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Hierarchy Of Various Types Of Social Media Actors: Perception And Optimization Of Influence

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Abstract

Objective of this paper presents an analysis of hierarchy of various types of social media actors and analysis of perception and optimization of influence. Methods: The study involved a cross-disciplinary approach using neural network technologies. To analyze the perception of actors and optimization of influence on social networks, it was developed and tested to the semantic model for the influence maximization analysis. The neural network technology TextAnalyst 2.3. was used as a toolkit to help form a semantic network common for the entire corpus of analyzed texts, from which the topic structure of the analyzed content was extracted; also, an associative search was performed. Findings: As a result of studying a specific urban planning conflict, it was concluded that the hierarchy of various types of actors in social media is dynamic and unstable. Optimization of the speech influence and perception by users is determined by a number of reasons: the accuracy of determining the specifics of the communicative situation, identifying relevant topics, generating messages on relevant topics using an imperative strategy that includes negative sentiment and aggression. An important role is played by the symbolic capital of the source of information dissemination for certain types of actors. One should also take into account the dynamism of communication processes taking place in the network environment and a sharp change in the situation in short time periods. Moreover, the choice of adequate communication means and successful solution of urgent communication tasks ensures active influence on the perception of network actors and translation of virtual intentions into real actions. Application: The results of the study can be used to identify social tension and prevent urban conflicts with residents.

Keywords: neural network approach, social media, perception, optimization of influence.

1. Introduction

Network communications are an important component of modern media space. The specific features of inter-personal and intergroup communication are shown in numerous scientific studies. In particular, researchers note that social networks can filter actors, close groups, reduce the chance of unintentional communication, isolate themselves from other groups, which causes some dosage and reduction of intergroup interaction of communities with different goals, political goals, interests,

etc. [1; 2]. User clustering in political discussions has been investigated in [3].

On the other hand, the creation of filter bubbles, echo chambers in groups with specific interests leads to the isolation of intragroup communication, the strengthening of group relationships and norms, while at the same time it hinders communication between members of different virtual communities [4].

Numerous and diverse studies are devoted to the analysis of social and political polarization that occurs in various communicative processes in the digital environment [5; 6].

Stadtfeld, Takács and Vörös argue that traditional social network theories that are concerned with the evolution of positive relations (forces of attraction) are not sufficient to explain the emergence of groups because they lack mechanisms explaining the emergence of group boundaries. Authors find that a model that considers forces of attraction and repulsion simultaneously is better at explaining groups in social networks [7]. Meanwhile, some social and systemic features of social networks contribute to intergroup communication even more than offline or traditional communication channels. Scott A. Golder and Sarita Yardi show that two structural characteristics, transitivity and mutuality, are significant predictors of the desire to form new ties [8].

Thus, on the one hand, social media can unite communities and significantly facilitate intergroup contacts; on the other hand, network communications make it possible for different communities of actors to be isolated and limited only by intragroup communication, increasing intergroup distance. That is, the question remains, which methods and techniques are most effective for purposeful management of the virtual group behavior, both within the digital space and in real life.

Among other things, of particular interest to researchers is the influence maximization analysis according to which it is necessary that k nodes influence the largest users of a social network [9]. Influence maximization in social networks, reflecting the game of innovation diffusion with multiple competing innovations such as when multiple companies market competing products using viral marketing is analyzed in the work of [10].

The aims of this study are as follows:

1. Analysis of hierarchy of various types of social media actors
2. Analysis of perception and optimization of influence in social media.

1.2. Method

The study involved a cross-disciplinary approach using neural network technologies [11]. To analyze the perception of actors and optimization of influence on social networks, it was developed and tested to the semantic model for the influence maximization analysis.

Influence maximization is a well-studied problem. However influence maximization is submodular at the most studies. Also many non-submodular problems have been proposed and researchers give a lot of algorithms to solve them. Wenguo Yang, Shengminjie Chen, Suixiang Gao & Ruidong Yan proposed activity probability maximization problem without submodular property. For a given social network G, a candidate edge set $\bar{E}$ and a constant k, the Activity Probability Maximization Problem asks for k edges in the candidate edge set that make the all nodes of G with highest probability of being activated under a pre-determined

seed set S. The authors developed the Sandwich framework called Semi-Sandwich framework. Based on the same optimal solution of lower and upper bounds, proposed a Difference Minimizing Greedy algorithm to get an approximation solution of the original problem [9].

In recent years, the analysis of influence maximization is carried out using quantitative methods and impressive results have been achieved in this area. Meanwhile, the problem of influence on social networks is closely related to the semantics of messages. Explicit and implicit knowledge has a strong influence on the perception of actors, therefore, in this study, a semantic analysis model to influence maximization in social networks was proposed.

The neural network technology TextAnalyst 2.3. (developed by one of the authors of the paper A. Kharlamov) was used as a toolkit to help form a semantic network common for the entire corpus of analyzed texts, from which the topic structure of the analyzed content was extracted; also, an associative search was performed.

To achieve the goals of the user-generated content research, various types of actors were identified and analyzed. The content of various Internet sites was analyzed in view of the highest popularity among users, the dynamics of the number of actors and their geographic location. When analyzing the semantics of the user-generated content, the sentiment of messages and the presence of aggression were considered, taking into account the type of messages, the type of source, the compilation of these parameters; and the sentiment and aggression in non-verbal digital footprints were analyzed as well. The study design is described in [12].

1.2. Data

The material for the study was data from social networks, microblogs, blogs, forums, video resources concerning reviews of the South-East Chord (SEC) construction in Moscow.

Due to the high level of Internet activity around the SEC construction and the large amount of data, the entire analyzed period of the study is conditionally divided into time stages (Table 1.).

Table 1. Data characteristic

N	Period	Audience
1.	from April 1, 2019 to June 30, 201	352 267
2.	from July 1, 2019 to September 30, 2019	17 583 997
3.	from October 1, 2019 to December 31, 201	65 588 267
4.	from January 1, 2020 to February 29, 2020	99 096 492
5.	rom March 1, 2020 to March 31, 2020	130 180 782

2. Results and discussion

2.1. Identification of various types of actors and analysis of the content and communicative behavior

The study identified the following types of actors: personal account, communities, media accounts, and of an undefined type (sites that are not identified by the type of actor). In the 1st period, the rating of the types of actors by audience and user involvement was led by communities, but starting already from the 2nd stage, personal accounts that formulate important (in the users' opinion) provisions and opinions criticizing the SEC construction, as well as negative assessments, gain maximum shares. The hierarchy of types of actors at various stages is shown in Fig. 4-8.

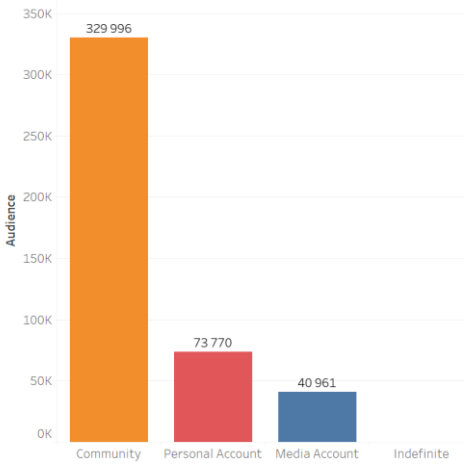


Figure 1. Hierarchy of various actors' types (stage 1)

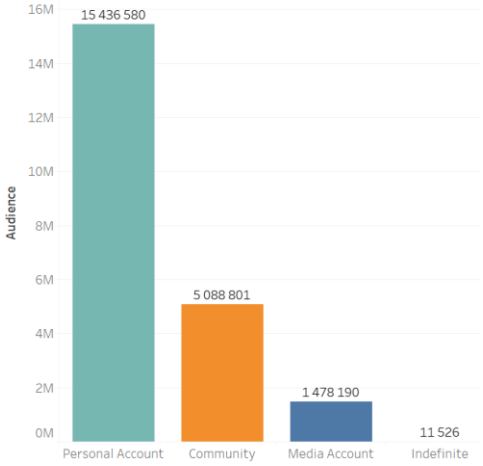


Figure 2. Hierarchy of various actors' types (stage 2)

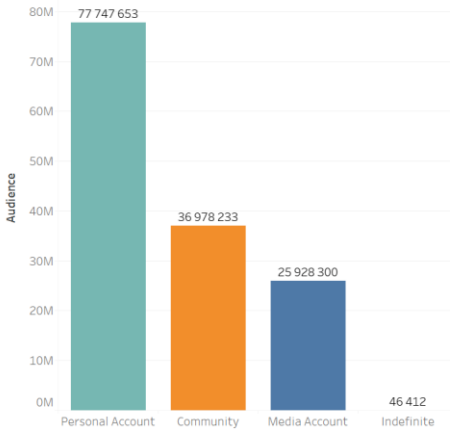


Figure 3. Hierarchy of various actors' types (stage 3)

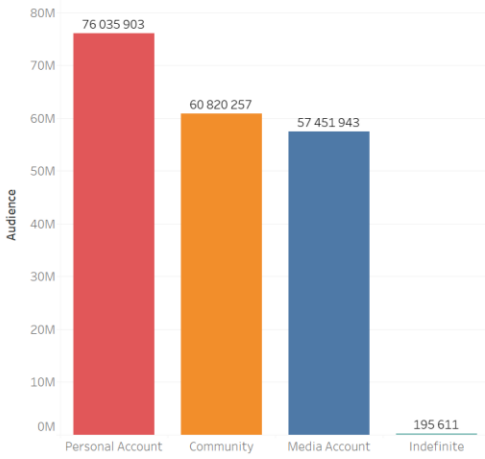


Figure 4. Hierarchy of various actors' types (stage 4)

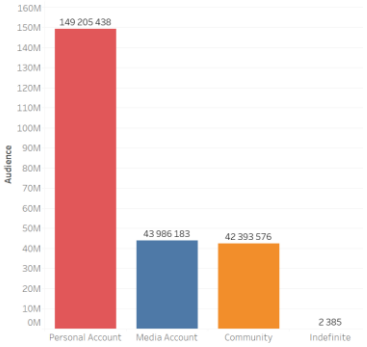
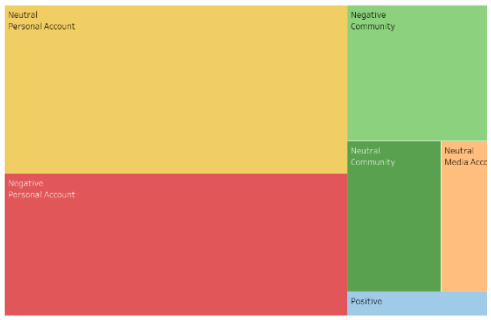


Figure 5. Hierarchy of various actors' types (stage 5)

The first stage is characterized by the communicative activity of communities, and the second stage is characterized by the communicative activity of personal accounts, in which the predominantly negative and neutral perception of the results of public hearings and approval of urban planning documentation is presented. Among the personal accounts participating in the discussion, public activists and municipal deputies stand out. These professional actors have a certain influence on social networks, have their own groups of supporters. They have certain competencies in legal matters and experience in political actions to defend collective interests.

The third stage is characterized by a certain predominance of the communicative activity of personal accounts; meanwhile, communities also participated widely in the formation of qualitative and quantitative Internet activity. Significantly, negative perceptions prevail in communities, media accounts, and undefined accounts. Here we can observe how the situation, which has become widespread in social networks, begins to attract the attention of the mass media. This in turn increases the audience and the number of participants in the discussions.

At the fourth stage, the active involvement of all types of authors with negative and neutral reactions in communication is observed. The fifth stage shows the high activity of personal accounts with neutral and negative assessments of the situation and criticism of the project only in terms of quantitative indicators (Fig. 6-10).



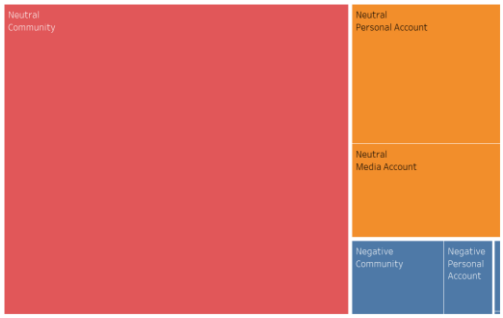
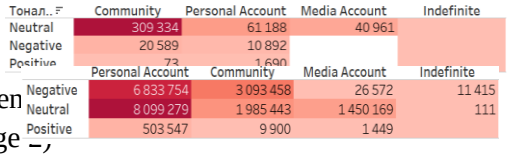


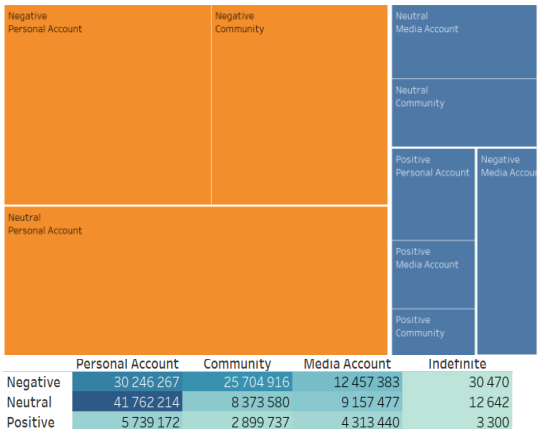
Figure 6. Content sentiment depending on the type of author (stage 1)



Тональ..	Community	Personal Account	Media Account	Indefinite
Neutral	309 334	61 188	40 961	
Negative	20 589	10 892		
Positive	73	1 690		

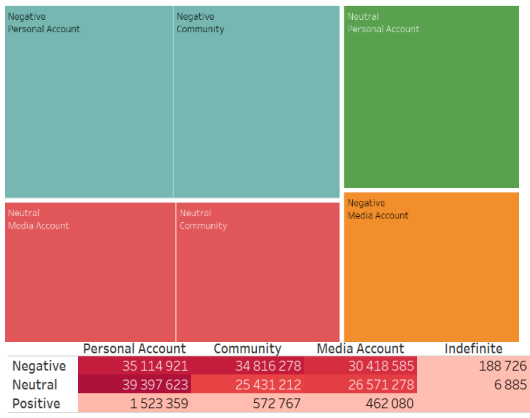
	Personal Account	Community	Media Account	Indefinite
Negative	6 833 754	3 093 458	26 572	11 415
Neutral	8 099 279	1 985 443	1 450 169	111
Positive	503 547	9 900	1 449	

Figure 7. Content sen type of author (stage 2)



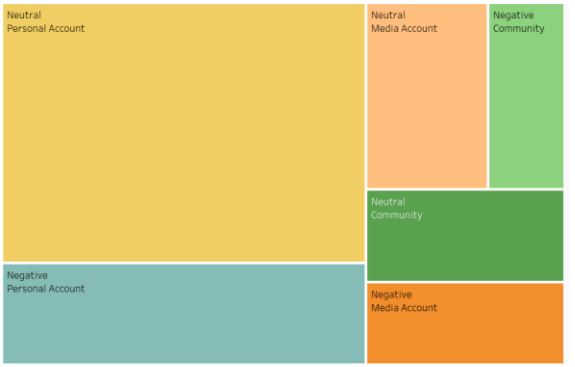
	Personal Account	Community	Media Account	Indefinite
Negative	30 246 267	25 704 916	12 457 383	30 470
Neutral	41 762 214	8 373 580	9 157 477	12 642
Positive	5 739 172	2 899 737	4 313 440	3 300

Figure 8. Content sentiment depending on the type of author (stage 3)



	Personal Account	Community	Media Account	Indefinite
Negative	35 114 921	34 816 278	30 418 585	188 726
Neutral	39 397 623	25 431 212	26 571 278	6 885
Positive	1 523 359	572 767	462 080	

Figure 9. Content sentiment depending on the type of author (stage 4)



	Personal Account	Media Account	Community	Indefinite
Negative	41 239 449	18 294 091	20 691 066	2 385
Neutral	105 179 196	25 317 948	20 434 384	
Positive	2 786 793	374 144	1 268 126	

Figure 10. Content sentiment depending on the type of author (stage 5)

At the first stage, the neutral character of the users' perception of the SEC construction is confirmed by the absence of aggression in the content. However, at the second stage, strong aggression appears in social networks and the presence of aggression in microblogs and social networks is observed.

A sharp increase in negative perception of the project implementation at stage 3 is determined by an increase in strong aggression in social networks and videos. Stage 4 is distinguished by a large number of aggression traces, as well as strong aggression in personal social media accounts. The persistence of a high degree of strong aggression in personal accounts of social networks at stage 5 testifies to the widespread sharply negative attitude towards the SEC construction (Fig. 11-15).

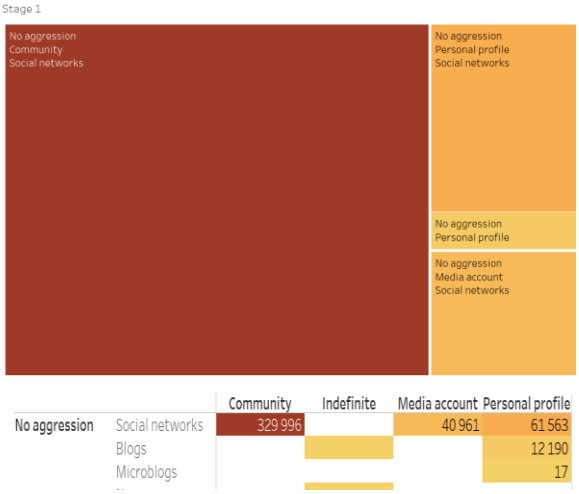


Figure 11. Aggression in the content depending on the type of author and source (stage 1)

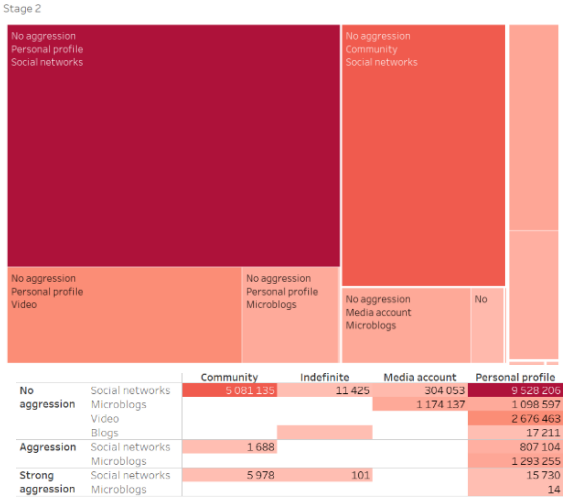
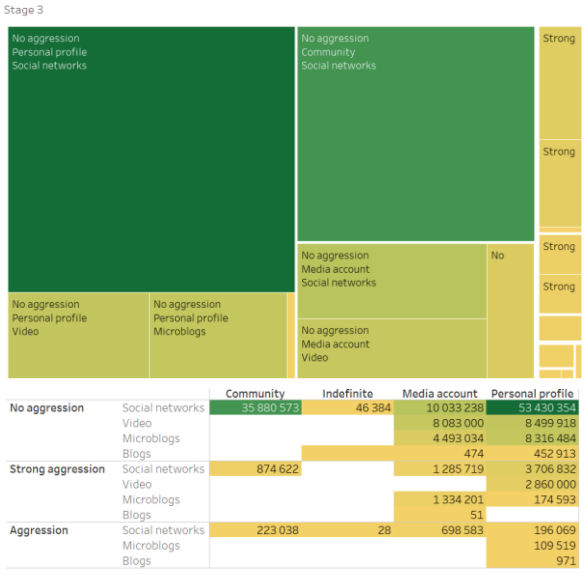


Figure 12. Aggression in the content depending on the type of author and source (stage 2)



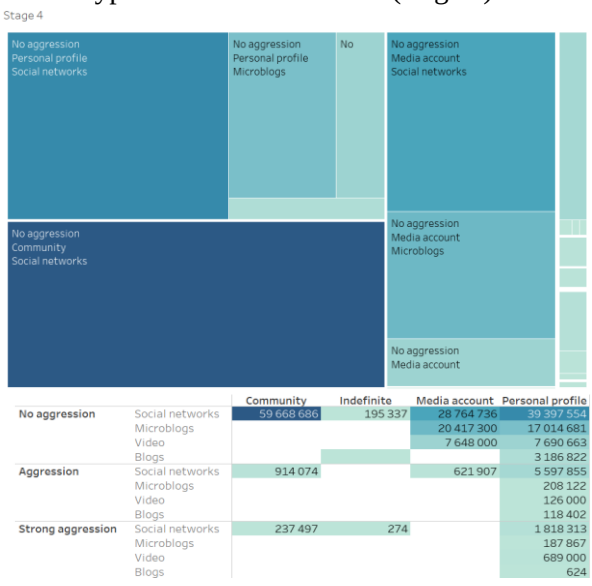
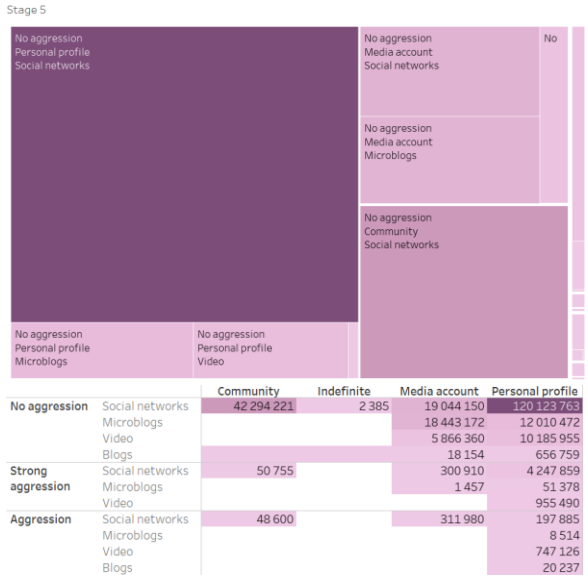


Figure 13. Aggression in the content depending on the type of author and source (stage 3)

Figure 14. Aggression in the content depending on the type of author and source (stage 4)



		Community	Indefinite	Media account	Personal profile
No aggression	Social networks	42 294 221	2 385	19 044 150	120 123 763
	Microblogs			18 443 172	12 010 472
	Video			5 866 360	10 185 955
	Blogs			18 154	656 759
Strong aggression	Social networks	50 755		300 910	4 247 859
	Microblogs			1 457	51 378
	Video				955 490
Aggression	Social networks	48 600		311 980	197 885
	Microblogs				8 514
	Video				747 126
	Blogs				20 237

Figure 15. Aggression in the content depending on the type of author and source (stage 5)

3. Conclusion

This paper presents an analysis of hierarchy of various types of social media actors and analysis of perception and optimization of influence.

As a result of studying a specific urban planning conflict, it was concluded that the hierarchy of various types of actors in social media is dynamic and unstable. Communities play a leading role only in the first stage of construction, when a large number of users are not yet interested in the problem. Meanwhile, negative perception is most efficiently formed and spread through personal accounts, and makes it possible to involve a larger number of users and form a negative attitude towards the SEC construction. Also in the hierarchy of actors by the number of attracted audiences, in addition to personal accounts, media accounts are of key importance as well.

Thus, it is possible to trace the typical dynamics of urban conflicts. The first informational stories about an event or incident appear in citywide, local or thematic communities. Then professional actors join the discussion: social activists and local politicians. As information spreads in social networks and the number of participants in the discussion increases, the conflict attracts the attention of the media, which creates a significant resonance in the information and communication space.

Optimization of the speech influence and perception by users is determined by a number of reasons: the accuracy of determining the specifics of the communicative situation, identifying relevant topics, generating messages on relevant topics using an imperative strategy that includes negative sentiment and aggression. An important role is played by

the symbolic capital of the source of information dissemination for certain types of actors. One should also take into account the dynamism of communication processes taking place in the network environment and a sharp change in the situation in short time periods.

The choice of adequate communication means and successful solution of urgent communication tasks ensures active influence on the perception of network actors and translation of virtual intentions into real actions.

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