

The Model and Analysis of Conformity in Opinion Formation

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Abstract: - The formation of public opinion has been focused by many scholars recently; a lot of models have been proposed to verify the process of formation. Many models have noticed that individuals can exchange their opinions and many scholars make their own rule of how individuals change their opinions. After year 2000, some classic models and their variants output some useful result, but there is no paper talk about group size and its influence. This paper presents a model from the social psychology points of view. The model considers both parts (positive opinions and negative opinions) of some connected people. We simulated the formation process using the proposed model, results show that the model is useful for explaining how group/herd mentality causes prevalence and how conformity lead to balance.

Key words: - opinion formation; group size; conformity; computer simulation;

1 Introduction

Opinion is a belief or conclusion held by individuals, these individuals may have confidence about their opinion, but in most times, there is no positive knowledge or proof to support this. Public opinion is opinion held by some people. Consensus is opinion held by all of the people, but in most cases, polarization and fragmentation are more usually. Public opinion is made up of four parts basically which are Opinions, Individuals, Media and Topics.

Opinions are held with Topics which could be politics, economics, and culture. Which kind of soft drink will you choose, Coke Cola or Pepsi? This is a question, and this is also a topic which could result in an endless debate. Question like choosing a movie from two or more and choosing colors of clothing are also topics which could easily produce many kinds of opinions.

Opinions are held by Individuals which may have big differences. People are difference-men and women, higher education level and less education level, wealth people and poor people, people live in downtown and people live in country, extremist and moderatist.

Without any positive knowledge or proof, one could easily make his/her decision. And without any strong evidence, one could easily change his/her original opinion.

Opinions are transformed by Media which could be broadcasting, television, newspapers, books, newsgroups, blogs, mails/e-mails and individuals. As new technology develops, more and more kinds of media join in. No matter what kinds of media are prevailing, no matter what kinds of media are strongly controlled, both authority messages and rumors can find their land and survived well.

In recent years, there have been a lot of interests in the fields of formation of public and the opinion dynamics in physics. The methods used by physicist are different with classical mass communication scholars. Physicist make a new interdisciplinary subject called sociophysics which mainly focused on explain the social phenomena with their skills in physics^[1-5]. Ref^[1,3] focus mainly opinion dynamics which give many interesting results and conclusions.

The most popular model in opinion dynamics is Sznajd model which presented by K Sznajd-Weron, and

J Sznajd at 2000^[6]. Sznajd model is developed from Ising spin model and has been tested with Monte Carlo simulations in a closed and one dimension community. In the presented model, individuals are described by interacting particles, with only two attitudes: A (positive) or B (negative). Stauffer et al generalization Sznajd model to a square lattice ^[7]. Hegselmann and Krause invested various models and bounded confidence of continuous opinion dynamics^[8].

In this paper, we proposed a model of opinion formation takes into account the conformity of individuals and the effect of group size in changing individuals' opinions. The remainder of this paper is organized as follows: Section 1 introduce the model and the supporting materials. Section 2 describes the simulation analysis of the proposed model in opinion formation. Section 3 is the conclusion and views the future work in this field.

2 The Model

The model proposed in this paper takes into account conformity of social psychology field. Conformity is the process by which people's beliefs or behaviors are influenced by others. People can be influenced via subtle, even unconscious processes, or by direct and overt peer pressure. This paper only focused on the opinion changes by an unforced way. Conformity is a social behavior which could happen in a group. One of the factors could affect conformity is group size. In Asch's famous conformity experiment, a high proportion (32%) conformed to the erroneous majority view of the others in the room when there were at least three confederates present, even when the erroneous ones make obvious mistakes ^[9].

The model is mainly inspired by Milgram et al ^[10]. Milgram and his colleague found that if one person stood in a Manhattan street gazing at a sixth floor window, 20% of pedestrians looked up; if five people stood gazing 80% of people looked up. Fig. 1 shows this using the data from Milgram^[10].

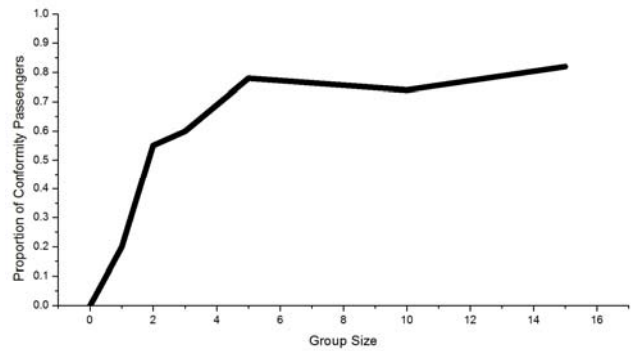


Fig. 1 The proportion of conformity passengers vs. Group size

Suppose a community as a $L \times L$ square lattice with each individual I in one grid. Every individual I has his/her own opinion S_i , S_i can be positive(+1) or negative(-1). Each individual has eight neighbors, these neighbors has their own opinions. Fig. 2 shows the position of one's neighbors.

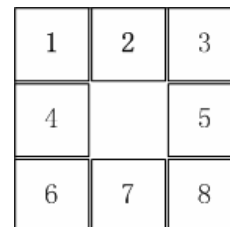


Fig. 2 The Position of Neighbors

Consider about the marginal grid in the square lattice, just like the grid labeled with number 3 in Fig. 2. In this model, we supposed that the marginal grids connect with the grid in the corresponding edge which means the righter grid of grid 3 is grid 1 and the upper grid of grid 3 is grid 8. Obviously, the right upper grid of grid 3 is grid 6.

In each step, individuals try to make their decisions. They mainly focus their neighbors' choice. Here we simplify the Milgram's data to the below:

$$y = \begin{cases} 0.16x, & x \in \{0, 1, 2, 3, 4\} \\ 0.8, & x \in \{5, 6, 7, 8\} \end{cases} \quad (1)$$

Suppose that y is the conformity probability of individuals to follow their neighbors' opinion according to their group size, x is the group size. Everyone has his initial opinion in this model, positive or negative, so there are two kinds of transformation, from positive to negative and from negative to positive. The equations below are the probability of the two way transformation.

$$P_{(+1 \rightarrow -1)} = \frac{P_{(-1)}}{P_{(+1)} + P_{(-1)}} \quad (2)$$

$$P_{(-1 \rightarrow +1)} = \frac{P_{(+1)}}{P_{(+1)} + P_{(-1)}} \quad (3)$$

Equation 2 is the probability of individuals changing their opinion to negative with initial opinion positive. Equation 3 is in reverse. $P_{(+1)}$ is conformity probability of the group with positive opinion, $P_{(-1)}$ is conformity probability of the group with negative opinion. The following equation is obvious.

$$P_{(+1 \rightarrow -1)} + P_{(-1 \rightarrow +1)} = 1 \quad (4)$$

Equation 4 ensures that the whole probability of a individual changing his/her original opinion and stick with his/her initial attitude is 1. Take a individual with initial positive opinion for example, $P_{(+1 \rightarrow -1)}$ is the probability of changing, $P_{(-1 \rightarrow +1)}$ is the probability of keeping.

The following pseudo code defines the whole process of opinion formation.

Table 1 Pseudo code of opinion formation process

```

1. Initialize the  $L \times L$  square lattice
2. Assign individuals with opinions in desired distribution
3. The formation of opinion.
stepcount  $\leftarrow$  0
while (stepcount < finalstep)
    for i = 1 to L
        for j = 1 to L
            if ( $S_i$  = positive)
                compute  $P_{(+1 \rightarrow -1)}$ 
                change opinion with  $P_{(+1 \rightarrow -1)}$ 
            else
                compute  $P_{(-1 \rightarrow +1)}$ 
                change opinion with  $P_{(-1 \rightarrow +1)}$ 
            end if
        next
    next
    stepcount++;
end while
    
```

3 Simulation analysis

Using a computer with Intel Pentium IV 1.4G, 512MB DDR, we simulate the proposed model for more than 1000 times with each time 10000 steps of evolution. The following representative figure is one of the simulation with one initial step, two intermediate steps and a final step.

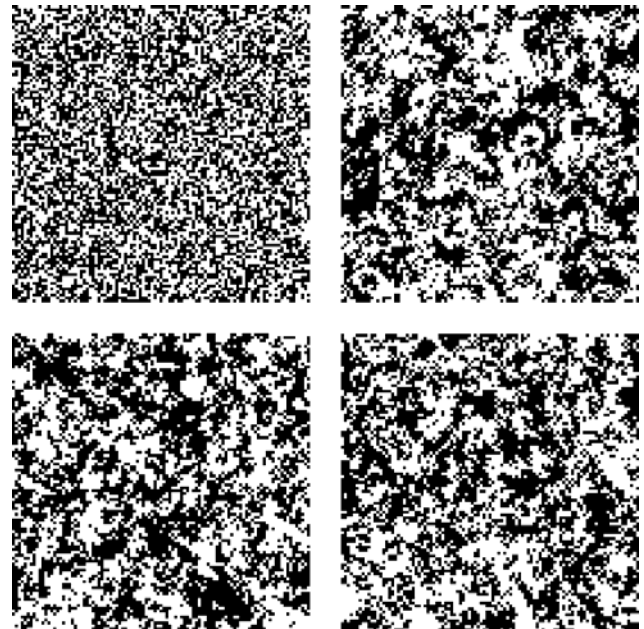


Fig. 3 Examples of simulation process

In Fig. 3, black points represent individuals with positive attitude and white points represent individuals with negative attitude.

Suppose the initial proportion of individuals with positive attitude to individuals with negative attitude is P_{init} . We have simulated with P_{init} from 9/1 to 1/9 which means the proportion of positive individuals decrease for 10% in each step and negative ones increase for 10%.

The global difference of opinions is a important indicator in the opinion formation process, supposed that m is the global difference, we define m as the following.

$$m = \frac{1}{L \times L} \sum_{i=1}^{L \times L} S_i \quad (5)$$

The following figure is the statistical result of all the

simulations running for the proposed model.

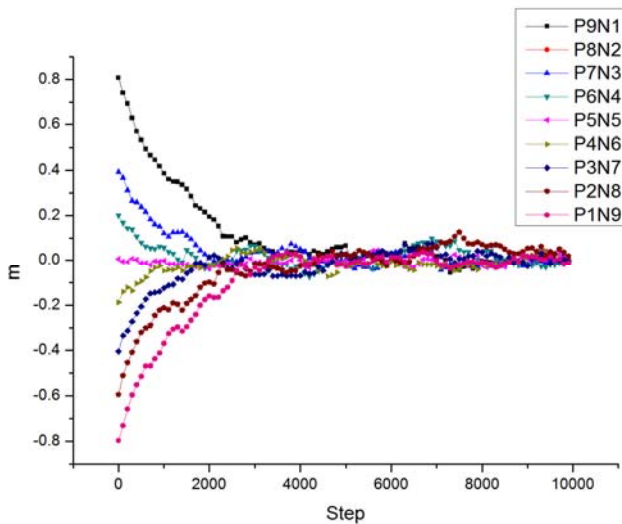


Fig. 4 The global opinions difference

Label of curves in Fig. 4 is formatted like $P*N*$. take P9N1 for example, P9N1 means that P_{init} is 9/1. Fig. 4 shows that it is hard to achieve dominance for one kind of opinion in our model. All kinds of initial distribution of positive opinions and negative opinions will return to the balance line of $m = 0$. More the initial difference is, sharper the initial parts of curves are. The curve with P_{init} equals 5/5 is a special one which has only fluctuations.

In order to understand the relationship between P_{init} and curves, we make nonlinear curve fit of all these grow curves including P1N9, P2N8, P3N7, P4N6 and P5N5. The fitting function is as below.

$$y = a - b \times c^x \tag{6}$$

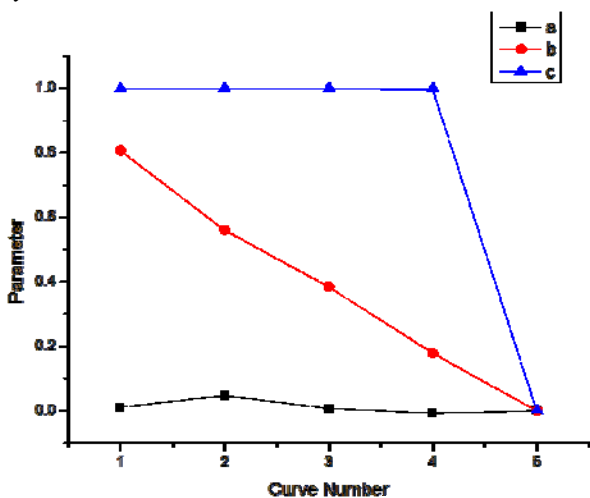


Fig. 5 Parameters of grow curves

Fig. 5 shows the fitting parameters including a, b and c. It is obvious that parameters a and c are almost the same except the special curve P5N5. Parameters b of all these curves connected with each other combine an almost straight line with slope equals 0.24313. The slope indicates the grow speed of all growing curves which could be useful for predicting the trends of opinion formation.

4 Conclusion and future work

Conformity is a common phenomenon in social life, group size is one of the factors will affect individuals' conformity behavior. Famous social psychologist study conformity itself, this paper concerns the effect of conformity in opinion formation. It can be proved that conformity will lead to opinion balance in a closed, edge connected, 2D square lattice and 8-neighbour community. Different initial distributions of positive attitude ones and negative attitude ones are simulated, the statistical result of global difference is computed.

Though interesting conclusion is gotten, there are still many variants which can be made to the original model. Future work can be the followings:

1. Not all of the individuals will be affected by others which means there are some of the stubborn ones whom can not be easily persuaded. It can be a future work to deal with different proportion of stubborn ones.
2. The real relationship between individuals in our society is a complex network. Some individuals have little friends who will affect them, others may have more.
3. There is no global or mass media who can affect big parts of individuals as external force in the proposed model. Such kind of influences should be considered and added in the simulation model in the future.

References:

[1] Stauffer D. Sociophysics Simulations[J]. Computing

- In Science & Engineering. 2003, 5(3): 71-75.
- [2] Schulze C, Stauffer D. Sociophysics Simulations I: Language Competition[C]. 2005.
- [3] Stauffer D. Sociophysics Simulations II: Opinion Dynamics[C]. 2005.
- [4] Zekri L, Stauffer D. Sociophysics Simulations III: Retirement Demography[C]. 2005.
- [5] Stauffer D. Sociophysics Simulations IV: Hierarchies of Bonabeau et al.[C]. 2005.
- [6] Sznajd-weron K, SznajdJózef. Opinion Evolution in Closed Community[J]. International Journal of Modern Physics C. 2000, 11(06): 1157-1165.
- [7] Stauffer D, Sousa A O, De Oliveira S M. Generalization to Square Lattice of Sznajd Sociophysics Model[J]. International Journal Of Modern Physics C. 2000, 11(06): 1239-1245.
- [8] Hegselmann R, Krause U. Opinion Dynamics and Bounded Confidence Models, Analysis and Simulation[J]. Journal of Artificial Societies and Social Simulation. 2002, 5(3).
- [9] Asch S E. Effects of Group Pressure Upon the Modification and Distortion of Judgements[J]. Groups, Leadership, and Men. 1951: 177-190.
- [10] Milgram S, Bickman L, Berkowitz L. Note on the drawing power of crowds of different size[J]. Journal of Personality and Social Psychology. 1969, 13: 79-82.