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STRUCTURAL STABILITY OF THE RUSSIAN SOCIOLOGISTS' ONLINE COMMUNITY: 2011—2018

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СТАБИЛЬНОСТЬ СТРУКТУРЫ ОНЛАЙН-СООБЩЕСТВА РОССИЙСКИХ СОЦИОЛОГОВ: 2011—2018 ГГ.

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Abstract. This study deals with the stability evaluation of the community structure of Russian sociologists' online group. Based on the data from the online community, which consisted of seven years of communication from 2011 to 2018, we constructed networks based on commenting and reacting. The participants' activities included four main periods for evaluating the stability of the community. Blockmodeling reveals the structural patterns of community interactions. The results show the "core-periphery" type of the global structure. The core and periphery are structured differently in networks of comments and reactions. The stability between the positions in the global structure is high, and while the structure may vary in some periods, the sizes of the core and periphery fluctuate. However, the stability within the positions of

Аннотация. Исследование посвящено оценке стабильности структуры сообщества онлайн-группы российских социологов. Используя данные онлайн-сообщества (семь лет взаимодействий с 2011 по 2018 г.), мы построили сети, основанные на комментариях и реакциях. Для оценки стабильности сообщества мы проанализировали коммуникацию его участников на протяжении четырех периодов, а также раскрыли структурные паттерны их взаимодействий с помощью инструмента блокмоделинга. Результаты исследования показывают соответствие структуры сообщества типу "ядро — периферия", где эти позиции структурированы по-разному в сетях комментариев и реакций. Размеры ядра и периферии в разные периоды времени колеблются, тем не менее стабильность их присутствия в общей структуре со-

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the global structure is low, according to the modified Rand index.

общества высока, хотя внутри самих этих позиций, согласно модифицированному индексу Rand, стабильность невелика.

Introduction

Along with the development of society in the 20th century, the concept of community, formulated in classical sociology, began to denote new interaction forms between individuals, such as those appearing in online communities [Rheingold, 1993]. The concept of communities of practice [Lave, Wenger, 1991] was proposed to denote professional online communities, where the same practice, knowledge and identity are shared among professional groups on the Internet. Studies have shown that the motivation for participation in such communities may vary [Hara, Hew, 2007; Hur, Brush, 2009], leading to different structural interaction forms within the community [Wasserman, Faust, 1994]. Research [Kronegger, Ferligoj, Doreian, 2011; Rykov, 2016] has shown that the structure in such communities has the "core-periphery" form, where the core consists of members who are highly connected with each other, and the periphery is linked only with the core and not between themselves. However, the question remains as to how stable these global structures are, whether they change over time, and how individual members move between positions in these structures.

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In our study, we consider the structure of communication based on the largest Facebook*[1] group of Russian sociologists. This group can be seen as an example of a community of practice that brings together people with the same professional interests in sociological research who are actively involved in professional discussions. It is important to study the case of Russian sociologists because the sociological discipline in the USSR and modern Russia has a unique and difficult history of formation. Its description is problematic and "defies rational description at all" because of too many different facts, turning any "beautiful and exhaustive historiographical scheme into an arbitrary construction" [Batigin, Deviatko, 1994]. The development of sociology has influenced the formation of the corresponding research community. The empirical studies, including those using a structural perspective, have shown that there are different groups of researchers that can be found within the "offline" sociologists' community [Sokolov et al., 2010; Batigin, Gradoselskaya, 2001]. However, an analysis of communities in an online format, by nature suggesting more horizontal relationships, can yield different results. While there are some studies of online communities of sociologists [Barkhatova, 2020; Kim, Maltseva, 2022], this study is the first attempt to provide a comprehensive overview of the community's global structure as well as its stability between and within subgroups over a long-term period. Based on information on posting and commenting, we observe the structural characteristics of a professional group over seven years (2011–2018) using the structural perspective and methods of social network analysis (SNA).

The remainder of this paper is organized as follows. The Literature review describes the theoretical background for studying communities in sociological research and identifies some characteristics of the online community of practice, as well as describes the development of the Russian sociological community. The Data and methodology section characterizes our case study, and describes the selected online professional community, presents data collection and network construction processes, and describes the methodology used for the analysis. The Results section provides the main findings: the global structure of the community and its stability between and within the obtained groups. The article finishes with a Conclusion and Discussion.

Communities: Theoretical background

The concept of community has played an important role in theory construction in social sciences. In the 19th century, it was defined as having clear ideological and political consequences. The Chicago School of Sociology conducted studies on the impact of industrialization on the preservation of urban communities. As part of the field research in the 1920–1930s, they confirmed earlier developments in community studies: instead of being included in a separate cohesive community, urban residents are limited members of various, loosely connected, and limited social networks. Such weak and disorganized relationships cannot provide social support to their members, making individuals more dependent on formal organizations, such as employment agencies. Indirect secondary relationships tied urban residents to the city, which effect to loss of solidarity and disorganization in areas as diverse as collective action, crime, and migration [Wirth, 1938].

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[1] Здесь и далее * означает социальные сети, деятельность которых запрещена на территории РФ [Hereafter * means social networks whose activities are prohibited in the territory of the Russian Federation].

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Wellman [1979] suggested considering the Community Question (CQ) from the structural perspective of SNA. He raised the question of how large-scale social system divisions of labor associated with urbanization and industrialization affect the organization and content of the main primary relations. As the division of labor in industrial bureaucratic societies has weakened solidarity in communities, the findings of the Chicago School were labeled by the term "Lost community". However, the mistake of the representatives of this approach was that "because of its assumption that strong primary ties naturally occur only in densely knit, self-contained solidarities, the argument has unduly neglected the question of whether primary ties have been structurally transformed, rather than attenuated, in industrial bureaucratic social systems" [ibid.: 1205].

The reaction of many urban sociologists to the evidence of the "Lost community" was the development of the opposite approach, which claimed that neighboring and related solidarity groups continue to exist successfully in industrial bureaucratic social systems [ibid.]. In 1940—60s, field research showed that citizens continued to organize personal communities in homogeneous living and working spaces (on the scale of the neighborhood, their friends, and work). The approach of the "Saved community" looks more positively at people's ability to adapt to complex social conditions; even in complex social and economic environments, people seek to organize social structures of mutual support.

The common problem for the two approaches is that, in many studies, the CQ includes two components: (1) the submission of a normative nature to the solidarity of sentiment in a community, and (2) an awareness of the specific spatial distribution of major linkages in local areas. As a result, "the fundamentally structural CQ has often been transmuted into a search for local solidarity, rather than a search for functioning primary ties, wherever located and however solidary" [ibid.: 1202]. As such, locality can no longer be considered one of the main constitutive characteristics of communities.

Further technological development contributed to the confirmation of this idea, but at the same time raised new CQs. Whereas the main volume of sociological community studies in the 20th century sought answers to the questions posed by scientists of the 19th century, the drastic revolutionary changes in technologies of the 1990–2000s meant new challenges to communities in their traditional forms. The concept of an online or virtual community was presented by Rheingold [1993], who described one of the first communities existing in network form — the Whole Earth Electronic Link (WELL). This study is one of the first to discuss the existence of communities in a virtual environment. It has been shown that members of online communities, combined with each other's interests, work, or training, reflect the same characteristics that can be found in offline communities (the formation of a common language, rules of conduct and compliance, social support, and the creation of a common shared history). Virtual communities are "social associations that arise from the network, when a sufficient number of people lead public discussions long enough, with enough human feeling, to form networks of personal relationships in cyberspace" [ibid.]. By the mid-1990s, owing to the spread of personal computers and the expansion of the Internet, real and virtual life began to converge. Cyberspace and its virtual communities, formerly understood as separate spheres of life, gradually began to enter people's

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daily practices. Studies on the intersection and complementarity of online practices with everyday practices have concluded that Internet-mediated communication has become another tool in the overall system of communication.

Conceptualizing the community as a social network, Wellman, Boase and Chen [2002] defined the "community before the Internet" as a homogeneous group with neighborhood interaction; as "networks of interpersonal ties that provide sociability, support, information, a sense of belonging, and social identity" [ibid.: 153]. Comparing the online community with a neighborhood, having some local geographical patterns, the authors denoted the new feature of online communication as "network individualism": "In networked societies, boundaries are more permeable, interactions are with diverse others, linkages switch between multiple networks, and hierarchies are flatter and more recursive" [ibid.: 160].

Currently, online forms of communication are typical for various types of communities, including professional communities. Traditionally, these communities have been studied in the sociology of professions and professional groups, based on the division of labor presented in the classical works of Spencer, Marks, Durkheim, and Weber. Technological progress has influenced the appearance of new forms of studying professions. To study professional communities in an online environment, the concept of community of practice (CoP), proposed in 1991 by Lave and Wenger [1991], may be relevant. CoP is defined as "groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" [Wenger, McDermott, Snyder, 2002: 4]. This term was developed in the context of a study of traditional apprenticeships. Describing the history of professional groups, Durkheim argued that the professional community could provide social connections that are important for strengthening social trust and mutual commitment, even when the forces of industrialization and social disruptions are trying to break the historical ties that unite people in the villages [Wenger et al., 2002]. The structural model of the CoP presupposes the existence of three main elements: community, practice, and the sphere of interest. Technology can be added to these three characteristics, as the use of such means of communication has become part of the CoP in online platforms. Hence, a special digital habitat of CoP exists — a virtual settlement [ibid.].

Researchers have distinguished between different motivations for participating in professional communities. Hara and Hew [2007] list four main reasons to share knowledge in the teacher's community: (a) collectivism: to improve the welfare of community members, (b) reciprocity: to receive help from others and give it back, (c) personal gain: to gain new knowledge, and (d) altruism: to support others. Hur and Brush [2009] found the following reasons to participate in teacher's online communities: (a) sharing emotions, (b) utilizing the advantages of online environments, (c) combating teacher and isolation, (d) exploring ideas, and (e) experiencing a sense of camaraderie. Some of these reasons can be found in other types of professional community.

Asymmetric activity of participants in online professional communities is another interest of researchers in community studies [Nonnecke, Preece 2003; Rafaeli, Ravid, Soroka, 2004]. In CoPs, different roles are assigned to members according to their participation in the community, such as newcomers, insiders, or outsiders. The mod-

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el of participants' entry into communication in the online community is based on the principle of acceptable peripheral participation [Lave, Wenger, 1991], and includes five trajectories:

— peripheral — observers (peripheral-lurker) who do not contribute to community resources;

— entries — newcomers (inbound-novice) who are trying to contribute to community activities;

— internal — regular members (insider-regular) who are actively involved in the community's activities;

— borderline — leaders who interact with participants, express themselves in conceptual ideas, and correct problems of interaction in the community;

— alienations — participants leaving the community (outbound-elder), no matter what reason, but switched to another activity or left.

Participants could move from legitimate peripheral participation to full participation in the community.

While communication in online professional communities is crucial for participants' career improvement and overall community's development, many people prefer lurking: "passive attention over active participation" [Rafaeli et al., 2004: 1]. Based on the study, the reported proportion of lurkers varies from 90 % to 50 % of the whole professional online community. Nonnecke and Preece [2003] described several reasons of lurking such as to ensure privacy, being shy about posting, or leaving the group.

Differences in the motivation and activities of community members can lead to different structural characteristics of communities. Wasserman and Faust [1992] described five types of structures that display certain community properties: cohesive subgroups, core-periphery, centralized, hierarchical, and transitive structures. The cohesive subgroups were not connected to each other. In core-periphery structure, one group is defined as "core group" which members are highly linked with each other, and second group defined as a "peripheral group", where its members are linked with the members of core group, but not with each other. In a centralized structure, all relationships are from one group member. In a hierarchy, the relational ties are directed from each member "below" to another one immediately "above". The transitive structure is characterized by the principle that if A is connected to B and B is connected to C, then A is also connected to C. Structure is a theoretical construct because real empirical network data can consist of variations in data from different structural patterns. Researchers have found that professional communities and CoPs can be characterized by the core-periphery structural type [Kronegger et al., 2011; Rykov, 2016], and have shown that the structures changes over time, raising the question of community stability measurement [Cugmas, Ferligoj, Kronegger, 2016].

Stability in an online community was shown to be an important characteristic, which helps to promote the viability in online communities, along with cohesiveness, sociability, and interactivity [McEwan, 2016]. It can be considered from the point of view of Signaling theory, originally developed in economics and animal behavior studies. It stated that people, who need to send and receive the information in the situation of information asymmetry, interpret available cues as evidence (signals) that a particular state of the world exists [Connelly at al., 2011]. Through communicative signals, such

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as messages, comments, and "likes", senders and receivers of information communicate with each other and strengthen their sense of membership and belonging to a community[2], that's why these signals can be seen as relevant means to study structural characteristics of communities over time.

Russian sociological community: Previous studies

The history of sociology in the USSR and modern Russia, and the corresponding community, can be described as nonlinear and dramatic [Batigin, Deviatko, 1994]. It is usually divided into two unrelated stages: the pre-revolutionary sociology developing before the October Revolution in 1917, and the sociology developing in the Soviet era. After the October revolution, Marxism-Leninism became a state science, and the tasks of sociology were confined to ideological control. It forced some scholars to immigrate: one of the prime examples is Pitirim Sorokin, who left the USSR in the 1920s and became a world-renowned sociologist and founder of the first sociological faculty in Harvard University [Firsov, 2012]. From that moment on, the development of sociology as a discipline stopped for some time. It was only in the 1960s when sociology "grew" again out of "factory research" (sociology of labor). As a result, in the mid-1970s, an undergraduate specialization in applied sociology was set up at the Ural, Minsk, and Leningrad universities. In 1984, the first sociological departments were established in the Moscow and Leningrad State Universities [Titarenko, Zdravomyslova, 2017]. Modern Russian sociology was born after the economic reforms of 1990's, followed by the creation of capitalistic relations, which made Russian intellectual elites revise the problems of Russian society and try to find the answers from the Western sociology. In 1988, the first All-Russian Public Opinion Research Center (ARPORC, also VCIOM) was launched [ibid.].

In recent decades, many sources appeared that allow researchers to dive into the historical context: documentary evidence about the history of sociology in the USSR and Russia [Firsov, 2012; Osipov, Moskvichev, 2008; Kozlova, 2018; Gorshkov, 2017]. Certain aspects of the development of sociology in the USSR and Russia, and the formation of the corresponding academic community, were studied in historiographical research based on the analysis of documents. However, official documents and protocols often create only an "external, institutional chronology of sociological science" [Batigin, 1999: 5], that is why other data sources such as personal stories based on memoirs, biographies, biographical and thematic interviews of famous sociologists are important.

Based on the in-depth biographical interviews with more than 200 scholars mostly from the academy, Doktorov [2016] described the individual trajectories of academic careers among sociologists. Using the transformed biographical information from the interviews, the collaboration networks of sociologists via network analysis were studied. The analysis of egocentric networks showed the career paths of sociologists and the development of the whole sociological community [Batigin, Gradoselskaya, 2001]. An analysis of affiliation networks of researchers showed organizations, research groups and centers, which influenced the development of the sociological community in the

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[2] Deeper analysis of community stability as operationalized by Signaling theory would include the analysis of linguistic patterns of communication and searching for specific words, forms, tenses, and associated emotions [McEwan, 2016].

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1960s-90s [Korpachev, 2006]; groups of sociologists from different generations were considered [Mazina, 2013]. Based on the same data, the approach for studying the meaning of relations underlying the formation of a professional community of sociologists was proposed [Maltseva et al., 2017; Maltseva, Moiseev, 2018].

Other studies considered some aspects of collaboration between the members of the sociological community. A study of the local academic community of sociologists (in St. Petersburg), based on citation and survey analysis [Sokolov et al., 2010], identified three main segments of sociologists: oriented towards international arena, focused on communication on the national level, and those who do not have an unidirectional strategy of development in Russia. The study of information culture and professional communication in the community of sociologists — practitioners working in the applied commercial sphere via a survey among research agencies [Zadorin, Maltseva, 2013], showed that Internet communication and social media are important sources of communication. An analysis of discussion in the professional online community of sociologists, which includes sociologists from academia and research agencies [3], identified several main leaders attracting attention of other participants. Recent studies [Barkhatova, 2020; Kim, Maltseva, 2022] illustrated the structural characteristics of communication in the online community, which, as it turned out, consists of a small core and huge number of peripheral groups.

The community of Russian sociologists varies for various grounds, both between groups (academicians and practitioners) and within them (e. g., schools of thought, generations, orientations towards international or national levels). These divisions may increase due to a remarkably high degree of centralization in Russia, formed around Moscow and St. Petersburg, as well as a lack of platforms for the direct communication of sociologists from different groups (own events, journals more oriented toward one or another group, etc.). In this sense, the online professional community as CoP can be the platform for bringing different people together and forming a joint community, as they suggest horizontal relations, and their analysis can bring insightful results.

Data and methodology

Based on Signaling theory, stating that "online communities simply are the language that shapes them" [McEwan, 2016], we focus our analysis on communicative signals, such as posts, comments, and reactions as the units for studying structural characteristics of a particular group of Russian sociologists on Facebook*[4]. Our study is the first attempt to make a comprehensive overview not only of the community's global structure, but also its stability between and within its subgroups over a long-term period.

We formulate the following **research questions**:
(1) Which type of the global structure can be attributed to the community under study? Does this structure fit the core-periphery model, as was found in previous research?
(2) How stable are the patterns of interactions between the positions of the global structure, and how do they change in time?

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[3] Maltseva D. (2016) Crimerian Poll: An Analysis of Discussions in the Online Group "Manufactura socpoh" (analytical report). URL: http://www.zircon.ru/upload/iblock/e2c/Socpoh_Krymskij_opros.pdf (accessed: 13.02.2024).

[4] We do not disclose the name of this group, as was done in previous research [Barkhatova, 2020].

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(3) How stable are the trajectories of individual membership within the positions of the global structure? Can we observe the migration from one trajectory to another?

Data description

The analyzed group can be seen as a community of practice, as it has all the necessary elements: (1) community itself — group of professional sociological researchers, including academicians and practitioners (pollsters), (2) joint sphere of interest — the same professional research expertise, field of activity, (3) practice — research and applied activities of the community members, (4) shared virtual habitat — Facebook* group. This group is an interesting case of self-organization of the sociological community representatives, and its originality and uniqueness are due to the following characteristics:

— Long period of existence — since 2011 and up to 2023 (the data available for analysis is up to 2018);

— Diversity of participants representing two main segments of Russian sociology (academics and practitioners), differing by institutions and organizations, age, gender, region of residence;

— Active discussions, attracting community members with divergent viewpoints, compliance with the rules of academic and professional freedom, without any censorship and banning.

Even though the structures observed in offline and online worlds are not the same, some similarities between them were claimed to exist [Reich, Subrahmanyam, Espinoza, 2012]. We fully understand that this group does not represent the community of sociologists in Russia; however, it can be a nice representation of its most active part, present on Facebook*.

The data were collected in January 2018, using Facebook's* official API. The database created from the collected data consists of more than 34,000 posts and comments written from October 2011 up to January 2018 by 818 group members. The collected dataset consisted of two parts: (1) information on the date, type of publication (post, comment to post, comment to comment), post text, author, achieved reactions, and number of comments; (2) information on the relationships between publications and author. The data were stored in a table in.csv format. Such organization of the database was crucial for the creation of networks.

There are several possible types of activity between the group members: writing a post, making a comment to a post or other comment (since 2015), and giving reaction ("like") to a post or comment. We consider the entire set of posts and comments as *publications* that are consistently linked to each other: a *post* is a separate message, *1-level comment* is a comment to the post, and *2-level comment* is a comment to 1-level comment. Thus, all *posts* and part of *1-level comments* belong to the *primary (commented)* publications, and all *2-level comments* and part of *1-level comments* belong to the *secondary (commenting)* publications. All three types of publications and reactions are considered as the units of data analysis.

Methodology

This study uses social network analysis (SNA) as a general methodological approach for revealing structural characteristics of the observed community. SNA includes quan-

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titative and qualitative types of analyses, which are widely used for studying communities and their different types, including CoP [MacNair, 1996]. Based on the data, we construct two types of networks. In *Comment network,* the relations between the vertices are based on commenting to each other. In *Reaction network,* the relations between the vertices are based on giving reactions to each other.

To study structural patters of networks, we use blockmodeling approach [Batagelj et al., 2004: 455], which allows clustering group members according to their similar structural characteristics (interactions with others), describe relations between the identified clusters, distinguish social positions (roles) of the group members, and identify the fundamental network structure, assigning it to one of the types observed by Wasserman and Faust [1994][5]. We apply an indirect approach to blockmodeling based on structural equivalence [ibid.: 457], as it works better with rather large (several hundreds of nodes) networks. For the computations, we use the program Pajek[6] [Batagelj et al., 2004].

To study the stability of the obtained structures, we observe the fundamental network structures in different time periods of group activity. We construct temporal networks, splitting the data into four time periods based on group activity, use blockmodeling to obtain the global structures in each period, and look at the stability of patterns of interactions between the positions of the structures[7]. To study the stability of the trajectories of individual membership within the positions of the global structure and their change through time, we visualized the trajectories of the community members between the clusters of the global structure. We use a modified Rand index [Cugmas, Ferlogoj, 2018: 7] to evaluate the stability of the group members' trajectories, which shows the stability of the community structure by considering the splitting and merging of clusters and level of incomers and outgoers.

Network construction

To produce networks, the program Text2Pajek[8] was used, which allows constructing 2-mode networks out of the data stored in different columns in table form. To produce the *Comments network CN*, we used 2-mode networks *Actor-Post AP* and *Post-Comment PC*. Network *AP* consist of data about *actors* and *posts* as separate message, as well as *links* among them. Network *PC* consist of data about *posts* and 1-st and 2-nd level *comments*, as well as *links* among them. The multiplication of these two networks constructs the 2-mode network of *Actor-Comment AC*. Multiplying this obtained 2-mode network *AC* with its transposed version *CA* results with the *CN*, where the actors *A* are connected through the relations of commenting each other (Equation 1.)

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[5] Other methods of splitting large and complex networks, such as community detection or k-means method [Ferligoj et al., 2014], split the network into clusters, but clusters of similar components are not necessarily identical to groups in the network. They also do not provide the information about the relations between the groups, or clusters, that they identify.

[6] URL: http://vlado.fmf.uni-lj.si/pub/networks/pajek/default.htm (accessed: 13.02.2024).

[7] Clusters of equivalent or similar members in the community are called positions, and the role structure is shown by links between these positions [Wasserman, Faust, 1994].

[8] URL: http://vlado.fmf.uni-lj.si/pub/networks/pajek/howto/text2pajek.htm (accessed: 13.02.2024).

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*Equation 1. **Formula for Comments network CN construction***

$$AP \times PC = AC$$

$$AC \times (AC)T = AC \times CA = AA(com) = \mathbf{CN}$$

The same approach was used to produce the *Reactions network **RN***. A 2-mode network *Actor-Post **AP*** was multiplied with 2-mode network *Post-Reaction **PR***, which resulted with a new 2-mode network *Actor-Reaction **AR***. A multiplication of this network to its transposed version resulted with **RN**, where the actors *A* are connected through the relations of reacting (giving "likes") to each other (Equation 2).

*Equation 2. **Formula for Reactions network RN construction***

$$AP \times PR = AR$$

$$AR \times (AR)T = AR \times RA = AA(react) = \mathbf{RN}$$

Both obtained networks are directed, showing that some group member is commenting another one, or giving reaction to them. Two networks are weighted: the strength of ties shows the number of comments or reactions from one group member to another. The **CN** consists of 818 vertices, and the **RN** — of 1,539 vertices.

Temporal networks for the four chosen periods (T1, T2, T3, and T4) were constructed manually. The data were split into four parts according to group activity, and then *Comments* and *Reactions networks* for each period were constructed, which were labeled, accordingly, **CN1**, **CN2**, **CN3**, **CN4**; and **RN1, RN2, RN3, RN4**.

Obtained temporal networks included many participants, who provided almost no communication within the group — "lurkers". To alleviate computation of the network stability within the positions of the global structure and measure Rand index, we had to reduce the temporal networks. As the line values were very skewed in obtained temporal networks, they were normalized by the logarithmic approach, and then recoded. In both types of networks in each period, we removed the actors, whose connections with others were not strong enough. It resulted in around 80 actors in each network, representing group members who were active in communication in the online community (Table 2). The obtained reduced temporal *Comments* and *Reactions* networks were labeled as **CNr1, CNr2, CNr3, CNR 4**; and **RNr1, RNr2, RNr3, RNr4**, accordingly.

*Table 2. **Number of actors in reduced temporal networks***

Reduced networks	Networks for periods	Number of actors
CN	CNr1	79
	CNr2	72
	CNr3	94
	CNr4	75
RN	RNr1	79
	RNr2	84
	RNr3	87
	RNr4	75

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Results

We begin with general statistics of the data obtained. Observing the activity of the group members, we found an uneven distribution with distinct peaks and falls in activity. We justified the choice of the four periods for which the data were split. We look at the global structure of the observed group, and check the stability of the relations between the obtained subgroups and within them.

Members' activity

The activity in the online community can be seen as the total number of posts and 1-level and 2-level comments, as well as reactions to all publications. Overall, in seven years, there were 2,591 posts published, which were commented on by 20,709 1-level comments, and extra 11,005 2-level comments, starting from 2015. The total number of reactions was 13,240.

Comparisons of the distributions of comments (1-and 2-level comments) and reactions show that they follow the same trend (Figure 1). The number of comments was usually lower than the number of reactions; however, in January 2015 and September 2017, the number of comments was larger than the number of reactions. The number of comments increased in 2014 and 2015 (Table 3). In 2016, the number of 2-level comments was the highest.

Over the seven years, commenting and reacting activities fluctuated almost every month (Figure 1). We can observe two periods with increased activity: one peak between January and November 2015 (11 months) and another between December 2015 and May 2016 (6 months). Based on the peaks of activity in the online community, we decided to split our data into 4 periods: two of which are already highlighted, the third from September 2011 — December 2014 (39 months), and the fourth period from June 2016 — January 2018 (20 months).

Figure 1. Number of comments and reactions to posts and comments, each month, 2011–2018
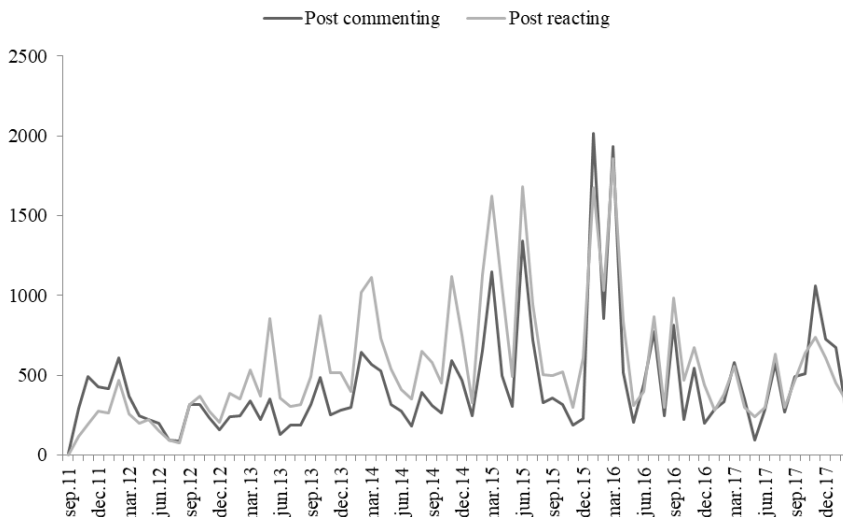
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Table 3. **Number of posts, 1-level and 2-level comments, and reactions**

Years	Posts	1-level comments	2-level comments	Reactions (all types)
2011	189	1035	0	322
2012	479	2803	0	1431
2013	386	2860	0	1884
2014	416	4432	0	2674
2015	367	5590	387	3206
2016	431	2406	5,954	2001
2017	276	1367	3,936	1394
2018	47	216	728	233
Overall	2,591	20,709	11,005	13,145

Table 4. **Network statistics by 4 periods**

| Period	N months	Posts and comments		Actors with comments		Actors with reactions	
		N	Norm	N	Norm	N	Norm
1 (Sept 2011 — Dec 2014)	39	12,600	323	416	11	689	18
2 (Jan — Nov 2015)	11	6,112	556	322	29	740	67
3 (Dec 2015 — May 2016)	6	5,765	961	292	49	769	128
4 (June 2016 — Jan 2018)	20	9,828	491	463	23	1,076	54
Average			451		11		20
Total	76	34,305		818		1,539	

Table 4 presents activity statistics for each period. Since the activity periods included different numbers of months, we normalized the data and counted the number of posts, actors with comments, and actors with reactions per month, as well as their average numbers. Even though the largest numbers of posts (12,600 and 9,828) were written in the 1st and 4th periods, the most intense periods were the 3rd and the 2nd, with 961 and 556 posts written per month, respectively, in comparison with 451 on average. The number (and, in such, diversity) of group members involved in commenting and providing reactions also changed during the four periods. Normalized values show an increased number of community members commenting on others in the 3rd period (49 actors per month in comparison with 11 on average), and those providing reactions to other community members in the 3rd and 2nd periods (128 and 67 actors per month, respectively, in comparison with 20 on average).

Global structure

Using blockmodeling, we extracted the global structures of the CN and RN (Figure 2). For both networks, the extracted structure can be classified as "core — periphery" type. The matrix on the left represents the global structure of the community based on comments, which consists of three parts: core group in black square, semi-periphery in

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grey square, and periphery white square. The matrix on the right represents the global structure of the community based on reactions, which consists of two positions: the core of group members tightly connected to each other, and the periphery of the members connected to the members in the core but ignoring each other. The number of group members in the core for the CN and RN networks were 10 and 57, respectively. The periphery of both networks includes 808 and 1,482 group members. CN also included a semi-periphery group consisting of 326 members.

Figure 3. Blockmodels of the Comments and Reactions networks **CN** and **RN**
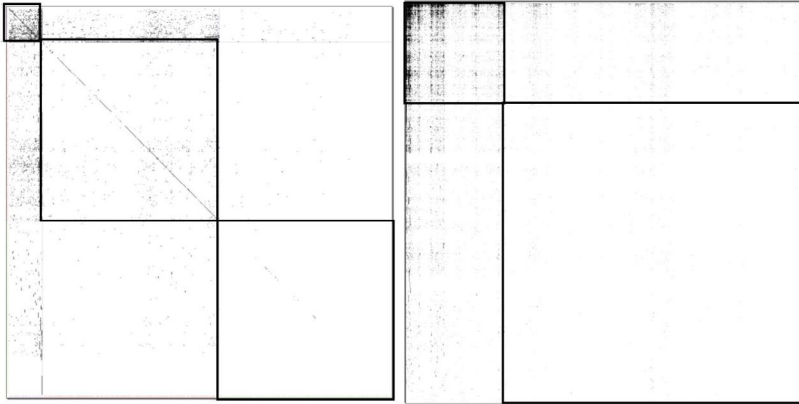
Stability between the positions of the global structure

To study the stability of the interaction patterns between the positions of the global structure, the blockmodeling approach was applied to the temporal *Comments networks* **CN 1**, **CN 2**, **CN 3**, **CN 4,** and *Reactions networks* **RN 1, RN 2, RN 3**, and **RN 4**. The obtained structures are presented in Figures 3 and 4.

Figure 4. Blockmodels of the Reactions networks ***RN1***, ***RN2***, ***RN3***, ***RN4***
RN1 RN2

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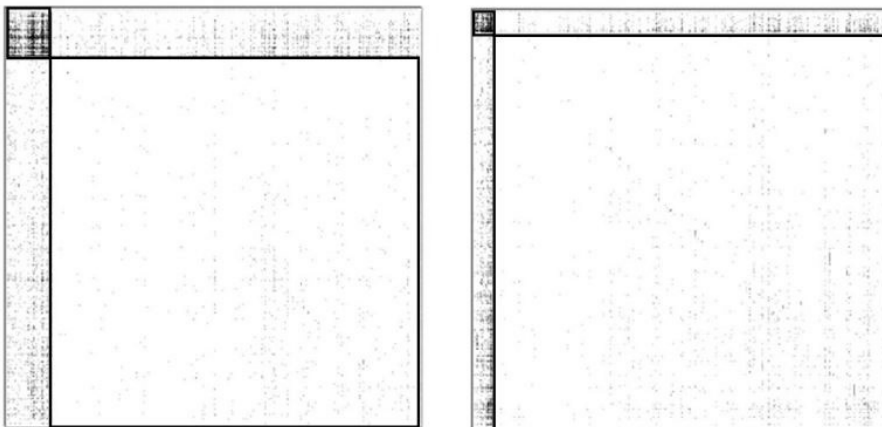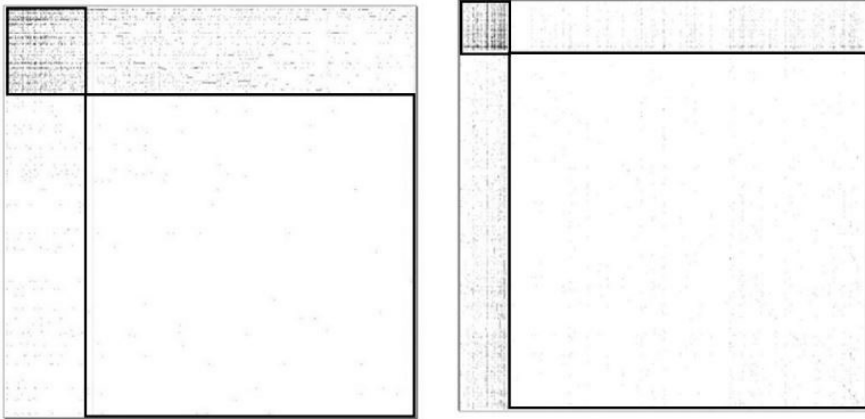
RN3 RN4

Figure 5. Blockmodels of the Comments networks **CN1**, **CN2**, **CN3**, **CN4**

CN1 CN2

CN3 CN4

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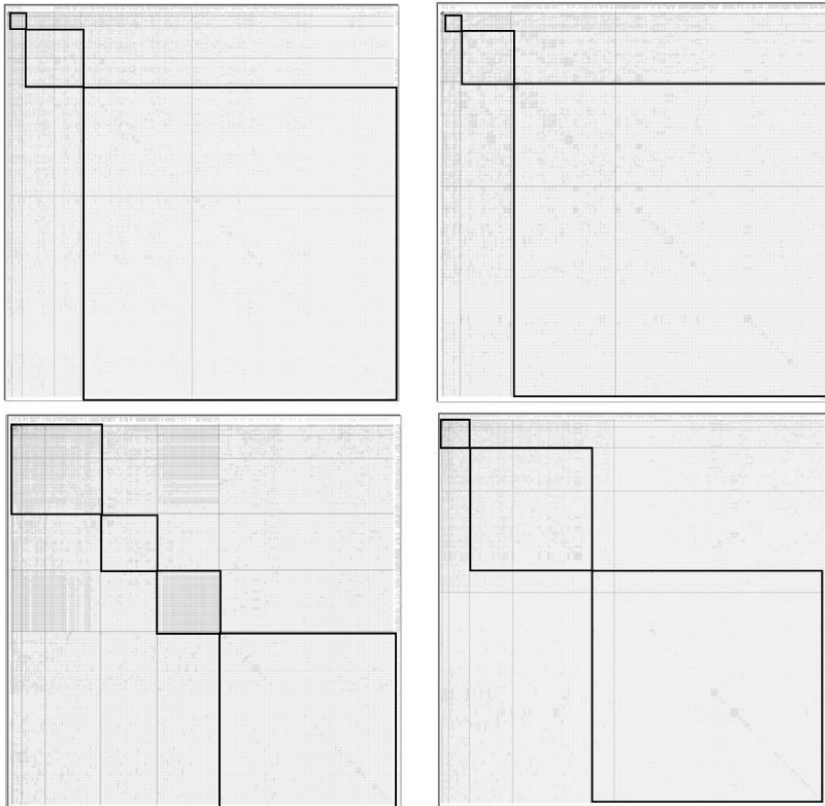
In **RN1**, a clear division of the core and periphery was found, where the core consists of about 10 % of all participants. In **RN2**, the core decreases, in the 3rd period — increases even more remarkably, and finally, in the 4th period, its size returns to that of the 1st period. Interestingly, in the 3rd period the structure of the network changed: the number of those who gave a reaction increased dramatically — 128 reacting actors in comparison to 20 on average (Table 4). In the 2nd period, there was a part of the periphery that started sharing reactions with each other, but in the following periods, such interactions disappeared.

In **CN1**, six main clusters can be distinguished, where the first cluster consists of only one person communicating with the entire network. Such an actor is called a "bridging" actor [Kronegger et al., 2011], and this participant is the leader of this online community. The next two small clusters are semi-peripheral — they are partly connected with the core and part of the periphery. The largest cluster is the periphery; however, it can be divided into clusters, with some connections between the semi-periphery and the core, and the true peripheral cluster almost without interactions. In the 2nd period, the peripheral cluster begins constructing tiny groups of people who comment on each other. In the 3rd period, the structure changed: one part of the semi-periphery starts actively commenting on the core (which has also grown), another part of the semi-periphery has less activity in communication with each other, but also has some interactions with the core, and the peripheral cluster became smaller than that in previous periods. In the 4th period, network **CN 4** reverts to a structure similar to that of the 1st and the 2nd periods.

Overall, all obtained blockmodels for the two networks have a "core-periphery" structural type, so the stability between the positions of the global structure is high. However, in some periods, the structure varies: the size of the core and periphery clusters fluctuates and a cluster of one "bridging" actor appears.

Stability within the positions of the global structure

To evaluate the stability of the trajectories of individual membership within the positions of the global structure and their changes over time, blockmodeling was applied to temporally reduce and normalize ***CNr*** and ***RNr***.

The blockmodeling statistics for ***RNr*** are listed in Table 5. The core clusters were formed by 11 % of the overall network members until the 3rd period when it increased to 15 %. In the 4th period, the core decreased to 2 %, or just two people. The blockmodeling statistics for ***CNr*** are illustrated in Table 6. Until the 3rd period, the core clusters were 37 % and 38 %, respectively, but then decreased to 17 %. In the 4th period, the core increased to 44 %.

*Table 5. **Blockmodeling statistics: core and periphery blocks in the RNr***

	RNr1		RNr2		RNr3		RNr4	
	N	%	N	%	N	%	N	%
Core	9	11	9	11	13	15	2	2
Periphery	70	89	75	89	74	85	86	98
Overall	79	100	84	100	87	100	88	100

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Table 6. **Blockmodeling statistics: core and periphery blocks in the CNr**

	CNr1		CNr2		CNr3		CNr4	
	N	%	N	%	N	%	N	%
Core	29	37	27	38	16	17	33	44
Periphery	50	63	45	63	78	83	42	56
Overall	79	100	72	100	94	100	75	100

Using the partitions of the clusters to which the actors were assigned (core or periphery), we created illustrations of the trajectories of the cluster members between these clusters. The terms "incomers" and "outgoers" were proposed to study these kinds of trajectories [Lave, Wenger, 1991], where the first term means the member joining the community, and the second — leaving it.
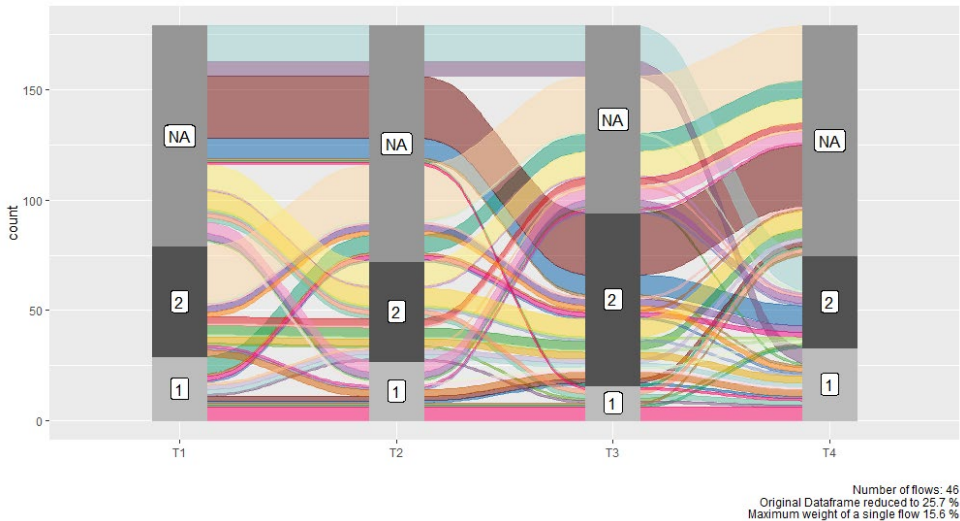
Figure 6 presents the trajectories of the active parts of the community members within the core and periphery in ***RNr1, RNr2, RNr3,*** and ***RNr4.*** In each period, there are three clusters to which a member can be assigned: 1 — core; 2 — periphery; NA — people who were not active in that period (had not yet joined the active part of the community or had already left). The main participants of the core seemed stable, even though the core became larger in the third period. As for the periphery, there were some members who were consistently present in the active part of the community during all four periods; some members left the active part of the network after the 2nd or 3rd periods. In each period, a large share of the incomers fell to the periphery. Regarding the NA cluster, some members moved from the periphery after each period and never returned. In some cases, members moved from the periphery to the NA cluster and then returned. In some cases, when members leave the community after being in the core cluster.

Figure 6. Trajectories within core and periphery in Reaction networks ***RNR1−RNR4***
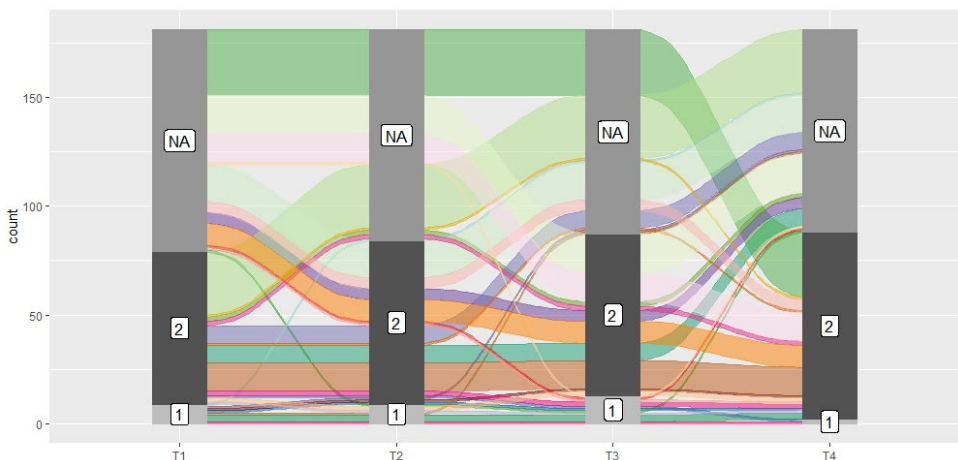
Number of flows: 30
Original Dataframe reduced to 16.6 %
Maximum weight of a single flow 16.6 %

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The trajectories for the **CNr1, CNr2, CNr3, CNr4** are shown in Figure 7. Compared to previous networks, the fluctuations in this network are more chaotic. Many group members enter the active part of the network within a certain period, leave it, and return later came back again. The participants in the core cluster are changing; however, there is a stable cluster of actors. Interestingly, there is no stability in the participants of the periphery cluster: members come in and leave, and some of them return again. Many representatives of the NA cluster only took part in the peripheral cluster in the 3rd period and subsequently left. Some community members came to the periphery only during the 4th period.

Figure. 7. Trajectories within core and periphery in Comments networks **CNr1 − CNr4**

Number of flows: 46
Original Dataframe reduced to 25.7 %
Maximum weight of a single flow 15.6 %

For **RNr**, the modified Rand index [Cugmas, Ferligoj, 2018] is 0.3, which is rather low, indicating that the structure in the four periods is not stable. Regarding core stability, only one actor has been in the same core during all four periods (this is the leader of this community, colored pink). The three actors were stable in the core cluster until the 4th period (green). At the same time, the periphery has some rather stable participants in all four periods (colored brown), three periods (green), and two periods from the beginning (lilac). The core also had some stable parts for all four periods (pink). Overall, in the **RNr,** the periphery was more stable than the core.

In **CNr**, the modified Rand index is even lower (0.08), which means that the structures in the four periods are not stable. However, unlike **RNr**, in this network, the core was more stable than the periphery. There were six actors in the core cluster during all the four periods (pink). The two actors were stable in the core cluster up to and including the 3rd period (green). The periphery is less stable: there are no community members in the same cluster in any of the four periods. There is more fluctuation between the clusters: members migrate from the periphery to the core and vice versa.

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The stability within the clusters of the global structure was low. However, different patterns were investigated for both the networks. In the **RNr,** the periphery was more stable than the core, whereas in the **CNr**, the periphery was less stable than the core.

Conclusion and discussion

The concept of community has acquired new features with respect to the development of technologies and the emergence of the Internet. Professional communities have adapted to the digital environment by creating professional groups on social media. Professional communities can also be studied online using the optics of CoPs.

In this study, we analyzed the structural characteristics of the professional online community of Russian sociologists, which exists as a Facebook* group, over 7 years (2011 — 2018). We assumed that the online community, which proposes flatter and more recursive hierarchies and more horizontal relations, could be a platform for bringing different people together and forming a joint community.

To study the structural characteristics of communities, it is possible to use the methodology of SNA and blockmodeling [Batagelj et al., 2004]. In this article, we study the online community by using a network perspective, which defines the global structural type of a community and provides a deep understanding through the evaluation of the stability of the patterns of interactions between the positions of this structure, as well as the stability of the trajectories of individual membership within these positions. Our research allows us to discover insights into the community structure by identifying not only an overall structure, but also showing its formation during time periods, and provides detailed analysis of members' trajectories in terms of foothold, switch, and alienation perspectives. Analysis of structural changes among periods is valuable for observing communication among community members. The migration of community members from one trajectory to another was examined.

The global structure of both observed networks can be defined as the "core-periphery" type. Although the CN is more complex than the RN, in addition to the two main clusters (core and periphery), there is a semi-periphery cluster that have characteristics of both clusters. The semi-periphery group aspires to get to the core group, which communicates with each other and with the periphery, but it does not have much support from the peripheral group, and their communication inside the cluster is not as active as in the core group. The obtained structure is in accordance with other studies of the structure of professional communities [Kronegger et al., 2011; Rykov, 2016]. It was shown that communication in these communities was based on the interaction of the most active participants, while less active participants tended to support and monitor an active group of participants. This was also true for the observed community of sociologists.

In both networks, the global structure can be characterized as the "core-periphery" for each of the 4 time periods. However, the number of members in the core, as well as of subclusters in both networks, varies according to the peaks of communication and growth of all types of communication experienced by the community in the 2nd and 3rd periods. This leads to the appearance of the subclusters among the members of the periphery in both networks. We can assume that the members of the periphery did not fully like the posts and comments written by the core group members

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and were interested in communicating with each other, forming small subclusters in the 2nd period and larger cluster in the 3rd period; however, this should be a question of a separate inquiry. In the 4th period, the clusters of the global structure returned to the characteristics of those in the 1st period. Another observation relates to the appearance of a cluster of one member — "bridging" actor [Kronegger et al., 2011], who communicates with the rest of the community.

According to the modified Rand index, the structure of the three possible trajectories was unstable during all periods in both types of networks. In comparison to **RNr, CNr** exhibits more structural instability. While comparing the flows of core and periphery members between the clusters, we see the opposite trend: the **RNr** has a stable part in the periphery, but there is no such stability in the core, while the **CNr** has a stable part in the core, but there is no such stable subcluster in the periphery.

To observe migration from one cluster to another, we used the types proposed by Lave and Wenger [1991], defining the position and behavior of participants in the community. Based on the results, we suggest that all these trajectory types are present in our online community in both types of networks:

— entries — for the incomers (from NA) who just joined the community,

— peripheral — for the periphery who communicate (provide comments and reactions) only to the members of the core,

— internal — for the core who are regular members of the community and actively communicate with all community members,

— borderline — for the "bridging" actor who created the community,

— alienation — for outgoers (to NA) leaving the community.

Dynamic data show that the types of trajectories can change their perspectives over time. All trajectories have three main perspectives: (1) **foothold**, when the trajectory is stable; (2) **switch,** when participants change cluster (from core to periphery and vice versa); and (3) **alienation**, the trajectory of leaving the active part of the community, which is visible by means of analysis (as we do not have information if the member really left the group).

All trajectories and perspectives were present for both **RNr** and **CNr** (Tables 7 and 8). Overall, the only stable trajectory in both networks during all periods is the **borderline trajectory**, which is defined as the trajectory for community leaders who interact with participants, express themselves in conceptual ideas, and correct any problems of interaction within the community, with the foothold perspective. This trajectory is taken by the "bridging" actor, the leader and creator of the community. All other trajectories were mixed from one period to another in both network types.

*Table 7. **Dynamical trajectory types in the Reactions networks RNr1–RNr4***

Trajectories	Foothold	Switch	Alienation
Peripheral	+		+
Entries	+	+	+
Internal	+	+	+
Borderline	+		
Alienations		+	+

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Table 8. **Dynamical trajectory types in the Comments networks CNr1–CNr4**

Trajectories	Foothold	Switch	Alienation
Peripheral		+	+
Entries	+	+	+
Internal	+	+	
Borderline	+		
Alienations		+	+

The **entries trajectory** is defined as the trajectory of incomers who joined the active part of the community. In both networks, most newcomers enter the community as peripheral members; however, for the *Comments networks*, a minority of newcomers enter the core from the very beginning. For both types of networks, the trajectories have three possible perspectives: foothold, switch, and alienation.

The **peripheral trajectory** is taken by members of the periphery who communicate only with the core by giving comments and reactions. The peripheral trajectory in the *Reactions networks* has two perspectives: foothold and alienation, which means that members of the periphery prefer to stay in the same position or stop giving reactions and leave an active part of the community. In comparison, the members who take the peripheral trajectory in the *Comments networks* can not only stop commenting and leave the active part of the community, but also switch their cluster and enter the core.

The **internal trajectory** is for core members who are actively involved in the community's commenting activities and reactions to each other. In the reaction network, the internal trajectory can be developed from three perspectives: foothold, switch, and alienation. *Comments networks* mainly have two perspectives: foothold, when the members of the core can stay in the same core or switch clusters and relocate to the periphery; however, in some cases, the alienation perspective is also possible.

The **trajectory of alienation** is the act of leaving an active part of the community. This trajectory has the same perspectives — switch and alienation — in both the *Reactions* and *Comments networks*. People who leave the active part of the community could have previously changed their position (from core to periphery, and vice versa) and then stopped communication or just left the active part of the community from their stable (core or periphery) position.

Thus, in this study, we empirically tested the model of trajectories proposed by Lave and Wenger [1991] and confirmed that all these trajectories can be found in the online format in both types of communication. The proposed trajectories have three main perspectives of development during different time periods: staying at the same position (foothold), switching the position (from core to periphery, and vice versa), and alienation (leaving the active part of the community). All these perspectives can characterize the entry trajectories in both types of networks, which is rather logical: people entering the community may find it interesting and either stay in the periphery, enter the core, or leave the cluster from lack of interest. This is also true for those taking an internal position (core of the group) in the *Reactions networks*. For members in the same position, in the *Comments networks*, the perspective of alienation is unpopular (however, there are some cases). This is a rather interesting observation, meaning

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that the core members of the online community have chances to either stay in their position or change it to the periphery, but not directly leave the community. Similar perspectives on switching and alienation can be found in both types of networks for members with alienation trajectories. The perspective of alienation is also one way of trajectory development for those in a peripheral position. We found that the members of the periphery could also stay at the same position (*Reactions networks*) and switch to the core position (*Comments networks*). We propose that this is due to the difference in relation. However, this argument should be examined in further studies. Finally, the borderline trajectory found in both networks was taken by only one community member, the creator, and the leader of this community.

Based on previous studies, we assumed a possible separation of sociologists in the online community into several groups (such as academics and practitioners, nationally and internationally oriented). Structural analysis does not support the assumption of division into several groups. Thus, we can conclude that the community under study can unite various sociologists from different offline groups and provide a means of communication for those who would like to communicate. Our initial assumption that this community can be a platform for bringing different people together and forming a joint community was confirmed.

Another important aspect is the feature of the "bridging" actor, who appears to be the creator of the community. The role of the community leader is highly important for the community, as he actively participates in community activities in all periods under study. With some fluctuations, this is the "bridging" actor, who brings stability to the network structure. The role of such leaders is extremely important in other professional online communities and CoPs.

One of the limitations of this study is that the subject of its empirical study is only one online community of sociologists, although very popular and large. Such analysis could be more disaggregated in periods, for example, using the temporal quantities approach recently proposed by Batagelj [Batagelj, Maltseva, 2020]; it will remain in the plans for further research.

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