The influence of repressive legislation on the structure of a social media network

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Abstract – Social media have been widely used to organise citizen movements. In 2012, 75% of university and college students in Québec, Canada, participated in mass protests against an announced increase in tuition fees. These protests were primarily organised using social media. To reduce public disruption, the government passed a special legislation designed to impede protest organisation. Here, we show that the legislation changed the behaviour of Twitter users but not the overall structure of the microblogging site social network. After the passage of the legislation, the rate of increase in tweets posted per day dropped. In addition, tweet exchanges became more clustered once the legislation was in place. However, the social network kept its scale-free hierarchical structure. This natural experiment shows the power of social media in political mobilization, as well as behavioural flexibility in information flow over a large number of individuals.

Introduction. – Social media are powerful tools to spread information and organise protests [1–4]. The potential of social media to facilitate citizen movements is widely known [5] and their use is banned in some authoritarian states [6,7]. For example, social media played an important role in organising demonstrations against the Egyptian government in 2011 [1]. Furthermore, during Moldova’s Revolution in April 2009, new internet-based information and communication technologies allowed the coordination of the revolution [2].

Social media also provide extensive datasets for social science research [8]. Electronic communication records create new opportunities to investigate human behaviour, such as the spread of information and opinions, and community dynamics. For example, a study using the Facebook social network showed that political opinions of individuals were strongly influenced by the opinions of their Facebook friends, and the friends of their Facebook friends [4]. This social effect was however small and could only be identified as a result of the very large sample the researchers has access to via social media [9]. In addition, policy makers have identified the importance of regulating online activity (e.g. access to data, usage of social media to organise social demonstrations) [5]. However, there is a paucity of data available to guide decision making and measure the impact of such regulations [5]. Thus, case-studies involving large data sets are required not only to develop analysis techniques, but also to gain insight into the response of people to policy decisions.

In the winter of 2012, 75% of college and university students (~300000 individuals) in the province of Québec, Canada, went on strike to protest against an announced increase in tuition fees. Social media such as the microblogging site Twitter were used to organise public demonstrations [10]. On May 18, after 14 weeks of the strike, the Québec government passed special emergency legislation (Bill 78) [11] to impede the organisation of protests. In short, under Bill 78, any organiser of a demonstration involving more than 50 people had to provide the local police with an itinerary of the demonstration at least 8 hours before the event and ensure that the demonstration followed the itinerary. Severe fines were given to individuals or organisations who did not follow Bill 78. There were also discussions in Parliament suggesting that individuals or organisations who used social media to organise or transfer information about illegal demonstrations could be fined [12].

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Here, we determine the effect of this legislation on the behaviour of social media users and the structure of their interaction network. Specifically, we compare the structure of the microblogging interaction network before and after the passage of Bill 78.

Material and methods. – The microblogging site Twitter was widely used to organise demonstrations during the student strike. Since Bill 78 aimed to reduce the rapid emergence of protests, and since the site proved useful to organise such short-notice protests, we investigated the impact of Bill 78 on the behaviour of Twitter users and on the structure of the social network emerging from their interactions. Here, the social network describes a set of nodes (people using Twitter), and their patterns of interactions (their exchanges of “tweets”). The network was directed because the direction of the tweets, from the senders to the receivers, was specified. Moreover, the network was weighted to reflect the rate of tweet exchanges between two users (tweets/day). We built a network for before (Feb 12–May 17, 105005 tweets) and after (May 18–June 4, 89589 tweets) the passage of Bill 78, fig. 1.

All Twitter data used in this study were made freely available by O. H. Beauchesne at olhib.com. A search of the microblogging site (twitter.com) was performed to find tweets including the following hashtags (keywords) associated with the student strike over the course of the study; #ggi, #manifesteurs, #casseroles and #non1625. For each tweet, the publication date, sender user name, hashtags, and addressee of the tweet were noted. A user needed to have written at least one tweet addressed to another user, who also wrote tweets about the strike, in order to be included in our interaction network.

We assessed whether the introduction of Bill 78 changed interactions on this network in three ways. First, we expected the Bill to affect interaction rates on the microblogging network. Specifically, we expected interactions about the strike to decrease after the Bill. Second, we expected that the influence of protest organisers would decrease after the Bill. We measured the eigenvector centrality of Twitter accounts before and after the Bill to estimate influence. Eigenvector centrality quantifies the connectivity of a user as well as the connectivity of its network neighbours. A user can acquire a high connectivity in two ways: 1) by having a large number of interactions and/or by having large interaction weights, and 2) by being connected to highly connected users [14].
We identified the nine most influential students associations and leaders that fell within the top 100 eigenvector centrality values. We also tested whether interactions became more cliquish using clustering coefficient estimates to quantify the connectivity of the neighbours of a user to each other [15]. Because our networks were directed, we obtained two measures for the clustering coefficient, the in-clustering coefficient for the received tweets and the out-clustering coefficient for the tweets sent. Because the network changed over time, we used a paired design to determine the change in user’s behavioural measures after the introduction of Bill 78 [16].

Finally, we investigated if these changes in behaviours affected the overall structure of the microblogging interaction network. If the effects of the Bill introduction were large, we expected that it would disrupt the overall network topology, impeding information flow on it.

**Results and discussion.** – Firstly, we investigated the effect of Bill 78 on the rate of tweet exchanges. While the number of tweets posted per day was higher after Bill 78 was implemented, the rate of increase in tweet exchanges dropped after the passage of Bill 78 (May 18, fig. 2). The best fitted piecewise regression model included break points at April 17 and May 17 ($F_{4,106} = 45.96$, $p < 0.001$, compared to a model with no breaks; break points were estimated by looking at the residual standard errors of models with all possible break points, ...
Bill 78, the control of information was more distributed among Twitter users. Decentralization has also been documented as the effect of intensive law-enforcement on a criminal network [17]. While the out-clustering coefficient increased (before April 17: 12 extra tweets/day/day; April 17–May 17: 29 extra tweets/day/day); however, after Bill 78, the rate of change in tweets per day decreased (241 less tweets/day/day, fig. 2).

The average eigenvector centrality of Twitter users decreased after the passage of Bill 78 (2836 users, paired permutation test with 9999 permutations, $p = 0.001$). This decrease was significantly higher for the most influential student associations than for the rest of the Twitter users (permutation test with 9999 permutations, $p < 0.001$, fig. 3). Thus, Bill 78 decreased the average connectivity of network users resulting in a decentralization of information transfer. After Bill 78, the interaction network of Twitter users was hierarchical because the clustering coefficients of users were larger for the student associations than for the rest of the Twitter users (permutation test with 9999 permutations, $p = 0.699$). This increase in the out-clustering coefficient was larger for the student associations than for the rest of the Twitter users (permutation test with 9999 permutations, $p = 0.037$, fig. 3) and indicated an increase in the cliquishness of the network of tweets sent. As a consequence, information was more likely to stay within cliques of users. This may have resulted after Bill 78 because students were more cautious regarding who they sent their tweets to about protests.

Lastly, the networks before and after the passage of Bill 78 followed a scale-free distribution [18,19] for both the in-strength (or weighted in-degree, another measure of connectivity calculated by the sum of the rates of the received tweets of an individual) and the out-strength (or weighted out-degree, the sum of the rates of the tweets sent, fig. 4). Thus, a few Twitter users had very high rates of tweet exchanges while most of the users had low rates of exchanges. Before and after Bill 78, the networks of Twitter users were hierarchical because the clustering coefficients of individuals were distributed following a power law in relation to their strengths [20]. In other words, individuals with a low connectivity tended to be found in highly interconnected cliques while individuals with high connectivity were positioned between cliques. There was no significant change in the hierarchy of the network before and after the passage of Bill 78 (pre-Bill models: $C_{in}(k_{in}) \sim k_{in}^{-0.48 \pm 0.004 \text{s.e.m.}}$, $C_{out}(k_{out}) \sim k_{out}^{-0.29 \pm 0.003 \text{s.e.m.}}$; post-Bill models: $C_{in}(k_{in}) \sim k_{in}^{-0.47 \pm 0.003 \text{s.e.m.}}$, $C_{out}(k_{out}) \sim k_{out}^{-0.36 \pm 0.03 \text{s.e.m.}}$). In hierarchical networks, small groups of highly connected individuals are organised in a hierarchical manner into increasingly larger groups, while maintaining a scale-free topology [20].

**Conclusion.** — The passage of Bill 78 changed the behaviour of microbloggers, but not the structure of their interaction network. While Twitter users were more likely to restrict their tweet exchanges to within their cliques after Bill 78, the scale-free and hierarchical structure of the network after the introduction of Bill 78 still allowed for information flow about this issue [21]. Thus, individuals were still able to organise mass social protests [22] thanks to the overall structure of their interaction network [23].

Large data sets are increasingly becoming available not only from social media, but from all actions that leave a digital trace such as searching the internet [24,25], calling with a mobile phone [26] and sending email [27]. New research opportunities are arising from these unprecedented, detailed, moment-by-moment data sets to provide information about the structure and content of human interactions [28]. Computational social science can not only advance our knowledge of human behaviour, but it can also be applied to understand how bottom-up and top-down policy development might be effective to affect behavioural changes [28].

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