Hidden footage in online communities: The assimilation processes of newcomers under the fluidity

Short Paper

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Abstract

Online communities (OCs), computer-mediated virtual space, have become one of the crucial parts of our lives. For example, users of Reddit.com visited 1.36 billion times in total in July 2017 that is comparable to Facebook or YouTube. While several studies explain the underlying mechanisms of members' participation and revisit behaviours, we still do not understand the evolutionary processes of members who progress from newcomers to core members. The gap mainly stems from the dominance of variance studies that deal with covariance between variables that capture different aspects of a given phenomenon in OC literature. This study takes process-oriented approach and aims to reveal evolutionary socialisation process of OC members by applying a novel inter-disciplinary computational qualitative method based on critical realism. Critical realism is employed for the study to help explaining complex structures of the online community and interactions between its users. Mainly, we analyse whole data from OC databases for two years including exposed as well as hidden events to OC members. The hidden events make us analyse how a newcomer begin to assimilate in the organisation that is not yet studied so far. We find sequences of events to identify demi-regularities through clustering and visualisation. Our results can show how newcomers are assimilated into OCs visually. We discuss theoretical contribution and practical implications in conclusions.

Keywords: Online community; Critical realism; Process mining; Sequence analysis

Introduction

Online communities have become one of the largest parts of our lives. An online community (OC) is a computer-mediated virtual space containing various functionalities such as a forum, chatting space, making a poll, or creating social groups (Faraj and Johnson 2011). OCs play as a knowledge sharing space that creates and maintains the wisdom of the crowd along with a socializing space where members mingle with each other. Members of Reddit.com, one of the largest OC globally and ranked 8th at July 2017[1], visited 1.36 billion times in total in July 2017, which is comparable to 2 billion times of Facebook or 1.5 billion times of YouTube[2]. Each member of Reddit reads 10.56 pages and stay 16 minutes on average in a day. Reddit.com has 36 million accounts as of June 2015. Based on the aggregated values, Reddit members use more than 12.09 million hours per a day, which is equivalent to 1,380 years. There are similar OCs for many countries: for example, Sina Weibo and WeChat in China, DCInside and Ppomppu in South Korea, and Mixi and 2ch in Japan. OC activities contribute to the welfare of people by using OCs in 21c digital era. Also, the global OCs are forming one of the largest online platform industries that attract many members and generate revenues from various forms such as an advertisement platform. How much unique contents are generated and how many unique visitors are maintained are key success factors of OCs. To explain OC's recent success, researchers focus on two distinctive characteristics of OCs: members' voluntary participation (Bateman et al. 2011; Hippel and Krogh 2003), which explain actors' intention to participate on OCs; and the fluidity of OC that indicates that the majority aspects of OCs can be fluid including dynamics of membership, participation, interaction patterns between actors as well as norms (Faraj et al. 2011).

Many studies on OCs are more focusing on the voluntary participation than the fluidity because it looks intuitive and can be direct explanation to generate contents for an OC's success. Several scholars propose theoretical frameworks to explain members' characteristics of voluntary participation in online communities (Bateman et al. 2011; Ray et al. 2014). Even though studies on the voluntary participation reveals why OC members devote their times and efforts to generate contents within OCs , we still do not understand how OC members progress from newcomers to core members of the communities. Understanding the evolution of membership is important to increase the retention of members for long term sustainability of OCs. The positivism and interpretivism which are the major approaches taken by the studies for voluntary participation are not appropriate to answer the questions as evolutionary aspects of membership require a process-oriented approach. Also, OCs are generally open system to which anybody can join and leave without much restrictions therefore consideration of the fluidity of OCs is important for seeking the answers.

To overcome shortcomings in relation with evolutionary changes and open systems, we adopt a process-mining approach as the main methodology under critical realism principle. In a process-oriented approach, event data is important to understand how members' activities (footages) unfold and change as time goes. However, in OC context, collecting whole footage data of members is usually difficult as we are limited to see only part of actual activities of members while majority of activities are hidden in OC platforms. For example, in OCs, we can trace a member's activities only when the member posts an article or make a comment while we usually do not know how often the member visits the OC and read how many articles. Such activities are stored in a database of an OC platform but not seen by other members. Due to such physical and structural limitation, we cannot store all footages of members in an OC and we are not able to trace member's mind change. Under critical realism, we can search the generative mechanisms of membership evolution from newcomers to old-timers considering these shortcomings.

We adopt the concept of fluidity suggested recently to handle OC's variable structure of membership and open system structure (Faraj et al. 2011). Since the concept of fluidity contains various actors and complex interactions between them, it is not well explored yet. Furthermore, limitations of data sets hinder the exploration of fluidity on OCs. We can utilize the newcomers' assimilation process that is widely explored on the organizational research (e.g., Morrison (1993) or Jones (1986)). Specifically, in

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[1] http://www.alexa.com/siteinfo/reddit.com and https://www.similarweb.com/website/reddit.com

[2] https://techcrunch.com/2017/06/27/facebook-2-billion-members/

this study, we do a case study using detailed data sets from a celebrity online community[3] to answer the research questions: *How does a newcomer evolve into old-timers in the OC? What are the generative mechanisms of newcomers' assimilation on the OC?* We answer the questions by analysing evolutionary change of newcomers' participation pattern by using internal databases that contain exposed activities such as posts and comments as well as unexposed footages of members such as direct message between members and voting for posts or comments. Traditionally, scholars use only visible data sets such as posts and comments on OC studies (Arguello et al. 2006; Wang et al. 2012) and on the traditional organizational studies that use the official education programs and feedback from other members (Jones 1986; Morrison 1993). By utilising hidden footages that are stored in the internal database of the OC, we can extend understanding on OCs by showing us which activities are done behind the scene between the exposed – writing a post or comments. By adopting computational processing mining techniques, we can identify the sequence of events that represent the assimilation process (Leenders et al. 2016). It also helps practitioners who run an OC as business as well as adopt online communities on their businesses to maintain high retention rate.

Literature Reviews

In this section, firstly, we review the pivotal different characteristics between traditional organizations and online communities. Secondly, we study how a traditional organization makes newcomers assimilated in its environments and what makes crucial roles in the assimilation processes. In so doing, we extract frameworks to understand aspects of members' dynamics in online communities.

Distinctive characteristics of online communities

There are many studies on online communities to reveal the entirely different organizational characteristics from traditional organizations (Arguello et al. 2006; Bateman et al. 2011; Oestreicher-Singer and Zalmanson 2013; Ray et al. 2014; Wang et al. 2012). Specifically, researchers focus on some important characteristics of OCs such as the classification of members of OCs (Sun et al. 2014; Velasquez et al. 2014), motivators of OC participation (Bateman et al. 2011; Ray et al. 2014), the design of OCs (Fiedler and Sarstedt 2014), and impact of members' sense of belonging by measuring the willingness to pay for business (Oestreicher-Singer and Zalmanson 2013).

Based on the previous studies, two features of OCs are considered as the most important factors that explain OCs. One is members' voluntary participation on OCs and it receives the most attention from researchers on OCs. It is introduced in the study of von Hippel and von Krogh (Hippel and Krogh 2003)'s open source software development community and subsequently widely accepted and studied in online community research. The voluntary participation has been dealt with as a core concept to explain members' voluntary activities in OCs (e.g., Bateman et al. (Bateman et al. 2011) or Ray et al. (2014)). Bateman et al. (Bateman et al. 2011) unravel why an OC member chooses to return repeatedly and engages in various behaviours such as writing posts and comments, and moderating discussions by developing a theory of community commitment that explains various aspects of members who visit again and actively participate in OCs voluntarily. Yang et al. (Yang et al. 2017) demonstrate that the different commitment levels (posters or lurkers) are induced by influences of perceived online community support and member relations. The authors use the organizational support theory to justify the relationships between commitment level and organizational factors.

Another pillar of OCs is the fluidity of OCs (Faraj et al. 2011). In OCs, any collaborative activities including knowledge sharing and creation can occur without the traditional organizational structural mechanisms such as stable membership. However, the collaborative activities appear repeatedly even though no existing social relationships (Faraj et al. 2011). The authors propose fluidity of OCs as a fundamental characteristic of OCs that makes collaboration possible. The authors depict fluid OCs as morphing continuously but preserving a recognizable shape. In consequence of the nature of fluidity of OCs, it is complicated to inspect who stays within the OC and who leaves. Looking more closely, newcomers are more influenced by fluidity than old-timers. One of prior studies using Usenet data

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[3] http://jungdonghagallery.com

reports that the rate of newcomers writing the second posts is only 27.8%, which is lower compared to old-timers' reposting rate, 72.2% (Arguello et al. 2006).

Since everybody can join and leave at any time due to fluidity of OCs, we imagine that the newcomers' assimilation process on OCs will be profoundly different from assimilation process of traditional organizations (e.g., Jones (1986) or Morrison (1993)). For example, traditional organizations have official and compulsory training programs for newcomers to deliver essential information of the organization and newcomers' role and responsibility, to feedback regularly from old-timers of the newcomers' performance, and to share information from unofficial channels when newcomers work in the workplace (Morrison 1993). Similar trials can be found in many OCs such as force to read notice posts or forum usage restriction before a newcomer writes her/his introduction post. But it is unexplored yet that these similar functions work on OCs for newcomers or if some functions exist, they work in a similar manner or are performed in a completely different way.

Other studies engage in organizational structure deeply such as impact of membership turnover (Qin et al. 2014; Ransbotham and Kane 2011), herding behaviours on OCs (Oh and Jeon 2007), and member attachment in OCs (Ren et al. 2012). Ransbotham and Kane (2011) test membership turnover and information generation and information attention in OCs using Wikipedia co-authoring data. They find that participant retention does not have a strictly positive effect on OCs. It is also known that adopting OC functionality into platforms can enhance members' experience and firm performance. Based on a recent study, members whose level of participation are higher show willingness to pay for the content exceedingly than others (Oestreicher-Singer and Zalmanson 2013). This result illustrates that OC functionalities directly help to improve members' sense of belonging.

Newcomers' assimilation of traditional organizations

The newcomers' assimilation process has been of interest to many scholars for a long time (Kramer and Miller 1999; Waldeck and Myers 2007). Since it has large impacts on organizational performance how short newcomers' assimilation is done, researchers make efforts to broaden our understanding on assimilation in organizations (Morrison 1993; Myers and Oetzel 2003). Ziller (1964) suggest assimilation processes as in two perspectives. On individual perspective, intrinsically, "the socialization (assimilation)[4] process involves conflict between satisfaction of individuals and group needs" due to the conflict between the for dependence and independence of an individual. Moreover, an organization grows, the problem gets harder to resolve. From group perspective, newcomers' assimilation on a group is a course of actions to learn behaviours and attitudes necessary for a role in organization (Morrison 1993).

Generally, newcomers can suffer from cultural and behavioural difference from other person's (old-timers) interpretations and response to actions or events of organizational members that do not conform the newcomers' pre-existing knowledges. As a result, newcomers have to re-evaluate their knowledge about the organization and try to find information about old-timers' behavioural styles and work specification. To minimise this kind of newcomer's difficulty, many organizations adopt socialization tactics (Jones 1986). Jones categorises six socialization tactics and tests them empirically. He identifies that different socialization tactics impact different social dimensions of socialization. Particularly, socialization tactics of investitures and serial processes impact significantly on role orientations and subsequent adjustments on organizations. He also shows that information about role requirements and future organizational progress unfolds on reducing the uncertainty of newcomer socialization process.

Following studies focus more on newcomers' proactive activities on socialization process. For instance, Morrison (1993) extends the proposed socialization model from the perspective of organizational tactics to an interactive model between organization and newcomers. She addresses newcomers' activities of proactive information seeking. She reports that newcomers' proactive information seeking activities as well as information given passively (such as official role-related training and manual for the role in the office) influences socialization perspectives of newcomers. Controlling for differences between two measurements for passively received information, newcomers' proactive information seeking behaviours are effective on socialization. Morrison points out that it is necessary to clarify the nature and timing of changes during newcomers' socialization, which may help to extend our understanding of the socialization

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[4] In this study, we use newcomers' socialization and assimilation interchangeably.

process. Kramer and Miller (1999) use similar approach to Morrison (1993)'s. They emphasize newcomers' proactiveness using role-making and organizational assimilation. In the end of the study, they call for further studies on the behaviours and processes related to organizational entry with combining multiple approaches better to explain the complex process during organization socialization.

Recently, Fang, Duffy, and Shaw (2011) suggest a holistic model to illustrate a member's lifecycle from socialization, role-making and role-taking to career success based on a concept of social capital. The researchers divide the model into the two main sections: socialization factors to access to social capital and newcomer adjustment to mobilise social capital. The socialization factors include organizational tactics (e.g., Jones (1986)) and newcomer's proactivity (e.g., Morrison (1993)). These factors make a member access to social capital such as social networks in the organization and resources in the networks. A newcomer circulates social capital by learning (role clarity, task mastery, and organizational knowledge) and assimilation (social integration and social identification). This study reviews the organizational socialization literature and suggest a fine-grained theoretical lens to understand socialization processes. However, this research lacks to clarify chronological order of newcomers' socialization process.

Based on review of prior studies above, those existing studies on OCs and assimilation in an organization are basically using variance study methodologies that deal with covariation between dependent and independent variables and can reveal major factors that explain the variance of dependent variables. The drawback of such studies is that variance studies are not able to provide evolutionary aspects of social phenomena, which includes nature and timing of changes during newcomers' assimilation that Morrison suggested to explore. In the precedent studies, researchers assume members are ready to participate or meet the level of commitment like a new employee of a company who passed the evaluation process of Levine and Moreland (1994)'s group socialization model. Other researchers deal with members who are actively participated in the target OCs. However, in the study of Ma & Agarwal (2007), member's tenure shows positive impact on perceived identify verification, and it directly impact on satisfaction and knowledge contribution. To overcome the methodological and data-side shortcomings, we adopt a different research design in this study.

Research design

OCs are an open information system that anyone can join and leave, make suggestions on norms to write a post or comments, and have no hierarchical structure to control systems and members. To analyse a case under open system environment and the changing members' status and interactions, we adopt a case study methodology based on the paradigms of critical realism. And we use sequence analysis to uncover newcomers' assimilation process, which is a powerful computational qualitative method to identify actor's frequently seen patterns. With our datasets, we find sequential patterns during newcomers' socialization.

Critical realism

Critical realism is recognised as a viable paradigm for social science because "critical realism research methodologies offer researchers new opportunities to investigate complex organizational phenomena in a holistic manner" in an open system (Wynn and Williams 2012). On the information systems discipline, researchers using critical realism paradigm to explore complex interactions on the information systems are increasing. For instance, Henfrdsson and Bygstad (2013) engender the generative mechanisms of digital infrastructure using case study method based on the intellectual foundation of critical realism. They mention that the digital infrastructures are too complex to illustrate based on the positivist or interpretivist paradigms that is mainly used in social science research. Dobson et al. (2013) also adopt critical realism to study broadband adoption in rural area. Since the broadband adoption has been affected by many aspects of members, companies, and government policy, it is hard to predict the exact impact of the broadband under controlling endogeneity (e.g., Chan et al. (2016)).

Based on paradigms of positivist or empiricism views, it is hard to explain impacts of technologies and agency's activities simultaneously because these paradigms assume that everything is measurable, or systems are closed – every aspect can be maintained without changing.

Many scholars assume technology in organization as fixed parts, so they ignore impacts of technological change on organizations or treat technology itself as unitary object (Volkoff et al. 2007). Since it is

necessary to explain interactions between members as well as interactions due to structures of information systems of an OC, we adopt critical realism in the study. Based on the critical realism, we use multi-method analysis for developing newcomers' assimilation process under the nature of fluidity.

Sequence analytics

We adopt process mining as the main methodology on the analysis of member's behavioural changes. Process mining is one of the computational qualitative methods frequently used in social science. Process studies generally aim to discover how and why things emerge, develop, grow, and terminate over time as distinct from variance questions dealing with covariation between dependent and independent variables (Langley et al. 2013). Thus, the temporal order and sequence of events are crucial components in process studies in IS and computational science techniques like sequence analytics (Gaskin et al. 2014), which is widely used in Genetics discipline and used to identify patterns of sequential events that may provide clues in finding similarities of processes in different organizational contexts (and named as Organizational Genetics (Arvey et al. 2016)). Sequence analytics, as one of the very few applications of computational science to process studies, proposes a very powerful alternative method by leveraging large volume of digital footprint (in our context, writing a post, commenting, messaging, recommending and complaining articles and so on). It allows the researchers to analyse micro-level individual activities based on the sequential pattern mining (Klarner and Raisch 2013). Sequence analytics can allow scholars to explore the unfolding sequence of events that are crucial in understanding the procedural dynamics (Abbott 1990; Gaskin et al. 2014).

Case description

Target community

We analyse data sets from the internal databases of a Korean celebrity fan online community. It maintained for two years (September 2012 – July 2014) after independence from a big online community and inactivated now. After two years, the most members of the forum agreed to move back to the original community. Since parts of old members (old-timers) at the initial stage were members from the original community, the old-timers and newcomers coexist from the beginning of the new OC. At the beginning stage of the new OC, a Korean celebrity appeared on TV shows frequently than before. According to his appearance on TV shows, it also boosts newcomers to join on the new OC. Thus, there are many heterogenous people joined the OC as newcomers. It makes our analysis not biased. Before joining the OC, newcomers and old-timers have no consensus except for the feeling that they both like the celebrity.

Classification	# of members	Active days	# of articles	# of comments
Newcomers	298	241.11	45.33	457.76
Old-timers	92	406.63	182.67	1058.04
Grand Total	401	286.95	93.33	662.65

Table 1. Descriptive statistics of members classified by usage and tenure

Preliminary results

There are 788 of registered members, 56,000 postings, and 428,748 comments in the community. Postings and comments are generated by members including unregistered members for two years. All postings are read by registered members and unregistered members about 47 million times in total. In the database, there are 79 tables including information of member, postings, comments, voting history, and declared history. Since we use the internal databases, our data contains all digital traces including direct messages between members, which covers broader range of member activities compared to web-scraped data sets.

Event	Action	Sender	Receiver	Type
DC1	Create a post	Writer	Everyone	Exposed
MM0	Sending a direct message	Sender in DM	Receiver in DM	Hidden

CC1	Writing a comment on a post	Writer	Writer of the post	Exposed
CV0	Voting a comment	Voter	Writer of the comment	Hidden
DV0	Voting a post	Voter	Writer of the post	Hidden
CD0	Declaring a comment	Declarer	Writer[5]	Hidden
DD0	Declare a post	Declarer	Writer	Hidden

Table 2. Relational events in the OC

We can find data sets that include postings, voting (recommendation) of each post and comment, declaration of post and comment by which a member can be done for problematic expression included such as swear words or breaking the rules, and messages exchanged among members directly in the database. We categorise actions in table 2 that are taken by a member in the online community and classify its type as exposed or hidden due to its appearance to other users. The events of DC1 and CC1 can be seen to everyone who visits the OC, however, other type of events is hidden from members of the OC.

$$h(p_i, ..., p_s) = -\sum_{i=1}^{s} p_i \log(p_i)$$

We perform sequence analysis using TraMineR implemented on R (Gabadinho et al. 2011). Firstly, as a form of feasibility test, we analyse and plot the Shannon's entropy index due to the group classification in table 1. In figure 1, we plot two entropy index movement for sequence. The entropy is defined as the below equation, where p_i denotes the proportion of events in state i at each state and the entropy, $h(p_i, ..., p_s)$, is calculated as a summation of $p_i * \log(p_i)$. The calculated entropy will be one in this case when all events are same type, otherwise zero when exposed and hidden types of events are even in each sequence.
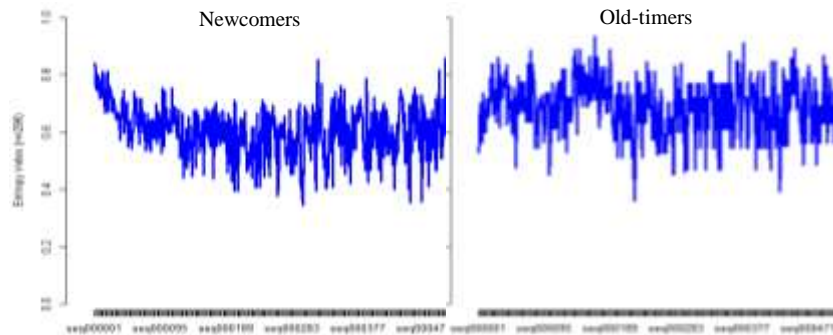

Figure 1. Shannon's entropy index for each group

We expect that pattern of entropy will be same if there is no difference within members' activities, but each group shows different pattern of activities, then the entropy will be greatly different from each group. We draw the entropy index plot based on the entropy calculated by event type (exposed or hidden) only. As we can see, the pattern of the entropy is different between newcomers and old-timers, but it emerges and shows similar pattern after 100 sequences. But when we analyse the exposed events (writing a post or a comment) which is generally done in the previous studies, we can see the only mean difference between groups. It means that old-timers write more posts than newcomers and it is consistent result with prior studies (e.g., Arguello et al. (2006)). Based on other results of sequence analysis, we also find that old-timers use hidden functionalities such as direct messaging and recommending a post more frequently than newcomers.

Conclusion

In this study, we combine process mining, critical realism, and hidden footages from a real OC database to try to provide answers of newcomers' assimilation process under fluid organizations. We expect this study expand our understanding of the role of fluidity in OCs among with newcomers' assimilation process in

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[5] When the cumulated declaration exceeds ten times, system automatically hides the declared post/comment. The writer of the post/comment can claim to reveal again to the system administrator using the direct messaging system.

organizations. In the recent works, there is an attempt to predict a member's life cycle using linguistic feature (Danescu-Niculescu-Mizil et al. 2013). This approach can help us to classify members based on their linguistic features that are written by each member. We will use this feature in the future analysis to classify members more precisely with quantified criteria. We also expect that our first analysis results of hidden footage of members help our understanding of expanding newcomers' assimilation process in an organization. The results of our study can help practitioners of OCs to provide insight how manage newcomers and make them settle down better.

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