A Conceptual Framework to Study Folksonomic Interaction

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ABSTRACT: This paper proposes a conceptual framework to recast a folksonomy as a Web classification and to use this to explore the ways in which people work with it in assessing, sharing, and navigating Web resources. The author uses information scent and foraging theory as a context to discuss how folksonomy is constructed through interactions among users, a folksonomic system, and a given domain that consists of a group of users who share the same interest or goals. The discussion centers on two dimensions of folksonomies: (1) folksonomy as a Web classification which puts like information together in a Web context; and (2) folksonomy as information scent which helps users to find related resources and users, and obtain desired information. This paper aims to integrate these two dimensions with a conceptual framework that addresses the structure of a folksonomy shaped by users' interactions. A proposed framework consists of three components of users' interactions with a folksonomy: (a) tagging – cognitive categorization of Web accessible resources by an individual user; (b) navigation – exploration and discovery of Web accessible resources in the folksonomic system; and (c) knowledge sharing – representation and communication of knowledge within a domain. This understanding will help us motivate possible future directions of research in folksonomy. This initial framework will frame a number of research questions and help lay the groundwork for future empirical research which focuses on qualitative analysis of a folksonomy and users' tagging behaviors.

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1.0 Introduction

In recent years, the folksonomy has been developed as a new concept of user-created classification and communication through shared metadata in the Web environment (Guy and Tonkin 2006). The term folksonomy was first coined by Vander Wal to denote a "practice of collaborative categorization using freely chosen keywords by a group of people cooperating spontaneously" (Quintarelli 2005, 5). Folksonomies feature prominently on a number of well-known Web-based information systems such as Amazon.com. Typically, such sites allow users to publicly tag and share their resources, so that they can not only classify information for themselves, but can also browse the information classified by others (Golder and Huberman 2006).

A folksonomy encourages users to organize information in their own way and involves users actively in the organizational system (Mathes 2004). In this sense, a folksonomy has the potential to serve as a Web classification that allows users to interact within a system and to participate in the development of a classification system on the Web. The interest in folksonomies arises from this relation between folksonomies and Web classifications, i.e., how a folksonomy differs from other types of Web classification and how users contribute to the development of a Web classification

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system. Despite increasing interests of a folksonomy in practice as well as in research, little has been done to build a solid conceptual framework to understand how people classify Web resources using a folksonomy. This paper attempts to articulate a conceptual framework that will help us better understand the structure of a folksonomy shaped by users' interactions.

To this end, this paper defines two dimensions of folksonomy: a folksonomy as a Web classification, and a folksonomy as information scent. The first dimension concerns how people use a folksonomy as a Web classification. The other dimension concerns how a folksonomy is structured through users' interactions, using information foraging and scent theory. These two dimensions will provide us a better understanding of tags as categories which put like things together, and as information scent which leads users to the information they seek and to interact with others in the context of a folksonomy. This paper aims to integrate these two dimensions of a folksonomy with a conceptual framework that addresses the structure of a folksonomy shaped by users' interactions. A conceptual framework consists of three different users' interactions with a folksonomy from users' points of view: tagging, navigation, and knowledge sharing. This unified conceptual framework might provide insight into the ways in which a folksonomy can reflect an interaction among users, a domain, and a classification structure. The proposed framework can be used to guide empirical research on users' interactions with a folksonomy.

I must first define the terms used in our discussion prior to addressing the dimensions of folksonomy. In this paper, the term "Web classification" is used to denote putting like Web-accessible resources, such as a photo, a blog, a Web site, or an article accessible on the Web, together. The concept of Web classification is generally used to describe Web-based information systems incorporating categories. For an example of Web classification, this paper widely refers to two kinds in practice: (1) implications of existing classification systems such as the Dewey Decimal Classification (DDC) and Library of Congress Classification (LCC) (e.g., DDC in NetFirst, CyberDewey, the Renardus Project); and (2) custom-built development of classifications (e.g., Wikipedia Contents Category, Open Directory Project). Here, this paper adds a folksonomy as a new kind of Web classification which is created by users with an emergent categorical structure. Section 3 describes the nature and structure of a folksonomy as a Web classification. To demonstrate how a folksonomy works as a Web classification, I will outline the classification theory that is shifted from a long standing classification approaches.

In order to better frame a users' interaction with a folksonomy, this paper also adapts an information foraging approach. Information foraging theory denotes adaptive information seeking behaviors of users within the human information interaction environment. When searching, people utilize a foraging mechanism evolved to help our animal ancestors find food (Chi et al 2001; Jacoby 2005). Information essentially has a scent and users rely heavily on information scent in order to optimize their search outcome; just as animals rely on local smell cues to make judgments about where to go next in pursing some preys (Pirolli and Card 1995). This paper refers "information scent" to a user's perception of the value and cost of accessing a piece of information based on the perceptual cues available to him or her. Section 4 outlines information foraging and scent theory to discuss how to identify users' interactions with a folksonomy.

With regard to the structure of a folksonomy, a "tag" refers to a keyword which people assign to Web resources with a purpose to share, discover, and recover them. The primary goals of this paper is to gain a better understanding of tag as a category that groups like things together as well as information scent, that is a primary navigation tool for finding relevant resources and people. For this purpose, therefore, these two terms, "tag" and "category," will be used interchangeably through the paper, especially concerning a folksonomy as a Web classification. The next section provides details on the approach to conceptualization of a folksonomy, tags, and the act of tagging.

2.0 Folksonomy, tagging, and tags

Because the folksonomy is implemented through tags, the term 'tagging system' is often used interchangeably. Users describe and organize pieces of information such as Web documents or photos with terms from their own vocabulary known as "tags" (Mathes 2004; Weinberger 2006). However, a folksonomy is clearly distinguished from tagging. Tagging is the process by which users assign one or more keywords (tags) to Web resources with a purpose to share, discover, and recover them, whereas a folksonomy is the grassroots classification that emerges from tagging.

Two generally recognized aspects of tagging make folksonomic mechanisms highly popular and useful in recent Web-based information systems. First, tagging is not restricted to authors or domain experts; anyone

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can produce tags. As a result, a folksonomy allows for diverse viewpoints of users who might tag the resource differently from the author or each other (Weinberger 2006). Second, tagging is social in that users are encouraged to publicly tag and share their tags and resources. Social tagging allows groups to form around similarities of interests and points of view. As soon as users assign a tag to a Web resource, they can see the cluster of related users and tags that are associated with the same resource. This instant feedback leads users to find and network with other users who are interested in the same topic.

Tagging collectively produces a larger classification system, a folksonomy. A folksonomy consists of a flat space defined by the set of tags with which a group of users tagged information resources. A folksonomy can be displayed through a tag cloud, a collection of the popular tags which the folksonomic system provides (see Figure 1) (Golder and Huberman 2006). This is an informal classification system. Categories are emerged in an ad hoc fashion from aggregated tags with contributions by any user who has access to information in the system over time (Shirky 2005; Weinberger 2006). Users classify Web resources using their chosen tags; in other words, tags act as categories grouping similar things together on the basis of similarity which they think useful at a given moment. Therefore, a folksonomy is distinct from formal classifications in which categories are defined only by properties that all members share.

There are a number of studies to evaluate these characteristics of a folksonomy. Previous studies have contributed to a general understanding of the structure of a folksonomy and tag usage. These studies mostly focused on the potential of a folksonomy and user-created tags for indexing and searching mechanisms. Various techniques have been used to bridge the gap between the existing controlled vocabularies (e.g.,› library classification and subject headings) and user-created tags in order to improve search effectiveness (i.e., Kipp 2007; Lin et al. 2006; Spiteri 2006; Trant 2006; Voss 2006; Xu et al. 2006). Such studies are often limited to consider a folksonomy and tags within a framework of directed searching or information retrieval. As Vander Wal (2007) points out, "tagging seemed to be working for finding things more from exploration and serendipity than through searching and intent." Some work has been done within a framework of browsing (Lerman and Jones 2007; Millen et al. 2007; Yun and Boqin 2008). Little is known, however, about the ways in which people interact with a folksonomy. This paper suggests a different angle to conceptualizing the structure of a folksonomy and the act of tagging, from an information foraging approach.

Figure 2 below illustrates our approach to conceptualization of a folksonomy and the act of tagging. The left side of Figure 2 indicates the scope of this paper and our interests in tags. In this paper, the concern is solely with the use of tags and a folksonomy in browsing or information foraging rather than directed searching or looking for a known target. For the purpose, tags are understood as categories and as information scent with respect to information foraging. This view is contrasting with the previous approaches that see tags as indexing and searching terms to improve search effectiveness in the framework of searching (the right side of Figure 2).

This paper explores how people use tags in organizing Web resources, specifically how they group

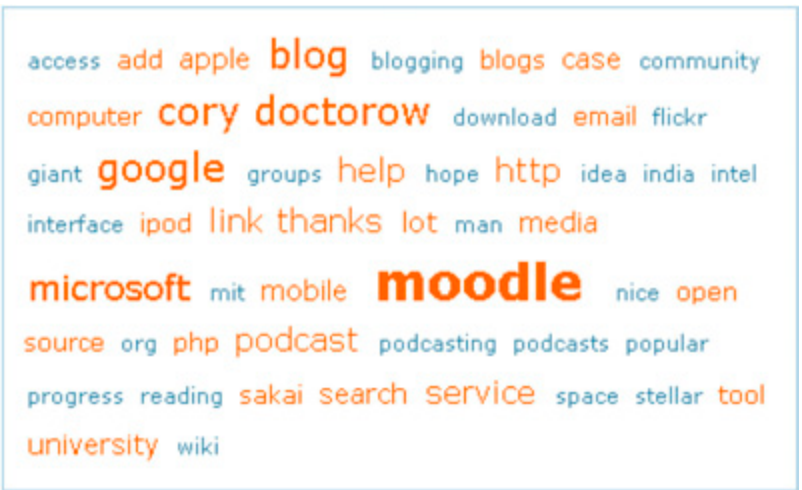

Figure 1. Tag Cloud

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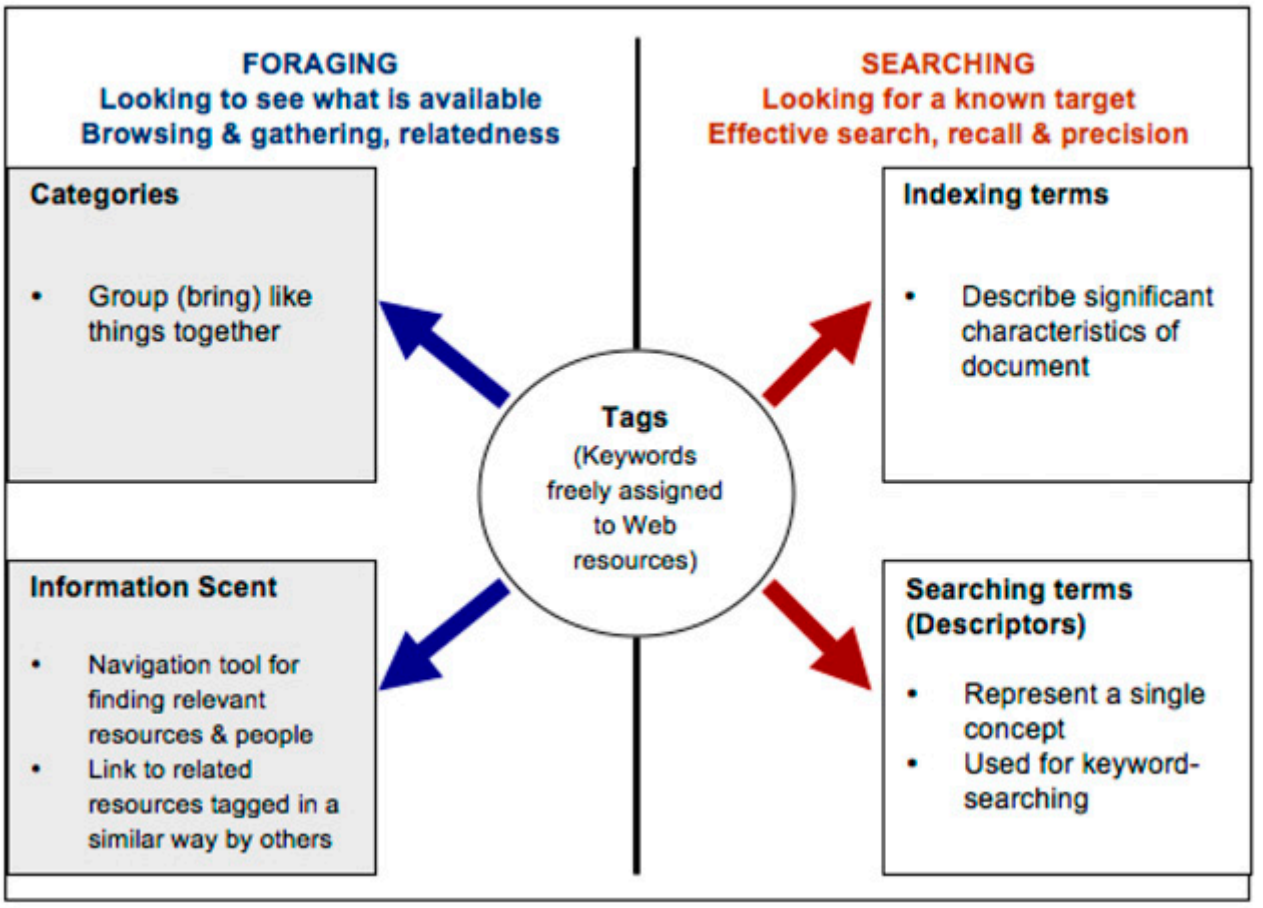

Figure 2. Approach to study tags

similar resources together through tagging. The approach to tags as categories proposes an alternative view of folksonomy which extends from traditional known-item retrieval capability to more exploratory and foraging capability. That is, rather than searching for resources by keywords (tags), users can gather and forage information through the tags assigned to collocate related information together.

This paper views tagging as being related to browsing and information foraging behavior because "people are constantly gathering, monitoring, and screening information around them as they go through daily life" (Rice et al. 2001, 8), in contrast to directed searching. In general, browsing is distinct from directed searching in the characteristics of the users' goals or tasks or their information needs. Browsing refers to the task of looking to see what is available, and searching refers to the task of looking for a known target (Furnas and Jul 1997). In the Web environment, browsing and searching are often referred to the terms, "navigation" and "querying" respectively. Olston and Chi (2001, 1) identify these two in terms of behaviors for locating information in the Web environment:

> Browsing is the process of viewing pages one at a time and navigating between them sequentially using hyperlinks. Searching is the process of entering a search query (usually a list of keywords) into a search engine, which produces a ranked list of links to pages that match the query.

Similarly, Marchionini (1995) distinguishes between browsing and searching as a general strategy. He defines browsing as being heuristic, which is dependent on recognizing relevant information. On the contrary, searching is analytic and depends on careful planning, recall of query terms, iterative query reformulations, and examination of results. He remarks that browsing is more dependent on interaction between the information seeker and the system because people continually guide themselves using browsing environmental cues. In this sense, browsing might not be an efficient strategy of locating specific infor-

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mation based on the criteria of precision and recall. It is more important that an information browser or forager recognize relevant information using classification and information scent than finding specific information quickly and precisely. Therefore, the primary concerns with tags are involved with their functions as categories and information scent to employ browsing and information foraging. The focus of this paper is on the conceptual issues that shape our understanding of tags as categories which put like things together, and as information scent, which helps users to find relevant information they seek.

3.0 Folksonomy as Web classification

3.1 Classificatory approach to folksonomy

In library-and-information science (LIS), classification is widely referred to as "putting together of like things" (Hjørland 2003, 103). In a narrow sense, this meaning of classification can be separated into two concepts: the process, namely classifying; and the product, a classification system (Kwasnik 1999). As a process, classification refers to the method of organizing information, which bring like information together on the basis of what they have in common. On the other hand, as a system, classification refers to a representational tool used to organize a collection of information resources. These two aspects of classification are separable but closely intertwined because "a full appreciation of the implication of classification systems for organizing information resources requires a basic understanding of the classification process itself" (Jacob 2004, 5). The definition of classification as the putting like things together is a broad definition. This paper adapts a broad definition of classification because the semantic ambiguities presented in folksonomies are not described accurately using the restricted bibliographic concept of classification, as mutually exclusive classes. A folksonomy requires a broad approach to the definition of classification based on the sharing of some similarity rather than of essential properties.

A thorough understanding of classification is based on the study of categorization (Iyer 1995). According to Iyer (1995), the classification process is often used with "categorization" in the literature because categorization is a fundamental human thought process and is the most natural way we know to organize information. Our conceptual structures are formed using categorization, and we experience and understand ideas and objects by grouping them in useful ways (Lakoff 1987). This process is reflected in the design of classification systems such that "the individual, idiosyncratic categories that each person forms are abstracted into more formal and general categories that can be logically perceived and used by anyone" (Iyer 1995, 88).

Theories of categorization have resulted in two distinct paradigms: the classical and the probabilistic (Iyer 1995; Jacob 1991, 2004; Lakoff 1987). The central assumption underlying the classical theories is that categories are defined only by a set of properties that all members share. Thus classical theory rests on three assumptions:

- The definition of a category is the union of the essential features that identify the memberships of that category;
- The defining features for a category are both individually necessary and jointly sufficient to define the category;
- Categories are nested, so that the subordinate category possesses all the features of the superordinate category (Iyer 1995; Jacob 2004; Lakoff 1987).

The classic theory has dominated our view of classification, informing and directing the systematic assignment of entities to classes according to an established set of principles. It leads to a formal classification system, or a hierarchical structure of fixed classes which reflect logical genus-species relationships. Classes should be mutually exclusive and totally exhaustive.

On the other hand, probabilistic approaches argue that the classical view of categorization can not account for the findings from empirical studies. Fieldwork in cognitive psychology and anthropology shows that category members need not share a common property (Lakoff 1987). Members can be similar to one another in different ways. According to Barsalou (1983), categories are defined solely in terms of how their members fulfill some desired goal or plan. For example, there are categories like "things to sell at a garage sale" and "things to take on a camping trip" which are spontaneously generated categories that group things in a goal-directed way (Murphy 2002). These goal-directed categories are ad hoc, and very little of the category structure is explained by necessary and sufficient conditions by which category members are defined. The central argument of probabilistic approaches is that human categorization is based on the nature of human bodies and our experience (Lakoff 1987).

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Probabilistic approaches emphasize that categorization is not merely a conceptual structure identifying the world, but a cognitive process closely associated with the individual perception. In particular, prototype effects, the conceptualization of a category by holding certain examples as ideals, are superficial (Lakoff 1987). Prototypes are influenced by culture and the environment, so people who hold different prototypes tend to think of categories differently and reach different conclusions. What constitutes a prototype category is also a matter of perspective, and thus may change as an individual's perception changes over time (Iyer 1995).

Looking at classification as this dichotomy of the classical and the probabilistic offers us a way to understand how people form categories and structure a folksonomy. In particular, probabilistic approaches provide us new insights on folksonomies in which idiosyncratic and communal categories coexist. Folksonomies allow users to classify Web resources in any sense which represents the way they perceive them with their chosen tags. Here, tags act as categories in terms of the structure of a folksonomy by bringing like Web resources together. Classifying is dynamic and creative, therefore idiosyncratic categories reflect the way an individual classifies things at the moment, to express his or her immediate information needs (Iyer 1995). In this sense, the tags that remind users of their projects and tasks (e.g., 'LIS2013' 'to read'), and those which could be only meaningful to the user including affective reactions (e.g., 'interesting' 'useful') are understood as idiosyncratic categories.

On the other hand, communal categories emerge in a collective pattern which seems to form from a nascent consensus (Golder and Huberman 2006). Communal categories are generated in a social context where users interact with each other. When users share their categories and contents, they tend to use the suggested popular categories, or imitate others' category formation (Campbell 2006; Golder and Huberman 2006; Shirky 2005). In most folksonomic systems, the user interface provides the immediate feedback from the community of users in various form of the aggregated tag use of all users. For example, popular tags for a given URL can influence the selection of tags by providing hints about how others have tagged the resource. As the empirical work of Golder and Huberman (2006) reveals, the communal category demonstrates important implications for the stability of the folksonomic structure using its social nature. The stable, consensual choices that emerge can be used on a large scale to describe how users see their relationship to the resource (Golder and Huberman 2006).

Unlike a formal classification system, a folksonomy generally does not provide hierarchical relations between categories. Instead, a folksonomy is a flat space in which related categories are automatically generated based on the similarity among tags given by their co-occurrence and the collaborative recordings of tags given to the same resource (Munk and Mork 2007). Categories are not rigidly bound but frequently overlapping; membership in one category does not prohibit membership in any other category because categories are not constrained by a requirement for mutual exclusivity. This conception is also well manifested by probabilistic approaches, which divides the world into groups of entities whose members are "in some way similar to each other" (18). Therefore, a folksonomy largely relies on an individual's ability to form the categories. Following Jacob's (2004, 519) conception of categorization, categories are apparently unstable, reflecting "a function of immediate context, personal goals, or past experience" of the individual. This plasticity may prohibit a folksonomy from being a persistent information structure.

3.2 Conceptualization of folksonomy as a reflective and interactive Web classification

The new concept of folksonomy has begun to extend a notion of classification beyond traditional classification to explain the semantic ambiguities presented in folksonomies. This section draws upon the potential of folksonomy to serve as a Web classification that allows users to participate in the development of a classification system and interact within a system.

A folksonomy has advantages as a reflective Web classification system. First, a folksonomy can directly reflect the vocabulary of users in the classification system (Mathes 2004). The strength of folksonomy is the ability of any given user to organize the world as he or she sees it (Guy and Tonkin 2006). Unlike the traditional classification systems undertaken by highly trained information professionals, using a scheme that may be biased (Olson 1998), all users can participate and contribute the category formation with their own tags in the structure of a folksonomy. Therefore, a folksonomy can reflect the users' conceptual model more accurately (Macgregor and McCulloch 2006). A folksonomy allows the variety of category definitions and the corresponding variability of category memberships as a reflection of immediate con-

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text. Because idiosyncratic views can co-exist and thrive in the form of idiosyncratic categories in the folksonomy, a folksonomy can discover the variety of users' needs and views without a singular or authoritative cultural, social, or political bias.

More importantly, a folksonomy provides useful social network as users share tags and resources. There exists a network among users, Web resources, and tags in the folksonomy (Cattuto 2006; Van Damme et al. 2007). A user creates the association between tags and resources by assigning tags to that resource; each tag serves as a link to additional resources tagged the same way by others. As a result, users are indirectly linked with others by sharing the same tags and/or resources. Through this complex network among shared tags, resources, and users, a folksonomy offers the opportunity for users to more easily discover others who have similar interests and to learn of their resources. This implies the potential of a folksonomy to represent a community that shares interests. Many folksonomic systems, including Biblsonomy, Flickr, and Connotea, provide the ability to join one or more groups, where users can engage in networking more actively. Through these social network applications, the users manage their references collaboratively, and agree to use tags which are appropriate for a given subject. In so doing, users can adapt to the norm of a domain or contribute to develop a shared semantic. Furthermore, this social aspect of a folksonomic system fosters the building of communal categories which reflect knowledge of a domain and stimulate knowledge sharing.

Additionally, through electronic methods such as the use of co-occurrence of categories and hyperlinks, a folksonomy supports findability of related resources when one browses resources classified by others. This is unlike semantic relationships which traditional classification systems employ, but instead, users are able to browse related tags and users through the folksonomic system. Users may also find other tags in the system with a close correspondence to the currently suggested tags. In particular, a tag cloud which displays popular tags serves as an effective navigational tool by providing a global contextual view of tags assigned to resources in system (Kipp 2007).

These potential benefits of folksonomies present an overall approach to construct or evaluate a Web classification which accounts for the interaction among users, a system, and a given domain. A folksonomy allows users to participate and contribute their own personal tags to generate a folksonomy; thus, a folksonomy can more accurately reflect users' conceptual models of the information around them. In addition, a folksonomy fosters the formation of a domain consisting of a group of users with the same interests through shared tags and resources. It leads to a shared classification structure which reflects the given goals, purposes and values of a particular domain. Lastly, a folksonomy supports users' browsing and serendipitous discovery of related information through the interlinked system of tags. The potential of folksonomy as a reflective and interactive Web classification has been discussed. In order to fully exploit this conception and support it, further empirical work is necessary to investigate how the folksonomy is structured through users' interaction. This leads us to our review of a folksonomy as information scent, which addresses how to identify users' interaction with a folksonomy.

4.0 Folksonomy as information scent: Information scent theory to understand folksonomic interaction

In the early 1990s, Pirolli and Card proposed information foraging theory as an approach to understanding human information-gathering and sense-making strategies. They report various studies of human interaction with information retrieval and Web systems based on information foraging theory (i.e., Pirolli 1997, 2002; Pirolli and Card 1995, 1999, Pirolli et al. 2005). Using empirical studies, they show that users in a rich information environment constantly weigh the potential information gained against the costs of performing a task necessary to find information. Users construct effective foraging patterns through continuously adapting decision-making and direction to the ever-changing environment.

In particular, when dealing with the complex context of the Web, information foraging and scent are understood as a significant factor in information seeking behavior. A few researchers attempt to provide a comprehensive explanation of Web information seeking behavior, integrating related models such as Ellis's six categories of information-seeking behaviors (Chi et al. 2000; Kalbach 2000; Choo et al. 2000). These studies demonstrate the rationale for creating information finding mechanism taken the information foraging and scent as a priori to Web information seeking behavior

With respect to information foraging, information scent is used to explain and predict users' Web information seeking behaviors. Users assess the utility of an information source in relation to other alternative

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sources (Pirolli and Card 1999; Spink and Cole 2006). In the Web navigation context, users follow the strongest scent for their desired information. And, if they somehow lose the scent (often by following a link that doesn't lead where they think it will), they have to loop back to pick up the scent all over again (Koman 1998). Thereby, information scent plays an important role in guiding users to the information they seek as well as in providing users with an overall sense of the contents of collections.

These previous studies provide strong support for the use of information scent to characterize information foraging behavior. The general findings tell us that models developed in this theory of information scent can (Pirolli 2002, 2):

- predict where people will navigate or what information resources they will select based on their information need;
- infer what information need they have, given observations of their navigation or information selections; and
- infer the category structure that people will induce from interaction with an information system.

Information foraging and scent theory presents us with a good understanding of Web information seeking behavior in general. In this context, folksonomic interactions are understood by realizing that people constantly weight information scent to optimize their interaction with a folksonomy. The empirical results of information foraging theory also demonstrate that information scent can be measured systematically, and such measurement can generate good predictions of Web interaction. However, this measurement of scent is not likely to help understand users' interactions because behavioral measures such as clickthroughs and log analysis merely tell us what works and what does not. Behavioral measurement should be employed with insight into user perceptions of information scent, or the manner in which they assess the environmental cues in judging information sources and navigating through information spaces.

Only few studies have explored information scent from a perceptual approach (Sundar et al. 2007). It is necessary to study users' perception and awareness of information scent in order to better understand users' interaction with the Web. In particular, folksonomies provide a relatively new information structure, and folksonomic interactions are little known. It is still questionable how users interact with a folksonomy in accessing, sharing and navigating Web resources, and how to explore the manner in which information scent facilitates information foraging behavior in a folksonomy. To address these questions, this paper suggests a qualitative approach to folksonomic interaction that is open to our awareness and perception.

5.0 Conceptual framework to study folksonomic interaction

In order to build a conceptual framework which reflects interactions among users, a given domain, and a classification system, the preceding sections have examined the dual concepts of a folksonomy as Web classification, and as information scent. Integrating these two, this paper suggests a conceptual framework for an empirical study to explore the structure of folksonomy shaped by users' interaction with a folksonomy. Figure 3 illustrates an interaction among users, a folksonomic system, and a given domain that consists of a group of users who share common interests or goals. It points to three components of a folksonomic interaction from an end user's view: (A) tagging - cognitive categorization and representation of a Web resource by an individual user; (B) navigation – exploration and discovery of a Web resource in the folksonomic system; and (C) knowledge sharing - representation and communication of knowledge within a domain.

When an individual user accesses a Web resource and classifies it by assigning tags or categories, the first interaction, (A) tagging—cognitive categorization occurs. For example, a user 1 assigns two tags 'Shirky' and 'folksonomy' to Shirky's 2005 article "Ontology is overrated: Categories, links, and tags." Using these tags, he classifies the article in his idiosyncratic categories 'Shirky' with other articles he perceives as similar such as articles by the same author and 'folksonomy' on the same topic of folksonomies. These idiosyncratic categories are only meaningful to user 1's interaction with Shirky's article. However, once these idiosyncratic categories become public and are shared with others, they become an interactive part of the folksonomy.

User 1's idiosyncratic categories ''Shirky' and 'folksonomy' aggregate *a folksonomy* that consists of other users' idiosyncratic categories for Shirky's article such as 'socialtagging,' 'toread,' and 'folksonomy'. The folksonomic system provides users with various forms of the aggregated tags of all users for that article. The system shows that 'folksonomy' is the most popular tag associated with this article through the use of tag cloud. The system also provides users instant feedback

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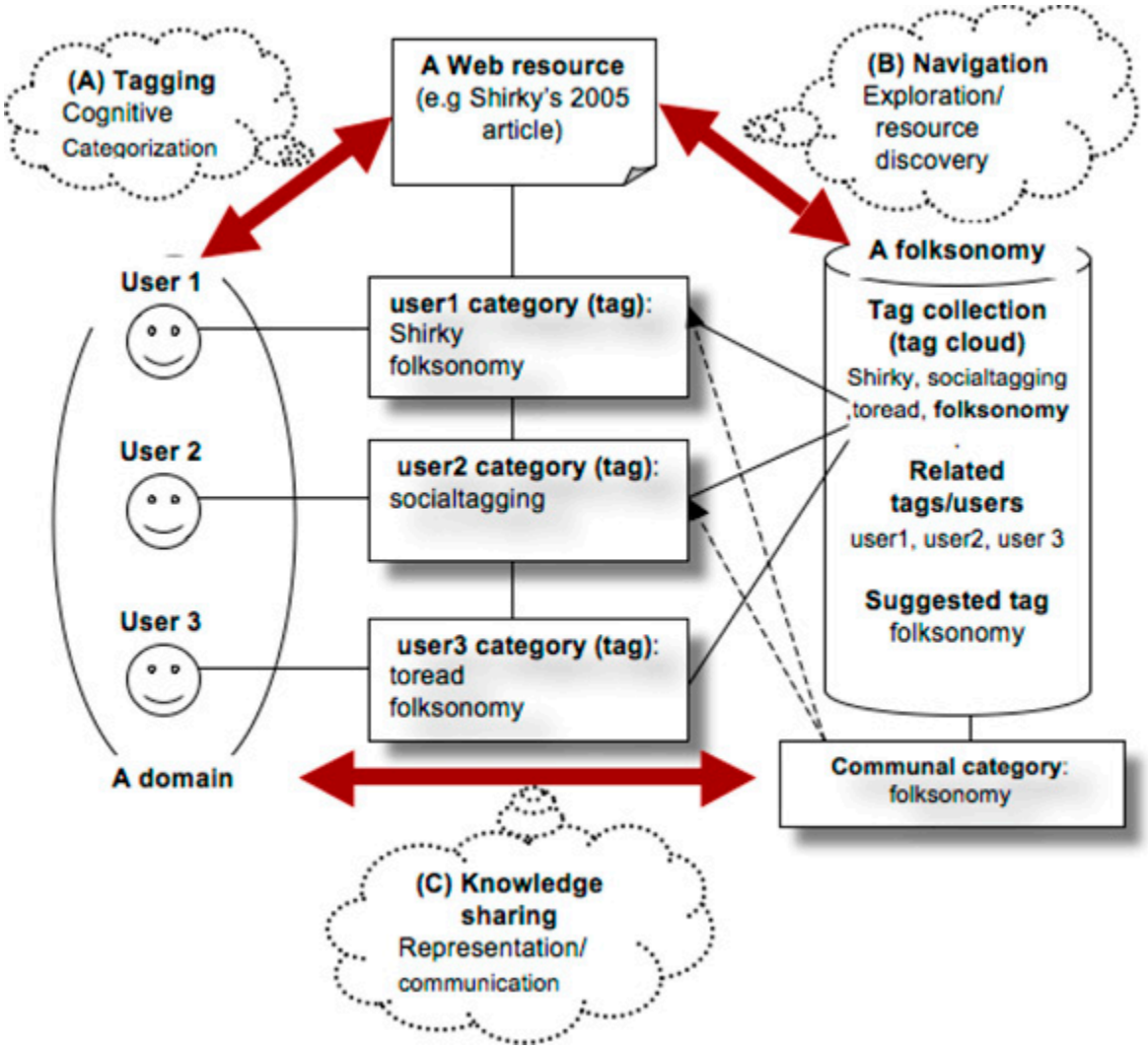

Figure 3. Folksonomic interaction

showing 'Related Users and Tags' and 'Suggested Tag' which are associated with Shirky's article. These are all related to a communal category that may influence users to add and/or modify their idiosyncratic categories. For example, through the tag cloud or suggested tag user 2 possibly discovers that 'folksonomy' is better than 'socialtagging' to represent the topic of this article in order to communicate with other users. And consequently, he may add and/or modify his category 'socialtagging' to 'folksonomy.' In this context, the category 'folksonomy' becomes a communal category which is generated in a context where users interact with each other. Through shared communal categories, a folksonomy supports users' (B) navigation–exploration and resource discovery.

In addition, while observing others' categories and sharing resources, a user group or domain which has the same interests, goals, or tasks may be established. For example, users 1, 2, and 3 can build a specific domain that is interested in sharing and communicating their knowledge on the topic of folksonomy through the folksonomic system. Here occurs an instance of (C) knowledge sharing- representation and communication in which the folksonomy works as a representational tool for a given domain. The folksonomy has grown up around a given domain of users who want to share their knowledge, creating a widely agreed upon classification.

Taking information foraging and scent theory as the theoretical framework, Figure 4 depicts how a folksonomy and tags are able to function as information scent. Through shared tags, folksonomies are able to provide users with a distinct information scent that leads to groups of Web resources in relation to

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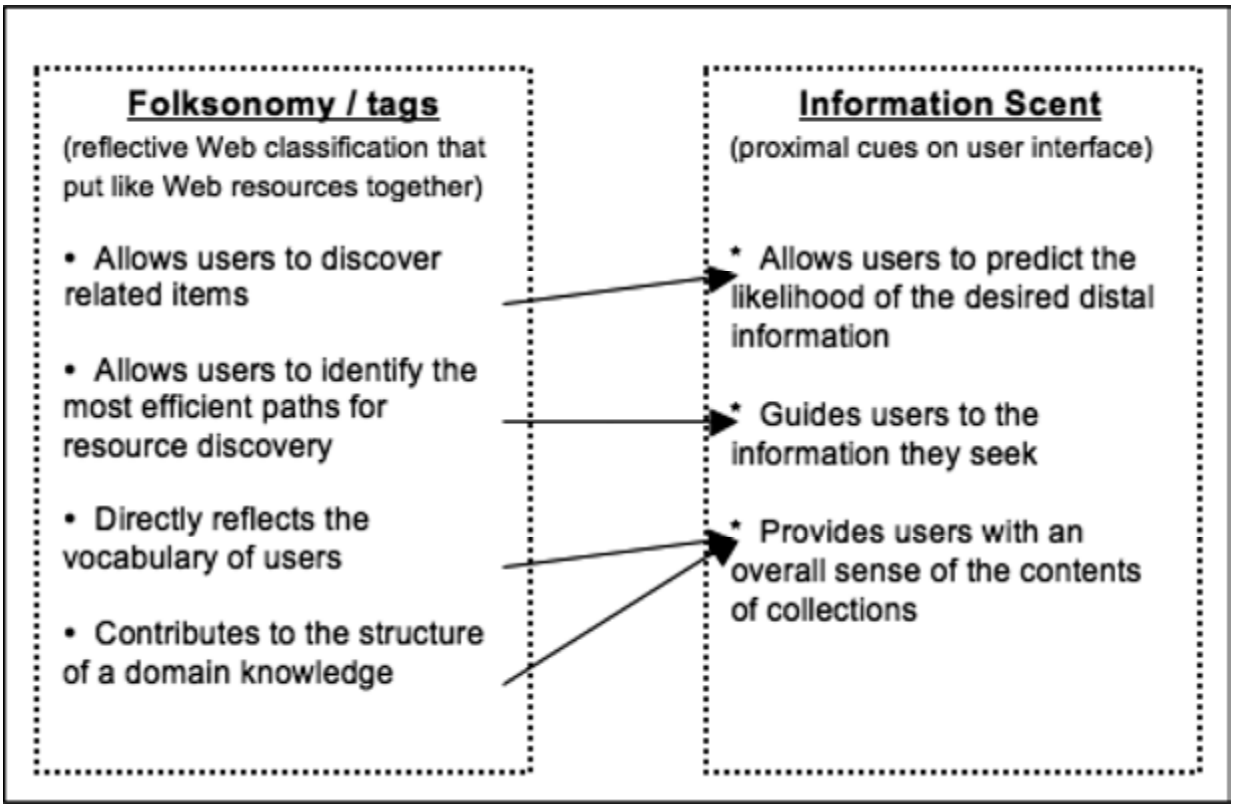

Figure 4. Folksonomy and tags as information scent

the information they are searching for, by grouping related resources and users together. Based on information foraging and scent theory, users' awareness of the role of tags as information scent should be further explored through empirical studies.

6.0 Discussion: Need for conceptual framework which can be formed by qualitative research on folksonomic interaction

Recently, there has been a considerable increase in the number of studies that explore the use of folksonomy, especially focusing on the formulation and distribution of tags (i.e., Fokker, Pouwelse, and Buitine 2006; Golder and Huberman 2006; Guy and Tonkin 2006; Kipp 2007; Kipp and Campbell 2006; Lin et al. 2006; Marlow et al. 2006; Tonkin 2006; Voss 2006). Most of these studies focus on how people formulate tags and folksonomy, and identify, based on a tag analysis, the pattern of tags used in a folksonomy.

This yields a one-sided understanding of a folksonomic interaction, drawn from the primarily quantitative aspects of a folksonomy including the distribution and pattern of tags. A quantitative approach does not yield any understanding of how users actually assign, use, and share tags in structuring a folksonomy. As Mathes (2004, 17) points out, "examining user behavior through ethnographic observation or interview to understand user motivation and cognitive processes in tagging items" is necessary to fully understand a folksonomic interaction.

A qualitative approach allows us to clarify the other side of a folksonomic interaction, in other words, users' perceptions and motivations. In particular, interviews enable the researcher to identify what factors directly influence the formation of a folksonomy, and how the motivation of group communication influences users' interaction with a folksonomy (Mathes 2004). Trevino (2006) provides an interesting analysis of the users' perceptions of the information they organized and the implications of Delicious's structure. She conducted face-to-face interviews with 16 participants asking their browsing activities, history of using Delicious, interactions with others on or about Delicious, general opinions or questions about Delicious and other users, and performed a content analysis of their comments. Her study identified the tensions between using Delicious for the purpose of a personal information archive and for public discovery, as well as those between personal privacy and the social norms of openness among users. The results are an important first step in the

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	Description of study	Folksonomic system	Data analysis	Data collection period
Fokker, Pouwelse, & Buitine (2006)	Comparative study of Flickr & Wikepedia (the nature of tags)	Flickr Wikepedia	Tag analysis (Ambiguity, synonyms)	Dec. 2005
Golder & Huberman (2006)	Tag usage pattern	Delicious	Tag frequency Regularities in user activity Types of tags Bursts of popularity in bookmarking	June 23-27, 2005
Guy & Tonkin (2006)	Tag usage pattern (Power law) Tag literacy	Delicious Flickr	Tag popularity Tag distribution	N.R.
Kipp (2007)	Types of tag (non-subject tags)	CiteULike Connnotea Delicious	Tag analysis (Types of tags:Time, task, emotion related tags)	Oct. 20-31, 2006
Kipp & Campbell (2006)	Tag usage pattern	Delicious	Frequency of tags # of unique tags # of users with a specific tag for each URL Count of the total # of tags & total # of unique tags for each URL	Jan. 30-31, 2006
Lin et al. (2007)	Nature of tagging	Connotea Flickr Delicious	Connotea: Similarity between tags & MeSH Flickr: category assignment for the user tags Delicious: Convergence of tags	N.R.
Marlow et al. (2006)	Tag usage pattern	Flickr	Usage correlation Distribution of tags Overlap of tag distribution for random users & contracts	N.R.
Sinclair & Cardew-Hall (2008)	Users' perceptions & usage patterns of interface design (Tag cloud)	Folksonomy-like system designed for experiment study	Experiments & survey (Task-based evaluations w/ 89 participants)	Aug. 17, 2008-May 25, 2006
Trevino (2006)	Users' perceptions on the information on Delicious & the implications of the site's structure	Delicious	User interviews (w/ 16 participants) Content analysis	Feb.-March, 2006
Voss (2006)	Nature of tagging (Comparison of structural properties among tags thesauri, & DDC)	Delicious Wikipedia	Descriptors per record Records per descriptor Descriptor levels	N.R.

Table 1. Summary of folksonomy studies

analysis of users' understanding and usage of a folksonomic system from a qualitative approach. However, the study focuses more on how people generally understand and use Delicious, rather than their actual activities of tagging or use of tags. It is important to examine the cognitive and behavioral aspects of folksonomy uses. What is the tagging behavior of people who use folksonomies? Why do people choose the tags they use; what motivations lead them to modify these tags; how do others' tags and tagging behaviors affect their tag decision? Until we understand more about the users' tagging behaviors, how they assign, use, and share the tags and their resources, it is difficult to understand fully their folksonomic interactions.

In addition, currently folksonomy studies focus on discussing issues involved with users' tagging activity

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and suggesting an agenda for further research. Despite increasing attention in academic research, little empirical research has been done to build a conceptual model in order to understand users' interactions with a folksonomy. In discussing folksonomy research, Macgregor and McCulloch (2006) point out the lack of a theoretical framework. They note that "[the] lack of conceptual progress has consequently manifested itself in a lack of testable conceptual models and empirical studies" (Macgregor & McCulloch 2006, 299). This paper, therefore, suggests to investigate the structure of folksonomy based on a solid conceptual model from a qualitative approach to better understand users' interaction with a folksonomy.

7.0 Conclusion and future directions

The twin dimensions of folksonomy as both Web classification and information scent provide useful insight into the ways in which folksonomy serves as a Web classification that reflects an interaction among users, a domain, and a classification structure. This paper addresses tags and the act of tagging involved with the structure of folksonomy. This paper claims tagging as being related to information gathering and browsing behavior because people are constantly gathering, monitoring, and screening information when using a folksonomy. Tags usually serve as categories, grouping like resources together. They collocate resources within a user's personal collection, as well as across the entire folksonomic system by showing all resources that are tagged with the same term by any member of the folksonomic system. Shared tags also function as information scent, guiding users to the information they seek and helping them to predict which resources will be pursued.

This approach to tags as categories and information scent can contribute to folksonomy studies, which have most currently focused on the function of tags in information retrieval. There has been concern with the quality or consistency of user-created tags, and the extent to which they will impact effective search and retrieval efficiency. Such approaches mostly limit to investigation of communal categories for knowledge sharing. The proposed model for folksonomic interaction, thus, suggests investigating both idiosyncratic and communal categories in order to explore a holistic view of folksonomy. This is especially important with respect to folksonomy structure, addressing how idiosyncratic and communal categories interact with each other.

The conceptual model this paper proposed will require an empirical investigation of users' interactions with a folksonomy. An understating of how people use and understand a folksonomy in practice has a potential to provide a realistic view of folksonomy as a Web classification, helping to lay the foundation for future research. Future work will involve testing the current conceptual model in various application practices, and developing methods to examine users' engaged experience and reflection. One area of future research is examining the tagging behaviors of users engaged in the folksonomic interactions. It will address how people are tagging in the practice of organizing Web resources, and how they are interacting with a folksonomy through tagging, identifying their motivation and cognitive processes in tagging Web resources.

Various research questions can arise from this proposed framework; for example, what activities are involved when people assign tags to Web resources? What are the observable patterns in the tagging process? Why do people choose tags they use? Do they consider others' tags and tagging behaviors? If so, how does it influence their tags and tagging behaviors? Qualitative research is appropriate to investigate the little known phenomena involved with the tagging behaviors of users engaged in the folksonomic interaction. Data collection and analysis incorporating interviews and observation will allow us to identify users' perception and interactions which determine their tagging behaviors and folksonomic interaction, and their understanding of folksonomy which they work with in organizing Web resources.

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