Towards Organized Search and Unexpected Discoveries: The Impacts of Product Tags and Featured Users on Online Product Search

Cheng Yi
National University of Singapore, yicheng@comp.nus.edu.sg

Zhenhui Jiang
National University of Singapore, jiang@comp.nus.edu.sg

Izak Benbasat
University of British Columbia, izak.benbasat@ubc.ca

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Completed Research Paper

Cheng Yi
National University of Singapore
13 Computing Drive, Singapore
yicheng@comp.nus.edu.sg

Zhenhui Jiang
National University of Singapore
13 Computing Drive, Singapore
jiang@comp.nus.edu.sg

Izak Benbasat
University of British Columbia
2053 Main Mall, Vancouver, Canada
izak.benbasat@ubc.ca

Abstract

Consumers are increasingly sharing product interests and experiences with others on websites. For example, consumers can “tag” products using their own words and these “product tags” are then aggregated and shared with other online consumers who seek for information. In addition, highly experienced and influential information contributors on websites are often highlighted as “featured users” and serve as direct information sources. This study examines the effects of these two distinct design mechanisms, i.e., product tags and featured users. While the former facilitates feature-based product search and evaluation, the latter facilitates people-based product search and evaluation. We constructed experimental websites using actual data from one of the largest social-network-based product-search websites in China. The results show that information seekers perceive their product search experience as highly diagnostic when product tags are provided. When both product tags and featured users are present, information seekers feel that the product search is serendipitous.

Keywords: User-generated contents, Web 2.0, social media, product tags, featured users, information foraging, perceived diagnosticity, perceived serendipity
**Introduction**

Over the past few years, collaborative platforms (e.g., Wikipedia, del.icio.us, digg.com, technocrati.com, flickr.com, thisnext.com, flixster.com) where people share knowledge, interests, bookmarks, product consumption experience, etc. have become increasingly popular. Instead of simply going out to shop or contacting friends for advice, people are reading or writing reviews, seeking information, and constructing their personal networks on popular websites. By facilitating access to user-generated contents, Web 2.0 has become a democratic, personalized, and do-it-yourself medium of communication (Turban et al., 2007, p812).

This study focuses on a particular type of e-commerce websites that allows individuals to share their opinions and interests about products or services, and to make further use of this information for facilitating product search, evaluation, and social networking. We label these websites social product-search (SPS) websites. For example, Yelp.com allows users to search and provide reviews for restaurants, shopping malls, etc., and facilitates connections between food lovers or shopping aficionados. Flixster.com encourages users to share their favorite movies, and facilitates movie search based on social networks. Although different SPS websites have different foci in terms of products and system functionalities, user-generated product information and social networking are always essential components.

In particular, many SPS websites allow community users to “label” products using their own words, so that products are indexed by various descriptive keywords, i.e., tags. For instance, on Amazon.com, the web page of the book “Gone with the Wind” shows that the book has been tagged by the online community as “historical fiction”, “American classics”, “civil war”, “great romance”, “women”, etc. Various community users can agree on the meaning of a certain tag and tag a particular product with the same word. Hence, for a particular product, every tag is associated with a number indicating how many people have used this tag for this product. Tags of different products are then interconnected to facilitate browsing of relevant products along tagged features. This represents the website’s ability to support product connectivity and navigation based on user-defined product dimensions. For example, if an information seeker wants to look for more civil war fictions, she can click on the “civil war” tag and be directed to a list of books tagged with “civil war” by the online community – including “Cold Mountain”, “Shades of Gray”, “Gone with the Wind”, and many others. Information seekers can then click on any book in the list and examine it in detail. This practice of collaboratively creating and managing keywords to annotate and categorize contents or products by consumers has attracted much research attention. For example, studies have investigated people’s incentives for tagging (e.g., Ames and Naaman, 2007), the linguistic properties of tags (e.g., Veres, 2006), and the growth pattern of tags on websites (e.g., Gold and Huberman, 2006). However, questions remain that how the presence of product tags shapes information seekers’ linear or non-linear search behavior1.

While product search and evaluation based on tags essentially relies on the direct and explicit product similarities along feature dimensions, many SPS websites also facilitate social connectivity so that information seekers can directly obtain product information from other community users (Hung et al., 2008). For example, Kaboodle.com and Stylehive.com feature the most experienced and influential community members who have provided useful information on displayed products. Information seekers can thus look for relevant information from these featured users through accessing their personal profiles. By clicking into their profiles, information seekers can get to know these users’ experiences and opinions about the focal products, which can be particularly specific and insightful in evaluating alternatives. They can also discover other diversified and attractive recommendations based on the rich experiences of the featured users (Burt, 2004). Researchers are paying increasingly more attention to featured users or “gurus” of online communities because of their disproportionately large influence on other users (e.g., Gyongyi et al., 2008; Hung et al., 2008; jurczyk and Agichtain, 2007). Related studies have primarily focused on the characteristics of these users’ social networks (e.g., Kratzer and Lettl, 2009), their roles in companies’ marketing initiatives (e.g., Luethje et al., 2005), and the empirical validation of their commercial impacts in various industries (e.g., Franke et al., 2006). But it is still unclear that, in the context of SPS websites, whether and how the social connections with those experienced community users can be truly useful to consumers’ product search.

Overall, unlike other e-commerce websites, SPS websites make use of user-generated contents to facilitate information seekers’ online activities. Just like in real life, where one makes a purchase decision by either

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1 In this paper we use “information seekers” to refer to visitors of social product-search websites who want to search, browse, and/or investigate products.
comparing products in directories or simply asking knowledgeable others for a recommendation (Ratchford et al., 2003), people can also search and assess products on SPS websites based on product attributes or by following advice from experienced community members. The presence of product tags and featured users thus support the two distinct ways of information search – product-feature-based and people-based. With different kinds of search cues in the online environment, information seekers may follow specific paths and find exactly what they intended to look for, or they may trace down non-linear paths, enjoying exploration in unanticipated directions and pleasant surprises. As a matter of fact, website navigational cues which facilitate information seekers’ product search in different ways are usually considered in isolation. Yet it may be fruitful to consider their complementarities, because by putting them together we may obtain a more complete picture of how information seekers forage information in the social Web. Accordingly, the objective of this study is to examine the individual and joint impacts of product tags as well featured users on an information seeker’s product search experience.

In the following sections, we first explain the major theoretical foundation of the study. Hypotheses are then proposed, followed by a description of research methodology and data analysis. Results are then reported and discussed. Finally, implications and future research directions are addressed.

**Theoretical Foundation: Scent-based Information Foraging**

Individuals who try to choose a product from among a number of alternatives often go through a constructive search process where their preferences are constructed and adjusted depending on the information environment (David et al., 2007; Payne et al., 1992). During this process, they gather a number of promising options and evaluate them in detail before committing to a final choice (Haubl and Trift, 2000; O'Keefe and McEachern, 1998). The stream of research in adaptive information foraging is thus relevant to this study.

Information Foraging Theory has been utilized in human-computer interaction (HCI) research to understand human information-seeking and sense-making behavior (Pirolli and Card, 1999; Priolli, 1997). The premise is that an individual usually does not just blindly stay with a fixed search path based on her a priori perceptions; instead, as she encounters more information during the course of the search, she will dynamically identify promising paths and then adjust them towards more suitable ones. Accordingly, in an online context, an individual’s information seeking behavior is largely shaped by the cues and affordances in the information environment (Lynch et al., 1991; Pirolli, 2007). For example, hyperlinks (and the associated text labels, thumbnail pictures, etc.) on websites are a common type of information cue to direct information seekers’ search behaviors. Meaningful cues on a web page match seekers’ information needs or evoke new search ideas, so that seekers are willing to follow these cues to get to promising information. Information scent is thus proposed as a measure of information seekers’ subjective sense of the extent to which navigational cues appear to be related to their information needs (Pirolli and Card, 1999; Priolli, 1997). In an increasingly socialized online environment, for example, the wide appearance of user-generated indices allows information seekers to explicitly recognize and locate useful paths based on traces of their peers, thus conveying strong information scent (Zhang et al., 2009). Overall, information seekers will continuously forage and assess the scent of the information cues, identify and adjust their search directions “on the fly”, and carry out scent-based navigation (Pirolli and Card 1999; Pirolli 2007, p89).

Hence, information search is a highly adaptive process. Online information seekers dynamically structure their search and decision process based on the available navigational cues. Interfaces with rich navigational cues and effective content grouping can thus support different strategies based on different information requirements (Pirolli and Card, 1999).

**Hypotheses Development**

**Product Search Process: Diagnosticity and Serendipity**

As noted by King and Hill (1994), the information gathering process must be distinguished from the decision outcome, and it is the process that shapes the ultimate decision. In this study, we are interested in how design mechanisms of SPS websites direct information seekers to search and discover products.

One important facet of a product search process is for information seekers to find relevant alternatives, unambiguously evaluate and compare them based on available information, and ultimately make an informed
choice. A key concept here is perceived diagnosticity, previously defined as the extent to which a site visitor believes that a website is helpful in terms of evaluating a product’s attributes (Jiang and Benbasat, 2004; Kempf and Smith, 1998; Pavlou and Fygenson, 2006). In the current study, as we focus on the overall product search process rather than evaluating individual products, we define perceived diagnosticity as information seekers’ perception of the extent to which an online product search experience helps them systematically and effectively search and compare relevant alternatives until reaching a final choice.

Also, scent-based information search implies that information seekers’ ultimate choices may not necessarily closely relate to their original intention (Payne et al., 1992; David et al., 2007). In other words, since information seekers usually work with a set of malleable and adaptive preferences that are sensitive to the information in the environment, there is an opportunity for serendipity, i.e., when seekers acquire something useful from an interaction without prior expectation (André et al., 2009; Nikolaeva and Sriram, 2006; Toms, 2000). Akin to the role of serendipity in scientific breakthroughs and discoveries, such serendipitous encounters are usually enriching and rewarding (Ross, 1999; Toms, 2000). Hence, we also look at information seekers’ perceived serendipity of the search experience, i.e., the extent to which the experience allows them to stumble across interesting findings which are beyond the initial search plan.

**Effects of Product Tags on Perceived Diagnosticity and Perceived Serendipity**

When tags are presented on a product’s page, they represent a community-constructed and comprehensive summary of product characteristics (Hsieh et al. 2008). For example, at Thesnext.com, a dress can be tagged with “strapless”, “black-and-white”, “bubble dress”, “above-the-knee”, “evening dress”, “homecoming dress” etc., indicating the diverse and fine styles of the dress and its dressing occasions. Having different set of tags thus directly signals the fine differences among products. In addition, the popularity of each tag, as indicated by its frequency count, provides a quick indicator of community agreement on the specific product feature. Since group behavior is an influential force in human decision making (Cialdini, 1993; Giner-Sorolla and Chaiken, 1997), the provision of such popularity information may also help reduce information seekers’ uncertainty when assessing alternatives. For example, if two dresses are both tagged as “evening dress”, then the one having the higher frequency count for this tag may hint information seekers that it is a more popular evening dress than the other.

Apart from serving as descriptors of individual products, tags also interconnect related products. In other words, a product-to-product network is formed via tags, revealing the relationships of products in the web space (Hsieh et al., 2008). Tags thus play an important role in organizing the product space along diverse product attributes (Ames and Naaman 2007; Pirolli 2009) and serve as high-scent navigational cues on websites (Kalbach, 2007; Zhang et al., 2009). This is because tags are consumers’ direct “consumption vocabulary” pertaining to products (West et al., 1996) and tracing these tags leads information seekers to related alternatives which closely possess the very quality they are looking for. Following the previous example, if the tag “bubble dress” of a particular product has also been applied to other products, then information seekers who are interested in bubble style dresses can click on this tag and be directed to a list of other bubble style dresses as identified by the user community. In this way, information seekers can consider groups of similar, highly relevant items along identified dimensions together, making the evaluation and comparison highly coherent. Past studies have also found that in this case, processing cost will be relatively low as compared to choosing among a less coherent product set (Shugan 1980). Seekers will then have the capacity to gather more relevant information for careful deliberation and comparison (Biggs et al., 1985; Payne et al., 1993).

Overall, tags as diverse and collective product descriptors may facilitate a quick understanding of products, and moreover, product connectivity enabled by tags can facilitate a coherent search and decision process. Therefore, we propose,

**H1:** SPS websites with product tags will lead to a higher level of perceived diagnosticity of the product search process than those without product tags.

Concurrent presence of a diversity of ideas usually stimulates people’s cognitive processes and interest spaces so that people tend to discover much more than they were initially looking for (Björneborn, 2008; Foskett, 1983). This can be especially prominent in a hyperlinked environment where scent-following adaptive search is a norm due to easy and immediate webpage switch. Like over-the-horizon radar, a diverse and comprehensive set of product tags may reveal to information seekers previously unforeseen product dimensions. The new product descriptors encountered may stimulate seekers’ latent interest and lead to subsequent change in their search and evaluation foci.
For example, an information seeker initially looking for a juicer may first follow the tag “juicer” and get to examine a good juicer product. But this juicer product can be associated with other tags such as “healthy eating”, which appear attractive to her since she realizes her latent interest in cooking healthy food at home. If products are connected via tags, she may treat this juicer as an anchoring point and follow the “healthy eating” tag to a list of relevant kitchenware products. She may then find many other useful and interesting products, such as a machine to make home-made all-natural peanut butter, which would be quite appealing if she happens to like peanut butter. Hence, she may end up buying a peanut butter machine. Such discovery would not have been possible if the information seeker did not recognize a particular latent interest during the exploration (e.g., healthy eating) or did not have a relevant search path like that provided by tags. Hence, the flexible and diverse tag-based product connectivity may enable information seekers to recognize their latent interests and pursue these interests immediately. Indeed, this represents a form of “faceted” and “pivot” browsing (Millen et al. 2006), i.e., information seekers can reorient search paths at any moment through explicit and diverse cues to access relevant alternatives. Mathes (2004) and Quintarelli (2005) have also suggested that interlinked tag sets are likely to increase opportunistic and often interesting discovery that would be unattainable without them. Therefore, we propose,

\[ H2: \text{SPS websites with product tags will lead to higher level of perceived serendipity of the product search process than those without product tags.} \]

**Effects of Featured Users on Perceived Diagnosticity and Perceived Serendipity**

Besides accessing mass-market discoveries by following tagged product dimensions, people also tend to seek advice directly from experienced individuals. Effective knowledge dissemination is usually facilitated by those experienced individuals because of their product knowledge and rich experience not available in others (Chaiken et al., 1989; Pirolli, 2007). Some SPS websites highlight “featured users”, i.e., those who actively provide useful comments and recommendations to other users based on their rich product experiences (Hung et al., 2008). For example, Yelp.com and Flixster.com provide links to particular experienced users who have made useful comments on the product being displayed. Through these links, information seekers can access these users’ personal profiles, which usually include the owners’ comments on the focal product as well as other high-quality recommendations. Accordingly, links to features users often serve as navigational cues with strong information scent as they usually attract information seekers to seek for more advice via a click. For example, someone examining a particular restaurant would probably like to know the opinions from the experienced visitors of this restaurant. Hence, connectivity with featured community members facilitates learning from experienced users and benefits product evaluation and comparison (e.g., Borgatti and Cross, 2003; Nebus, 2006). Therefore, we propose,

\[ H3: \text{SPS websites that present featured users will lead to a higher level of perceived diagnosticity of the product search process than those that do not present featured users.} \]

Highly experienced users of an online community have usually detected and exploited many attractive opportunities and organized their diverse findings in the profiles in their own preferred ways. Visiting these users’ profiles may at times broaden information seekers’ search scope but may not obtain options strictly convergent to their original needs. For example, an information seeker browsing a stylish French restaurant may access the profile of a featured user who has given a thorough review on this restaurant. This profile, however, may include this featured user’s personal restaurant recommendations – such as “my favorite big-night-out restaurants”, or “fanciest restaurants in the bay” – prompting the information seeker to consider a wider variety of restaurants serving different cuisines. Hence, with the presence of featured users, information seekers’ search path can become largely explorative and discretionary, making it more conducive to serendipitous discovery. Just as previous studies have suggested, serendipity travels in good social networks because people with adequate knowledge may provide unexpected solutions during social interactions (Nahapiet and Ghoshal, 1998, p258). Establishing social connectivity with featured users is thus expected to help information seekers think “out of the box” and recognize their latent interests, and make unexpected interesting discoveries (Granovetter, 1983). Therefore, we propose,

\[ H4: \text{SPS websites that present featured users will lead to a higher level of perceived serendipity of the product search process than those that do not present featured users.} \]
The Disparity and Complementarity of Product Tags and Featured Users

As mentioned earlier, information search and processing is usually an adaptive process. Upon inspecting a product, information seekers may treat it as an anchoring point from which they trace high-scent navigational cues to obtain more information about this product and other related products. As more information unfolds, seekers may recognize other comparable options and directions, which are then evaluated against previous findings and serve as new anchoring points for subsequent search. Product tags and featured user links are both navigational cues that play a role in this process, though they facilitate product search and evaluation in different ways. Tags are created to describe various aspects of a product; hence, search following a tag leads to alternatives closely related to the current product in terms of the tagged attribute. The presence of product tags could thus facilitate structured and convergent information processing as information seekers can easily follow an agenda to search for similar alternatives and conduct normative comparisons (Shugan 1980). In contrast, information from featured users’ profiles will be more freely-structured, which may bear relatively loose connection to the initial search criteria. Some emerging information may be unexpected but appear interesting to seekers, which likely lead subsequent decision criteria and information search to depart from the initial intention. This makes it a less structured and divergent discovery process which does not strictly follow a particular agenda.

Indeed, convergent and divergent information behaviors have long been recognized as the two distinct approaches of human reasoning and problem-solving (Guilford, 1967). While convergent information search yields findings that are accurately and logically related to a defined criterion, divergent search leads to more dissimilar or cross-domain findings. Empirical studies have shown that in real life, these two types of behavior are usually mixed, complementing and reinforcing each other (Björneborn, 2008; Ford, 1999). On the one hand, divergent search usually proceeds to a significant degree via convergent thought processes, as identifying central interests enables users to better integrate resources and recognize the potential value of diversified findings (Ford 1999). Just as “chance favors the prepared mind” suggests, if users have a questioning mind entailing certain aspects of interest, they will be more willing to explore and able to effectively link the unexpected, diverse encounters to their needs (Csikszentmihalyi and Sawyer, 1995; Ford, 1999; Van Andel, 1994). On the other hand, diverse information encountered may entail the need for more organized and convergent processing, because in doing so, deeper understanding can be achieved to ensure the appropriateness of the unexpected information (Björneborn, 2008; Gale, 2001). In sum, one type of information foraging behavior may enhance users’ capacity of engaging in the other. When both are facilitated, users may become motivated to explore information more extensively as compared to the simple aggregation of their individual effects.

Accordingly, based on the contrasting styles of information foraging behavior facilitated by product tags and featured users, we expect their co-presence to improve, in a non-linear way, the information seekers’ ability to search and integrate information. Specifically, product tags allow information seekers to explicitly identify preferences, which could then serve as anchors to accommodate and discover the potential value of other divergent findings (André et al., 2009; Ford, 1999). Being able to search and compare products along identified preferences in a structured way also gives information seekers the capacity to incorporate more information, thus motivating them to be more explorative (Shugan, 1980; Biggs et al., 1985). On the other hand, connectivity with featured users provides access to insightful product information as well as unanticipated diverse alternatives. These new alternatives may also bring out new product dimensions not considered before, e.g., as elicited by their tags. The more structured and convergent search based on these tags will then be highly appreciated as information seekers can coherently investigate related alternatives along the new dimensions.

Overall, product tags and featured users may serve as “catalysts” for each other’s impacts by encouraging information seekers to engage in the other type of information behavior to support the current activity. Together, they create a synergy in facilitating information seekers’ product search, over and above a mere aggregation of individual effects. Therefore, we propose,

H5: There is a synergistic interaction effect between product tags and featured users on the perceived diagnosticity of the product search process, i.e., their individual impact will be amplified with the presence of the other.

H6: There is a synergistic interaction effect between product tags and featured users on the perceived serendipity of the product search process, i.e., their individual impact will be amplified with the presence of the other.
Research Methodology

Experimental Website Design

An empirical study was conducted to test the hypotheses. To enhance the realism (Singleton and Straits, 1999, p194) and the generalizability of the findings, we collaborated with one of the largest social product-search websites in China, Dianping.com. This website combines reviews, tags, and social networking functionality for consumers to search and discuss local businesses, consisting mainly of restaurants and other dining services. Dianping.com shared with us their database about around 1000 restaurants in Shanghai and over 60,000 registered users in Shanghai2—a data fragment that forms a well-connected social network clique. To remove brand identification of the website, we developed our own experimental websites by adopting a different interface style, such as color scheme and page layout, as well as a different domain name. Specifically, from the main page, users could search and browse all the restaurants featured on the website. Each restaurant information page shows an objective description of a restaurant, such as its name, detailed location together with Google map, telephone numbers, a picture of the restaurant, as well as all the individual user reviews and an overall star rating (based on a 5-star rating scale) of the restaurant. Each person’s profile page contains basic information about the person, such as her demographic data, past product reviews, favorite product collections, as well as her network of friends.

The provision of product tags and featured users are both manipulated on product information pages. The presence of product tags is manipulated at two levels. The control condition does not show any tag for the displayed restaurant. The treatment condition presents tags associated with restaurants, which often include such attributes as featured dishes, cuisine type, dining situation (e.g., friends gathering, dating, or casual eating), and ambience (e.g., live performance, private booth, open-air seats). The popularity count for each tag, i.e., a count indicating how many users have used the tag for the particular restaurant, is also provided. Moreover, if information seekers recognize an interesting tag of a restaurant, they can click on the tag and then be directed to a list of restaurants that are also tagged by the online community with the same attribute keyword.

The presence of featured users is manipulated at two levels. In the treatment condition, a list of featured users are shown on the right-hand panel of the restaurant’s information page and represented through their thumbnail pictures and names. These featured users have provided useful evaluations on the displayed restaurant and their overall contribution scores3 are among the highest of the online community. This is based on the actual user data provided by Dianping.com. If information seekers click on a featured user’s name or thumbnail picture, they will be directed to the featured user’s personal profile page, which contains her personal information, her collections of favorite restaurants, and comments on the restaurants. In the control condition, the featured users’ links are not provided. In both treatment and control conditions, information seekers can access the profiles of individual reviewers by clicking on each reviewer’s names or thumbnails, which are just beside their reviews.

In sum, we implemented a 2 (with vs. without product tags) * 2 (with vs. without featured users) between-subject experimental design. The screen capture of a restaurant information page for the condition with product tags and featured users is provided in Appendix A.

Experimental Procedures

The participants consisted of a total of 112 undergraduate and graduate students (i.e., 28 subjects per group, with 4 groups), recruited from a major university in Shanghai. Participants were assigned randomly to a condition and asked to fill in a pre-experiment questionnaire that measured demographic information and control variables including knowledge and interest in restaurants in Shanghai. They were then briefed on the features of the website and given several minutes to get familiar with how to use it. Afterwards they were instructed to use the website with the task of finding a restaurant to dine with several friends in the coming weekend. After making the restaurant

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2 The actual information, such as real names of the users, was masked.
3 A user’s overall contribution score is obtained from Dianping.com. Specifically, it is computed according to her past information contribution, i.e., her provision of witty, informative, useful, and personal advice. Identifying featured users based on this contribution score has been adopted by most SPS websites (e.g., Thisnext.com, Kaboodle.com, and Stylehive.com).
choice, the participants completed the questionnaires and were paid around US$6 each as a participation reward. The measurements for dependent variables are presented in Appendix B. Since this study was conducted in China, the questionnaire was translated into Chinese first and a backward translation method was used to ensure the consistency between the Chinese and English versions of the questionnaire.

Data Analysis

Subject Background Information

The student participants were from 27 different academic departments, representing diverse backgrounds. The average age was 22. In general, they were very familiar with using the Internet (mean = 6.11, 7-point scale). They were on average interested in exploring restaurants in Shanghai (mean = 4.96, 7-point scale), but were not very knowledgeable about the restaurants (mean = 3.43, 7-point scale). There was no difference in these variables across the different treatment groups.

Construct Validity

Exploratory factor analysis was performed on perceived diagnosticity and perceived serendipity. Results show that measurement items load heavily on their intended factors and lightly on other factors, indicating adequate convergent and discriminant validity (see Table 1 for factor loadings).

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Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Perceived Diagnosticity of the Product Search Process

The Cronbach’s alpha for perceived diagnosticity is 0.82. There is significant main effect of product tags (p<.001), i.e., the condition with product tags leads to significantly higher level of perceived diagnosticity than the condition without product tags. Hence, H1 is supported. However, there is no main effect of featured users on perceived diagnosticity, thus H3 is not supported. Also, no interaction effect exists, i.e., H5 is not supported (see Table 2 and 3).
Perceived Serendipity of the Product Search Process

The Cronbach’s alpha for perceived serendipity is 0.90. There is no significant main effect of product tags on perceived serendipity, hence H2 is not supported. The presence of featured users does not have a main effect on perceived serendipity either, hence rejecting H4. However, there is a significant interaction effect on perceived serendipity between product tags and featured users (F (1, 108) = 8.79, p<.01) (see Table 2 and 3). The Simple main effect analysis shows that the condition with featured users leads to a significantly higher level of perceived serendipity than the condition without featured users only when product tags are provided (p<.05). The condition with product tags leads to higher level of serendipity than the condition without tags only when featured users are also present (p<.01). Hence, H6 is supported. Figure 1 shows the pattern of the interaction effect.
Discussions of Results

The experimental results of this study have provided valuable insights into the impacts of product tags and featured users on information seekers’ perceived diagnosticity and serendipity of the product search process. First, product connectivity based on tags is important in improving information seekers’ search process in terms of perceived diagnosticity. Particularly, product tags allow information seekers to conduct “faceted” or “pivot” browsing (Millen et al. 2006), i.e., they can reorient search paths at any moment through explicit and diverse cues to access relevant alternatives. Being able to find and compare similar alternatives along selected criteria thus makes the information seekers feel that the product search and evaluation has been effective.

Connection with featured users, however, does not seem to effectively improve the diagnosticity of the search process. One plausible reason may be that, the presence of featured users alone cannot directly help narrow down information seekers’ search scope or help them conduct thorough comparison between alternatives along particular preference dimensions. Without a clear and organized way of obtaining and comparing related alternatives, a search process with useful product information and diverse discoveries may still leave information seekers with uncertainty in their evaluations (Huber and Klein, 1991; Payne et al., 1993, p183). That is, they may still not be sure whether what they have encountered is the best of the breed since they do not have an overview of the relative quality of products alike.

The results on serendipity reveal that the presence of product tags or featured users alone does not make the search process more serendipitous. However, when they are both provided, information seekers will perceive their product search experience as consisting of unexpected useful discoveries. While we expected that the explicit presence of diverse tags and the diversified recommendations provided by featured users should both facilitate a serendipitous search, the results imply that in terms of inducing valuable but “out of the box” discoveries, being able to conduct a clear, structured search that mixed with divergent encounters is important. In the current context, product tags allow people to identify their interests explicitly and pursue it in a coherent manner, whereas connection to featured users broadens people’s search scope by revealing more loosely-related alternatives. Interesting alternatives discovered from connected featured users, when coupled with tag-enabled product connectivity, may then trigger information seekers’ interests in previously unseen product properties and their intention to switch and explore further. As the new findings become anchoring points and are further investigated in an organized and coherent way, the value of product connectivity and social connectivity in inducing serendipity can be fully revealed.
Implications of Findings

Despite the heated discussions on Web 2.0 phenomena, significant research progress is yet to be made. On e-commerce product search websites, what has been amazing is the number of new emerging social features invented to influence users’ online search experience. This study focuses on two of the latest and most popular design features based on user-generated contents on SPS websites – product tags and featured users – and examines their effects on information seekers’ product search experience. This is also in line with the goal of design-science research, which is to build and evaluate purposeful and innovative IT artifacts to solve identified problems (Hevner et al., 2004). This study has several theoretical and practical implications.

The increased attention paid to information seekers’ online search behavior gives rise to questions regarding how to organize the massive amounts of products and user-generated information related to them to facilitate navigation and search. Information Foraging Theory has been a popular theory for understanding how information seekers choose their search paths. At its core is the premise that individuals follow high-scent cues to navigate, expecting useful information to be revealed. In the current study, product tags and featured users represent different types of information scent – i.e., product-feature-based and people-based – on today’s social Web. Connecting products through tags is demonstrated to be an effective design to facilitate a diagnostic search process, as the ease of accessing related products enables information seekers to get a sense of relative quality of the related products that suits their needs. When product tags are provided, being able to conveniently seek information from featured users may also facilitate obtaining novel knowledge and identifying hidden interests. Overall, this study extends Information Foraging Theory by considering different types of “scent” designs on social product-search websites and suggesting that these designs may facilitate distinct information behaviors.

Information Foraging Theory is also largely silent regarding how information seekers process or make use of information along specific paths, especially when different types of navigational cues coexist and jointly influence seekers’ search behavior. In the context of product search and decision making, information seekers’ selection of navigational cues reflects their dynamic search goals or evaluation criteria. They may conduct a thorough investigation following a particular path, or they may switch between different search paths because various encounters en route change their ongoing information requirements or strategies. In this regard, theories and studies on human decision making have contended that humans are adaptive decision makers, and often maintain a mix of structured and opportunistic information processing (Payne et al. 1993). Our study reveals a positive interaction between the two distinct design mechanisms that support different information behaviors, i.e., when social connectivity is coupled with tag-enabled product connectivity, information seekers will be able to discover more unplanned but valuable findings. In this regard, this study provides further empirical evidences to theories and studies on adaptive human information foraging in the context of the social Web.

In relation to various navigational cues and information processing styles, our study stresses that information seekers may not just stick to a particular search goal or follow a particular search direction. At times they may deviate from their existing search paths to explore and discover interesting things. They may not recognize something they really want until they actually see it (Zhang et al., 2009). They often acquire useful information through incidental or serendipitous discoveries that are less related to the original intent (e.g., André et al., 2009; Toms, 2000). Indeed, our study shows that serendipitous search experience is associated with final choices that are beyond information seekers’ initial expectations or goals. Such an adaptive search process frees seekers from a constrained view and prepares them for deriving value from unanticipated information. However, information search and retrieval in traditional information systems has put much emphasis on concepts such as relevance and convergence, largely ignoring the aspect of serendipity. Hence, the present study fills in this research gap and advocates that divergent and serendipitous encounters complement a convergent and relevant search pertaining to a specific goal. Together, they provide a holistic approach to study information acquisition and decision making.

Indeed, a number of computer scientists have attempted to develop systems that deliberately induce serendipity (e.g., Beale, 2007; Lieberman, 1995), but most of these systems have focused on the more superficial aspect, i.e., encouraging chance encounters by simply providing a diverse range of information. As a result, the triggering mechanism and thus the navigational trails are still far from being logically and fully understood (Toms, 2000). The

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4 We measured participants’ perceived discrepancy between their initial expectations and their final choice (e.g., Koufaris et al. 2001). The correlation test reveals that perceived serendipity of search process and perceived discrepancy between expectations and choice are positively associated (correlation = 0.344, p<.001).
interaction effects between product tags and featured users in our study suggests that the critical design factor to induce serendipity on SPS websites is not only to provide diverse cues, but also to facilitate recognizing the association between the novel findings and information seekers’ needs as well as the continued logical investigation around the novel findings. In other words, while experiencing serendipity is often deemed as being fortunate since people never know when it will strike, systems that aim to create such experience should not only provide diversified encounters, but also assist users in recognizing the serendipitous moment and seizing it when it presents.

For website designers, the most direct message is that organizing and exploiting the potential of online social networks and large-scale user-generated contents is crucial. Enabling linkages between pieces of information so as to construct a well connected product network is highly important. In this way, individuals’ ability of resource seeking and evaluation can be largely improved. On the other hand, by also identifying and providing convenient access to other experienced users within the community, the website can encourage the flow of novel and informative knowledge within the social network, i.e., inducing serendipitous discoveries. This implies that active and influential individuals within social networks may increase the exposure and recognition of various interesting products in the market because of their social embeddedness and modeling role. Hence, website owners and designers should be clear about the power of different forms of design mechanisms built upon the user-generated contents. In particular, although each mechanism often has its unique capability in influencing user experience, a deeper understanding of how they complement or substitute each other is essential to help website designers decide how to combine them on a platform in order to elicit their full potential.

Limitations

This study is not without limitations. First, it considers only one type of product, i.e., restaurants. This may impede the generalizability of our findings. Different products may influence people’s desire to contribute information or express feelings; hence the number of tags or the extent of product connectivity, as well as the influence of social networks can differ.

Second, the findings of our study are best applied to product search tasks where there exists a general search goal such that users tend to perform scent-based information foraging (e.g., search for a restaurant for friends’ gathering). They cannot directly address many of the other ways in which users might use tags and social networks. For example, people may browse information completely out of curiosity or entertainment, without a general search goal or direction. They may just be interested in the latest news or what others have been doing, which represents a form of lightweight learning (e.g., Millen et al., 2007). In contrast, extremely goal-oriented shoppers might have highly specific preferences such as buying a certain brand or a specific item. They aim to find the item as efficiently as possible and may ignore diverse cues that do not exhibit direct relevance to the search goal. Hence, the effects of tag-based product connectivity and social connectivity with featured users may be different for different search tasks.

Suggestions for Future Research

The recent emergence of Web 2.0-related applications has transformed the Web from an information pool to a platform for social interactions and knowledge sharing. Increasingly more websites are exploiting the power of resource sharing and social connection to help information seekers make better decisions.

This study demonstrates that information seekers can benefit from knowledge shared by others whom they may not have known previously, be it through tags or featured users’ profiles. Another interesting possibility is to enable connection to users’ acquaintances on the website, e.g., Flixster.com allows visitors to directly seek advice from their friends who are online. This also highlights a form of dynamic and synchronous user interaction beyond the connection to static user profiles. One promising application which aims at facilitating such real-time user connectivity within existing social networks is Facebook Connect, which works with various websites to bring users’ identity and existing social connections to their online shopping. Hence, future research could investigate website features based on social information and connectivity between users who are acquainted with each other.

Besides investigating how different website designs facilitate information search activities, future studies could also look at how they influence the development and maintenance of online communities. For example, collaborative tagging, besides being a way to share and connect products, may also be a channel to identify similar people in the community. Indeed, on websites such as Flickr.com and Amazon.com, there are already clear evidences of
communication and ad-hoc social clique formation through tags (Hotho et al., 2006; Mathes, 2004). Other website mechanisms such as those that enable reciprocal behaviors, e.g., giving compliments to a product recommender and replying to a product review, have also been recognized as a way to keep the user community lively and well-tended.

In sum, there are certainly plenty of chances for future research to contribute to a better understanding of mechanisms on SPS websites in particular and on the social Web in general.

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Appendix A: Screen capture of a restaurant information page with product tags and featured users

![Screen capture of a restaurant information page with product tags and featured users]

Notes:
1. The sections of “restaurant name, location and contact information”, “User review”, and “Map” are provided for all the four conditions.
2. The section of “Tags” is only provided in conditions with product tags.
3. The section of “Featured Users” is only provided in the condition with featured users.

Appendix B: Measurement items for dependent variables

Perceived diagnosticity of the product search process (Adapted from Jiang and Benbasat, 2004; Kempf and Smith, 1998):

- This website helps me to systematically and effectively search among and compare many different restaurants in order to find the most suitable one.
- This website helps me to effectively evaluate the restaurants I browse during the search process based on information from other consumers.
- Through this website I can effectively obtain a good understanding of the main features of the restaurants that I browsed during the search process.
- This website provides me a chance to search among and assess many restaurants in a systematic and effective way.
Perceived serendipity of the product search process (Adapted from Parboteeah, 2005):

- The restaurant search experience I just had helped me discover some restaurants which suit my needs but I had not planned for.
- My restaurant search on this website provided some unexpected but useful findings.
- During the search process I encountered many good restaurants which worth a try but were beyond my initial search plans.
- The search experience provided me with some surprising yet interesting findings about restaurants.