Cooperation and defection in ghetto

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Abstract

We consider ghetto as a community of people ruled against their will by an external power. Members of the community feel that their laws are broken. However, attempts to leave ghetto makes their situation worse. We discuss the relation of the ghetto inhabitants to the ruling power in context of their needs, organized according to the Maslow hierarchy. Decisions how to satisfy successive needs are undertaken in cooperation with or defection the ruling power. This issue allows to construct the tree of decisions and to adopt the pruning technique from the game theory. Dynamics of decisions can be described within the formalism of fundamental equations. The result is that the strategy of defection is stabilized by the estimated payoff.

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1 Introduction

In human history, violence is continuously with us, despite our optimistic belief that it is less and less widespread. In our minds, violence of armed against disarmed people is particularly repulsive. However, still it happens in numerous places on earth. Perhaps a new element is that all of us are more conscious of the situation, than ever before. The question is if victims of the violence -treated as a community - can accept it. If yes, the situation will remain stable; if not, they will resist, and the violence is expected to spread. This duality - to resist or not - is especially inevitable in a ghetto, where an escape is not possible or at least very difficult. Here we are going to attack this problem by sociophysical methods, i.e. by a construction of an appropriate model.

As a model base, we propose two elements. First is the Maslow theory [1]. Its basic assumption is that people are going to satisfy their needs one after another, in order from most basic to most sophisticated. Our central question -the decision of the victims about resistance - is to be considered in the context of their subsequent decisions how to satisfy their needs. In other words, each vital decision in the situation of violence is to be made in relation to this violence. Second element of the model is the mean field approach, as applied to a strike by Galam, Gefen and Shapir [2]. This approach profits from the analogy to ferro-paramagnetic transition in the Ising model. In this description, the ferromagnetic phase with given orientation of spins is equivalent to a given decision
(as to take part in a strike or not), made by the majority as a consequence of social interactions.

This author imagines that the goal of this paper is twofold. First is a reconstruction of chains of subsequent decisions of people. We apply the decision tree - a concept from the game theory [3]. This concept is modified here in the sense that there is only one player. Still, each decision selects a branch, and getting there defines a new situation. In some cases, estimation of expected payoffs allows to apply the pruning technique: as the player decides as to get larger payoff, some branches with very low payoff can be a priori eliminated. The second goal is to use the obtained scheme to discuss the problem of resistance in a ghetto.

Historically, "ghetto" is the area of iron foundry in Venice, where an enclosed neighborhood was created for Jews in 1516 to protect them against persecution from Roman Catholic Church. More recently, the term 'ghetto' is explicitly assigned to bounded areas in Warsaw, Lodz, Riga, Budapest, Cluj, Terezin and many others under Nazi rules, where Jewish people were gathered prior to the Holocaust. In social sciences, the meaning of the term includes also Jewish diaspora in early modern Europe, quarters of black Americans in large cities and some ethnic communities in Africa and East Asia [4]. Although this meaning remains under dispute [4], attempts to describe ghettos in current world should at least be remarked [5, 6], not pretending to completeness. Social processes leading to the formation of ghettos was simulated by [7] and more recently by [8, 9]. The present work concerns with dynamics of decisions in a ghetto community. For our purposes, two traits are to be distinguished: i) an attempt of an inhabitant of ghetto to leave the area makes his situation worse, ii) human laws, as understood by inhabitants, are broken by an external power. This wide definition applies to refugee camps as well as settlements in countries controlled by army, as in Palestine, Tibet, Chechnya and Darfur. Although in most cases ghettos are inhabited by ethnic minorities, here we do not need to emphasize this ethnic trait.

To refer to the game theory, below we adopt the abbreviations $C$ and $D$ (cooperate or defect), although maybe withdraw or resist would be more appropriate. In two subsequent sections we introduce the model and we apply it to the case of ghetto. Last section is devoted to discussion.

2 The model

2.1 Hierarchy of human needs

According to the theory of Maslow, human needs are arranged hierarchically, from physiological needs, safety, belongingness, to esteem and self-actualization [1]. People become interested in their safety to the extent of which their physiological needs are satisfied; being safe, they start to struggle for belongingness, and so on. This author and maybe this reader happened to be born in a milieu where three first needs were satisfied from the very beginning till adulthood. However, in numerous cases the situation is less fortuitous. More than often, a
human unit has to determine a strategy to realize his/her most basic needs in this or that way. In such a strategy, one of most important decision is which limitations of human needs are to be accepted [10]. This problem appears to be even more crucial in ghetto, where the above mentioned limitations are particularly painful.

Trying to reach its needs in any milieu, a human unit has to consider at each step the context of situation. In particular, in ghetto the problem of any action is if it is legal, or - in other words - if this action is allowed by the ruling power. This remains true when we ask about actions taken up in order to satisfy human needs at all levels. At the physiological level, to cooperate is equivalent to join common life in frames of the society, using money, sleeping home and eating food bought in a market. An alternative is to look for a desolate place in a forest or a desert, or to form a small community out of or at least at the border of, say, normal civilization. To continue, at the safety level the problem is to accept law or not. Whereas in our world of white collars this alternative is concentrated around payment of taxes, in ghetto the defection can include uprising, riots, guerilla or terror. At the level of belongingness, we have to select our group of reference. Again, in ghetto the world is sharply divided into two: "we" and "they". The power is with "them", and the quest is to identify with whom? Further, at the level of esteem the problem is, in which group this esteem is looked for? Here we guess that this choice is strongly correlated with the previous one, and our analysis will be simpler because of this correlation. Finally, reaching esteem, our human unit tends to self-actualization. In principle, this again can be expressed as a social action directed against the power or supporting it. However, consequences of these decisions are usually less crucial, human behavior at this level is much more individualized and it is often affective and expressive rather than aim-oriented [11]. That is why the level of self-actualization is difficult for a sociophysical modelling.

2.2 Tree of decisions

Those who defect at the very root, i.e. at the physiological level, place themselves out of frames of the society. It is very hard to defect public access to water, shops and houses. The alternative is to live wildly in the forest. Yet this choice happens in several places on Earth, where climatic circumstances allow to do it at least temporarily and some strong obstacles prevent to live in accord with law. This kind of defection happens in large social scale only in societies in strongest crisis, e.g. during a civil war. Although these situations are of central importance, they will be not discussed here. In a ghetto, there is no possibility to fight in open way; main splitting of human behavior happens at higher levels. Then, for the sake of our subject all decisions discussed here start from \( C \) (cooperate).

In the same way we are going to comment further decisions, which form chains as the one presented in Table 1. This particular chain will be denoted as \( CCDDDD \) from now on. In this notation, \( CD \) means that we discuss the decision \( D \) (at the safety level) of those who decided \( C \) at the physiological level.
| physiology | C |
| safety     | C |
| belongingness | D |
| esteem     | D |
| self-actualization | D |

Table 1. A chain of subsequent decisions of a human unit (man or woman): defect (D) or cooperate (C) with the power.

In Fig.1 a part of the resulting tree of decisions is shown. There, the whole branch starting from D at the physiological level is omitted, except its beginning. Also, the decisions D or C at the level of self-actualization are not shown for clarity of the figure.

Omitting the physiological needs, we are going to concentrate on the level of safety. A population considered selected C as their first choice, i.e. they decided to live within the community and to profit its facilities. Now and each time their decision is C or D, i.e. they wonder if their path is to be CC or CD. The probabilities of these paths depend on the expected payoffs. Then the choice these people is to decide, if they will be safer when cooperating with the power of when defecting it.

As it was indicated by Maslow, people are able to struggle for their safety to the extent in which their physiological needs are satisfied. Further, their search for belongingness is limited by their lack of safety, and so on. Maslow gives an example with numbers; an average citizen could have satisfied his successive needs in 85, 70, 50, 40 and 10 percent, in order as in Table 1. Provided, for example, that the safety needs of somebody are not satisfied at all, he will not bother about belongingness, not to speak about esteem or self-actualization. It is not clear how the effort for a need of next level depends on the satisfaction of a need in a previous level; the Maslow theory is formulated in words, not in numbers. The area is open for speculations, with the only condition that any proposed mathematical formulation reflects the above mentioned rules. On the other hand it is obvious that the validity of any numbers we can get is limited to statistical considerations. It seems that for this kind of problems, the fundamental equations [12] can provide a proper tool.

2.3 Mathematical formulation

From these equations, we expect to obtain the probabilities that people in a given situation (read: at a given node of the tree) select this or that decision. External conditions met by a given community can be introduced as the set of payoffs $\alpha_X$, describing maximal possible percentage of satisfying needs at node $X$ of the decision tree. As explained in the caption to Fig. 1, the node index $X$ is equivalent to a chain of decisions, leading to that node. The root is treated as the chain of zeroth length. Simultaneously, $\alpha_X$ is the maximal amount of people who are able to struggle for satisfaction of higher needs at nodes $XC$ and $XD$. Both these ‘maximal’ deal with a virtual case when the payoff is limited
Figure 1: Right half of the tree of decisions. Last level (self-actualization) is not shown. Being at the root and selecting $C$, one is placed at node $C$; selecting $D$ as next level one is placed at node $CD$ and so on. Then, nodes at the physiology level are indexed with one label, $D$ and $C$ from left to right, nodes at the safety level - by two labels ($DD$ or $CD$ not shown, or $CD$ or $CC$ shown from left to right), and so on. At the esteem level, first node from the left is indexed as $CDDD$. 
neither by parameters of previous nodes, nor by human decisions at these nodes.

Keeping the above example of the chain $CCDDD$ as an individual path, the value of satisfaction $s_X$ of a human unit - member of the community - at node $C$ (at the physiological level) is then $s_C = \alpha_C$. At higher level $s_X$ fulfils an iterative equation

$$s_Y = s_X \alpha_Y,$$

for $Y = XC, XD$. Provided, that the set $s_X$ of satisfaction of our human unit accords with the above exemplary values given by Maslow, we obtain at five successive nodes of the path $\alpha_C = 0.85, \alpha_{CC} = 0.7/0.85 \approx 0.82, \alpha_{CCD} = 0.5/0.7 \approx 0.71, \alpha_{CCDD} = 0.4/0.5 = 0.8$ and $\alpha_{CCDDD} = 0.1/0.4 = 0.25$. These values of $\alpha_X$ allow to reproduce via Eq. 1 the above given exemplary chain of individual satisfactions: $s_C = 0.85, s_{CC} = 0.7, s_{CCD} = 0.5, s_{CCDD} = 0.4$ and $s_{CCDDD} = 0.1$.

The above vital path consists successive decisions, for our example $CCDDD$, as in Table 1. In reality, these decisions are much more detailed than a cooperation with or a deflection the ruling power. Actually, the decision can be as specific as to marry one particular member of a group of revolutionists - or not to marry. However, having defined our issue - to withdraw or to resist, we are interested not as in a decision of selecting a detailed person, but - averaging out over different possibilities - in a decision to be involved in a revolutionistic group, which is equivalent to satisfying some needs by the choice $D$.

Up to now, we dealt with individual path. Now we can introduce conditional probabilities $p(C \mid X) = p(XC)/p(X)$ and $p(D \mid X) = p(XD)/p(X)$ that, leaving node $X$, a human unit is going to $C$ or $D$. In this case the normalization condition should be $p(C \mid X) + p(D \mid X) + 1 - \alpha_X = 1$. This should be not confused with a probability that a human unit will stay at node $X$ with probability $1 - \alpha_X$. Such a formulation would disagree with the original interpretation of Maslow. Instead, the factor $1 - \alpha_X$ measures the amount of effort spent inefficiently at node $X$, in the same way as it was assumed for an individual path. In the latter case, either $p(C \mid X) = 0$ or $p(D \mid X) = 0$, and the path was fully determined by subsequent individual decisions. Then, individual satisfaction at subsequent levels depends only on the payoffs $\alpha_X$, as explained in the second paragraph of this section. Instead of using the conditional probabilities, it is simpler to use individual effort $w_X$ and averaged effort $W_X$. In the above example of individual path, $CCDDD$, the set of individual efforts is: $w_C = 1$ at the root, $w_{CC} = 1$ at the node $C$, $w_{CCD} = 1$ at the node $CC$, $w_{CCDD} = 1$ at the node $CCD$ and $w_{CCDDD} = 1$ at the node $CCDD$. Other efforts are zero, either along the decision (as $w_{CD}$) or because a given node was not reached by a given human unit (as $w_{DD}$).

Averaging over individual paths, we get a set of average amounts of effort $W_X$ at all nodes $X$. Then for the physiological level we have $W_C + W_D = 1$. The average satisfactions at the physiological level, $X = C, D$, are $S_C = W_C \alpha_C$, and $S_D = W_D \alpha_D$. Considering the safety level we take into account that efforts to reach the nodes $CC$ and $CD$ are reduced because $\alpha_C \leq 1$. Then,
$W_{CC} + W_{CD} = W_C \alpha_C$, and similarly $W_{DC} + W_{DD} = W_D \alpha_D$. As a rule,

$$W_{XC} + W_{XD} = W_X \alpha_X,$$

(2)

where $XC$ and $XD$ are nodes available from node $X$ by decision $C$ or $D$. The whole set $W_X$ is equivalent to a map of social efforts, put into various ways of attempts of satisfying the needs. At each node, the average satisfaction $S_X = W_X \alpha_X \leq W_X$. Satisfaction is less or equal than effort, for individual paths as well as in the average.

In a deterministic picture, people are expected to select always the nodes with larger payoff. However, it is clear even for a physicist that in reality people have their individual preferences, and a common payoff for everybody can be introduced only for a statistical description. This intuition on individual character of payoffs is confirmed by the utility theory [3]. Working in statistical physics, we are tempted to use some noise as a measure of, say, lack of information of the community members. Then we expect that the ratio $W_{XC}/W_{XD}$ in stationary state depends on $\beta(\alpha_{XC} - \alpha_{XD})$, where $\beta = 0$ for absolute lack of information on the payoffs, and $\beta$ is large when the information is well accessible. From this point, it is only one step to mimic the statistical mechanics, writing the stationary probability of selecting $C$ from node $X$

$$p(XC)_{eq} = \frac{W_{XC}}{\alpha_X W_X} \propto \exp \left[ \beta(\alpha_{XC} - \alpha_{XD}) \right],$$

(3)

and to postulate a dynamic description in the form of fundamental (or Master) equation

$$\frac{dp(XC,t)}{dt} = -r(XC)p(XC,t) + r(XD)[1 - p(XC,t)],$$

(4)

where $r(XC) \propto p(XC)_{eq}$. Here, the constant of proportionality determines the timescale of the dynamics. The dynamics of the probabilities $p(X)$ is equivalent to the dynamics of efforts $W_X$.

In, say, a standard society the information on the payoffs is well accessible and the successive selections are almost deterministic. Then, people who decide to live in a wild forest are rare exceptions in the society: almost everybody selects $C$ at the physiological level. It is less clear if the payoffs for those who break law are indeed smaller than for the others. In any case, a great effort is paid to ensure the population that sooner or later this payoff will be strongly reduced. Because of this effort, the statistical data on the choice of $CD$ are usually less sure. Looking for belongingness and needs of higher order is not directly connected with our issue; anyway, in democratic systems we are partially involved into the ruling power, which cannot then be treated as external and is maybe not entirely against our will. Summarizing this section, this author believes that the concept of the decision tree, as an adaptation of the Maslow hierarchy, can be useful in many issues.
3 The case of ghetto

As it is expected to be clear from the definition of ghetto, accepted above, the key point of the decision tree is the node \( C \), where crucial decision is to be taken: \( CC \) or \( CD \). The reason is as follows. All what we know about ghetto confirms that there, it is almost impossible to satisfy the safety need. The payoff of a useful solution \( CC \) is drastically reduced with respect to other communities. Examples of this painful truth fill newspapers and TV or, even worse, remain unknown if information is prohibited. To bring these examples here, although justified from the point of view of the subject, would drive us too far from sociophysics. Instead, let us consider the consequences for the payoff.

Imagine that the safety is strongly reduced in an initially normal society. The reason can be war or revolution, or other abrupt fall of the political system. It is clear that the accessibility of information deteriorates, and in this situation many people do not know what to do. What is the payoff if I withdraw? if I resist? who will win? what will be the consequences for me? my family? my assets? and so on. As a rule, a remarkable percentage of people resist, just because - a physicist would say - large entropy in the system. This thermodynamic formulation should not be offending to anyone. Obviously, it does not comprise individual decisions, which are sometimes dramatic and full of unanswered questions. It is a common experience that we decide, not knowing the final results; in most difficult situations, the amount of information is too low to allow for a logical reasoning. This experience is encoded in sociology as the law of unforeseen consequences [13]. However, here we consider the case when finally some power, external for the ghetto inhabitants, prevails and the information on payoffs becomes more clear. But the above mentioned group keeps resisting; despite the variety of their motivations, their effort can be translated into numbers and handled by statistical tools. They fight against the external power and its supporters - the mechanism known too well, indeed. Relaxing to the stationary state, the system finds that the payoff of the choice \( CC \) is reduced by an expected repression by the resisting group. The ruling power tries to balance this repression by defeating the resistance fighters. Soon, the level of aggression of both sides becomes equivalent; both find convenient justifications.

This author believes that what can be said mathematically, can be said - although longer - in words. Here we try the opposite way. Violence bears violence - this sentence is short. In sociophysical language, the same content can be expressed as a stability of the solution of Eq. 4, characterized by the condition \( \alpha_{CC} < \alpha_{CD} \). This stability relies on the following premises: i) the payoff \( \alpha_{CC} \) is drastically lowered by the repressive actions of the resistant group, ii) struggling for their safety, people are not motivated to select \( CC \) instead of \( CD \), if \( \alpha_{CC} < \alpha_{CD} \), iii) selection of \( CD \) in a social scale reinforces the resistant group. As we see, this closed circle does not rely on a particular choice of the functional dependence of the effort \( w \) on the payoff \( \alpha \). In fact, the resistant group can be compared to a nucleation center, which initiates the new phase. However, the nucleation process cannot be described within the simplest version of the mean field theory, used here.
As a result, the whole tree becomes degenerated. For those who decided to resist, it is not possible to look for belongingness or esteem out of the resistant group. On the other hand, those who select \( CC \) remain under fear of, from one side, being accused of treason and, from the other side, blind actions of the ruling power. Not being able to get safety, they follow the solidarity with the resistant group, whereby they look for belongingness and esteem. As a rule, when the safety is at risk, no effort can be put to struggle for higher needs. In effect, upper branches disappear.

Trying to illustrate the above processes with some simulations, we need the values of several parameters, as the payoffs at the nodes etc. Measurement of these parameters or at least a thorough discussion of their values far exceeds the frames of this work - in social sciences, this is almost an euphemism. Instead, we can present a qualitative consequences of an abrupt change of ruling power. The event is a special and most simple example of what was discussed before. We limit the calculations to the safety level. In the formalism developed above, the dynamics of this level does not depend on the parameters on higher levels. In the calculations, the difference of the payoffs consists two factors: external \( \Delta \) (provided by the ruling power, old or new) and internal, due to interaction between the community members. The latter is proportional to the actual difference of efforts, \( W_{CD} - W_{CC} \). This proportionality encodes the above discussed positive feedback between the value of the difference of efforts and its time derivative. In fact, this positive feedback is at the core of the mean field theory [14].

To simulate the change of the ruling power (for example, from a well-established to an external), two agents cannot be omitted: a strong decrease of \( \alpha_C \), which is a direct consequence of unavoidable war, and a change of sign of \( \Delta \). Simultaneously, the up-to-now cooperators become defectors and the opposite. We keep the node \( D \) unoccupied (\( W_C = 1 \) and \( W_D = 0 \)); this reflects the assumed fact that nobody can leave the ghetto. For simplicity we keep the parameter \( \beta \) constant in time, although it is almost surely not realistic; still we are left with three parameters. The value of \( \alpha_C \) before the political overthrow is assumed to be unity. Its value after the overthrow, kept constant in time, is one of the parameters. The remaining parameters are \( \beta \) and \( \Delta \). Initial ratio of the variables \( W_{CC} \) and \( W_{CD} \) is taken as their ratio at equilibrium before the overthrow. As a rule, \( W_{CD} > W_{CC} \) at initial time, because most people supported the ancient regime before the overthrow; what was the cooperation, now is treated as defection, and the opposite.

In Fig. 1 we show the effort \( W_{CD} \) put at the resistance, against the satisfaction \( \alpha_C \) of the physiological needs at node C. These data are for the stationary state. As remarked above, we assume that all the social effort at the root is put to satisfy physiological needs within the community. However, these needs can be satisfied only partially. The parameter \( \alpha_C \) measures the level of this satisfaction. Further, it measures also the effort which can be put to struggle for safety, in this (\( CC \)) or that (\( CD \)) way. The parameters for the plot are: \( \beta = 3.0 \), and \( \Delta = 0.2 \).

As we see in Fig. 1, there is a jump of the data on \( W_{CD} \) near \( \alpha_C = 0.7 \). Below this value, the effort put to resistance is negligible. Above this value, it
Figure 2: The effort $W_{CD}$ put at the resistance at the safety level against the parameter $\alpha_C$.

is close to its maximal value $\alpha_C$. This means that the initial state of resistance is stable. The results are typical, as long as $\beta$ is not too small, and $\Delta$ is not too large. Within the magnetic analogy, the results mean that the metastable phase is possible as long as the field ($\Delta$) and the temperature ($1/\beta$) are not too large. Within the sociophysical picture, it means that it is advantageous for the ruling power to keep the whole ghetto community at the limit of starvation i.e. with small value of satisfaction $\alpha_C$ of physiological needs. Then, instead of fighting, they are kept in a queue for water and flour, provided by the army. Then, the best thing is to make a movie and show it in TV news; those who get water are happy. Please do not blame this author for the invention - it is known for a long time.

4 Discussion

Our conclusions are to be divided in three parts. The first is sociophysical. Our mathematical description is equivalent to the mean-field theory of the ferromagnetic phase, where two stable solutions coexist [14]. This model is well established in applications of physics to social sciences [2, 15]. It is known that the stability of the ferromagnetic phase is overestimated by mean field theory; in fact, it depends on the structure. Here we are faced with the question, what is a realistic structure of a community. Much effort has been done by sociologists to advance our knowledge on the subject; however, even the characteristic size of social networks remains under dispute [16, 17]. On the other hand, stability of ordered Ising phase at low temperatures has been found in computer simulations.
for most of investigated structures [18, 19, 20, 21], with directed Albert-Barabási networks [22, 23] and one-dimensional chains and related models [24] as exceptions. Actually, time dependence of persisting opinion of a resistant group was discussed recently by [25] on the basis of one-dimensional Ising model. (We note that the condition of low temperature is equivalent to large value of the uncertainty factor $\beta$ in our considerations.) For social applications, the condition of an eternal stability of the ferromagnetic phase can be substituted by a weaker condition of appearance of long-living ordered domains. We can conclude that sociophysical arguments work for this hypothesis, and not against it.

The second conclusion is aimed to be sociological. The results of our analysis indicate, that when an external power struggles for control of an isolated community, the problem of safety remains crucial. Obvious aim of the power must be: to guarantee the safety for still neutral part of the community. If this is not possible, war becomes eternal, without winners. Not so rarely, the responsibility for safety of isolated communities remains in hands of army, without control of civil agencies or free press. This is precisely what eliminates the possibility of a peaceful solution: army people are trained to fight, not to bring safety. In sociology, the role of safety is known for a long time: first edition of the Maslow’s book [1] appeared in 1954. The advantage of this work is to express it in more formalized language. One could ask if such a formulation is worthwhile. On the other hand, still some powerful people seem not to recognize the validity of the conclusions of Maslow theory. Maybe they will be convinced by mathematics.

In my last word I declare to share the opinion that ghettos are shameful for human civilisation. Nevertheless this respectable and rather common opinion, such places exist, as we are mercilessly informed by free media. Some people even claim, that some of these places are established to protect our laws to free life, where at the last level of the tree of decisions we can write our sociophysical papers. If this is done without care about safety of the ghetto inhabitants, the way is destructive and mindless.

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