

The Effect of Awareness Information on Information Gathering in Social Bookmarking Service

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Abstract The paper proposes a new mechanism to foster collaborative information gathering in social bookmarking service by providing awareness information about other users. Browsed users function provides information about to whom a user has browsed into the bookmark library and who browsed the user's bookmark library. The experiment has been conducted to evaluate the effect of this function on information gathering behaviors using an experimental social bookmarking site. The result implies that the effect of awareness information on information discovery is comparable to other fundamental navigation functions of social bookmarking service.

1. Introduction

Collaborative Information Gathering (CIG) is an approach to solve the problem of Internet Information Overload by organizing cooperation among users [22]. Since scientific researchers spend too effort for gathering and monitoring information sources that are useful and relevant to their work, CIG can yield more undiscovered public information than single information seekers [3]. Members of a community may provide potential resources that can be utilized to achieve individual goals, so number of researches attempt to understand the effect of collaborative information gathering in online spaces [7, 8]. The results indicate that the potential resources can be provided through social interaction [15]. Another result shows that the information hints, which come from others' searches, can be used to guide the new searches and increase individual searching performance [3]. It assumes that cooperative information foraging encourages collaboration in the way of information sharing and gathering. Since people share information for some mean such as aware of others, mutual information sharing can be explained as the situation that researchers both benefit from the results of each other's search and aware of other's information [1].

One of the first definitions of awareness in CSCW settings is that: "Awareness is an understanding of the activities of other, which provides a context for your own activity" [5]. Studies of CSCW highlight the importance of awareness about the activities of other users as being fundamental to the effective collaboration. In field study of CSCL, others' awareness such as awareness of interested knowledge or known knowledge can be used to support learning services focused on personalization and collaboration [23]. In online communities, awareness of who are the people and what are the information that are interesting for the user make great decisions to find

the useful information. So awareness information can be used to foster CIG in social software such as Social Bookmarking Service (SBS). The paper proposes a new mechanism to foster CIG in Social Bookmarking Service (SBS) by providing awareness information about mutual browsing behavior.

The paper is organized as follows: Section 2 describes CIG in SBS based on the literatures on the benefits of CIG for information seekers and the previous research on information gathering behavior in SBS. Section 3 then explains the effect of awareness information about browsing behavior and the design of mutual awareness function. Section 4 describes an experiment on the effect of mutual awareness function and its results. Section 5 provides the discussion and related work and Section 6 describes conclusion and future work.

2. Collaborative Information Gathering in SBS

2.1. Collaborative Information Gathering

Among the researches on the benefits of CIG for search communities, information foraging theory [2, 3] studies the effect of the diversity of information foragers and their hints to individuals and community. It presents that people can discover knowledge quickly and thoroughly by foraging in groups. The benefits of cooperative information foraging confirm the success of social software that allows groups of people to discuss problems and to discover knowledge at a faster speed than the individual information seeker. Another research proposes important elements in online spaces for fostering social interaction as place-making, common ground, awareness, and interaction mechanisms [15]. These four elements do not only support physical social interaction but also contribute distributed online work groups. In the context of SBS, it should provide these four elements as fundamental functions; shared bookmark as place

making, tagging system as common ground, others' activities as awareness, and social navigation as interaction mechanism [9, 14].

2.2. Information Gathering Behavior in SBS

A number of researches studied the users' behaviors for information discovery according to the usage of social navigation [19] and how social navigation can be used to enhance information discovery in SBS [16, 17, 20]. The result of usage pattern analysis shows that tagging system is an effective way for information gathering where users frequently select tags in a bookmark collection to find a new bookmark. This provides the evidence for the hypothesis that users frequently select tags to focus the search topics. In addition to navigation through tags, users prefer to explore the bookmark libraries of others to find the related bookmarks around the focused topic and discover frequently bookmarks in the libraries of the selected users [13]. Users prefer to navigate through others' bookmark libraries to gather the useful information for their interest. Therefore, SBS should provide the presences of others' activities in mean of awareness information in order to extend the way of social navigation.

3. Awareness Information about Browsing Behavior

3.1. The effect of awareness information

Awareness is widely applied to increase collaboration opportunities and efficiency in CSCW and CSCL [23]. It is found that information of other's activity is one of the most important factors of successful collaboration. Shared feedback, which is an example of providing awareness information to a community, offers members to see the results of each other's action. It benefits for making decision what is the interested information by whom [10]. Although SBS provides the fundamental functions for fostering CIG, it still lacks sufficient awareness information about other's browsing behavior [14]. Information about others' activities in current SBS deals with information about posting behaviors, which is appeared in Recent Activities function. Researchers need to know who may has the similar search topic by examining the awareness information about their browsing behaviors, which is the information about to whom a user has browsed into the bookmark library and who browsed the user's bookmark library. This information should provide not only who browsed or who has been browsed but also the direction of browsing behavior as one way browsing or mutual browsing.

3.2. Mutual awareness of browsing behavior

Mutual awareness on browsing behavior is useful for fostering collaborative activities and community building based on the benefit of social interaction, since individual information seekers should aware of other's presence through social interaction in order to form a community [18]. By providing awareness information of browsing behavior in SBS, the users can aware of who may has similar search interest and might browse other's bookmark library through this information. This mechanism extends the search ability of individual information seekers since an effective way to discover useful bookmarks comes from exploration into other's bookmark libraries.

Figure 1 depicts how mutual awareness of browsing behavior contributes to discovering useful bookmarks in the way of collaborative activities. The scenario can be separated into 3 phases. Beginning phase starts when user A browsed into user B's library and copied a bookmark in user B's library. By this action, user B can acknowledge that user A has browsed into his bookmark library and copied a bookmark. In Intermediate phase, there are 2 types of situations that can occur; (1) user B may want to examine user A's library and browse into user A's library, (2) although user B does not give any response with user A's action, user A still browse into user B's library to monitor for the new bookmarks. These behaviors in the Intermediate phase affect the browsing behaviors in the next Collaboration phase. When user B posts a new bookmark, this action is notified to user A. If the new bookmark is valuable for user A, then it may foster new research and result in a new post of user A, and so on.

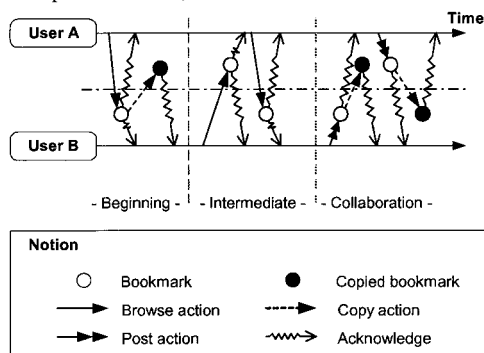


Figure 1. The mutual awareness on browsing behavior for information gathering in SBS

A scenario for the development of collaboration in SBS is described below.

(1) Finding an interesting user phase

When a user browsed into other's bookmark Library, the action is recorded in the top of Browsed

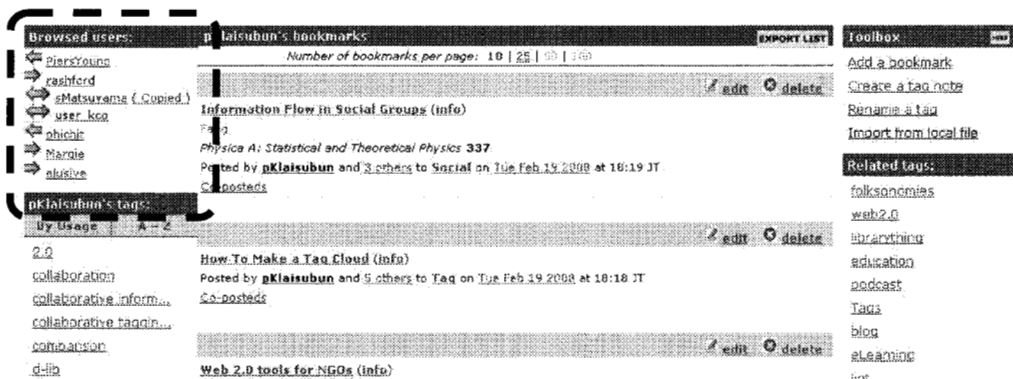


Figure 2. Browsed users list in a social bookmarking service

users list and frequently browsed usernames are displayed in the upper area. A user can find an interesting other user in Browsed user list.

(2) Mutual browsing phase

When a user browsed into other's bookmark library, the action is also recorded in the top of the other's Browsed users list and frequently browsed other usernames are displayed in the upper area. The other user can find an interesting user and they start mutual browsing.

(3) Collaboration phase

When a user posted a new bookmark, the event is notified to other users who have browsed the posted user's bookmark library. If the new bookmark is valuable for another user, it can foster the other's research and result in posting of a new bookmark from others. The interaction through SBS can encourage collaboration in online space.

3.3. Design of mutual awareness function

A new function to foster CIG in SBS is designed to provide mutual awareness information [14]. The aim of this function is to provide information about browsing behaviors, i.e., whose library is browsed into by a user and who browsed into a user's library. By aware of others' browsing behaviors, users may browse into other's library of who seems to be the like-minded and discover useful bookmarks in other's libraries.

The function of mutual awareness information about browsing behaviors can be implemented with the user interface as shown in Figure 2. The Browsed users list appears as a global navigation after logging to SBS. Usernames in the list are classified into 3 types: other user who browsed into the user's library, other user whom has been browsed into library by the user, and other user who has mutual browsing behavior with the user. By clicking a username in this list, user can browse into the library of that username. Figure 3 illustrates the anatomy of Browsed users list.

The direction of an arrow for each username represents users' browsing behavior. Username presents other who has interaction with user. Forward direction (->) means user browsed other's library whereas backward direction (-<) means other who browsed into user's library. Mutual direction (-<->) is the information about both users browsed mutually into each other's library. The word "Copied" notifies that the user had copied any bookmarks in the user's library. The Browsed users list is ordered by recent browsing behavior.

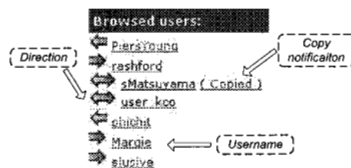


Figure 3. The anatomy of Browsed users list

4. Experiment

4.1. Objective

The experiment aims at evaluating the effect of awareness information about browsing behaviors on information discovery in CIG. The effect in providing awareness information about browsing behaviors is measured by the conversion rate for click-through Browsed users list. Conversions in this experiment are classified into 2 actions: copying a bookmark from others' libraries and accessing to original resource by clicking a bookmark title as the results of information discovery.

4.2. Method

The experiment collects both quantitative and qualitative data on the usage of a SBS. The behaviors of 21 subjects (12 professional researchers and 9 grad-

Table 1. Results for navigational types

Navigation Type	#Click Through	Conversion		Conversion Rate	
		#Copy	#Access	%Copy	%Access
Global Navigation					
Search	210	35	138	17%	66%
Popular Links	18	10	5	56%	28%
Recent Activities	33	9	11	27%	33%
<i>Browsed Users</i>	60	13	20	22%	33%
Forward Direction	58	13	20	22%	34%
Backward Direction	2	0	0	0%	0%
Total	321	67	174	21%	54%
Local Navigation					
Users' Tags	37	4	16	11%	43%
Related Tags	55	24	35	44%	64%
Tag used in the bookmarks	75	13	99	17%	132%
Users who posted the bookmarks	13	4	13	31%	100%
Total	180	45	163	25%	91%
Bookmark links					
Tag	9	3	2	33%	22%
User	7	4	1	57%	14%
Total	16	7	3	44%	19%
Grand Total	517	119	340	23%	66%

uate students) were recorded in the web server logs. The subjects were asked to use an experimental SBS ReMarkables [11] for their information gathering purpose. ReMarkables, which is implemented as an extension of open source software Connotea code [4], offers a new function of providing awareness information about browsing behaviors to users. The criterion in information discovery in this experiment is either the found bookmark was accessed to the original resource by clicking bookmark title and copied into subject's own library.

During the experiment period about 2 months, the users' activities were recorded in the web server logs and database. There are 52,295 bookmarks data used in this experiment, which were imported from other SBS for the tags that the subjects have interested in. The analysis of the experiment is based on 3,087 users' actions recorded in the ReMarkables database in the period from November 9, 2007 to December 31, 2007. During the period, click-through and conversion rates of clicking a bookmark title and copying a bookmark has been recorded. The navigation functions of the system for information gathering are classified into 3 types as Global navigation, Local navigation, and Bookmark links as described below. These three types of navigation represent different users' strategies in their information gathering process.

- (1) Global Navigation: navigation through main functions of the system.
- By keyword (Search)
 - By frequency (Popular Links)

- By time (Recent Activities)
 - By awareness information (Browsed Users)
- (2) Local Navigation: exploring through a bookmark collection.
- By tags of others (Users' Tags)
 - By tags used by others (Related Tags)
 - By tags for a bookmark list (Tags describing these bookmarks)
 - By users who posted bookmark (User who posted these bookmarks)
- (3) Bookmark Links: exploring through a bookmark.
- By users who posted a bookmark in the bookmark list (Users).
 - By tags used for a bookmark in the bookmark list (Tags).

4.3. Result

The effect of awareness information is evaluated by comparing the conversion rate to the other navigation functions. The results of data analysis grouped by the different types of navigation for information gathering are presented in Table 1. The number of times that a particular navigation path resulted in a page view is represented as click-through. The number of times for browsing to original resource and copying bookmarks to user own library is represents as conversion. Conversion rate represents percentage of each conversion to each click through. Table 1 shows that conversion rate of accessing to the original resources through Local navigations is the

most (91%) whereas the most conversion rate of copying the useful bookmarks come from Bookmark links (44%). In case of Browsed users list, the conversion rate of copying bookmarks for click-through Browsed users list is not less than other global navigation functions i.e., Popular Links and Recent Activities. It implies that the effect of awareness information about browsing behaviors is comparable to other global navigation functions.

In addition to quantitative analysis, qualitative data has been examined by a user survey. Questionnaires for the user survey were asked to the subjects in order to evaluate the validity of the experiment and the function of Browsed users list for their information gathering. Table 2 shows the questionnaires for the user survey and the top 3 answers for each question. We collected users' experiences from 11 subjects (52.4% of the subjects; 5 subjects are professional researchers whereas 6 subjects are graduate students). The result for Q1 shows that around 73% of the subjects agree that reference management is the most benefit of SBS. Also 64% of the subjects agree that using SBS provides the chances to discover the like-minded users and found the useful bookmarks from others' libraries. For Q2, 82% of users agree that they browse into others' libraries because their bookmarks are interested. From the answer for Q4, the validity of providing mechanisms for CIG can be explained as that: 55% of users agree that CIG yield more undiscovered bookmarks than individual information gathering. This result confirms that users prefer to use SBS in order to discover the like-minded people and gather information efficiently from others' bookmark library. It implies that SBS is useful for collaborative information gathering by providing awareness information about others behaviors.

Table 2. The results of questionnaire

Question and Answer	%
Q1. Why you use social bookmarking service?	
- It eases to maintain bookmark collection on the web.	73%
- It eases to discover the like-minded other users.	64%
- It eases to discover the useful bookmarks from others' libraries.	45%
Q2. Why you browse others' bookmark library?	
- Interested in the bookmarks of others.	82%
- Interested in the bookmarks of others matching a tag.	55%
- The copied bookmarks come from others.	18%
Q3. Why you participate in collaborative information gathering activity?	
- It yields more useful information than individual seekers.	56%

Question and Answer	%
- User can discover a new bookmark from this activity.	45%
- User can discover a bookmarks list related to search topic.	45%
Q4. What is the information to which the subject need social bookmark service offer?	
- New bookmarks that are not copied before.	55%
- Popular bookmarks that others users have copied.	37%
- Popular bookmarks that others users have read (Remarkable Links)	27%

5. Discussion and Related Work

The result of the experiment shows the positive effect of awareness information on information gathering in SBS. During the information gathering process, Browsed users list will be shown to users whether he/she has browsed into other' bookmark library or copied a bookmark from other's. This awareness information about browsing behaviors does not only foster CIG but also contribute community building in online space. Since a user interacts with other users through browsing behavior, it may lead to building a community and extends the ability to gather useful information from others' bookmark library. Although the conversion for click-through Browsed users list with Backward direction shows zero effect, the result does not implies that awareness information about users who browsed the user's library has no effect, because the result of user survey provides another evidence that users prefer to use SBS to discover others who may has similar interested topic. Therefore Browsed users list is a promising way to provide information about like-minded users based on their browsing behaviors. Mutual awareness information provides the presence of other users who has interaction with the user through bookmark libraries. This mechanism does not only extend the chance for information discovery as CIG but also foster community building among like-minded users.

There are some studies on providing the presence of others and information about social activities on information gathering behavior. CiteSeer collaboratory [6] facilitates community building and collaboration for the users of CiteSeer: Scientific Literature Digital Library. CiteSeer collaboratory provides awareness about potential collaborators to users in order to construct collaboratory. The system uses notification systems to convey activity awareness whereas the mutual awareness information provides presence of others' browsing behavior to users. Dogear [21] is a social bookmarking service for enterprise in which three types of search activities are observed; community browsing, personal search, and explicit search. Community browsing is the most frequently used. The study confirmed the value of the

social aspects of social bookmarking service. The enterprise bookmarking service differs from public social bookmarking services in that the aim of social bookmarking service for the enterprise is for knowledge management whereas public social bookmarking service offers the chance to discover like-minded communities that foster collaborative activities in online spaces.

6. Conclusions and Future Work

The paper proposes a new mechanism to foster collaborative information gathering in social bookmarking service and evaluates the effect of awareness information on CIG. The mechanism provides awareness information of browsing behaviors, which are the information about who browsed into user's bookmarks library and who has been browsed into bookmarks library by the user. The experiment has been conducted by using an experimental SBS ReMarkables for subjective information gathering. The result of experiment shows that mutual awareness information is useful for information gathering in SBS.

In addition to fostering CIG, supporting scientific research is a challenge for developing social software. Scientific research needs more supports for information gathering, reference management, and research collaboration [12]. The research will perform studying about social reference management and collaboration activities in online communities as the future work.

References

- [1] Bao, X. and France, B. "Information Sharing: As a Type of Information Behavior." McGill University Canada. May 2007.
- [2] Chi, E.H. and Pirolli, P. "Social Information Foraging and Collaborative Search." In Proc. of HCIC'06, USA (2006).
- [3] Chi, E.H., Pirolli, P., and Lam, K. "Aspects of Augmented Social Cognition: Social Information Foraging and Social Search", HCII'07, LNCS 4564, pp. 60-69 (2007).
- [4] Connotea, at <http://www.connotea.org>.
- [5] Dourish, P. and Bellotii, V. "Awareness and coordination in shared workspaces." In Proc. of CSCW'92, Canada (1992).
- [6] Farooq, U, Ganoe, C.H., Carroll, J. M., and Giles, L. "Supporting distributed scientific collaboration: Implications for designing the CiteSeer collaboratory." In Proc. of 40th HICSS, Hawaii (2007).
- [7] Grasso, M.A., Borghoff, U. M., Glance, N., and Willamowski, J. "Collaborative Information Gathering." In Proc. of WEBTEC'98, San Diego, pp. 65 - 72 (1998).
- [8] Guo, H. and Hausen, H.L. "TopicMark: A Topic-focused Bookmark Service for Professional Groups." In Proc. of 6th DELOS workshop (1998).
- [9] Hammond, T., Hannay, T., Lund, B., and Scott, J. "Social Bookmarking Tool (I): A General Overview." D-Lib Magazine, Vol 11(4), April 2005.
- [10] Hook, K., Benyon, D., and Munro, A. J. (Eds) "Designing Information Spaces: The Social Navigation Approach." Springer-Verlag London, UK, 2003.
- [11] Ishikawa, T., Klaisubun, P., Honma, M., and Qian, M. Z. "ReMarkables: A Web-based Research Collaboration Support System Using Social Bookmarking Tools." In Proc. of WSS'06, pp 192-195, Hong Kong, December 2006.
- [12] Klaisubun, P. and Ishikawa, T. "Supporting Scientific Research Utilizing a Social Bookmarking Service." IPSJ SIG Notes, Vol 32, pp. 67-72, March 2006.
- [13] Klaisubun, P. and Ishikawa, T. "Behavior Patterns of Information Discovery in Social Bookmarking Service." In Proc. of WI'07, pp 784-787, U.S.A., November 2007.
- [14] Klaisubun, P., Honma, M., Ishikawa, T., "Fostering Collaborative Information Gathering in Social Bookmarking Service." In Proc. of SIGGN 2007, pp 49-54. Japan, November 2007.
- [15] Lee, A., Danis, D., Miller, T., and Jung, Y. "Fostering Social Interaction in Online Spaces." In Proc. of INTERACT'01, 2001.
- [16] Lee, K. J. "What Goes Around Comes Around: An analysis of del.icio.us as social space." In Proc. of CSCW'06, Canada, November 2006.
- [17] Lerman, K. and Jones, L. A. "Social Browsing on Flickr." In Proc. of ICWSM'07, U.S.A. (2007).
- [18] Lin, Y.R., Sundaram, H., Chi, Y., Tatemura, J., and Tseng, B. "Discovery of Blog Communities based on Mutual Awareness." In Proc. of WWE'06, U.S.A., March 2006.
- [19] Millen, D., Feinberg, J., and Kerr, B. "Social Bookmarking in the Enterprise." ACM Queue, November 2005.
- [20] Millen, D. and Feinberg, J. "Using Social Tagging to Improve Social Navigation." In Proc. of AH'06, Ireland, June 2006.
- [21] Millen, D., Whittaker, M.Y.S., and Feinberg, J. "Social bookmarking and exploratory search." In Proc. of ECSCW'07, Ireland, September 2007.
- [22] Yi, L., Lu, Z. X., and Li, Y. D. "The Organizational Structure in Collaborative Information Gathering." In Proc. of ICII'01, pp. 263 - 268, Beijing, China, (2001).
- [23] Zheng, Y., Ogata, H., Li, L., and Yano, Y. "Using Knowledge Awareness Support Learning Services Providing in e-Learning Environment." In Proc. of WI'04, China, 2004.