The Evolution of Friendships in Chinese Online Social Networks

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Abstract—**We study the evolution of friendships on Douban, an online social network frequently used by the youth in China. We look at several factors that can affect the evolution of friendships, such as having memberships in the same discussion groups and sharing common interests or common friends. We compare these factors in causing the formation of online friendships. Finally, we determine how Douban users' interests are influenced by their online friends' interests.**

Keywords-**diffusion model; homophily; social influence; social network; web structure analysis**

I. INTRODUCTION

Online social networks have become a major platform for the youth in China to gather information and to make friends with like-minded individuals [1]. Research has been done on the formation of online friendships and the adaptation of trends and influence in Western online social networks [2] [3] [4]. In this paper, we study how online friendships are formed and how interests are adopted in a Chinese online social network.

A. Summary of Findings

Douban is a popular Chinese online social network and media recommendation system. Douban users can indicate on their profiles interests in particular items in media (media items) such as books, movies, events, music (artists or albums), or brands (such as Converse, Nike, ect.). Users can also make online friends and join discussion groups on different topics.

We monitored the local linking structures of 10,000 user profiles, 40,000 media item profiles, and 10,000 discussion groups every week for four months and discovered that having memberships in the same discussion groups is a major cause for the formation of online friendships. Surprisingly, sharing common friends is less likely to be the cause for the formation of online friendships. Lastly, users indicating interests in the same media items is least likely to be the cause for the formation of online friendships.

We also observe that a person's interest in media items and discussion groups is influenced by their friends' tastes and decisions and the pattern of influence follows the threshold model [5].

B. Paper Organization

In Section 2 we provide some basic definitions. In Section 3, we survey related work in sociology and in computer science. We describe the interface of Douban in Section 4 . We show our experimental results in Section 5 and discuss the implication of our findings in Section 6. Finally, in Section 7, we give our conclusion.

II. DEFINITIONS

A. Homophily

Homophily in a social network is the concept of people's bonding with similar others. Typically, an individual's friends are not just random samples from the underlying population, they tend to be similar to the individual in terms of age, ethnic background, gender, interests, beliefs and so on. A social network's surrounding context can be the force behind the formation of its friendship links [6].

One can represent the surrounding context in the social network itself. A social-affiliation network consists of nodes representing individuals, links representing friendships, and nodes representing *foci*: "social, psychological, legal, or physical entit[ies] around which joint activities are organized (e.g. workplace, social groups) [6]." Over time, friendships and memberships can be established or diminished due to the relationships between individuals and foci in the network. Macpherson [6] identifies three basic patterns in which friendships and memberships can evolve.

1) Triadic Closure: if nodes A, B, C are persons in the network and A is friends with B and C. Over time, A can be the force behind the formation of friendship between B and C, even if B and C are both unaware of the existence of their mutual friendships with A [7].

2) Focal Closure: if A and B are persons in the network, and C is a focus that both A and B participate in. Over time, A and B can form a friendship due to the common focus.

3) Membership Closure: if A and B are friends, and C is a focus that A participate in. Over time, B can participate in the same focus due to A's involvement.

B. Diffusion Model

Diffusion is the process in social networks describing the cascading of behaviors from person to person like an epidemic [8]. There are two main types of model: independent contagion and threshold [5]. In the independent contagion model, each node influences its neighbor nodes with an independent probability. In the threshold model, each node can adopt a behavior based on a "threshold" number of neighbors who have already adopted it.

C. The Power Law

A graph is said to follow the power law in its degree distribution if the fraction of nodes with degree i is proportional to $1/i^\alpha$ for some constant α [9]. A scale-free network is a network whose degree distribution follows the power law [10].

D. Guanxi

Guanxi refers to the unique process of establishing personal connections in China [11] [12]. *Guanxi* has been defined as

> An informal, particularistic personal connection between two individuals who are bounded [sic] by an implicit psychological contract to follow the social norm of guanxi such as maintaining a long term relationship, mutual commitment, loyalty, and obligation. A quality guanxi is also characterized by the mutual trust and feeling developed between the two parties through numerous interactions following the self-disclosure, dynamic reciprocity, and long-term equity principles. [12]

The Chinese *guanxi* network has been defined as

> A group of people connected by personally defined reciprocal bonds or particularistic interpersonal ties. [13]

It is said that individuals in the Chinese society are less likely to initiate friendships with others they are not associated with [12]. To establish *guanxi*, two people need to first establish a "connection" known as a *guanxi* base. For example, two people can claim to have attended the same school, worked at the same place, or are from the same area. Additionally, two people can have *guanxi* because they have been acquainted through a third party with whom they both have *guanxi* with. Once the *guanxi* base is established, *guanxi* can be developed through the exchange of capitals [14]. *Guanxi* illustrates that people in the Chinese society tend to form friendships through certain types of focal closure and dyadic closure.

III. RELATED WORK

Our work builds on previous work in sociology and in computer science. We briefly survey related topics in each area.

A. Analysis of Offline Social Networks

For many years the structure of various social networks have been studied by sociologists and computer scientists (see [15] [16] [17] for surveys). Scott [18] identifies the various cliques, dyads, components and circles in which social networks can be formed and the significance of positions in those networks.

Homophily has been discovered in a vast array of social networks involving foci such as gender, age, religion, education, occupation, social class, and location [6]. Researchers also find that homophily exists in a large number of societies, but its level and characteristics may differ from country to country [19] [20].

B. Analysis of Chinese Offline Social Networks

Researchers have also analyzed the structure of various Chinese offline social networks and *guanxi* networks [21] [22] [23] [24]. Blau et al. [19] find roughly the same level of educational and occupational homophily in a Chinese urban city as in the United States.

Fang et al. [25] looks at the tendency for Chinese adolescents to smoke relative to their social position and find that adolescents are more likely to experiment with cigarettes on their own than in a social group. After the adolescents take up smoking, they tend to socialize with other smokers.

Xu et al. [26] looks at Chinese children's aggressive behavior as related to their positions in the social network. As a method of controlling the aggression, teachers in China tend to put aggressive children in a peer group with non-aggressive children. Over time, Xu et al. [26] find that friendships can be formed between aggressive children and non-agressive children. For the aggressive children who are group members, the number of intra-group friendships moderates the children's aggressive behaviors.

We observe from descriptions above that the network analyzed by Fang et al. [25] exhibits weak membership closure and strong focal closure while the network analyzed by Xu et al. [26] exhibits strong membership closure and weak focal closure.

C. Analysis of Online Social Networks

Mislove et al. [16] presents a large-scale measurement study and analysis of the structure of online social networks such as Orkut, YouTube, and Flickr. Their result shows that online social networks follow the power-law and small-world properties. Kumar et al. [27] looks at the structural evolution of Flickr and Yahoo! 360.

Leskovec et al. [28] analyzes the properties of triadic closure in LinkedIn, Flickr, Del.icio.us and Yahoo! Answers. Kossinets and Watss [29] looks for focal closure and triadic closure using emails from students in a large U.S university and find that a single shared class has roughly the same absolute effect on the formation of friendship as a single shared friend.

Backstrom et al. [30] shows that the probability of an individual joining the LiveJournal community increases as the number of their friends who have already joined increases. Crandall et al. [31] looks at the communication between individuals editing Wikipedia articles and find that editors tend to share common interests prior to becoming acquainted and form friendships after editing the same Wikipedia articles.

D. Analysis of Chinese Online Social Networks

King et al. [32] looks at the local linking structure between Chinese web sites and find that some web sites are establishing *guanxi*-like relationships with each other. A guanxi base can be initiated, precipitating the eventual establishment and maintenance of guanxi.

Jin [1] looks at various aspects of the Chinese online Bulletin Board Systems (BBS), a type of online social network. These includes the history and development of Chinese BBS, Chinese BBS regulation and censorship. Jin [1] also provides observations about the structure and interface of Chinese BBS and the behavioral patterns of Chinese BBS users.

Xin [33] conducts a survey on BBS's influence on the University students in China and their behavior on Chinese BBS.

Our work is the first large scale empirical study on the evolution of friendships in a Chinese online social network.

Fig. 1: An user profile on Douban

Fig. 2: A discussion group Douban

(a) Douban　　　　　　　(b) Facebook

Fig. 3: Distribution of Profiles with # of Friends

Our findings provide support for the observations and survey analysis of Jin [1] and Xin [33], respectively.

IV. BACKGROUND AND RELATED CONCEPTS

Online social networks are a major part of the Chinese Internet culture [1]. Netizens[1] in China organize themselves using forums, discussion groups, blogs, and social networking platforms to engage in group activities such as exchanging viewpoints and sharing information [1].

The majority of the Internet users in China are young students between the ages of 18 and 24. More than half of the Internet users are under 25, and 69% are below 30 years old [35]. This demographic structure largely determines the unique Internet culture in China.
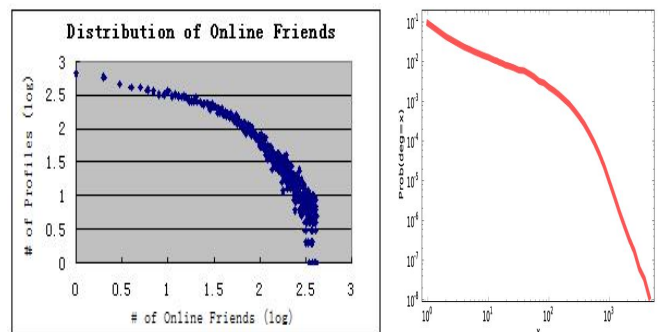
We choose to analyze *Douban* (*www.douban.com*), a Chinese social networking platform. *Douban* provides users with review and recommendation services for movies, books, music, events and brands. It is also the largest online media items database and one of the largest online communities in China [36].

On a typical user profile, Douban users can indicate the books they want to read, the movies they want to watch, the music they want to listen to, the events they want to attend, the brand they support and so on. An user profile also consist of a list of user's online friends. Figure 1 illustrates a typical user profile on Douban.

Douban users can also join discussion groups. The topics of these discussion groups range from a brand, a person or an organizations (Brad Pitt, Nike, the CBC) to topics of general interests (I love coffee, people living in *Beijing*). Figure 2 illustrates a typical discussion group on Douban.

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[1]A netizen is a person actively involved in online communities [34]

V. EMPIRICAL STUDY OF DOUBAN

In this section, we present an analysis with data we collected from weekly crawls of Douban over a four month period.

A. Static Analysis of User Profiles

First, we conduct a static graph analysis of user profiles on Douban. We randomly select 100,000 user profiles and look at the distribution of users' online friends. Figure 3(a) illustrates this distribution. The y-axis indicates the number of profiles which each have x friends.

We notice that the distribution does not follow the power law. This result agrees with what one might expect to find in a pure social network such as an acquaintance network. Adamic et al. [37] presents an analysis of Club Nexus, an online community at Stanford University which represents a small pure social network on the web. Their result shows that the distribution of the number of connections users make does not follow the power law. The main reason given is that, in a pure social network such as an acquaintance network, "there is a recurring cost in term of time and effort to maintain a friendship, and given the limited resources people have, they
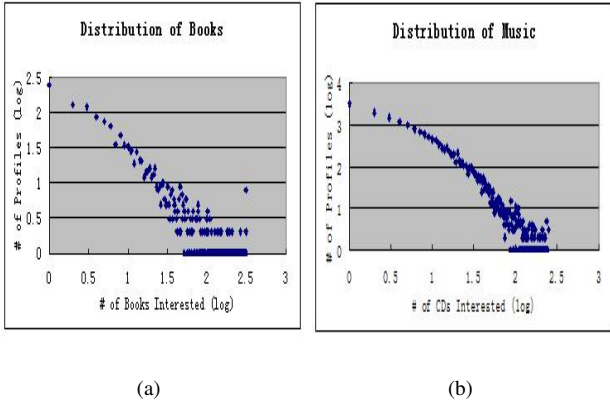
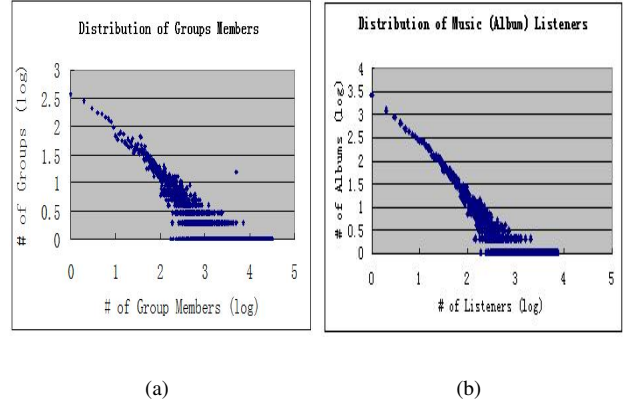Fig. 4: Distribution of # of Books and Music Interested
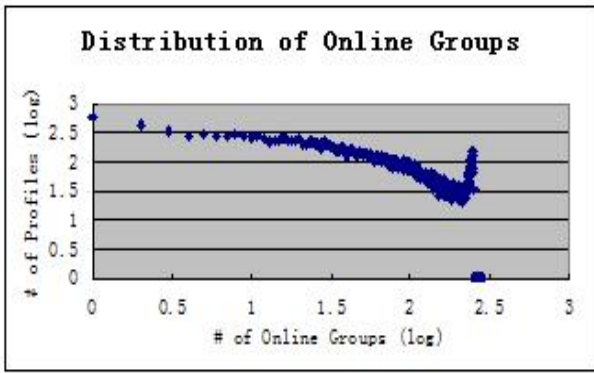

Fig. 6: Distribution of Followers

Fig. 5: Distribution of Profiles with # of Discussion Groups

can only maintain a certain number of them [37]." Gjoka et al. [38] looks at the distribution of the number of online friends for users on Facebook (figure 3(b)). Our distribution of users' online friends has a similar shape as the distribution by Gjoka et al. [38].

We look at the distribution for the number of users' favorite music, movies, books, events and brands. Figure 4 illustrates the distributions for the number of users' favorite books and favorite music. We observe that all of the distributions follow the power law. Table 1 illustrates the power law exponents for these distributions.

TABLE I: Power Law Exponents I

Distributions	Exponents
Users' Favorite Music	1.9
Users' Favorite Movies	0.6
Users' Favorite Books	0.9
Users' Favorite Events	0.8
Users' Favorite Brands	1.2

We look at the distribution for the number of discussion groups joined by users (figure 5). We observe that the distribution does not follow the power law. And, the distribution is not found in the study of Western online social networks.

The tail of the distribution suggests that there is an unusually large number of users joining a large number of discussion groups. We observe that the pattern of behavior when users join discussion groups is different from the pattern of behavior when users choose their favorite books, music, movies, events, and brands.

B. Static Analysis of Followers

In the previous section, we look at the distributions for the number of media items and discussion groups listed on users' profiles. In this section, we focus on the users who join the discussion groups or are interested in the media items. We refer to them as followers.

The Douban interface allows us to select a particular media item or discussion group and retrieve a complete list of followers for that media item or discussion group. We randomly select 10,000 books, 10,000 movies, 10,000 albums, 10,000 events, 10,000 discussion groups and 10,000 brands and look at the distributions for the number of followers. We observe that all the distributions follow the power law. Table 2 illustrates the power law exponents for all the distributions. Figure 6 illustrates the distributions for the number of followers for discussion groups and music.

The distributions fit our expectation of how media items and discussion groups attract followers: the more existing followers they have, the more likely they are to attract future followers.

TABLE II: Power Law Exponents II

Distributions	Exponents
Music Followers	1.8
Movie Followers	1.2
Book Followers	1.6
Event Followers	1.4
Brand Followers	1.7
Discussion Group Followers	1.3

Week	1	2	3	4	5	6	7	8	9	10
Add		1.96%	1.61%	1.49%	3.53%	1.76%	1.50%	1.79%	2.43%	1.89%
Delete	0.53%	0.58%	0.48%	0.94%	0.43%	0.41%	0.45%	0.46%	0.61%	0.39%

* Add – % of links that are newly added

* Delete – % of links deleted from current week to the next
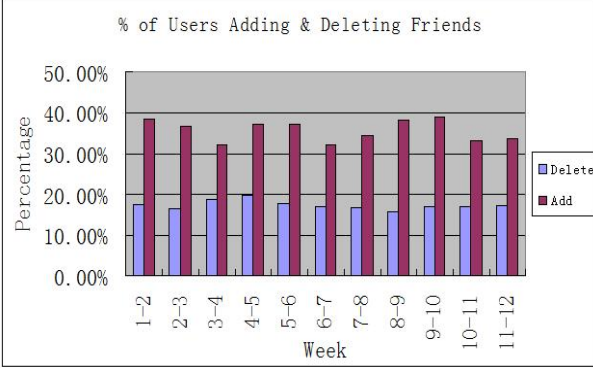
Fig. 7: % Links Added & Deleted

Fig. 8: % of Users Adding & Deleting Friends

% newly added friendships with profiles that share the same friends or interests

Week	1	2	3	4	5	6	7	8	Average
Friend(s)	46.10%	50.20%	47.88%	48.07%	44.97%	46.90%	47.20%	47.45%	47.35%
Artist(s)	19.00%	14.22%	14.04%	14.08%	14.44%	14.82%	16.42%	14.82%	15.23%
Music(s)	8.50%	11.89%	8.35%	11.64%	7.35%	9.35%	11.23%	8.90%	9.65%
Book(s)	6.30%	9.33%	9.57%	9.35%	8.29%	9.50%	10.84%	9.92%	9.14%
Movies(s)	13.50%	17.08%	12.41%	14.10%	11.35%	12.92%	13.35%	16.35%	13.88%
Group(s)	81.40%	74.37%	77.43%	78.39%	79.54%	77.53%	81.34%	74.95%	78.12%
Event(s)	11.60%	7.43%	5.58%	6.59%	7.44%	6.44%	9.67%	11.05%	8.23%
Company(s)	5.00%	4.64%	4.73%	7.89%	4.23%	6.56%	4.25%	4.64%	5.24%

% newly deleted friendships with profiles that share the same friends or interests

Week	1	2	3	4	5	6	7	8	Average
Friend(s)	44.00%	35.62%	32.32%	35.22%	37.89%	41.21%	37.77%	33.65%	37.21%
Artist(s)	15.70%	10.79%	9.79%	11.14%	11.45%	8.55%	15.46%	12.23%	11.89%
Music(s)	11.60%	10.00%	9.19%	9.24%	10.23%	11.04%	9.56%	9.00%	9.98%
Book(s)	10.70%	9.10%	7.27%	8.55%	8.57%	8.43%	9.44%	9.23%	8.91%
Movies(s)	16.10%	12.58%	12.11%	14.44%	11.35%	12.44%	15.35%	13.98%	13.54%
Group(s)	75.01%	77.42%	71.88%	74.22%	77.56%	72.55%	71.22%	77.35%	74.65%
Event(s)	6.80%	4.04%	4.95%	5.21%	6.43%	4.67%	3.35%	4.44%	4.99%
Company(s)	4.00%	3.48%	3.64%	4.34%	4.44%	3.44%	4.44%	3.30%	3.88%

Fig. 9: % of Users With Common Friends or Interests

C. Time Analysis of User Profiles

We monitor 10,000 user profiles for four months and observe the rate in which users' online friends are added and deleted (figure 7). We observe that although only a small percentage of the online friends are changed from users' profiles, the percentage of friends added to users' profiles is larger than the percentage of friends deleted. We observe that the distributions for the number of friends added to and deleted from users' profiles every week follow the power law.

Figure 8 illustrates the percentage of users adding and deleting friends. We observe that a large percentage of the users on Douban engage in these activities every week. And, the percentage of users adding friends is larger than the percentage of users deleting friends.

D. Time Analysis of Online Friendships

We monitor the newly added and newly deleted friendships in our sample and focus on the pairs of profiles that are involved in the addition and deletion of links. Figure 9 illustrates the percentage of added and deleted friendships in which the pairs of profiles involved share at least one friend, music, book, movie, discussion group, or event in common.

We observe that a high percentage of the newly added and deleted friendships involve pairs of profiles that share at least one friend in common. This result illustrates the principle of triadic closure.

Surprisingly, we observe that on average the percentage of newly added and deleted friendships involving pairs of profiles that share at least one discussion group in common is 30% higher than the percentage of newly added and deleted

friendships involving pairs of profiles that share at least one friend in common.

We look at the weekly distributions for the number of friends, artists, music, books, movies, events and discussion groups shared by the pairs of profiles involved in the adding and deleting of friendships. We observe that all of the distributions follow the power law. Figure 10 illustrates the distributions derived from one week's data, the number of common friends and common discussion groups shared by pairs of profiles involved in the adding and deleting of friendships.

E. Time Analysis of Followers

We monitor 10,000 discussion groups on Douban every week for four months and observe if users newly joining the discussion groups have friends that are already members. We observe that 76% of the users joining a discussion group do not have friends that are already members. The pattern of users joining discussion groups in the friendship network follows the threshold model [5], i.e, increasing the number of users' friends joining a discussion group beyond a threshold does not increase the probability of the users joining the discussion group.

We monitor 10,000 books on Douban every week for four months and observe that 85% of the new readers for any particular book have at least one friend that is already a reader of that book. The pattern of users adopting media items in the friendship network also follows the threshold model.

We calculate that the threshold for the adaptation of books is 2.3 and the threshold for the adaptation of discussion groups is 2.6.
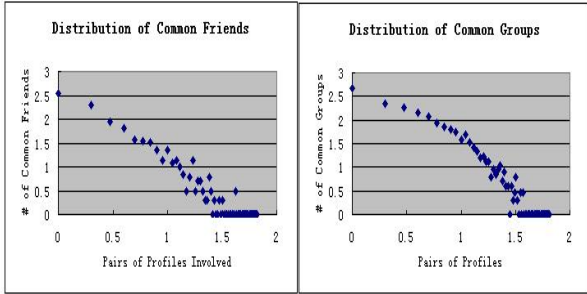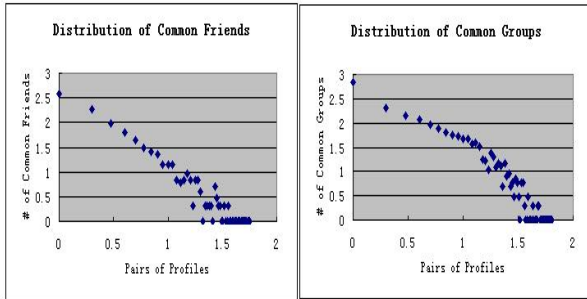
Fig. 10: Common Friends and Discussion Groups Distributions

VI. OBSERVATIONS AND IMPLICATIONS

We observe that triadic closure is a major force behind the formation of online friendships. Surprisingly, the effect of certain types of focal closure is larger than the effect of triadic closure, as more friendships are formed between members of the same discussion groups. Users are less likely to form friendships by indicating interests in the same media items on their profiles.

Perhaps the most puzzling finding of our empirical study is the large number of users joining discussion groups without influence from their online friends and the large number of friendships established between members of the same discussion groups.

A similar phenomenon can be observed from the analysis of Wikipedia by Crandall et al. [31]. In both cases, individuals share common interests before collaboration or discussion and form friendships after.

In contrast, the study of LiveJournal by Backstrom et al. [30] shows that users have a set of friends before joining a community. The probability of a user joining the community increases as the the number of their friends who have already joined increases.

We compare the motivation and implication of joining a discussion group on Douban to editing an article on Wikipedia and joining a community on LiveJournal:

1) Individuals tend to join a discussion group on Douban or edit a Wikipedia article based on interests in the topics. On the other hand, it seems that individuals join the

LiveJournal community to keep in contact with existing friends.
2) Editing Wikipedia articles or participating in discussions involves a substantial amount of interaction between co-editors or discussion group members, resp., which could result in the formation of friendships. When a user in the LiveJournal community publishes a blog post, although other users may respond to the post, the amount of interactions between users is still limited.
3) Editing Wikipedia articles and participating in discussions are both ways to seek out more information through collaboration.

We relate our findings to the traditional concept of *guanxi* and observe that discussions on common interests is not typically used as a type of *guanxi* base for the establishment of *guanxi* between individuals [11] [12]. In contrast, our result shows that Douban users in the same discussion groups are establishing friendships, a type of *guanxi*, with each other. In other words, Chinese netizens, who are mostly young students under the age of 30, are establishing friendships through discussions and are sharing information through social networking. We observe that some discussion group topics, e.g. people living in *Beijing*, can be seen as *guanxi* base in the traditional concept of *guanxi*, while others, e.g. I love coffee, cannot.

Jin [1] observes that almost all comprehensive Chinese online forums provide sub-forums for users from the same area, same school, same province, and having the same interests. She states that "this is rarely seen in Western BBS." Chinese BBS users tend to establish friendships and participate in discussions in their corresponding sub-forums, while popular discussion topics propagate from sub-forum to sub-forum. We observe that the categorization of the sub-forums in Chinese BBS is similar to the categorization of the discussion groups on Douban.

Jin [1] points out that since information is tightly controlled in the Chinese mainstream media such as television, radio and newspaper, Chinese netizens are utilizing online social networks such as BBS to seek out the information they are interested in. Xin [33] lists seven reasons why University students in China are enthusiastic about Chinese BBS. among them are "giving and receiving information," "the psychological satisfaction brought by online communication," "the stimulation of joining public discussions and chat," and "making friends."

Overall, individuals have a similar motive when they are participating in discussions on Douban, in Chinese BBS and when they are editing Wikipedia articles. They hope to seek out more information through discussions and tend to establish friendships in the process. For individuals in China, this method of establishing friendships is different from the traditional method of establishing friendships in the Chinese society.

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