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**SOCIAL NETWORKS MODELLING: THE CASE OF VIRTUAL
BUDDHIST COMMUNITIES**

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Abstract

Social media has become an environment for the emergence of new forms of religious activity. They are a very promising field for the sociological research of religious activity and identity. Actually, digital religion is a new agenda in the Sociology of Religion and Digital Social Studies. At the same time, this field is connected to the methodological and technical problems of “Big Data” and studies of social networks with its weak structured and increasing volume. “VKontakte” is the most popular social network in Russia with more than 380 million users. So, digital sociological research increasingly requires application of modelling in the form of network structures; it allows obtaining valuable information on general regularities of interaction between community members and comparing different social groups. The article attempts to analyse a number of important topographic characteristics for creation of the graph model of Buddhist communities in the social networking service “VKontakte”. The authors have investigated assortativity, the degrees of vertices, and the lengths of the shortest paths for the friendship graph of Russian Buddhists. It is shown that currently there is a significant growth of the Buddhist segment of social networking service, a number of Buddhist communities and Buddhist users are increasing. This segment as a whole reproduces social networking characteristics, but Buddhism is not an assortative feature, and Buddhist communities are weakly structured and influenced by many differentiating factors.

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Keywords: Buddhism, mathematical modeling, social networks, Internet.



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1. Introduction

The study of religion and religious behavior on the Internet in the light of its increasing influence on people's lives is one of the most promising areas of sociological research. Social media have become an environment for development of new forms of religious activity, giving unprecedented capacity to transfer and exchange information, transmit religious ideas, involve people in virtual and real communities. Religious ideas are translated online, religious groups and organizations involving new believers are being created on the web, political and religious discourse is being formed. The Internet allows creating a global "non-spatial" organization of religious interaction, coordination of religious activities and even its control.

The audience of the largest Russian-speaking social network "Vkontakte" has more than 380 million users. According to SimilarWeb, "VKontakte" is the most popular site in Russia and Ukraine and the sixth most popular in the world. According to the results of the investigation of social networks in Russia, carried out by BrandAnalytics, its monthly audience amounts more than 46.6 million people at least once a month visiting the site. More than 80 million users visit the site every day, about 65% of visitors live in Russia. According to the expert estimates, in January 2014 real people in "Vkontakte" had about 52.7 million. The percentage of adolescents and students among the users of "Vkontakte" is slightly higher than of other networks.

Sociological research in social networking services requires the solution of several important methodological and technical problems. The first problem related to the fact, that social media represent an extremely large rapidly growing real-time volume of weakly structured data. In addition, social networking services impose technical restrictions on the search for information, their search engines allow a limited number of requests, hence it significantly complicates the search and retrieval of information. Data privacy restricts research capabilities because access is permitted only for authorized users (Korshunov et al., 2014: 441). Also privacy is provided by the user profile settings, providing an opportunity to "close" it from outside observers, and "open" only to friends. The next problem is mismatch of real people and user profiles, what makes it difficult to verify data, socio-demographic and other characteristics, especially when using online surveys. In general, the studies by psychologists show that "the profiles of users of social networking services correctly reflect their real identity and primal self" (Voiskunskii et al., 2013: 67). At the same time, many people for different reasons have several profiles, besides, a certain percentage of social networking profiles are "fake" accounts intended for electronic mailing.

Currently, sociology is actively searching for an adequate methodology of Internet research with acceptable time, technical and financial costs. The development of the Internet and new media has caused the problem of "large data" as an imperfection of the existing methods of data collection and analysis, since "the development of methods for processing and analysing large amounts of data is faster than the theoretical comprehension and interpretation of the results" (Dudina, 2016: 29). At the same time, the rapid development of social media, replacement of traditional forms of social activity in them and creation of new ones, spontaneous and independent from the researcher developing data in social networking services open new opportunities for sociology, herewith "the emergence of new automated methods for studying society offers the prospect of more extensive and detailed research" (Korytnikova,

2015: 14). A special development trend of digital sociology is use of "non-reactive methods" (Devyatko, 2012). They are based on collection of Internet data without direct interaction with the studied object. Quantitative methods aims at measuring the quantitative characteristics of Internet users' behavior and Internet interactions, these methods have great opportunities in studying virtual space. Construction of mathematical, in particular, graphical models of virtual religious community of Internet users is a relevant instrument for such a research. Modelling in social networking services is of particular interest: the communities are formed and developed on the interactive basis, and the users themselves update information.

2. Problem Statement

Religious information is a rather significant segment in "VKontakte". The user can identify him/herself as belonging to a certain confession by choosing one of the following positions of the category "life philosophy" in box "worldview": Judaism, Orthodoxy, Catholicism, Protestantism, Islam, Buddhism, Confucianism, secular humanism, "Pastafarianism", or independently enter another confession or worldview. In 2011, 363 thousands of "VKontakte" users had chosen Buddhism (Orthodoxy — 13 214 082) as their identity. According to the data obtained through the web search queries in "VKontakte" in April 2015 and in April 2017, there has been a growth in the number of "VKontakte" users, who have indicated Buddhism as a their worldview. If in April 2015 there were 505 908 of them, in April 2017 their number had increased to 593 126. Moreover, this social networking service has 2.097 communities with a large number of followers (in 2015, there were 727 such communities). For comparison, the number of Orthodox communities has increased from 2135 in April 2015 to 8009 in April 2017.

Table 01. Dynamics in the number of followers of "Vkontakte" Buddhist communities

№	Community Name	Number of Participants / Followers	
		2015	2017
1	Zen Buddhism	312532	336269
2	Precious Advice from His Holiness the Dalai Lama	182 546	210427
3	Buddha • Buddha's Teaching • Buddhism	55628	82414
4	Buddhism	-	38081
5	Tibetan Buddhism	-	18699
6	Buddhism Buddha Dhamma Sangha Theravada	17260	16208
7	Khambo Lama Dashi-Dorzho Itigilov	16 274	23708
8	Saryg Shazhyn Tuvada (Tuvan Buddhism)	15 328	26730
9	St. Petersburg's Buddhist temple "The Datsan Gunzechoinei" Buddhism	13977	22191
10	Buddhism Mahayana Gelug	11546	18061
11	Karma Kagyu Diamond Way Buddhism	10823	14441

The growth in the number of participants of Buddhist communities is greatly influenced by a set of factors. E. V. Ryigas studying the religious views in virtual reality identifies the models of direct (for example, Catholic), reverse (anti-Buddhist, anti-Catholic) and indefinite (Orthodox Buddhism, Orthodox

Muslim) religious identity expressing attitudes of “VKontakte” users towards religion (Rygas, 2013). Ethnic and confessional traditions of the Buryats, Kalmyks, Tuvinians and other ethnoses, historically practicing Buddhism, affect the representation of religiosity of many users. At the same time, many users professing Buddhism, including clergy and laity, do not mentioned Buddhism as their worldview, although they can actively disseminate religious information. On the other hand, Buddhist game identity unrelated to religious practice has spread in social networking services, due to the entry of Buddhist ideas and images into the mass consciousness. The territorial distribution of user profiles demonstrates that Ulan-Ude, Elista, Moscow, St. Petersburg, big Russian and foreign cities, primarily in Ukraine and Belarus, have the largest number of Buddhists. This corresponds to the distribution of Buddhist religious organizations in modern Russia. According to Russian Federal State Statistics Service, 252 Buddhist religious organizations were registered on the territory of the Russian Federation in April 2016. In this case, the authors can see a significant prevalence of the number of virtual communities over real Buddhist communities.

3. Research Questions

In 2004, Charles Prebish identified three types of Buddhist Internet communities (Prebish, 2004). The first include the web pages of traditional Buddhist groups making their communication easier. The second type represents "virtual temples" created by traditional sanghas in addition to their activities. The third is "purely online communities" that do not exist offline. Buddhist communities in “VKontakte” can be divided into the differentiated according to traditions and schools of Buddhism and the undifferentiated, representing "all the variety of Buddhist denomination".

Many communities are created by representatives of Buddhist religious organizations. So, 277 communities are official groups of Buddhist datsans of Buryatia. The followers of "The Association of Diamond Way Buddhists of Karma Kagyu Tradition" created 114 groups "tied" to a certain settlement, they are characterized by common coordination up to a unified name and visual design. 207 groups unites virtual Theravada followers from different towns and regions. It is noteworthy that there are only 22 "Mahayan" groups with approximately twenty thousand members, and the largest of them, “Buddhism | Mahayana | Gelug”, has 18 000 followers. Most of the real Russian Buddhist communities belong to the Gelug and Karma Kagyu tradition of Mahayana, due to the historical traditions and activity of the Tibetan diaspora; here with differentiating factors of schools and ethnocultural specifics are of great importance for them. Sociological studies show that Buddhism as an ethnic and religious tradition is important for many traditional believers, while clerics and members of worldly communities consider philosophical and practical aspects more significant (Badmatsyrenov, 2017). Great differences between real religious practice and identity are also observed in social networking services. O. V. Dorzhigushaeva and B. Dondukov note that "the ideological and sociocultural differences between "traditional" Buddhists and "neophytes", adherents of Mahayana and Theravada give rise to conflicts between representatives of different schools" in social networking services (Dorzhigushaeva, Dondukov, 2016).

Another group of communities is not related to real offline organizations and exists only in the social networking service. The most popular Buddhist community "Zen Buddhism" has 336 093 followers, who receive electronic newsletters, participate in discussions, comment messages of

moderators, the founder of “VKontakte” Pavel Durov is also subscribed to this community. It is noteworthy that there are 3 694 Zen communities in “VKontakte”, although not all of them have clearly Buddhist specificity. So, the most popular community “Zen” has 2 134 236 followers and is related to the category "arts and entertainment."

The authors can assume that the initiators of promoting Buddhist groups in social networking services are Buddhist laypeople, active members of real Buddhist communities. Buddhist leaders and clergymen, middle-aged and older monks rarely maintain their pages independently, even if they have a profile. Younger Buddhist monks can maintain several accounts in different networks, moderate communities and lead an active "online" life. It should also be noted that most of the followers of Buddhist communities do not identify themselves as Buddhists in their profiles. All these confirm the thesis that religion on the Internet is marked by online culture with its interactivity and content filled by users, as well as by the traditional religion with beliefs and rituals associated with historically emerged communities (Campbell, 2012: 4).

4. Purpose of the Study

The purpose of this article is to analyse the main characteristics of the empirical graph of Russian Buddhists in the social networking service “VKontakte”. These characteristics are basic in constructing graph models of the studied community

5. Research Methods

Application of graph models for modelling social media is caused by various binary relations between users. In particular, in this article, the authors use the undirected relations of bidirectional virtual "friendship", subsequently the users mentioned "Buddhism" in box "Worldview" of their profile with a non-zero number of friends (in the graph under consideration) are vertices of the graph. The total number of users belonging themselves to "Buddhism" have been 593 126 by April 2017, but the authors use only open profiles in modelling the graph, the number of which is 84 927. The cardinal number of vertices sets and tree edges is 84 927 and 370 875, respectively. The ratio of the number of users to the number of connections, equal to only 0.57, is determined by "friendliness" of Buddhists, most of whose friends, in turn, are not Buddhists, and therefore do not belong to the set of vertices of the graph under consideration. Later in the article the authors will make an empirical evaluation of a number of important topological characteristics of the graph of Buddhists in “VKontakte” (Zhukovskii et al, 2012).

6. Findings

Assortativity is a term of social genetics, which denotes non-random marriages based on similarity of spouses by some features. In graph models, assortativity coefficient is traditionally used to estimate the formation of connections between vertices of different degrees (Newman, 2003), (Ostroumova-Prokhorenkova, Krot, 2016). The degree of a vertex is the number of edges incident to it. Its high rate for a certain network means that the nodes having a high degree (so-called hubs) preferentially form links with the nodes that also have a high degree. Low rate of the degree of a vertex indicates that hubs

communicate not directly with each other, but through the chains that pass through vertices of lower degrees. High rates of assortativity are characteristic for social networking services; disassortativity (a negative value of the coefficient) is common for biological or engineering networks. The assortativity coefficient for a certain network is calculated according to the formula:

$$r = \frac{\sum_{i=0}^M j_i k_i - M^{-1} \left(\sum_{i=0}^M j_i \right) \left(\sum_{i=0}^M k_i \right)}{\sqrt{\left(\sum_{i=0}^M j_i^2 - M^{-1} \left(\sum_{i=0}^M j_i \right)^2 \right) \left(\sum_{i=0}^M k_i^2 - M^{-1} \left(\sum_{i=0}^M k_i \right)^2 \right)}}$$

where M — the number of oriented edges, j_i and k_i — the residual degrees of the start and end of the edge. If hubs communicate directly with each other, then $r > 0$. If hubs are connected to nodes with a low degree, then $r < 0$. The values of assortativity are calculated for different networks (see Table 02) (Newman, 2003). Their comparison shows that the assortativity coefficient of Buddhists in “VKontakte” is similar to the values of an address book in e-mail or an electrical grid.

Table 02. Comparison of values of assortativity coefficient for various networks

Network	Number of nodes, n	Assortativity, r
Co-authorship in Physics	52 909	0,363
Cooperation of companies directors	7 673	0,276
Cooperation of Hollywood actors in films	449 913	0,208
Co-authorship in Biology	1 520 251	0,127
Co-authorship in Mathematics	253 339	0,12
Address book in e-mail	16 881	0,092
Buddhists in “VKontakte”	84 927	0,0166
Electrical grid	4 941	-0,003
Acquaintance of students with each other	573	-0,029
World Wide Web	269 504	-0,067
Internet	10 697	-0,189

The most important characteristic of a vertex of the graph is its degree or the number of connections it has, and the corresponding topological characteristic of the entire graph is the distribution of the degrees of the vertices; i.e. the number of vertices in the graph with the degree. Distribution in social networking services, as a rule, is subject to a power law.

$$P(k) = C / k^\gamma$$

where C is some constant (Albert, 1999). Figure 01 shows the distribution of the number of vertices of one or another degree (for the first 30 values of degrees).

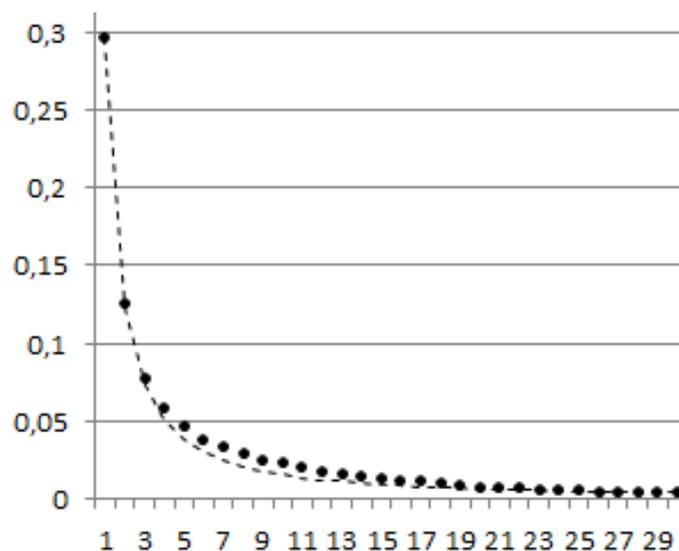


Figure 01. Graph of the empirical and model distribution of vertices degrees

The calculations resulted in the following type of distribution $P(k) = 0.2966 / k^{1.2764}$ (See Fig. 01). Thus, the fulfillment of a power law for the distribution under consideration is shown, and therefore it can be argued that Buddhists in “VKontakte” actually form a social network within the social networking service. Comparison with some other networks is presented in Table 03 (Albert, 2002).

Table 03. Comparison of the degree exponents in the law of distribution of vertices degrees

Network	Number of nodes	Number of edges	The exponent in the law of distribution of vertices degrees
Co-authorship in SPIRES	56 627	–	1.2
Buddhists in “VKontakte”	84 927	370 875	1.2764
Cooperation of Hollywood actors	449 913	25 516 482	2.3
Pages nd.edu portal	269 504	1 497 135	2.1/2.4
Electrical grid	4 941	6 594	–
Electrical network	24 097	53 248	3.0

Social networking services refer to the so-called "small worlds" - graphs that have a relatively small number of vertices with a relatively small diameter. For this purpose, both the diameter of the graph (the length of the shortest path) and the average length of the shortest path between the vertices of the graph are measured, where the path length is the number of connections between people (one connection is one unit of the path length). Friendship connections embrace all Buddhist users in “VKontakte”, about 6.62 users on average. This confirms the theory of six degrees of separation spread in social networking services (see Table 04) (Myers, 2014). The diameter of the graph under consideration is 29 connections.

Table 04. Comparison of average lengths of shortest paths in various social networking services

Network	The average length of the shortest path
Facebook users	4.74
Facebook users in the USA	4.37
MSN users	6.6
Buddhists in “VKontakte”	6.62

Thus, universal graph models that allow generation with the predefined values of the investigated characteristics are appropriate for modeling the virtual graph of Buddhists in “VKontakte”.

7. Conclusion

The investigated graph has an assortativity close to zero — 0.0166. Together with the maximum value of 1255, it indicates that the virtual Buddhist community is poorly integrated. There are no universally recognized super popular Buddhist users, with whom each Buddhist user want to be friend. At the same time, there are local communities with their own small hubs, which are connected both directly and through the chains of friends.

The key conclusion is that Buddhism is not an assortative factor, and Buddhist users are integrated into relatively weakly related communities. However, distribution of the vertices degree according to a power law and the average length of the shortest path (the theory of six degrees of separation) show that the graph of Buddhist users in “VKontakte” corresponds to the topological characteristics of social networking service.

These characteristics are basic. Further areas of research are the expansion of the list of topological characteristics taken into account in models and work with other binary relations, in particular, reposts and likes.

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