Understanding the Cultural Influence on Tagging Pattern

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Abstract

To design a user-centric recommender system, the first and foremost task we need to do is understanding the users. In this regard, this paper starts by evaluating tagging behavior from different cultures, and introduce our future works.

Tagging behavior in social network has been studied in great detail by peer researchers, and various metrics are proposed to evaluate such patterns. However, not many studies have dealt with the important cultural dimension associated with tagging manners. To this end, this study investigates the tagging behaviors in SongTaste and Last.FM, two tagging-enabled music social networks targeted at Eastern Asian users and European users respectively. We examined tag agreements among friends and members, what kinds of tags are favored by different cultures, tag discrimination and the non-obviousness of tag. Our results suggest that the cultural dimension significantly matters the tagging behavior.

We conclude with a discussion on the potential impacts of our findings and on-going works.

1 Introduction

User-centric design of recommendation system is to develop a recommendation system addressing the users' needs. Unlike the existing systems, they were developed in a way regardless of the target subject. Their approach is good for the generic purpose, but not sufficient to meet the individual needs or neglected the importance of contextual information, such as the cultural originality of user. To this end, our works attempt to understand and evaluate the fundamental needs of users, and hence we investigate the tagging behavior in our first step.

Collaborative tagging is the process of describing a resource by user-created annotation. It could be in the form of short-phrases or keywords, in which adding new contextual dimensions(metatag) to resources by mean of the resources' type, discipline, content or strings that are meaningful to certain users [1, 5]. This has been getting more and more common as many popular social websites, such as Flickr, Last.FM, del.icio.us and Digg, deploying this mechanism.

The phenomenon of adopting tags into recommender systems in order to better calculate user-user similarity in collaborative filtering, given that tags may infer users detailed preferences on item features, are well studied by a number of researchers [3]. However, most of their works are focusing on research citation sites (e.g. CiteULike), or webpage bookmarking sites (Delicious) [9, 10]. In this lack of detailed investigation of tag analysis in other domains, we are particularly interested in studying social music sites, one of primarily targeted product domains in social recommender systems.

On the other hand, it is observed that the cultural dimension would matter human behavior. Take the example of social greeting, western people will hug each other for politeness's sake, whereas eastern asian won't contact so closely in this way. With this observation, we speculate the tagging behavior will also be impacted the cultural origin of users. Therefore, driven by the existing limitations and observations, our work reveal the differences of tagging behavior of users from different cultural backgrounds when they are actively interacting with a music sharing sites. We expect that the analysis results can be suggestive to related works on recommenders and social search, so as to best leverage the gap between cultural originality and tagging patterns. To the best of our knowledge, we are the first to probe into the cultural effect on tagging behavior.

In particular, this paper addresses the following questions:

RQ1: What is the tag agreement among friends in both cultures?

RQ2: What is the tag agreement among members in both cultures?

RQ3: What is the tag non-obviousness index in oriental users compare with western user?

RQ4: How is the tag discrimination value change from Eastern Asian to European?

RQ5: How the tags classes distribution diverse from oriental users to western user?

And these in turn will be further explained in subsequent sections.

2 Related Works

If a tag is not appearing in item's content, the item's description for instance, this tag will be valuable since it adds extra information to that item. Furthermore, the ability of a tag distinguishing between this collection of resources and other resources can also be measured. These two evaluations are modeled by tag non-obviousness and tag discrimination [4]. Tags can be classified into different categories. Golder and Huberman [5] present a classification scheme in which put the tags into seven categories. Sen et al. [11] further refine the seven categories into three more general classes. One can better understand the tagging behavior at the level of categories of tags.

In social network, one of the characteristic is the collaboration between users. Users can explicitly state the friendship with others. They may be real world friend, or they just share common interest in a virtual world and thus become a virtual friend. This kind of relationship always bidirectional, that is, user has to confirm the friend request before the relationship established. But this depends on individual system design. Studies [3, 8, 10] show that the presence of friends will affect user's tagging pattern in certain extent. Such as re-applying the tag his/her friends used before.

Additional to friendship, various social ties can also be found in social network [9, 10, 11]. People join the same discussion group or participate in a common event are some of the examples. Users join the same group implied that they share some common interests. This connection could be shown in their tagging patterns.

Another important aspect is the cultural origin of tagger. It is observed that the cultural dimension would matter human behavior [6]. Take the example of greeting, European like to have a close hug, while Chinese reserve some distance to others. This cultural divergence in human behavior also found in the preference of product recommendation interfaces and attention on object [2, 7]. Oriental users are found to be holistic, while western are more analytic.

3 Experimental Materials

3.1 Dataset

To emphasis the cultural dissimilarity, our experimental data was crawled from two popular music social websites: SongTaste[1] and Last.FM[2]. They have more than 2.3M and 30M registered users resp. And they also share similar features, like allowing users to listen to the song, leave comments on it, and different rankings are available. And more importantly, they have different target user groups, namely Chinese and European, which fit our investigation.

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[1]http://www.songtaste.com, Chinese as primary user
[2]http://last.fm, European as primary user

The dataset consists of 200 popular songs each from SongTast and Last.FM (cut-off date is 6t December, 2009). Users commented on these songs and their friends were considered, also for the tags applied by them. In summary, 6,500 users (each applied at least one tag) from the two websites were selected for analysis throughout this paper,the average number of tags applied are 10.3 (SD 74.47) and 62.1 (SD 36.34) in SongTaste and Last.FM respectively.

4 Metrics

In the following analysis, unless otherwise specified, t-test assuming unequal variances with a risk level of 0.05 is used. Table 1 summarized our results.

4.1 Tag Agreement among Friends & among Members

RQ1: What is the tag agreement among friends in both cultures?
RQ2: What is the tag agreement among members in both cultures?

To measure how the tags agree with each other, we use the Symmetric Jaccard Coefficient [3, 10], which is the fraction of tags common in both users.

$$\frac{|T_{user} \bigcap T_{friend}|}{|T_{user} \bigcup T_{friend}|} \qquad (1)$$

The tag agreement among friends are found to be 0.004 and 0.086 from SongTaste and Last.FM respectively ($t= 1.96$, $p < 0.05$). This indicates that the friendship agreement in western users is significantly stronger than oriental users.

We then measure the tag agreement among members in a similar manner. To achieve so, we need to find out which discussion group(s) the subject user has joined, and then all the members belong to these groups. The next step was to find all the tags used by the subject user and members.

Aftermath, we can apply equation 1 to obtain the value. The coefficients of SongTaste and Last.FM are 0.001 and 0.071 respectively ($t = 1.96$, $p < 0.05$), which indicates that the agreement among members in western.

We also compare the different tag agreements within the system, which is the cultural independent difference of tag agreements. In the Chinese groups, the agreements among friends is 0.001 and that in members is 0.002 (by t-test: paired two-sample for means, $t=1.96$, $p < 0.00$), while the values in European groups are 0.111 and 0.097 (by t-test: paired two-sample for means, $t=1.96$, $p < 0.00$). Details result is shown in Table 4.

These results are in line with our observations. The social affiliation in European is stronger than in Eastern Asian. People in the former group share more with others, they

Table 1. T-test results for different comparisons

	Friends Agreement		Members Agreement		Within Domain				non-obviousness	
	SongTaste	Last.FM	SongTaste	Last.FM	ST_{frd}	ST_{mem}	FM_{frd}	FM_{mem}	SongTaste	Last.FM
Mean	0.0006328	0.1105970	0.002105	0.0973138	0.00063	0.00210	0.11059	0.09731	0.93023	0.95873
Variance	0.00002998	0.005808	0.000486	0.00520	0.00002	0.00048	0.00580	0.00520	0.01778	0.00215
P value	0		0		8.6×10^{-8}		4.47×10^{-35}		0.00477	
t Critical two-tail	1.960325		1.960271		1.96032		1.96032		2.59604	

Table 2. Examples of tags in the three categories in [11]

Class	Definition	Examples
Personal	They are often used to organize a user's own resources	ok computer, new prog, always in my mind
Subjective	Express people opinions related to a web resource	amazing, awesome, favorites
Factual	Identify facts about the described web resource	beatles, pop, electronic

Table 3. Examples of tags in the three categories in [11]

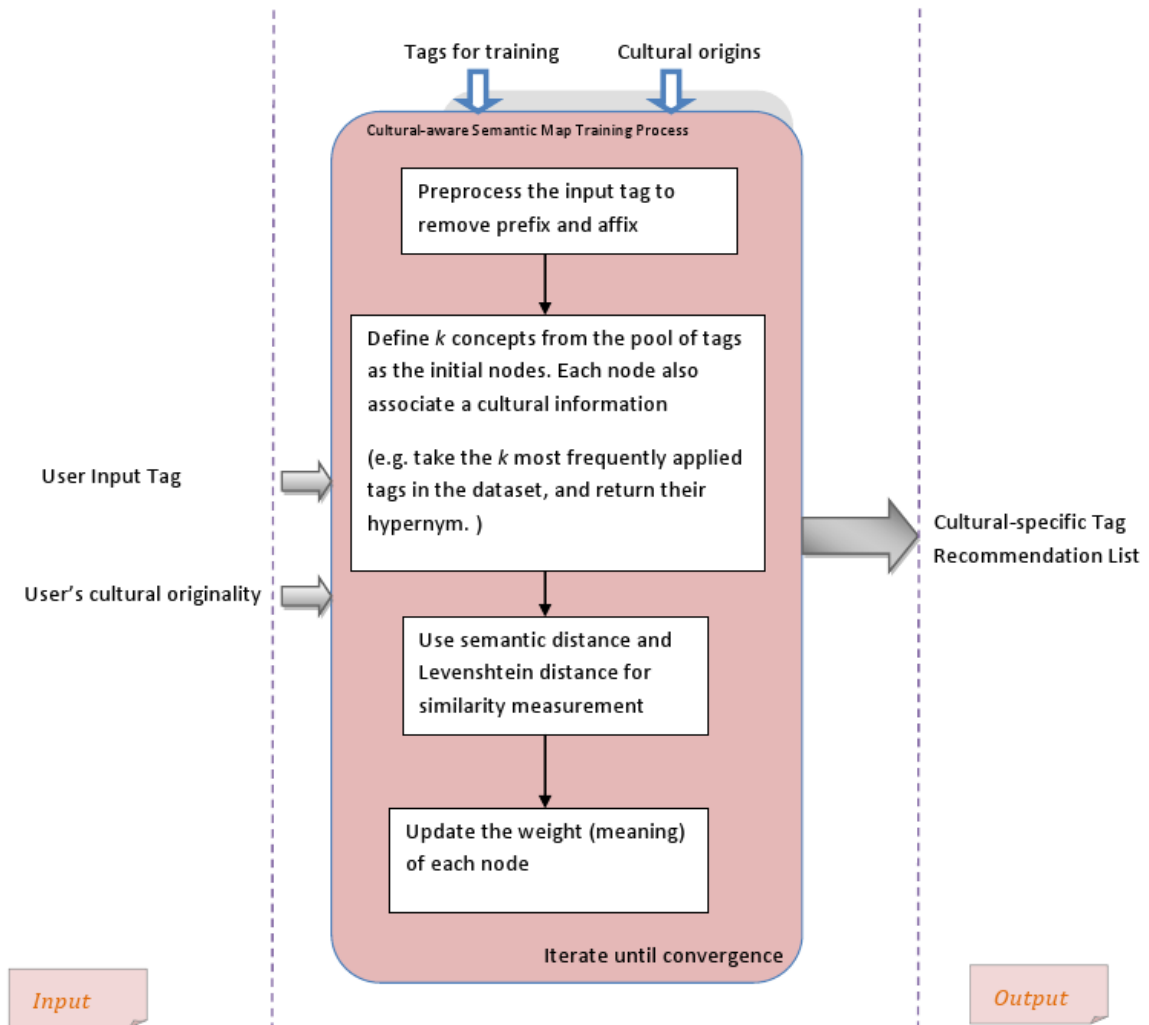| Class	Definition	Examples
Cat. 1	Identifying What (or Who) it is About.	john lennon, male vocalists, hard rock
Cat .2	Identifying What it is.	singer-songwriter,original, experimental
Cat .3	Identifying Who Owns It.	beatles, pop, electronic
Cat .4	Refining Categories.	60s, uk, orchestral
Cat .5	Identifying Qualities or Characteristics.	good, relax, perfect
Cat .6	Self Reference.	jumping, memories, god
Cat .7	Task Organizing.	hand claps, dance, party

Tags for training   Cultural origins

Cultural-aware Semantic Map Training Process

Preprocess the input tag to remove prefix and affix

Define *k* concepts from the pool of tags as the initial nodes. Each node also associate a cultural information

(e.g. take the *k* most frequently applied tags in the dataset, and return their hypernym.)

Use semantic distance and Levenshtein distance for similarity measurement

Update the weight (meaning) of each node

Iterate until convergence

User Input Tag

User's cultural originality

Cultural-specific Tag Recommendation List

Input

Output

Figure 1. Cultural-aware Semantic Map based on SOM Tag Recommendation Algorithm

always have gathering with friends for instance. Consequently, the values of tag agreement in both friendship and membership are larger comparing with the Chinese one. The larger value in the friendship agreement in the European implied that the relationship of friend embedded the interest sharing information. People have friendship may somehow due to the sharing of common interest.

4.2 Tag non-obviousness

RQ3: What is the tag non-obviousness index in oriental users compare with western user?

Tag non-obviousness is the ratio of tags not appear in the content to the total number of tags of that item (200 songs in our case). To analyze the tag non-obviousness in both systems, we additionally crawled the items' content, and compare against the tags designated to that item.

$$\frac{|T \notin Content|}{|T \in song|} \times 100\% \tag{2}$$

93% and 95% of the tags in SongTaste and Last.FM respectively are found to be non-obvious (t=2.60, p = 0.004). This suggests users in both cultures tend to apply tags that put intellectual value to the item. In other words, people in both cultures prefer to associate tag that is not appear in the content (for example, words appearing in the title). They might think that applying obvious tag is redundant, and no information can be gained in this way. Instead, they apply tags that hold extra information and can help themselves or others to more understand the items.

Also from the t-test analysis, though the result is shown to be significant, we can see that the difference in tag agreements in the two cultures is more manifest. Consequently, we draw the conclusion that dependence of cultural origin and 'obvious' of tag is not as important as those in tag agreement and cultural origin.

4.3 Tag Discrimination

RQ4: How is the tag discrimination value change from Eastern Asian to European?

Based on our 400 popular songs, we can measure the tag-discrimination values using the formula proposed in [4], with the distinct papers substituted by distinct songs in our case.

$$\frac{\sum(\#\_of\_distinct\_songs\_for\_each\_tag)}{\#\_of\_tags} \tag{3}$$

To the two extreme cases, when each song is just tagged one, we have the lower bound of 1.0 songs/tag; alternatively, when we have the upper bound of 200 songs/tag
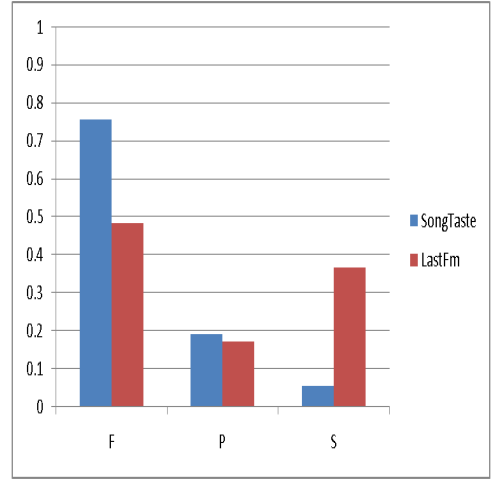

Figure 2. 3-class classification

when each song is associated with every other tag. And therefore the tag discrimination value should lie between the lower and upper bond inclusively. With these considerations, we calculate the tag discrimination values of Song-Taste and Last.FM to be 2.16 songs/tag and 53.18 songs/tag respectively.

From the information theory perspective, the information gain that a tag provides in Last.FM is much larger than that in SongTaste. And the tags in the former system are well discriminating the resources generally. This result is expectable, since the number of tags in Last.FM is more than in SongTaste, and we didn't process the semantically related tags, and hence the result is reasonable.

4.4 Tag Classes Distribution

RQ5: How the tags classes distribution diverse from oriental users to western user?

Due to only a small portion of overlap in the 400 songs mentioned above, another twenty songs common in both systems and their tags were extracted to perform the tag classes' analysis. We then manually identify the 1,313 tags into the seven categories in [5] and also the three categories in [11]. This is to give reader a full picture of how the classes defined and emerge, and also avoid the deficiency of a particular scheme. Here we give some examples of what tags belong to which class in Table 2 and Table 3. The 7-class classification scheme is the first to put tags into different categories in del.icio.us, a collaborative tagging system for web bookmark, and therefore some of the categories are specific for this domain. As for the 3-class classification scheme, it is based on the former one, and is designed for generic purpose.

Figure 2 and Figure 3 show the tag classes distribution under the two classification schemes. We can see that the
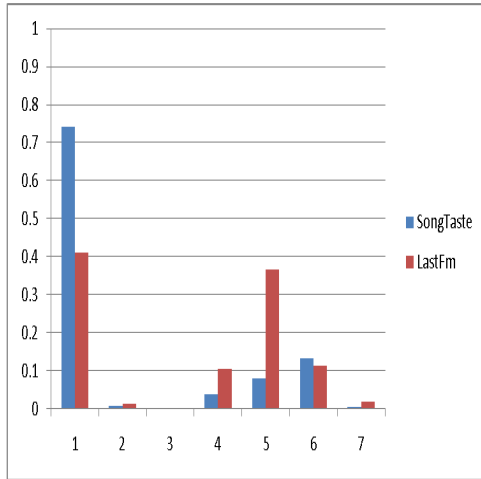
Figure 3. 7-class classification

Factual class or Cat. 1 take a major proportion of tags in both cultures whereas the difference lie in the rest of the classes. The European tags span wider range of variety compare with the Chinese one. This also inherent the cultural characteristic that European would like to express them more as reflected in their tagging pattern. As in the case of other areas, Chinese prefer the one with higher utility value. Readers should note that there are no tags fall in Cat. 3 under the classification scheme of [5] in both websites, this is because Cat. 3 is not applicable to our domain.

5 Discussion

The results presented in the previous section suggest that oriental users and western users share some common characteristics in tagging behavior, as well as some dissimilarity.
Similarity:
S1: The agreement among friends is not significant in both systems. Only a small portion of user's tags is overlapped with the tags applied by his/her friends. (Friends agreement)
S2: Most of the tags assigned by users, regardless of cultural origin, are belonged to the Factual class. (Tag classes distribution)
S3: The tags assigned by both cultures give additional information to the item. (Tag non-obviousness)
Dissimilarity:
D1: The agreement among users who join the same discussion group have more tags in common in the case of European. (Member agreement)
D2: European would like to express their feeling towards the song to a higher degree. (Tag classes distribution)
D3: Tags applied by the western group are more valuable in identifying items. (Tag discrimination)

It seems that the overall social affiliation is stronger in western users than oriental users. Western users are willing to share more with each others, while the individualism is stronger in oriental users. This may inherit from the traditional cultures. Besides, the popularity of web 2.0 technology in oriental users is yet as good as that in western user, it can be revealed from the participation rate in both systems.

Furthermore, the low overlapping in Within Domain comparison found in SongTaste, could be explained by the goal of personal information management [9]. The objective of using tags for Chinese users might due to the personal information management purpose.

Based on these findings on dissimilarity in tagging behavior, we suggest designers can embed this information in their system design. One can also develop a cultural-specific tag recommendation algorithm. The performance of such algorithm should outperform those traditional algorithms for generic purpose.

5.1 Limitation

There are far more aspects of tagging patterns can be analysis, such as re-tagging, tagging trend, so on and so forth. However, we got limited access to the real world data. We have discovered many Chinese websites that are similar to those popular in the western during the data collection stage, but many of them do not provide API nor enough information such as the tagging timestamp, who has tagged what item, for analysis. To better study the cultural difference in tagging behavior, we suggest researchers to create a experimental system to collect the data, and hence have more control and data available.

6 Conclusion and On-Going Progress

As proved in the above sections, the two cultures exhibit different tagging behaviors. Regarding to theses findings, we will develop a cultural-aware tag recommender algorithm. With the recommended tags returned to user, his/her tag profile will be lengthened, and we can recommend better candidate items based on this lengthened tag provide. In the following subsection, we introduce the concept of our tag recommendation algorithm first.

6.1 Proposed Tag Recommendation Algorithm

Our purpose is to design a tag recommendation algorithm such that it takes the cultural dimension into account as well as the semantic meaning of tags. Consequently, we named our algorithm as Cultural-aware Semantic Map based on SOM Tag Recommender.

The core part of this algorithm is the semantic map. It is trained using tags and cultural information.

To train the map, the input tags have to go through the cleaning process, in which remove the prefix and affix of the tags. Then from the pool of the training tags, the algorithm will extract k concepts from the pool. The k concepts can be found by the most frequently applied tags in the dataset, and return their hypernym. Each node of the map also associated with a cultural information.

As in the traditional SOM, the best matching unit (BMU) can be located by measuring the similarity of the nodes and the input vector. In order to address the semantic meaning, sematic distance and Levenshtein distance can be used. Each iteration will update the meaning of the nodes, until convergence or the stopping criteria reached.

Upon the map has been constructed, we can recommend cultural-specific tags given the user input tag and her cultural originality. Figure 1 conceptualize our algorithm.

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