



An emotional contagion model for heterogeneous social media with multiple behaviors



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HIGHLIGHTS

- The transmissibility is introduced to measure the capability of spreading emotion.
- A model is proposed to describe the spatio-temporal features of emotion contagion.
- The transmissibility changes with interactions types and community structures.
- The proposed model shows better performance than other models of emotion contagion.
- The simulation results of our model reveal some interesting characteristics of social media.

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ABSTRACT

The emotion varies and propagates with the spatial and temporal information of individuals through social media, which uncovers several interaction mechanisms and features the community structure in order to facilitate individuals' communication and emotional contagion in social networks. Aiming to show the detailed process and characteristics of emotional contagion within social media, we propose an emotional independent cascade model in which individual emotion can affect the subsequent emotion of his/her friends. The transmissibility is introduced to measure the capability of propagating emotion with respect to an individual in social networks. By analyzing the patterns of emotional contagion on Twitter data, we find that the value of transmissibility differs on different layers and on different community structures. Extensive experiments were conducted and the results reveal that, the polar emotion of hub users can lead to the disappearance of opposite emotion, and the transmissibility makes no sense. The final emotional distribution depends on the initial emotional distribution and the transmissibilities. Individuals from a small community are more likely to change their mood by the influence of community leaders. In addition, we compared the proposed model with two other models, the emotion-based spreader-ignorant-stifler model and the standard independent cascade model. The results demonstrate that the proposed model can reflect the real-world situation of emotional

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contagion for heterogeneous social media while the computational complexities of all these three models are similar.

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1. Introduction

As a complicated psychological experience, the emotion has been proved to be transferred directly from one individual to another one via mimicry and copying of emotion-relevant bodily actions like facial expressions [1]. The individual emotion is affected by various non-verbal clues. Currently, the study on emotion has aroused the interest in a wide range of disciplines, including economics, neuroscience and psychology. Empirical studies have demonstrated that people can “catch” emotional states they observe from others over time ranging from seconds to months [2], and the probability of emotional contagion between strangers, even those in ephemeral contact, has been documented by the effects of “service with a smile” on customer satisfaction and tipping [3]. With the shift in the usage of the Web from information consumption to information production and sharing, numerous social media services have emerged. Internet has accumulated a large volume of user generated content. The online social media have been the main platform for communication and emotional expression. One of the examples is shown as follows:

Example 1. Jeff Bezos, the founder of Amazon, announced on Twitter that they had implemented the soft landing of rockets in 2015. The message was reposted and spread in a quick speed and his followers were immersed in an excited mood. Simultaneously, unhappiness and depression emerged and spread in the followers of SpaceX and its CEO Elon Musk, who expressed his unhappiness and responded later in his tweets that his rocket had completed sub-orbital flight for six times three years ago. His followers were inspired by these words and became excited in a short period of time.

We can see from the above example that emotion propagation in online social networks have the characteristics such as diversity, broad societal impact and unpredictability.

The motivations inspiring this work are given as follows:

- (1) The individual emotion of social media varies with the time and the distance between individuals. To retrieve spatio-temporal features from large-scale Web data is an essential work, which can improve the accuracy of forecasting the spreading trend of emotion via social media.
- (2) Social media feature several interaction mechanisms to facilitate the communication and the emotional contagion among users. The effect of different behaviors on emotional contagion is a very important issue to be considered.
- (3) Users from the same online community often have specific relations (e.g. classmates or workmates) or share common interests. High frequent contacts in the same community make the emotion spread more quickly than across the communities. It plays an essential role of analyzing the effect of community structures on emotional contagion.

Based on the heterogeneity of social media, we propose an emotional independent cascade model to show the detailed process and characteristics of emotional contagion on social media. In this study, the original contributions are given as follows:

- (1) The transmissibility, a network parameter, is introduced to measure the capability of spreading emotion between two users. The statistical results on a Twitter dataset show that the transmissibility value does change on different interaction layers as well as different community structures.
- (2) In our proposed model, individual emotion can affect his/her friends' subsequent emotion. The proposed model demonstrates better performance than other typical models for emotional contagion, such as the emotion-based spreader-ignorant-stifler model [4] and the standard independent cascade model [5].
- (3) The experiments reveal that the polar emotion of hub users leads to the disappearance of the opposite emotion, irrelevant to the transmissibility value. The emotional distribution depends on the initial emotional distribution and the transmissibility values. Users in a small community are more likely to change their moods by the influence of community leaders.

The remainder of this paper is organized as follows: Section 2 surveys related work in information diffusion, emotional contagion, heterogeneous networks and sentimental analysis. Section 3 provides the problem statement and the preliminary results and definitions. We introduce the emotional independent cascade model in Section 4. The experimental results are presented in Section 5 and we compare the different models in Section 6. Lastly, we conclude this study in Section 7.

2. Related works

In this section, we will introduce the relevant works from four research areas as given below.

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