogeneous groups apart from the randomly chosen initiators some other additional initiators could appear if for some players their assigned parameter was $\alpha > 100$ (and therefore for them $\alpha_i > \beta_i$).

In the case of non-structural parameters of the simulations, the distribution of simulations is equal for all parameters considered, e.g one third of the simulations were carried out for one initiator, one third for three initiatiors and the remaining one third for five initiators.

Initial conditions – network of social relations

Although there are only twenty players and the relations are symmetrical, the number of possible network structures is close to infinite. Therefore, just as is usually done in simulation analysis, a specific algorithm was used in order to create networks of relations. Since the analysis was mainly exploratory in nature, I chose one of the simplest existing algorithms, namely the Erdös-Renyi random graph. For a given number of players n each of $n(n-1)/2$ possible relations are created independently, with a fixed probability p_{link}, selected by the investigator. Therefore, the main parameter that describes the network is the value of this probability, referred to hereinafter as p_{link}. The higher this value, the higher the network density, and higher the average number of neighbours.

In the case of this type of graph, there are two values of p_{link}, for which we can talk about phase transitions, i.e. the networks differ significantly above and below these values. Phase transitions are defined and described in Table 1. The first such transition occurs for $p_{link} = 1/(n-1)$ (for a network of 20 nodes the value equals 0.053). Above this value, a giant component appears, i.e. the network of relations connects a large part of the group. The second transition occurs for $p_{link} = \ln(n-1)/(n-1)$ (for 20 nodes, this value equals 0.158). Above this value there are no more outsiders, the network is nearly always connected – there are no such players who have no relations with any other member of the group. With the increase of p_{link} there is an increase in the density of the network and the expected average number of friends of the player. A number of values of p_{link} was selected for the simulations, starting with those before the first phase transition up to a very high value indicating the almost complete network, in which all are friends with everyone. p_{link} values used in the simulations are described in Table 1.

In the case of homogeneous groups for each combination of non-structural parameters (the threshold value and the number of randomly chosen initiators) and the value of p_{link}, ten different networks were created randomly and for each of them the initiators were randomly selected ten times, with the result that for each combination of non-structural parameters and p_{link} a hundred simulations were carried out. In special cases, in order to explore observed differences and ranges of parameters, additional simulations were carried out and added to the database for analysis.

Table 1

Expected (average) number of player's friends depending on the value of p_{link}

p_{link}[a]	Average degree	Phase transitions	Network characteristics – description of relations in the group	Number of simulations	
				homogenous groups[b]	heterogenous groups[c]
{0.03; 0.04}	below 1	before the 1st phase transition	Scarce relations of friendship, many members of the group do not have friends	5400	7200
{0.05; 0.06}	circa 1	1st phase transition – giant component	the network of relations connects a large part of the group	5400	–
{0.07; 0.08; . . . ; 0.14}	1.3–2.7	before the 2nd phase transition	the network of relations connects a large part of the group, there are still some members of the group with no friends	21600[a]	7200
{0.15; 0.16}	circa 3	2nd phase transition – connected network, no outsiders	no more outsiders, every member of the group has at least one friend, the network of relations connects the whole group	27000[a]	–
{0.2; 0.3; 0.4; 0.5}	3.8 – 9.5	after 2nd phase transition	the network of relations connects the whole group, the average number of friends is quite high (and growing with an increase of p_{link})	10800	21600
0.8	15.2	very dense, almost complete network	players are friends with more than half of the group (on average a player has 15 friends), it is almost as if all members were friends with everyone	2700	–

[a] For the sake of clarity, the results will be presented not for all the specific values of plink but for different ranges of values, representing different characteristics of the group.

[b] The simulations for the homogenous groups were of exploratory character. For some chosen values close to phase transitions and for the range of values between phase transitions more simulations were carried out in order to analyse the results within that range in detail.

[c] As the simulations for the heterogenous groups were carried out later and there was no need for a more detailed analysis of any specific range of values of plink, only five values were chosen: 0.04, 0.1, 0.2, 0.3 and 0.4 (7200 simulations for each of these values).

For heterogeneous groups five values for p_{link} were selected, representing different types of network structures: 0.04 (before the 1st phase transition), 0.1 (before the 2nd phase transition), 0.2, 0.3 and 0.4 (after the 2nd phase transition, with growing network density). There were three variants of number of initiators (one, three and five). For each of these combinations 20 networks were created, and for each of them 20 times the roles of initiators were assigned, which gave 400 simulations for each combination of parameters. In total, 72,900 simulations were performed for homogeneous groups and 36,000 simulations for heterogeneous groups.

It is worth noting that for the analyses described below it is not the absolute values of the dependent variable (scope of diffusion) that matter but the differences depending on different non-structural and structural characteristics of the group.

The range of possible outcomes and description of the analysed variables

All the simulations began with almost universal passivity. Only the initiators (players for whom $\alpha_i > \beta_i$) started the game with behaviour R. Outsiders, or players who do not have friends, are in a special situation as they are neither influenced by the behaviour of other players, nor do they influence other players themselves, as in this model people are only affected by their friends' behaviour, not by the whole group. In the simulation I assumed that the outsiders, who have no relations that would connect them to the group in any way (they have no friends, neighbours etc.), remain passive until the end of the game except for two specific situations (analogous to other players who are not outsiders):

- If an outsider is randomly drawn from the group as a hero-initiator, he or she starts the game by reacting to violence and remains 'playing hero' until the end of the game.
- If an outsider becomes a hero as a result of the random assignment of parameters in such way that for him or her $\alpha_i > \beta_i$, he or she also becomes an active witness and remains so until the end of the game.

At the start of the game, depending on randomly selected parameters and links with other players, players could perform the following roles:

- **hero** – a player who as a result of the random draw of heroes-initiators or a random draw of parameters ($\alpha_i > \beta_i$), starts the game by intervening/reacting (R)
  - if it is not an outsider, it is a player whose behaviour could provoke a change in behaviour of other players

  - hero – outsider – who starts the game by reacting (and remains being a hero until the end of the game), but his or her behaviour does not affect the behaviour of other players
- **potential hero** – a player who starts the game with passivity and may join the other responders in the course of the game
- **passive outsider** – remains passive until the end of the game

There are no cycles in the game, and the number of players reacting to undesirable behaviour can only remain constant or grow. You could say that once a player has broken the "conspiracy of silence" he or she cannot withdraw their decision (with given utility functions it would not happen, because once somebody has decided to react, no matter what others did, it would be a better option for him or her until the end of the game). This is why the game leads to partial or massive intervention. The final result of the game may be described by a number of players who are intervening in the equilibrium result[3]. However, some players have started the game by intervening (heroes) and some (passive outsiders) can never be reached by the process of diffusion. Therefore, the best variable to describe the result of the game is **the percentage of potential heroes who joined in the intervention in the course of the game**. This parameter will be referred to as a '**range of diffusion**' indicator.

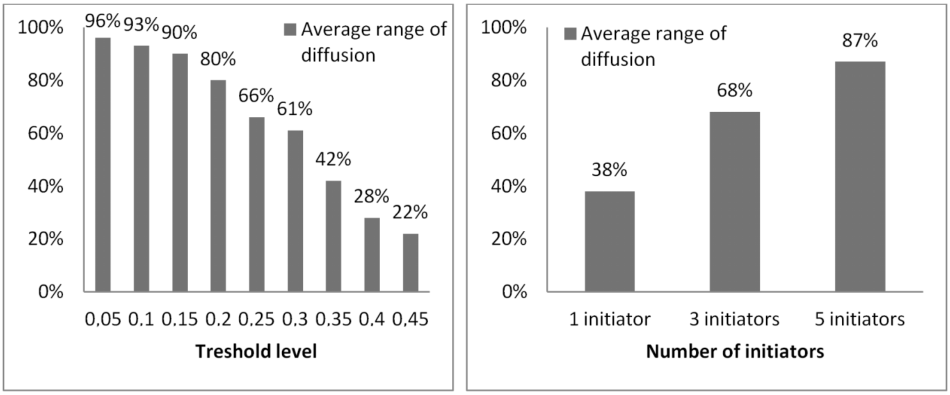
Two key dependent variables (the number of active witnesses in the equilibrium and diffusion indicator) were analysed against the main independent variables including: non-structural parameters (threshold level, threshold variance, number of heroes-initiators drawn randomly from the group) and structural factors, represented by the level of p_{link}.

Results

As for the impact of the thresholds level and the number of randomly drawn heroes-initiators on the range of diffusion, the direction of the relationship in both cases is consistent with intuition. The lower the response threshold and the more the initiators, the easier it is to change the behaviour of potential heroes and the easier it is to achieve a massive reaction (all potential heroes join in the intervention in the course of the game). The results for the homogeneous population are presented in graphs 1 and 2.

Given these two non-structural factors, one could determine the situations that are extremely unfavourable in terms of potential for change of behaviour of the potential heroes, as well as situations that support the intervention. For example, it would be extremely unfavourable for diffusion

Graph 1 and 2. Range of diffusion[a] depending on threshold level and the number of heroes-initiators (homogenous groups, N = 72900)



[a] The main dependent variable is the range of diffusion – an indicator described above. Average values of that indicator have been calculated for different initial conditions. E.g. the average range 96% for the threshold value 0.05 means that for those simulations that were run for homogenous groups with threshold 0.05 on average 96% of potential heroes eventually joined in the reaction.

Source: Komendant-Brodowska, 2014

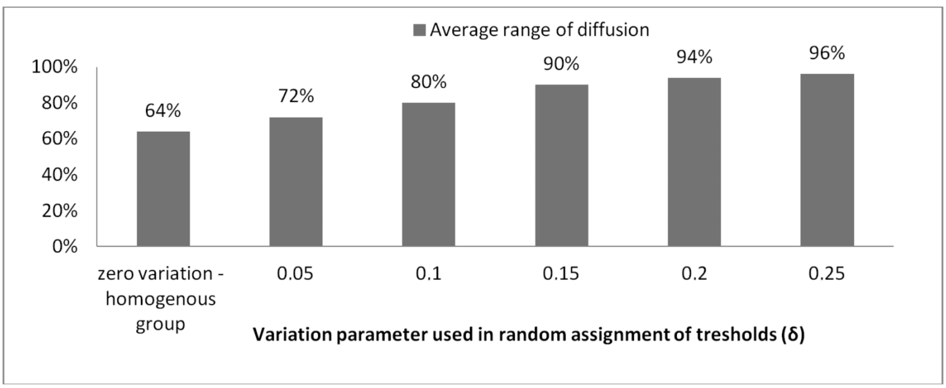
if we had a group with a very high threshold level (0.45) and only one hero-initiator. For such initial conditions, in 78% of simulations none of the potential heroes have joined the initiator. On the other hand, it should be noted that despite such unfavourable conditions, in groups of certain structural features, there was a change in the behaviour of potential heroes and such a change occurred in 22% of simulations.

On the other end of the continuum, with an extremely low threshold level, indicating that the group is made up entirely of "almost-heroes" (threshold $t^* = 0.05$), it makes a full mobilization of the group almost certain. In such cases, the number of heroes-initiators is almost irrelevant. In more than 90% of the simulations for such a low threshold level, the game ended in such a way that all potential heroes joined the initiators.

Meanwhile, in situations "in-between" we can observe a high variation of results. For example, for $t^* = 0.25$ and one initiator, 58% simulations ended in a lack of change in behaviour, in 24% simulations the observed change was relatively small, i.e., one or more players joined to the initiator, whereupon the diffusion hit a blocking cluster formed by the rest of the group. And in 13% of cases the change started by only one initiator led to a full mobilization of the group. It is worth noting that it is the structural factors that influenced the final result. Namely, for given non-structural conditions everything depended on the shape of the network and on the position of the initiator in that network. In the group with the same threshold level, if there were three initiators, no change occurred only in 11% of simulations, and full mobilisation occurred in more than three quarters (76%) of games.

Another non-structural factor influencing the scale of diffusion was the variance of thresholds. Firstly, the analysis of data from simulations for heterogeneous groups confirmed that the average level of thresholds[4] is negatively correlated with the scope of diffusion while the number of initiators influences diffusion in a positive way. Secondly, analysis of simulations carried out for such groups shows that the size of the variance of thresholds significantly altered the outcome of the game. The greater diversity of thresholds, the more players joined the initiators and the more often the game ended in a full mobilisation. In groups with zero variance 58% of simulations ended this way, and when the variance was at its largest, such an end to the end of the game was observed in as many as 91% of simulations. Graph 3 shows the average value of the range of diffusion for different variance values assumed in the draw of parameter α, which determined the response threshold of individual players.

Graph 3. Range of diffusion depending on the variation parameter (heterogeneous groups, N = 36000)



Apart from the variation parameter treated as one of the initial conditions of the game, the real standard deviation of thresholds in the group was used in the analysis (different from the parameter used in simulations e.g. because there were also heroes-initiators in the group, with the threshold minimally below zero). For heterogeneous groups the following variables were used as independents:

- average threshold level in the group (real average, including the heroes-initiators) – $E(t^*)$

- standard deviation of thresholds in the group – $D(t^*)$
- Number of heroes-initiators drawn randomly from the group – n_{init}

The higher the average threshold level in the group, the smaller the percentage of potential heroes who changed their behavior in the course of the game. In the case of the other two variables, the relationship had a different direction – the greater the degree of dispersion of the thresholds in the group and the more the initiators, the better for the range of diffusion. After examining the relations between variables, linear regression coefficients were calculated for these three variables (Table 2). The square of the correlation coefficient was $R^2_{zmiana|E(t^*),D(t^*),n_{init}} = 0.385$, and partial correlation of the threshold deviation level and the range of diffusion (control variables: the average threshold in the group and the number of initiators) was $\rho_{zmiana|D(t^*),E(t^*),n_{init}} = 0{,}41$.

Table 2

Linear regression coefficients. Dependent: range of diffusion (heterogeneous groups, $N = 36000$)

Dependents	Non-standardized coefficients – B	Standardized coefficients – Beta
(Constant)	0.551	
Average threshold in the group $E(t^*)$[a]	– 1.915	– 0.183
Standard deviation of thresholds in the group $D(t^*)$[a]	4.061	0.388
Number of heroes-initiators n_{init}	0.046	0.214

[a] For every player, for whom $t_i^* < 0$ it was assumed that $t_i^* = 0$ for the purpose of counting the average level of threshold and standard deviation of thresholds in the group. Otherwise lower levels of threshold would affect both parameters although all negative values of $t_i^* < 0$ have the same meaning in the game and their absolute value does not affect the game in any way.

The effect of thresholds variance on the scale of the reaction of the group is illustrated in Figures 1 and 2. It shows how easy it is to "penetrate" a subgroup of players with different levels of thresholds than a homogenous subgroup with the same average threshold.

Figure 1 shows a fragment of a network consisting of six nodes, the nodes numbered 1 to 6 represent witnesses of violence who are intervening. The threshold level of nodes 2, 3, 4 and 5 is $t^* = 0.3$. With such a threshold value this group of four nodes creates a blocking cluster.

Figure 2 shows how the game would proceed in a network of the same shape, the same initial behaviour distribution, and the same average level of thresholds (0.3). The only difference is the variation of the thresholds.

Figure 1. An example of how the game would proceed in a fragment of a network – no variation of thresholds

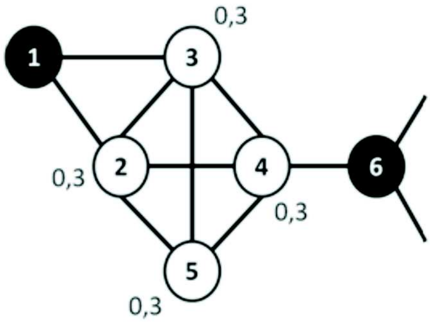
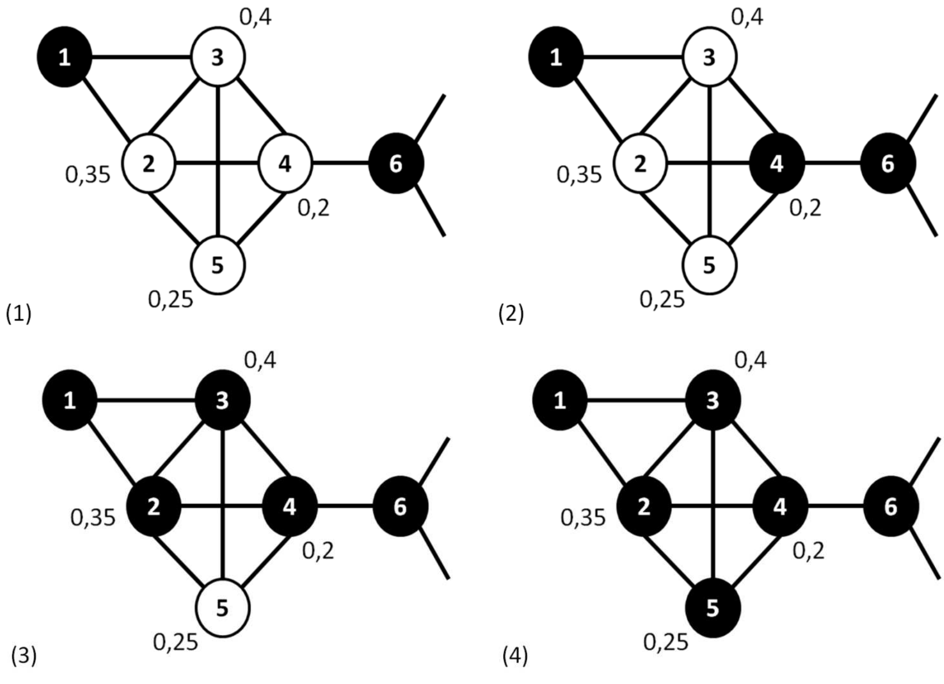


Figure 2. An example of how the game would proceed in a fragment of a network – different thresholds



Players 2 and 3 are less willing to react than in the previous example ($t_2^* = 0.35$ and $t_3^* = 0.4$), those with numbers 4 and 5 are more willing to intervene and break the conspiracy of silence ($t_4^* = 0.2$ and $t_5^* = 0.25$). Here, although the average threshold level is the same, the subgroup is more prone to join in the intervention.

Due to the fact that player 4 has a lower threshold than in the case of the network illustrated in Figure 1, it is possible for the whole group of players to join those witnesses who have already responded. Although a higher variance of thresholds in the group means that some players are more reluctant to intervene, on the other hand – and what is much more important – we have those who are more eager to react and to join in on the intervention. If they are friends with those who have high thresholds, they make it is easier to exceed this threshold.

The dependence of the range of diffusion of the thresholds level and the number of initiators is quite obvious. Less obvious is the fact that the dissemination of socially desirable behaviour, is strongly influenced by the differences in thresholds. The more diverse the group is in terms of the degree of norm internalization and conformity level, the higher the odds that such a group will actually do something when faced with a problem. It is worth noting that the degree of thresholds variance also affects the chance that there will be heroes in the group. Therefore, the threshold variance has a positive impact on the level of group reaction in a two-fold way: by increasing the probability of the appearance of heroes, as well as the chance that someone will join them.

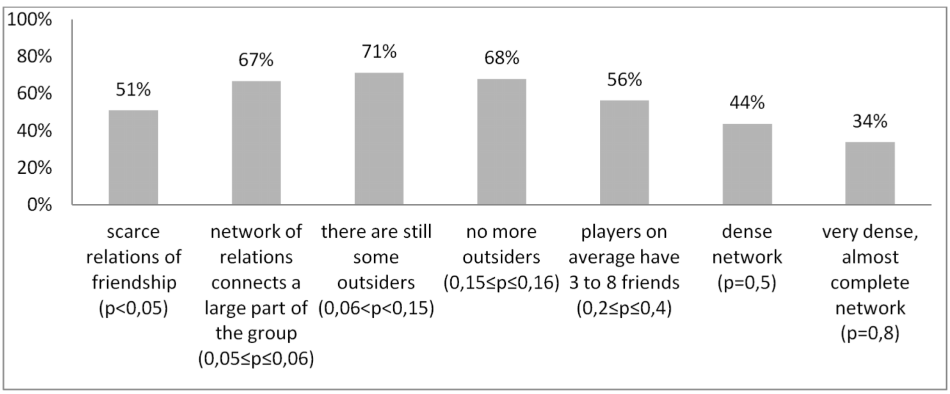
Structural characteristics

In this section of the article I would like to present the conclusions about the influence of structural features of the group on the range of reaction to undesirable behavior. As we could see in the previous section, for the given non-structural initial conditions there was a significant amount of variance in the results which indicates the importance of structural features for diffusion. It should be noted that in the simulations only one networking algorithm was used, a very simple one leading to creation of networks with specific characteristics. ER networks can be described by a single parameter p_{link}, the probability of the existence of links between two arbitrarily selected players. For such networks, both the number of links, the density of the network, as well as the average number of friends, grow together with the values p_{link}, so sometimes I will be using these terms interchangeably, which would not be possible for networks constructed on the basis of different algorithms. Conclusions from the analysis here relate only to networks with similar characteristics to those characteristic of the Erdös-Renyi (ER) graph. For networks with other properties the relationship between the average degree of a node or network density and the results of the game could be quite different in nature and it is certainly an issue that should be explored in the future.

The relationship between network density and the range of diffusion is quite complex. On the one hand, the greater the concentration of the relations, the greater the chance that players will have at least one initiator among their friends. What's more, if we think of a highly dispersed network consisting of multiple unrelated subgroups, the changes in behavior can only be expected in such subgroups where there were some heroes-initiators and, therefore, low density networks could block changes in the behaviour of the group. On the other hand, there is the problem of blocking clusters (analysed more thoroughly in the context of the described model in: Komendant-Brodowska, 2013). If a player has many friends, the fact that one of them broke the silence, may not be enough for him or her to encourage them to join in. Thus, higher network density can lead to block diffusion. In other words, the higher the degree of a certain node, the more stable its behaviour (which is in line with the results of analyses of Lelarge, 2012).

Analysis of the impact of the characteristics of the network structure on the outcome of the game allows us to show that the two intuitions described above are reflected in the data. The relationship between the scope of the response of the group to undesirable behaviour and network density is non-linear. Graph 4 presents the mean values of the range of diffusion for the various characteristics of the network structure corresponding to certain ranges of parameter p_{link}.

Graph 4. Average range of diffusion depending on network characteristics (homogenous groups, N = 72900)



On the one hand, for the spread of reaction, potential heroes need to have some contact with the initiators, or a chance that there will be someone intervening among their friends. It can be a hero-initiator or someone who has joined in later, in the course of the game. On the other hand, players should not have too many passive friends, because then they would represent for him the most important point of reference in the selection of behaviour.

These observations are confirmed by the analysis of the correlation between the density of the network and the range of diffusion performed separately for the unconnected networks ($n = 18360$) and connected networks ($n = 54540$). In the first group, the denser the network, the higher the range of diffusion ($\rho_{zmiana,p_{link}} = 0.169$). Meanwhile, when analyzing only the connected networks the correlation between these variables was negative ($\rho_{zmiana,p_{link}} = -0.222$). It was also checked whether in the case of non-connected networks the relationship is not solely due to the fact that in such networks there can be many outsiders and therefore the odds are high that the heroes-initiators were drawn precisely from this group, which, of course, prevents diffusion. Of more than eighteen thousand simulations I ruled out all those in which at least one hero-initiator was drawn from outsiders (in other words, all simulations with at least one hero-outsider ruled out). In such networks, the correlation between the density of the network and the range of diffusion was still positive ($\rho_{zmiana,p_{link}} = 0.108$). Table 3 summarizes those results.

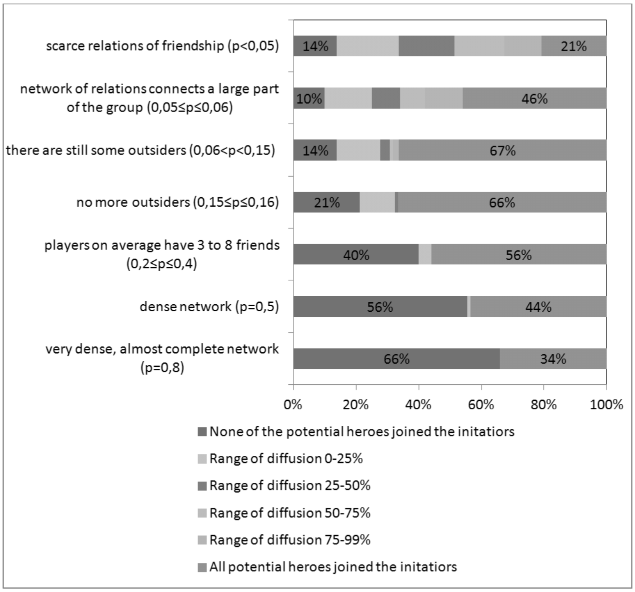
Table 3

Correlations between network density and the range of diffusion for connected and unconnected networks (homogenous groups, N = 72900)

Network type	Pearson's correlation coefficient	Number of simulations	Remarks
unconnected networks – total	0.169	18360	–
unconnected networks without heroes-initiators	0.108	12261	All cases where there was at least one hero-outsider were ruled out ($n = 6099$)
connected networks	– 0.222	54500	–

What is important, in different types of networks, not only the average level of results measured in absolute (number of defenders) or relative terms (percentage of potential heroes who joined in the intervention during the course of the game), but also the level of variation of results is different. Only in dispersed networks are there some cases of partial equilibriums, in which a significant fraction of witnesses intervene while another significant fraction do not. When a network is connected (after the second phase transition) such situations hardly ever occur and there are only extreme results – either all potential heroes eventually join the initiators, or none of them do (graph 5).

Graph 5. Range of diffusion depending on network characteristics (homogenous groups, N = 72900)



As we can see, the shape of the network affects the scale diffusion in a complex way. Moreover, there are also interactions between structural and non-structural characteristics of the group as far as the impact on diffusion is concerned. The shape of the relationship between the scale diffusion and network density is different for groups of people more motivated to respond (low threshold levels), the other for medium-motivated, and still another for a group of players who have very high thresholds. For the last group, with lowest thresholds $t^* = 0.05$ the highest percentage of potential heroes react when the network is very dense. When the threshold is $t^* = 0.45$ greater diffusion can only be observed in dispersed networks. For intermediate thresholds we can observe the same non-linear shape of the relationship between the two variables as described for the whole group. It is also worth underlining that even in the case of networks with diverse thresholds we have to deal with the interaction of non-structural and structural factors. The variance of thresholds is of greater significance for the outcome of the game in denser networks than in sparser ones (the direction of the relationship is the same, that is, the greater the diversity, the greater the expected change of the behaviour of potential heroes). However, a broader analysis of interactions between non-structural and structural factors, goes beyond the objectives of this article (description of the interactions between structural and non-structural factors: Komendant-Brodowska, 2014b).

Discussion

The aim of the paper was to analyse group characteristics that can enable or hinder the chances of group intervention when faced with undesirable behaviour of one of its members or somebody known to the group. It was assumed that group members have internalised a norm telling them to react to those undesirable behaviours, but on the other hand no one wants to act out of line. Depending on the levels of norm internalisation and conformity every player was characterised by a parameter called a threshold. In short, the threshold level describes players' attitudes towards the issue. In means that any player would intervene if a certain fraction of his or her friends have already done so. The assumptions of the model could be seen as "optimistic" for two reasons: none of the players had a threshold higher than $\frac{1}{2}$. Secondly, for all simulations one, three, or five initiators were chosen randomly from the group. The main dependent variable was the scope of diffusion.

Firstly, I'd like to underline that one of the assumptions of the model is an important factor which should be taken into account when we try to answer the frequently posed question "Why did no one react?" In the model I assumed there's no common knowledge[5] of players' attitudes toward the problem. In other words, the model describes a small group where members don't know what the others think about the problem and there is a kind of culture of silence, at least considering the issue. This makes it impossible for people to coordinate their actions[6]. The model shows what happens when people don't talk about undesirable behaviour. It illustrates how easy it is for such a group to be locked in a social trap, where everyone would like to act but are uncertain as to whether this is appropriate (it may be inadvisable if nobody does it), and wait for others to make the first step. And even if somebody does, it doesn't mean that we will observe immediate and massive intervention. It seems that certain problems are more prone never to be spoken of openly, because they are embarrassing or taboo, e.g. when there is some sexual context involved (sexual harassment, sexual abuse). Anyway, it is worth noticing that the quality of communication among group members is an important factor when we think about the way a group reacts to undesirable behaviour (or a suspicion of such). And for example, in the case of school bullying, one of the main elements of prevention programs advocated by researchers and practitioners is holding regular meetings and discussions that provide group members with an opportunity to talk about the problem (e.g. Olweus, 1993, Kärnä et al., 2010).

What are the main results of the analyses? In line with intuition, there is a positive relationship between the scope of group reaction and the strength of the internalized norm. The level of conformity affects the chances of group intervention in a negative way. What is less obvious, is the fact that heterogeneity of the group is an important factor. The scope of reaction is higher when members of the group have different levels of norm internalisation and conformity. The more diverse the thresholds are, keeping the mean level of the thresholds constant, the more players decide to react. Obviously, higher levels of dispersion of thresholds boost the chances that there will be spontaneous initiators in a group. But it is not so obvious that it also makes the diffusion process itself much easier, which is especially important in densely knit groups.

As far as structural features are concerned, there is a non-linear relationship between network density and the scope of reaction. Both low and high density can make it harder for people to act. When members of a community are just loosely connected, when they don't know each other well, diffusion is impossible because a group is just a collection of outsiders (or pairs, or triples) and unless there are many individual initiators, reaction will be close to none. This could be the case of a block of flats where people meet in the corridors without even saying hello to each other. On the other hand, in a small community where everyone knows everyone else, even when someone initiates an intervention (e.g. in case of a suspicion of domestic violence), his friends or family may still prefer to stay silent because the majority hasn't done anything. Although the model is rather simple, it illustrates quite well how density of the network influences diffusion. In addition, there are interactions between structural and non-structural characteristics of the group – different levels of network density support diffusion in a different way depending on the level of thresholds.

The presented model is of course quite simple and can be used as a basis for further development. First of all, other networking algorithms should be applied in order to analyse the influence of various network characteristics on the range of reaction of the group to undesirable behaviour. For example, a preferential attachment or "small world" models could be used instead of ER random graphs. The first, known by the names of the authors Barabasi-Albert is based on the assumption that the network is formed by adding additional nodes to a primary small group in such a way that each new node is more likely to bind itself to the nodes that have a higher degree (popular nodes are preferred over unpopular ones). This creates a network where some nodes have many neighbours and much of the group has only very few of them. For such networks we would have a completely different degree of distribution than in the case of an ER graph. The second mentioned type of algorithm, whose authors are Watts and Strogatz, in turn, has the property that at the same time the average path length is relatively low, but there is a high degree of clustering, which can be translated into the language of social relationship in a way that one becomes friends with his or her friends more often than with some random member of a group (for a description of both algorithms and their properties see: Jackson, 2008, p. 111–112; 174–179).

In conclusion, the analyses described above show how both non-structural and structural features of the group may severely impede on its ability to react to undesirable behaviour. As the above discussion has noted, however, there is a need to build on this exploratory work, both by developing the model itself, by carrying out simulations for diverse initial conditions and last but not least, by using the results of those analyses to form hypotheses for empirical research.

NOTES

[1] The article is partly based on a paper titled "Świadkowie przemocy na strukturalnym polu minowym. Analiza zależności między strukturą grupy a zakresem reakcji na agresję" published in *Decyzje, 2/2014* whose aim was to analyse a particular case of bystander intervention, namely that concerning school bullying. The paper was published in Polish and that limited the accessibility to the English-speaking readers. Therefore, some parts of the Polish paper (esp. those concerning homogenous groups) are replicated here. The main subject of this paper is a broader social issue than in the case of Polish paper. Also, some additional analyses for the homogenous groups and the results of the analyses for the heterogeneous groups have been added.

[2] I would like to thank Jan Klimaszewski (Politechnika Warszawska) for constructing the appropriate NetLogo and Java programs that were necessary to carry out these simulations.

[3] It took on the average over four iterations to reach the equilibrium both in case of homogenous (4.4 iterations) and heterogeneous groups (4.9 iterations). Iteration is understood as a whole round of the game during which every player has updated his or her status. As the number of rounds depends on non-structural and structural characteristics of the group (e.g. eta-squared for the number of iterations depending on the plink is over 0.14) and could be a separate topic of analysis, the average values mentioned above only serve the purpose of describing the simulation process, not to be treated as a result of analyses.

[4] It is worth noting that the range of average thresholds levels here was very limited (ranging from 0.05 to 0.34, on average 0.2, with more than 80% simulations with an average threshold between 0.15 and 0.25). In case of the number of initiators, the distribution of this variable was analogous to the homogenous groups, with one third of simulations carried out with one, three and five randomly selected initiators. The average values of range of diffusion were 0.6; 0.9 and 0.97 respectively.

[5] Common knowledge requires not only the mutual knowledge of each others' preferences but also the knowledge that the others know one's preferences etc. It is an assumption often made in game theory (Haman, 2014)

[6] Chwe (2000) analyses threshold models with different assumptions concerning players' knowledge of other players' thresholds and relations and shows how this assumption can change the game. Chwe's model was based on a basic threshold model proposed by Granovetter (described e.g. in Granovetter, Soong, 1983).

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