NAUKI O MEDIACH / MEDIA STUDIES

ARTEM ZAKHARCHENKO

EVALUATING THE SOCIAL IMPACT
OF INTERNET MEDIA NEWS

INTRODUCTION

The phenomenon of rapid horizontal spread of information via the Internet media is of interest to scientists and experts not as a bare fact only. The exchange of knowledge without the mediation of professional communicants – from one person to another – produces major changes in the society. It also makes social trends more evident as they are all reproduced in one way or another in the horizontal information flows circulating in social networks, and therefore, are available for research.

As shown by Brazilian medical scientists from the State University of San Paolo[1], sharing of a particular post indicates its effect on the recipient's mind, changing the mind, and statistically processed data on the messaging in a social group can describe its effect on group consciousness.

In practice, media and PR experts constantly take shares as a measure of the audience interest in certain content. However, the total number of shares depends on many factors, including – apart from the message impact on the audience – primarily the audience size and network topology in which the information is transmitted.

The dynamics of message sharing in social networks has become one of the world science trends in these two years. It was studied by many researchers from different countries and the studies usually had a similar structure. Based on the research objectives a certain social network model was built in order to

ARTEM ZAKHARCHENKO, PhD in Social Communications, lecturer of the Department of Multimedia Technologies and Media Design, Institute of Journalism, Taras Shevchenko National University of Kyiv; e-mail: artem.zakh@gmail.com

A.F. da Rocha, E. Massad, P.C.C. dos Santos, A. Pereira, *A neurobiologically inspired model of social cognition: Memes spreading in the Internet*, „Biol. Inspired Cogn. Archit", V. 141(2015), p. 86–96.

find a mathematical pattern of the information spread reproduction rate. Most of the researchers emphasized that the formulas they obtained were identical to the patterns of epidemics, genetic mutations, or the rate of chain reactions – chemical or nuclear.

One of the most famous studies in this area is the joint project of Google Research and Microsoft Research[2], which, using the social networks Myspace and Blogsphere as examples, tried to find out ways to spread the knowledge on a certain commercial product at the lowest cost. Their model has nothing to do with media sphere but it works excellent in the field of marketing. It can be summarized through defining a number of key participants in the social network, which in turn ensures full coverage of the rest of the audience.

Researchers from the Indian Institute of Information Technology Anurag Singh and Yatindra Nath Singh[3] set the opposite task: how to stop rumor spreading in social network by influencing clearly defined users, the search for which was actually the main objective of the study.

The above-quoted Brazilian researchers – Armando Freitas da Rocha et al. – derived a very similar to ours exponential formula for a meme-replication rate[4]. As the object for their study they used humorous collages dedicated to the political life of Brazil. Their formula determined the risk of 'being infected' with media virus, but did not describe the impact of information on the system. The researchers did not touch the patterns of changing the public attention regarding certain political topics.

International team headed by Wojciech Galuba studied the distribution of URL-addresses via Twitter trying to determine the probability of sharing a certain URL based by the users , based on their responds to previous posts on the subject[5].

Maziar Nekovee et al. focused on a concept of 'threshold' , which could trigger the explosive spread of information[6]. The concept was borrowed from epidemiology, where epidemic threshold is set and once it is crossed over the disease is difficult to stop.

Finally, interesting research was made by Tatsuro Kawamoto and Naomichi Hatano from the University of Tokyo[7] where the most detailed model of information spread was created. Researchers introduced a concept of 'spreading factor' for each 'circle' around the point of 'seeding' the information: first circle

[2] E. Even-Dar, A. Shapira, *A note on maximizing the spread of influence in social networks*, „Inf. Process. Lett", V. 111, Is. 4(2011), pp.184–187.

[3] A. Singh, Y.N. Singh, *Rumor dynamics in weighted scale-free networks with degree correlations*, „J. Complex Networks", V. 3, Is. 3(2015), pp. 450–468. doi:10.1093/comnet/cnu047.

[4] A.F. da Rocha, *A neurobiologically…*

[5] W. Galuba, K. Aberer, *Outtweeting the Twitterers − Predicting Information Cascades in Microblogs*, "Proceedings of the 3rd Conference on Online Social Networks", USENIX Association Berkeley (2010), pp. 3−11.

[6] M. Nekovee, Y. Moreno, G. Bianconi, M. Marsili, *Theory of rumour spreading in complex social networks*, „Physica A: Statistical Mechanics and its Applications", vol. 374, no. 1(2007), pp 457–470.

[7] T. Kawamoto, N. Hatano, *Viral spreading of daily information in online social networks*, „Physica A: Statistical Mechanics and its Applications", 406(2014), pp 34–41.

is the people directly related to the source; the second is the users related to those people and so on. The model is quite cumbersome though and requires knowledge of social relations topology for each particular user. Similar approach – requiring in-depth knowledge of network structure – is adopted by Adrien Guille and Hakim Hacid from French universities[8].

So, as we see, researchers around the world mainly focus on using the patterns of information transmission dynamics in social networks to predict the scale of information spreading and ways to influence this scale. Though, even detailed and complex mathematical models cannot ensure prediction of high accuracy. It depends on too many random, often subjective, factors. We should therefore abandon predictions and start using analysis of the actual dynamics of information transmission to assess social processes. In this context, the notion of news 'series'– the topics exploited by media to generate news over extended periods – is important. According to Pocheptsov, today news is made according to tradition of TV series. "It must necessarily continue tomorrow as the events in most cases do not finish in a previous episode", says the scientist[9].

Therefore, our study aims at learning how to apply data on information transmission dynamics to study social processes including those related to 'news series'. Our objectives include: building a model of news diffusion in social networks, describing dynamics of news sharing by audience, founding processes that explain the dynamics, and determining factors influencing the rate of post sharing.

1. Material and methods

1.1. Collected information

We collected real-time information regarding news published in one of the most visited and influential Ukrainian websites: Pravda.com.ua, considered the main communication platform for active Ukrainians. Every half an hour, using API of social networks like Facebook, VKontakte and Twitter, we counted the number of users' interactions (Like, Share/Tweet, Comment) with each news story from Ukrainska Pravda. We accounted all interactions, not only shares, as today any interaction with the news story in social network can be enough for your friends to see it.

As shown by monitoring, only interactions with news in the first network were suitable for statistical analysis while the number of interaction in other two

———————
[8] A. Guille, H. Hacid, *A predictive model for the temporal dynamics of information diffusion in online social networks*, WWW '12 Companion Proceedings of the 21st International Conference on World Wide Web (2012), pp. 1145−1152.

[9] G.G. Pocheptsov, *«House of Cards»: how the clip thinking changes to series thinking*, "Khvylia", (2016), 11 March, available at: <http://hvylya.net/analytics/society/kartochnyiy-domik-kak-na-smenu-klipovomu-myishleniyu-prihodit-serialnoe.html>, accessed June 12, 2017.

networks was too low. We selected for the study only the posts with Facebook users' interaction exceeding 600 times.

At the current stage, there can be from 75 to 90 such news per month. For example, in January 2017 there were 79 such news stories and in February 86. Interestingly, a year ago this amount stayed within 55 to 65 stories, confirming the fact that Facebook audience in Ukraine is rapidly developing not only quantitatively, but qualitatively also.

1.2. Time of audience

Traditionally, interaction dynamics is taken as dependence of number of interactions on time. However, these curves are not suitable for mathematical analysis as internet users' activity depends on the time of day and other factors. We correlated interactions with the respective media audience activity rather than with time. This activity is determined by visits of some of model pool of Internet resources topically similar to the studied media.

Therefore, we can use a kind of substitute for time: $\tau = Y/Y_0$, where the numerator is the total attendance of model resources pool from the moment of news publication till the moment of measure taking, and the denominator is their attendance for model range of time. In this study we used $Y_0 = 100,000$ visits to media registered with the "media" section in a public meter of Liveinternet. ru service. τ can be taken as a kind of local time of topical information space. It will be called the time of media audience.

1.3. Interactive potential

We introduced the concept of interactive potential φ, describing the message ability to encourage users of defined social group to share it at a certain time, similarly to the mechanism of chain reaction in nuclear physics. Interactive potential is defined as an average number of social media interactions with some publications caused by each previous interaction. If $\varphi < 0$ in a particular social network, sharing chain is more likely to interrupt than branch and therefore no explosion of shares is observed. And conversely, if $\varphi > 0$, post is spreading over the social network at rapid fire pace.

In our previous paper, the concept of interactive capacity was substantiated mathematically[10]. This study will proceed with experimental data.

1.4. Approach to model construction

The model was defined by generalization of common features in posts sharing dynamics based on the available practical monitoring results. Using the model, we defined a quantitative indicator that clearly describes audience reaction

---

[10] A. Zakharchenko, *Measurement of the efficiency of message impact on the activity of social networks members*, „Aktualjni pytannja masovoji komunikaciji", Is. 15(2014), pp 36−49.

to the post and therefore post impact on audience. This figure is hardly dependent on audience size and other parameters. Using this technique, we discovered how the figure changed for different political 'news series' broadcasted in 2016 and early 2017.

2. Theory

2.1. Typical graphs for dynamics of interaction with news

Analysis of interaction dynamics curves shows that for each news story, which had more than a thousand interactions, dynamics contains to the power function law. It lasts from 3 to 10 hours; afterwards significant deviations from the power function curve occur.
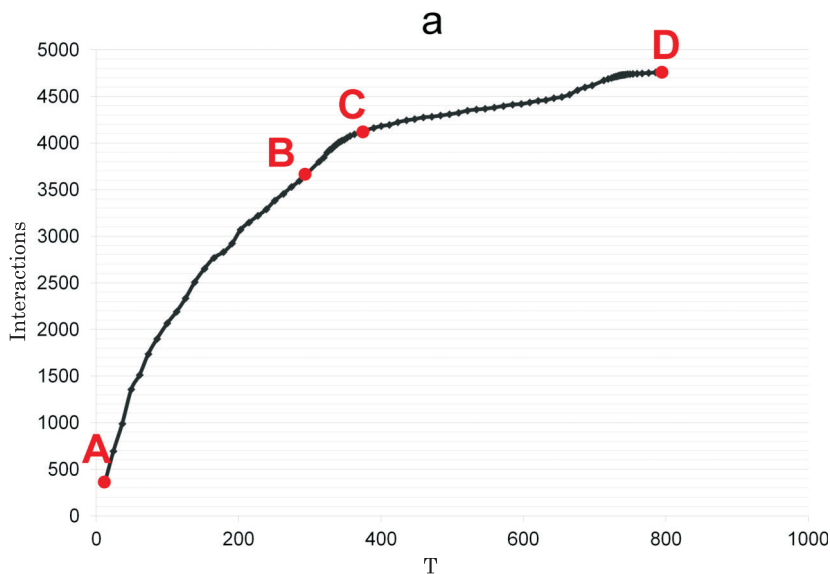
The described situation is shown in Fig. 1a.

Fig. 1a. Typical graphs for dynamics of interaction with news in social networks

Here the segment between A (news posting at about 11 a.m.) and B corresponds to the simple power function law. Interaction rate increases again between B and C, at the end of the first day of news posting. Then, between C and D, the share dynamics slows down. Sometimes there is also a situation where for one to three hours after the news posting the dynamics of interaction is untypical slow and only later acquires usual power function curve shape. Most often this comes when the publication is made late at night or at lunch time, as in Fig. 1b.
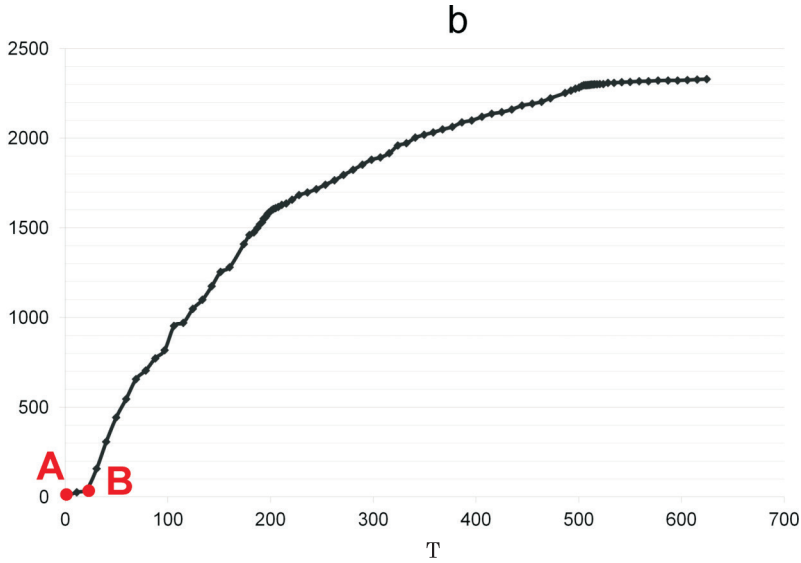
Fig. 1b. Typical graphs for dynamics of interaction with news in social networks

Finally, the third option is when for the first half an hour or hour the interaction rate is much higher than expected and only after the second or third hour typical power function curve shape appears.

2.2. Information sharing model

Above observations contributed to construction of following information sharing model.

First, we consider modern media as a cross-platform communication framework. Interaction with audience occurs there both horizontally and vertically, i.e. in some cases users consciously consume information from this media. In other cases, people receive information from the media in 'horizontal' way – from their friends that shared the information.

Second, different stages in the dynamics of interaction can be explained by existence of several user groups usually with common interests. Each group (let's call them α, ß, γ ...) has its value φ > 0. In Fig. 2, α − the people most interested in the news, γ − the least interested.

A line connecting nodes shows next user learning the news with which previous user interacted. The mechanism of content sharing:

1. Media posts a news story, which catches the eye of media core audience. Since core audience is the most loyal to this media, it usually most readily reacts to the news story. Therefore, the first hour exhibits an excessive rate of interactions.
2. Representatives of α, ß, γ-groups read the news and start sharing it with varying rate.

News appeared
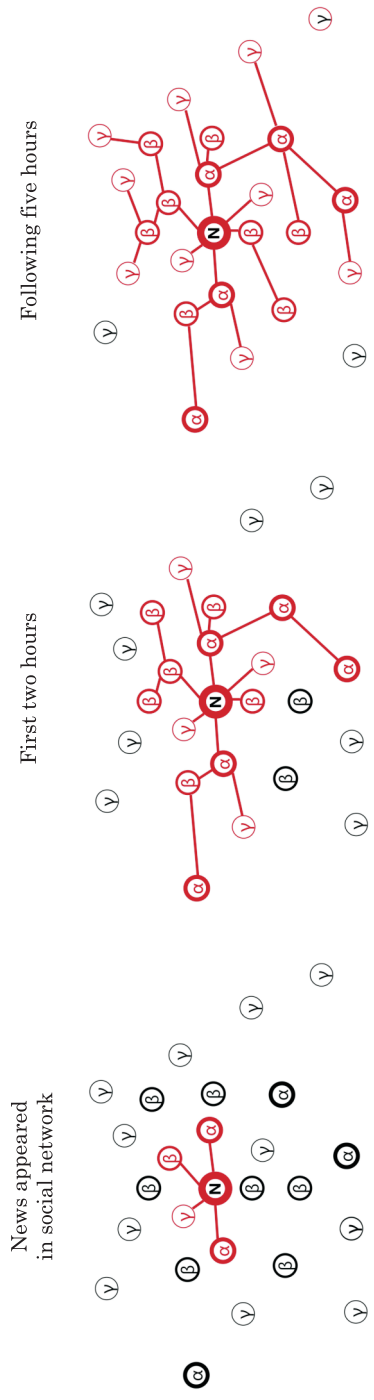in social network

First two hours

Following five hours

Fig. 2. Model of news sharing in a social network

3. If during the first some hours (Fig. 1b) α-group members did not read the news, for example, they are not the usual audience of the media, the number of shares is temperate. The active stage starts once the post contacts α-group.

4. New members of these groups learn the news at different rates. Sooner or later, depending on the α-group size, its members "run out". Interaction rate will decrease drastically (C point in Fig. 1a).

5. Interaction revival may occur at $A - C$ and $C - D$ segments. This may be the result of top bloggers interaction with the news or news promotion. The post urgency may also increase due to additional previously unknown information disclosure.

6. Sudden slowdown of sharing dynamics is possible if another news story switched audience attention.

7. By the end of the second day, potential of all groups with positive $\varphi - α$, ß, ɣ ... – gets exhausted, the number of shares flattens out.

To handle this model we have to make some assumptions.

Firstly, we consider the network structure to be practically unchangeable during the experiment. It's because for two days – the lifetime of the news story – the number of new connections of average user is insignificant as compared to the number of his/her existing connections.

Secondly, the popularity of the studied online media allows skipping the concept of "epidemic threshold". This concept makes sense for news posted on webpage with a low number of connections. In this case, even really exciting news can go unnoticed. Ukrainska Pravda is high-traffic website. We encounter a kind of "epidemic threshold" only when α-group is not direct audience of Ukrainska Pravda and is related to it through ß- and ɣ-groups.

2.3. Defining interactive potential

Given these assumptions, we can proceed to analyze post interaction dynamics curve. We are interested in segment that usually starts in about an hour after the news release when its "vertical" spreading has slowed down and it is shared mainly horizontally. This period lasts three to ten hours until α-group is exhausted or disengaged from the subject. This segment of graph will be further referred to as specific segment. It is easily identified on the graph even visually, especially when attendance and time of audience are substituted with their logarithms on graph axes. In this case the power function curve becomes a straight line (Fig. 3).

Here, $A - B$ segment is a specific segment.

Defining the specific segment we are trying to avoid the impact of network`s topology, in particular for the initial 1−2 hours, when the greatest number of news website followers accelerates the news spread, or later, when the so-called top-bloggers start reposting our publication and the impressive number of their friends starts interacting with it. We need the figure that depicts the spread speed from one common user to another in the initial part of the publication's life.
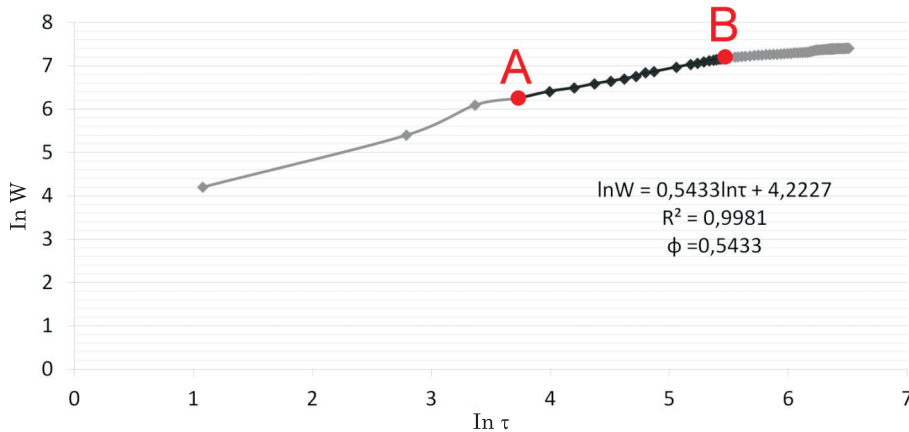
Fig. 3. Shares curve in logarithmic scale

Experimental data suggests that this straight line is perfect, provided that the number of shares is more than 1 000, then its correlation index R^2 is 0.94 to 0.99. This segment will be further referred to as specific segment. It is uniquely described by formula (1):

$$W = A\,\tau^{\varphi} \qquad (1)$$

where W is the number of page shares, φ is an interactive potential, which is the average number of interactions caused by each previous interaction. A is a factor that may vary depending on the duration of "incubation period" of the news story, activity of the media loyal audience, size of the target audience, headlines exposure on the media main page, etc. Analysis of A value is not a target of our research.

φ value, defined in practice, describes the impact of post on the social group of news consumers generally. This group being quasi-homogeneous as it may be composed of different groups still behaves as homogeneous within a specific segment. Specific segment length indicates the size of α-group, if only the news was "overwritten" by other posts before it swept the audience.

If φ-value of news story is a measure of its impact on news consumers, the comparison of φ-values of different news and defining regularities can describe social processes.

3. Method Testing: defining public readiness for protests

We tested the effectiveness of our method by taking monthly measurements of interaction of Ukrainian Internet audience with news on various topics. In this way, in particular, you can monitor how much is the proactive part of society (most often they are Facebook users) interested in political life and is ready to act.

3.1. Evolution of attention to various topics in 2016 – early 2017

We see that during 2016 the information trend consistently shifted from criticism of the authorities to other topics.

Since January and partially February are traditionally passive months in information environment, it was in March that the culmination of the government and prosecutorial crises occurred. In the same period, the 'idealistic' calls for civil society regarding the need to struggle for reform and control authorities were abundant.

But already in April and May, the authorities managed to reassure public discontent with their policies, appointing new prosecutor and the prime minister. Since then, even the offshore scandal, where P. Poroshenko was accused of financial fraud, could not stir the audience to the previous level.

In June, it was hot again in the infosphere but the discussions rarely were related to the authorities. The network was obsessed with the LGBT rights. The case of the fugitive oligarch Onishchenko was also hotly debated. With this agenda the Ukrainians were sent on vacation.

In September, the IP was relatively weak despite several headline-making events: Inter TV channel blocking and arson, shooting of policemen in Dnipro, detention of Ukrainian journalist Roman Sushchenko in Moscow. Still one topic did work out – the interactive potential of the demand of the Ukrainian Parliament Speaker, Andriy Parubiy, to introduce a visa regime with the Russian Federation reached 1.67, becoming the seventh in the rating of the most influential news 2016.

October was the most information-rich month of the year. However, the political news again was not noticeable. Among others the public services and e-declaration caused the greatest stir. But still the audience was more concerned about 'traditional/modern' discourse, in particular, the prohibition of abortion in Poland.

November showed that the audience takes public quarrels of politicians and financial-industrial groups much less emotionally than at the beginning of the year. After all, until a certain time – namely, until nationalization of Privatbank in December – these disputes did not affect people's pockets. And since criticism of government stemmed more often not from 'civil society' but from the opposition politicians, who traditionally enjoy little trust of people, that criticism went largely unnoticed against the background of other topics.

What topics were the most effective smoke screens for the audience criticism of authorities?

The answer to this question is in analysis of the top10 news with the highest interactive potential.

Exactly half of them (5) are within the 'traditional/modern' discourse: meaning the LGBT rights, the prohibition of abortion, the personality of Ukrainian Greek Catholic Church (UGCC) Major Archbishop, etc. The struggle between 'traditional' and 'modern' values was discussed much more actively than the fight against corruption.
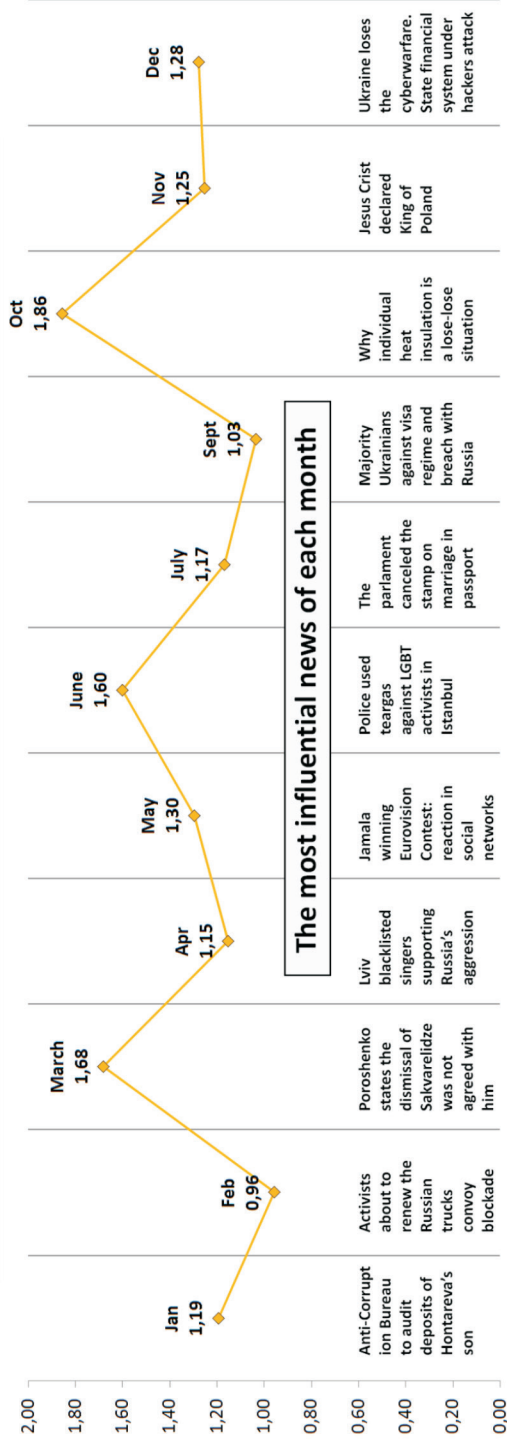
Fig. 4. Average IP of five most influential news of each month in 2016

The remaining five news of our top 10 include two news devoted to situation in the public utilities sector. Another two were 'convenient' for the authorities. They include the story about the 'Onishchenko case' that was used by the authorities at that time for own promotion, and the statement of Parubiy, which is rather a good promise than a direction to real actions. And only one news sparked public outcry: attempt of the Prosecutor General's Office to press the Center for Counteracting Corruption. But this news appeared in March, during the 'crisis in the Prosecutor General's Office'.

However, more thoughtful analysis of political discourse showed that prerequisites for returning people to political discourse appeared as early as in December 2016.

Investigative reports and other criticism of Poroshenko still did not reach such IP as the news from the 'critical' March. Those negative publications still remained less discussed than the social issues or economy. But the level of their IP was already about the same as it had been during the May 'offshore scandal'. Thus, the story of the President's undeclared villa (the information was subsequently refuted) received IP of 1.09. The article that Poroshenko's friends control orders by Ukroboronprom (Ukrainian Defense Industry) came in a close second (IP = 0.97).

Indeed, in January – February 2017 this trend came on full display. News with the greatest interactive potential, as in the second half of 2016, concerned primarily the humanities: culture, science, health, and consumer sector of economy. But the values of IP were extremely high.

Even in January, the monthly 'information temperature' was almost at the level of the October record of last year, and in February it became even one unit higher.

Moreover, interesting is the fact that almost all the 'humanitarian' news that caused response activity was not related to contradictory topics, and rather united supporters of traditional and modern values. They were news about the international prize for the Ukrainian scientist, pictures of Ivan Marchuk, scholarships for the Ukrainian in Stanford, etc. Special attention deserves the news about the mobile app launch by Ukrzaliznytsia (Ukrainian railways). Its interactive potential was 5.29 and became a record for the whole monitor history, since January 2016. Actually that consumer news, which contained a link to the long-awaited service, stirred up Facebook audience to the greatest extent for the recent year.

Yet, a good warning about people's readiness for protests was that in early February, news of anti-corruption rallies in Romania got high interactive potential (2.79). So, March was just to begin when the audience flat out forgot about the 'humanities' and switched into critical political discourse. All the news included in our sample concerned political topics (mostly the case of the former head of the Fiscal Service Roman Nasirov) or war and international events (mostly the Donbas (ORDLO) blockade).

So, the following trend can be identified. In January 2017, the local Facebook audience deescalated tension of quarrels about values and even some weak
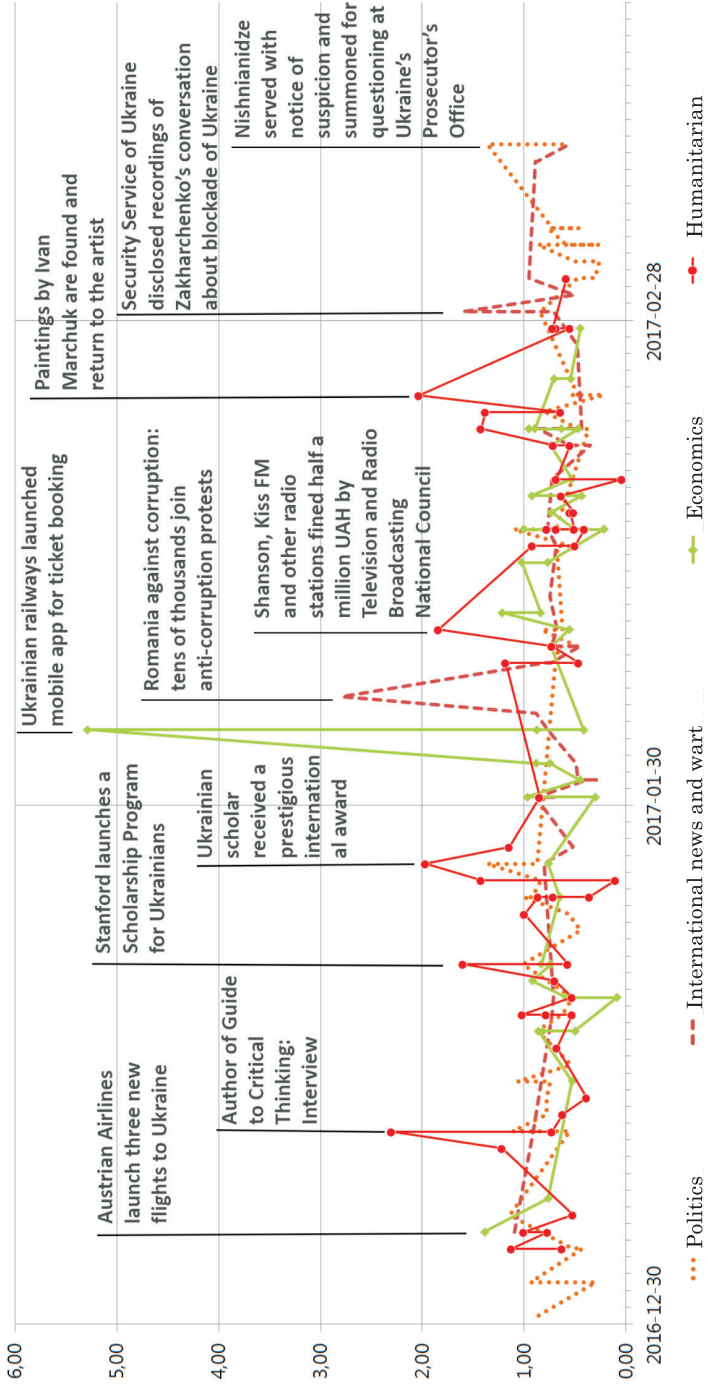
Fig. 5. Interactive potential of news on various topics from December 30, 2016 to March 10, 2017

Austrian Airlines launch three new flights to Ukraine

Author of Guide to Critical Thinking: Interview

Stanford launches a Scholarship Program for Ukrainians

Ukrainian scholar received a prestigious international award

Ukrainian railways launched mobile app for ticket booking

Romania against corruption: tens of thousands join anti-corruption protests

Shanson, Kiss FM and other radio stations fined half a million UAH by Television and Radio Broadcasting National Council

Paintings by Ivan Marchuk are found and return to the artist

Security Service of Ukraine disclosed recordings of Zakharchenko's conversation about blockade of Ukraine

Nishnianidze served with notice of suspicion and summoned for questioning at Ukraine's Prosecutor's Office

6.00 5.00 4.00 3.00 2.00 1.00 0.00

2016-12-30   2017-01-30   2017-02-28

.... Politics   — — International news and wart   —◆— Economics   —●— Humanitarian

tendencies to unite around the solution of humanitarian problems and struggle against the influence of the Russian Federation were recorded. In February and March, once the proper conditions were formed, this newly harmonized audience was again interested in political topics, took part in public speeches or at least supported them.

The above observations enable us to construct a model of the proactive part of society.

3.2. The model of Ukrainian Facebook space

Among the opinion makers in the Ukrainian segment of Facebook there are two relative and rather large fractions of the authorities critics with their loyal core supporters. First include supporters of liberal ideas – those who favor DemAlliance and the Movement of New Forces in political issues and second include 'radicals', mostly supporters of the Right Sector, volunteer battalions and Semen Semenchenko, and, partially, deputies from the Radical Party of Oleh Lyashko (the latter recently took a pro-government position).

But most of the Facebook audience, with its distrust of politicians, does not associate itself with any of these factions, and in one or another way, makes itself familiar with the arguments of both sides, and in addition with the position of pro-government opinion leaders like Medvedev or Gerashchenko. Having familiarized itself with the above, it forms its attitude to those or other events and phenomena of the political agenda.

Until recently, both 'fractions' of active citizens had no clear consensus regarding the authorities. 'Radicals' have long advocated impeachment and restriction of President's power. While 'liberals' refrained from trenchant criticism of the authorities, considering it a kind of 'lesser evil', especially against the background of the summer results of opinion polls, which forecasted Batkivshchyna and Opposition Bloc rise to power.

There was no consent between the 'fractions' in other issues as well: as we saw, the conflict between traditional and modern values was the largest stumbling block dividing proactive part of society.

However, in early 2017, the position of 'liberals' regarding authorities changed: aggressive criticism of the presidential team comes not only from Saakashvili but also from DemAlliance and public organizations close to them. The authorities have ignored the demands of these activists for too long.

Curiously, the disputes about LGBT rights, traditional family and other things have become much weaker in 2017.

Consequently, the Facebook audience from both 'fractions' hears critical comments about the authorities. And there are no fuses that would restrain it from active actions, including street protests.

CONCLUSION

As can be seen, the dynamics of publication's interactions in social networks is an important data source for the social trends investigation. For the Ukrainian society, its main goal is to describe the processes occurring within a group of proactive people, most of which are Facebook users.

The most informative part of the dynamics graph is the so-called *specific segment*, which shows the publication's ability to spread in a common social media environment. Thereby, the result is an independent topology of social network and quantitative differentiation between 'vertical' and 'horizontal' communications in the Internet media, in other words, between 'natural', horizontal information transmission and 'vertical', typical for the traditional media − reader model.

The shape of the graph in the specific period allows calculation of a quantity index that unambiguously characterizes an impact of messages on a social network: the interactive potential. It is a degree index in equation that describes the dynamics of interactions with information within a given period of time. It can be defined as an average number of social media interactions with some publications caused by each previous interaction.

The comprehensive mathematical analysis of this dynamics, particularly, the content of A-coefficient from formula (1) needs some additional research. It would help to analyze the interaction with certain news even more precisely and learn to retrieve additional information from the form of the news diffusion curve.

SUMMARY

The goal of the research is to develop a method for measuring topical social information impact on active people through monitoring the dynamics of social networks users interaction. We introduced the concept of interactive potential which can be determined through dynamics curve analysis in order to interact with information. Regular measuring of news' interactive potential allows tracing the dynamics of social interest in some topics. We used the method to analyze trending topics in Ukrainian media and to describe the dynamics of people's concern with political life and their readiness for public protests.

KEY WORDS: Interactive potential, information spreading, information impact, social networks, online media