

# Development of measures to counter information extremism

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## Abstract

Information exchange is one of the essential processes in any social system. Contemporary channels of social communication and, primarily, the global information space (the Internet) and its social media are actively used to organize a range of activities which have an information and psychological impact on individual personality, social groups, and society as a whole. A well-known negative aspect of this practice is propaganda of extremist ideologies, terrorism, and other kinds of illegal activities.

Various extremist and terrorist organizations have begun to actively use the possibilities of modern communication technologies to influence the consciousness of various social groups through destructive information campaigns. To develop effective measures to counter the influence of extremists, it is necessary to analyze and understand the mechanisms of information dissemination in society. To achieve this goal, a simulation model of the process of information interaction in social systems is described in this paper.

Keywords: Mathematical Model, Information Dissemination, Information Management, Countering Extremism.

## 1 Introduction

Various forms of extremism pose a serious threat to the life of people and the development of modern society. Generally speaking, extremism is understood as "a commitment to extreme and radical views" and includes illegal actions with various goals and means of achieving them. Experts identify the following types of extremism: ideological, nationalist, gender-based, political, religious, spiritual, and criminal extremism [Gro17].

The following actions can be considered extremist [Il'i17, Kar17]:

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- initiation of social, racial, national or religious strife and calls for discrimination against people on the basis of a particular characteristic;
- organization of and participation in mass disturbances, hooliganism and vandalism on the basis of hatred and enmity against any social group;
- calls for violence and illegal actions based on intolerance, stigmatization, prejudice, ethnocentrism, discrimination, xenophobia, and/or nationalism;
- humiliation of national dignity;
- acceptance of radical religious views and denial of the cultural, spiritual, and moral foundations of his/her own nation;
- propaganda and public display of Nazi paraphernalia or symbols;
- organization and participation in terrorist activities;
- financing and promotion of terrorist activities (or providing other kinds of assistance);
- stimulating protest activity with the purpose to destabilize the political system.

The following trend should be noted: non-violent, hidden forms of extremism based on using modern means of communication and access to information resources are becoming more widespread, along with overt displays of aggression. Verbal forms of extremism begin to prevail over physical ones [Gro17]. So-called "information extremism" is becoming a pressing problem in modern society.

The modern-day information and communication technologies provide powerful means to influence the consciousness of social groups by organizing and guiding processes of mass communication. The advancement of technologies has influenced the processes of social communication, data exchange, education and socialization of an individual, and thus bolstered the arsenal of tools employed by extremists with various means of influence, such as information and psychological subversion, spread of rumors, mind control, and substitution of concepts and cultural values.

The following features of Internet communication contribute significantly to the spreading the ideas of extremism [Kaz17, Kul16, Moz15]:

- a sharp decline in the quality of information;
- generation of large amounts of unnecessary "background" information, which leads to the destruction of the barriers to the perception of malicious and anti-social information;
- individuals and groups often cannot correctly assess the information received;
- emergence of information "phantoms" due to the possibility of spreading rumors in a virtual environment;
- Internet addiction which is particularly relevant among young people.

In order to develop counter-measures against the destructive information activity of the extremists, it is necessary to have a clear understanding of the mechanisms of information dissemination. Therefore, a pressing task is to develop algorithms and models that enable us to explore the patterns of information interaction, monitor the "information background", and predict the public mood.

## 2 Mathematical model of the information interaction process

In order to simulate the Information Interaction Process (IIP), it is necessary to describe the social system that is the average for information exchange. A Social System (SS) is a complex ordered entity that includes individuals and social communities united by a variety of connections and relationships. Significant parameters of SS are connectivity, sociability and susceptibility to external influences [Mac18].

Almost any processes in social systems necessarily entail the factor of subjective uncertainty. This makes it difficult for a modeler to formalize the processes that are taking place in such systems [Azh13]. It seems reasonable to use the theory of fuzzy sets for the analysis of subjective factors [Azh16, Azh17].

In order to formalize subjective data, it is proposed to introduce a linguistic variable (LV) "Factor Level" and define a term-set of its values, which consists of 3 or 5 elements:

$$\{low; average; high\}; \quad (1)$$

$$\{strongly\_negative; negative; neutral; positive; strongly\_positive\} \quad (2)$$

Dissemination of information takes place as follows. Any information is brought to the SS at the initial time point  $t = 0$  by some finite number of its representatives. The set will hereinafter be called the initiating set (IS). When the information impact is conscious and purposeful, the members of the initiating set tend to have or actively demonstrate a strong positive or negative opinion about this information. The subsequent interpersonal information exchange ensures the dissemination of information between other participants. The purpose of IIP modelling is to determine the proportion of informed SS members as well as the distribution of opinions in terms of the set 2 at each step  $t = t + 1$ .

The number  $K$  of informed members of the social system in step  $t = t + 1$  is represented by the following dependency:

$$K_{(t+1)} = K_{(t+1)}(L, \bar{b}, q_t, K_{(t)}), \quad (3)$$

where  $L$  is the numerical composition of the initiating set,  $\bar{b}$  is the SS connectivity factor (average number of connections between the participants in the system),  $q_t$  is the proportion of participants in step  $t$  who are willing to further disseminate the information (make a repost).

The value of the  $q_t$  factor depends on the percentage of participants with a high level of sociability, as well as on the relevance of the information being disseminated at the time point step  $t$ . The sociability level is an inherent characteristic of the SS participants and is independent of time; however, the relevance of the information decreases over time. Hence, the following formula for  $q_t$  is proposed:

$$q_t = Com \cdot Act_t = Com \cdot Act_0 \cdot e^{-\alpha \cdot t / \tau_{act}}, \quad (4)$$

where  $Com$  is the proportion of participants with high sociability levels,  $Act_0$  is the initial (at  $t = 0$ ) information relevance, which is usually set to 1;  $\alpha$  is the relevance decline factor (according to numerous studies, e. g. [Der10],  $\alpha = 2.3$ );  $\tau_{act}$  is the maximum time for the information disseminated to maintain its relevance (information lifecycle duration).

The initial data on the number of connections in the system, sociability, and susceptibility/conservatism of the members of large SS may have parameters of statistical distributions. The same applies to the initial distribution of opinions in the system regarding the subject of the information disseminated. To obtain these data, it is recommended to use the method of sociological survey based on a representative sample. This method makes it possible to extrapolate the findings to the entire social system.

The "level of susceptibility" indicator characterizes the tendency of a person to change his/her point of view according to the opinions of others. "Low susceptibility" means the ability of an individual to remain of the same opinion despite the influence of the information background, and "high susceptibility" has a significant degree of conformity.

Given the above, we can formulate rules of information exchange and opinion formation in SS that will allow us to formalize and automate mathematical calculations:

1. Only participants who have the following characteristics usually share information:
  - (a) high degree of sociability;
  - (b) strong own opinion (positive or negative) about this information.
2. The opinions of participants with low susceptibility do not change. Participants with average and high susceptibility change their opinions upon receiving emotionally charged feedback.
3. Participants with average susceptibility are moderately susceptible to outside influence: upon receiving respective feedback, they give up a neutral opinion in favor of a positive or negative one (or vice versa), and instead of a positive or negative opinion, they can demonstrate a strongly expressed positive or negative attitude.

4. Participants with high susceptibility can easily give up under pressure from others: they give up a negative opinion in favor of a positive one, and instead of a neutral opinion they can demonstrate a strongly expressed positive or negative attitude.

We shall introduce the following notation:

- $\omega^L, \omega^A, \omega^H$  are proportions of SS participants with low, average and high susceptibility;
- $K_t^{++}$  and  $\nu_t^{++}$  are, respectively, the number and proportion of participants with a highly positive attitude to the discussed information at a given point in time  $t$ ;
- $K_t^+$  and  $\nu_t^+$  are the number and proportion of participants with a positive opinion;
- $K_t^N$  and  $\nu_t^N$  are the number and proportion of participants with a neutral opinion;
- $K_t^-$  and  $\nu_t^-$  are participants with a negative opinion;
- $K_t^{--}$  and  $\nu_t^{--}$  are participants with a highly negative attitude at a particular point in time  $t$ .

Thus, the number of informed participants of the social system can be calculated by using the following formula:

$$K_{t+1} = K_t + q_t \cdot \left( \frac{N - K_t}{N} \right) \cdot (K_t^{++} + K_t^{--}) \cdot \bar{b}, \quad (5)$$

where  $N$  is the total SS population, and the  $\frac{N - K_t}{N}$  factor represents the proportion of participants that remained uninformed at the previous iteration.

The number of participants with a positive attitude can be calculated by using the following formula:

$$\begin{aligned} K_{t+1}^+ = K_t^+ &+ (K_{t+1} - K_t) \cdot [\nu_0^+ - \nu_0^+ \cdot (\omega^A + \omega^H) \cdot \left( \frac{K_t^{++}}{K_t^{++} + K_t^{--}} \right) - \nu_0^+ \cdot (\omega^A + \omega^H) \cdot \left( \frac{K_t^{--}}{K_t^{++} + K_t^{--}} \right) + \\ &+ \nu_0^{++} \cdot \omega^A \cdot \left( \frac{K_t^{--}}{K_t^{++} + K_t^{--}} \right) + \nu_0^- \cdot \omega^H \cdot \left( \frac{K_t^{++}}{K_t^{++} + K_t^{--}} \right) + \nu_0^N \cdot \omega^A \cdot \left( \frac{K_t^{++}}{K_t^{++} + K_t^{--}} \right)] \end{aligned} \quad (6)$$

The factors  $\frac{K_t^{++}}{K_t^{++} + K_t^{--}}$  and  $\frac{K_t^{--}}{K_t^{++} + K_t^{--}}$  reflect the proportions of information exchange participants sharing strongly expressed positive and negative opinions, respectively. The formula shows how participants with average and high susceptibility are influenced by them and change their opinions in one way or another (they are subtracted or added).

In turn, the number of participants with a highly positive attitude can be calculated by using the following formula:

$$\begin{aligned} K_{t+1}^{++} = K_t^{++} &+ (K_{t+1} - K_t) \cdot [\nu_0^{++} - \nu_0^{++} \cdot (\omega^A + \omega^H) \cdot \left( \frac{K_t^{--}}{K_t^{++} + K_t^{--}} \right) + \\ &+ \nu_0^+ \cdot (\omega^A + \omega^H) \cdot \left( \frac{K_t^{++}}{K_t^{++} + K_t^{--}} \right) + \nu_0^N \cdot \omega^H \cdot \left( \frac{K_t^{++}}{K_t^{++} + K_t^{--}} \right)] \end{aligned} \quad (7)$$

The number of participants with a neutral attitude:

$$\begin{aligned} K_{t+1}^N = K_t^N &+ (K_{t+1} - K_t) \cdot [\nu_0^N - \nu_0^N \cdot (\omega^A + \omega^H) + \nu_0^- \cdot \omega^A \cdot \left( \frac{K_t^{++}}{K_t^{++} + K_t^{--}} \right) + \\ &+ \nu_0^+ \cdot \omega^A \cdot \left( \frac{K_t^{--}}{K_t^{++} + K_t^{--}} \right) + \nu_0^{++} \cdot \omega^H \cdot \left( \frac{K_t^{--}}{K_t^{++} + K_t^{--}} \right) + \nu_0^{--} \cdot \omega^H \cdot \left( \frac{K_t^{++}}{K_t^{++} + K_t^{--}} \right)] \end{aligned} \quad (8)$$

The number of participants with negative and highly negative opinions can be calculated similarly.

#### Calculation example

To identify the patterns of IIP, let's look at an example of a social system consisting of 10 million people and having the following indicators:

1. The number of connections between SS participants: 80% had 1 to 5 communication connections; and 20% had 6 to 36 contacts;
2. The factors of susceptibility to others' opinions were as follows: Low = 20%, Average = 60% and High = 20%;
3. The initial distribution of opinions in a social system towards information being disseminated  $I$ :  $\nu_0^{++} = \nu_0^{--} = 0.05$ ;  $\nu_0^+ = \nu_0^- = 0.15$ ;  $\nu_0^N = 0.6$  (predominantly neutral equilibrium environment);
4. The initiating set included 0.01% of the general population or 1000 people with a highly positive attitude towards  $I$ ;
5. The proportion of participants willing to disseminate the information at a particular point in time  $t = 0$  was equal to  $q_0 = 0.4$ .

Diagrams showing increase in the number of informed participants and the distributions of their opinions at each iteration are shown in Figure 1.

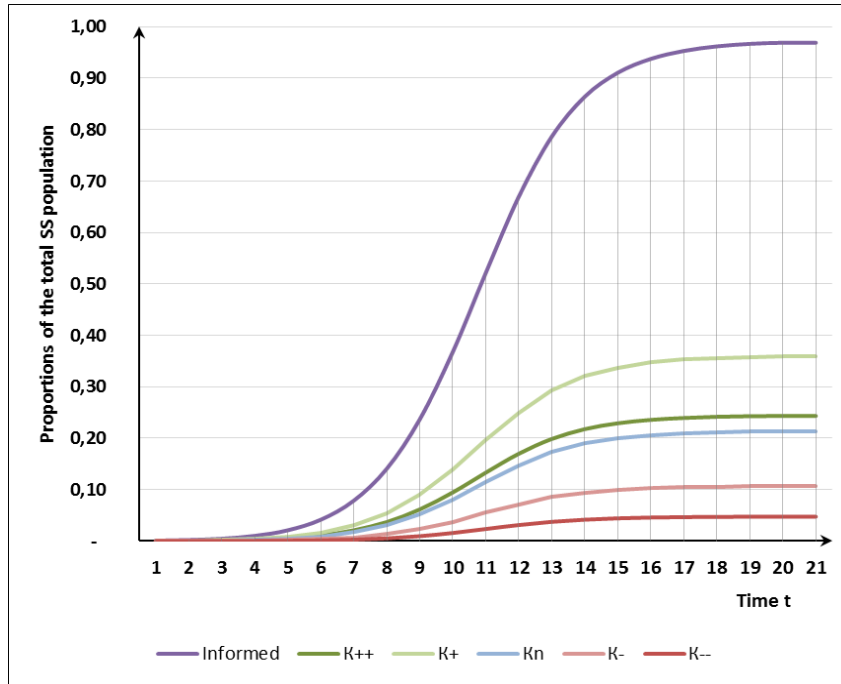


Figure 1: Diagrams showing increase in the number of informed IIP participants and the distributions of their opinions

The plots have a sigmoid shape. As it can be seen, there is a certain point in time associated with a sharp increase in the number of informed participants, after which the growth slows down, and over time the further information transfer is practically stopped (the vector of information awareness remains constant). It is important to note that full SS awareness is never reached, as the information being disseminated becomes irrelevant). Nevertheless, the exchange of opinions between the participants may continue longer, and the results of the calculations show that the "vector of opinions" continues to change slightly.

This visual representation of the information interaction process based on the given model reveals important analytical relationships between the parameters of social systems (connectivity, susceptibility, sociability) and the information exchange dynamics.

For example, if we reduce the initiating set to 0.005%, then with all other things being equal, this change does not have a significant impact on the final distribution of opinions in the system. However, the period of sharp increase in the number of informed participants comes a little later, and the total number of SS participants who will have time to get information before it loses its relevance will be less (please see Figure 2).

If we reduce the initial value of the  $q_0$  factor to 0.35, this also leads to a noticeable decrease in the number of informed participants (please see Figure 3).

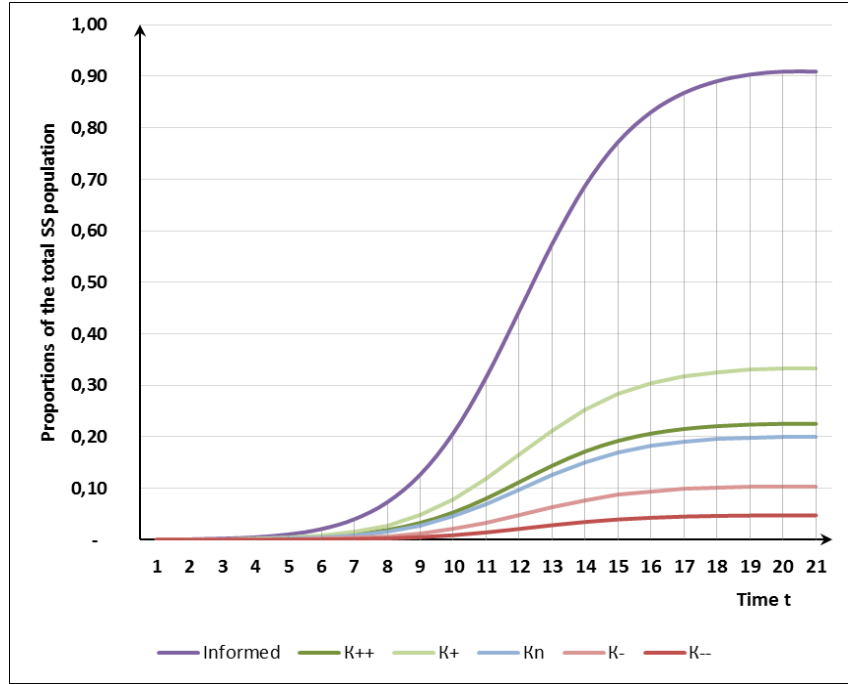


Figure 2: IIP diagrams for an initiating set equal to 0,005%

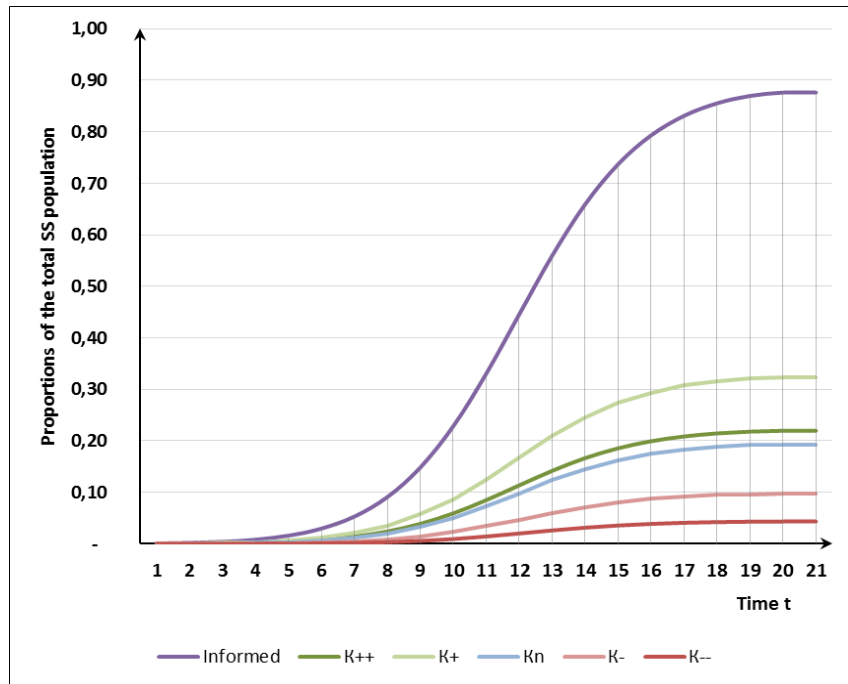


Figure 3: IIP diagrams for a  $q_0 = 0.35$

In addition, the calculations show that the decrease in the overall susceptibility of the social system to the information background leads to both a decrease in awareness and a change in the proportions of participants' opinions about the information received (with a predominance of the neutral attitude) (please see Figure 4).

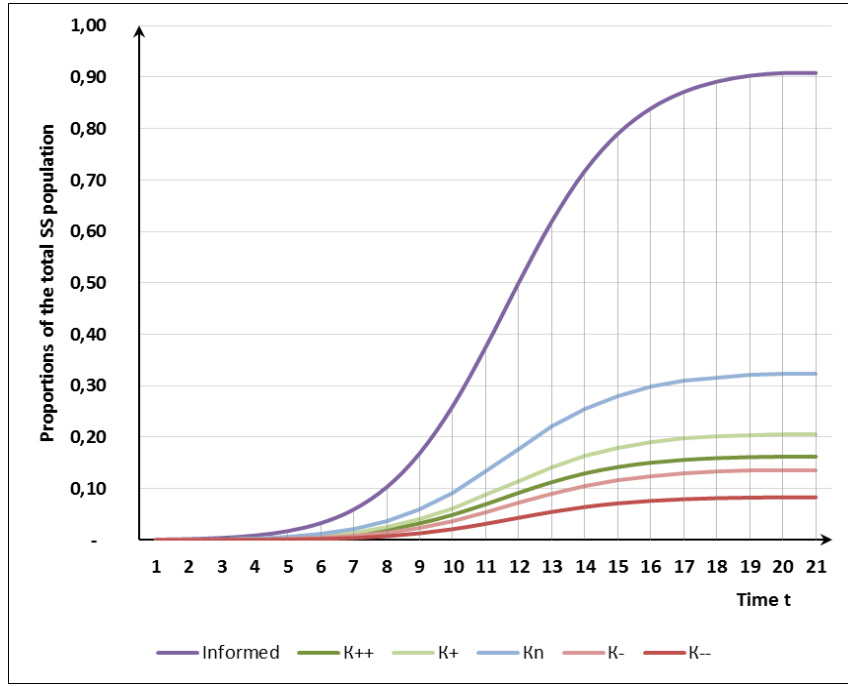


Figure 4: IIP diagrams for  $\omega^L = 0.5, \omega^A = 0.3, \omega^H = 0.2$

Based on the above, we can propose the following measures for influencing the social system in order to change its characteristics and counter the spread of malicious information:

1. Discrediting the source of the destructive information disseminated, which will lead to a decrease in its credibility and the susceptibility to it.
2. Initiating and launching another information unit that deflects the attention of the communication participants from the initial destructive information, reducing its relevance and the readiness to distribute it.

We should also keep in mind that the counteraction measures will be most efficient at the initial stage of the malicious information dissemination, before the process enters the fast growth stage.

### 3 Conclusion

The advancement of communication technologies has significantly diversified the possible ways of presenting information to society. As of today, such technologies are used not only for good, but also for illegal activities carried out by various extremist and terrorist organizations. Taking information management measures should become an adequate response to the destructive information processes caused by actions of such kind. In order to plan and organize information campaigns, it is necessary to develop a practically oriented scientific approach to create viable and effective models.

The simulation of the information interaction process makes it possible to predict the public response to the publication of certain information and take measures to regulate and stabilize the information background, which, in turn, helps to reduce the manifestations of anti-social behavior.

In the applied research of real social systems, the knowledge of the patterns of IIP and the dynamics of opinion formation, as well as the specific nature of the social communication processes in large systems allows the experts to analyze the opportunities and consequences of targeted intervention in the information dissemination process in order to control it.

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