

Using Social Tags and Controlled Vocabularies As Filters for Searching and Browsing: A Health Science Experiment

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ABSTRACT

The retrieval of health information on the Web is limited by the vocabulary gap between the human searcher and the terms used by authors of medical documents. Social tagging and Medical Subject Headings (MeSH) have the potential to help close this gap by providing peer and professionally created terms that may be valuable in guiding searchers to health information resources. Search interfaces that provide terms to modify or expand health-related queries can help searchers fully explore unfamiliar concepts. In this paper we present a search system enhanced with social tags and MeSH terms, and report the results of an experiment exploring its use. Our prototype interface exposed terms to users that could be used to modify search queries, and was rated useful by participants in a user study.

Categories and Subject Descriptors

H.3.5 [Information Systems]: Information Storage and Retrieval – *On-line information systems.*

General Terms

Design, Experimentation, Human Factors

Keywords

Social Tagging, Controlled Vocabularies, Folksonomy, Social Search, Web Search, Health Informatics

1. INTRODUCTION

Web search is an important part of health information behavior. The Pew Internet and American Life Project reported eight of ten US adults online, or 59% of the total US adult population, look for health information on the Internet [4]. General search engines are a common starting point for healthcare information seeking sessions, yet many consumers report feeling frustrated at not finding the information they need [5]. Healthcare consumers have difficulty formulating effective queries due to their inability to use medical terms while searching [14]. This “vocabulary gap” between medical content creators and laypersons can limit search

effectiveness and may negatively affect health outcomes [16].

Lack of a shared vocabulary between patient and doctor can be “a barrier to full participation in health care” [17]. Just as patient-doctor communication can be constrained by the user’s comprehension of medical terminology, so can the effectiveness of information retrieval systems. Displaying terms from peer-created and controlled vocabularies, to expand or modify Web searches, can help bridge the vocabulary gap and improve retrieval. Towards this goal, we designed a system that supports keyword searches with social tags collected from the social bookmarking site Delicious.com, and Medical Subject Headings (MeSH) from the US National Library of Medicine (NLM).

The research presented here explores user interaction with a prototype search system supported by social tags and MeSH terms. We tested the search system with lay-users who have no medical training, and thus little exposure to medical terms, and students in the health sciences familiar with professional medical terms. Our results suggest both user groups would use the features of our prototype in their real-world health searches.

2. RELATED LITERATURE

The health information search process has been described as one of trial and error [14]. Laypersons searching the Web for health information often encounter difficulties. They may use “suboptimal” search strategies [3], and encounter incorrect information or misunderstand the information they find [10]. These searchers may even suffer from “cyberchondria,” an escalation of anxiety when self-diagnosing medical symptoms that interrupt a user’s search activities costing valuable time and energy [15]. Clearly, consumer health search can be improved.

Experimental interfaces supporting query recommendation and expansion have been designed to provide terms that might supplement the short queries, generally between 2 and 3 terms [12], used by health information searchers. For example, recommended terms generated in an experimental health search system helped users create more successful queries [16]. MeSH terms are used in several faceted health search interfaces. The NLM websites MedlinePlus and PubMed both display MeSH terms in their search results page. Search tools like Hubmed [2] and Multi-faceted Access to PubMed (MAP) both successfully incorporated MeSH with other resources while basing results primarily on PubMed article retrieval [13]. Social tags however, are not yet used in a systematic way to enhance health-related Web searches despite having the potential to improve organization and retrieval of health resources.

Tags can be a valuable resource for navigation and search systems as a community can benefit from the aggregation of individual tagging efforts [6]. Several studies have attempted to identify

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those tags that would be most useful for search systems, often with a focus on what have been labeled “power tags” that may be used to enhance search precision [11]. It has been suggested greater than 50% of tags have information about a resource not found in existing content, such as the title, and that most of these tags can be used for search [1]. Tags from Delicious can be used to improve Web search, as most tags are relevant and objective [7]. Users of an exploratory search browser utilizing social tags as search guides reported greater exploratory search and more domain learning than a baseline system [8]. These results suggest that users may have a better search experience and more fully explore medical concepts, when using a MeSH and social tag supported search system.

3. RESEARCH OBJECTIVES

Systems like our prototype that combine data from multiple providers are commonly referred to as “mashups.” Mashups are increasingly encouraged by the health informatics community, as shown by the launch of healthdata.gov, and the many health apps developed to re-use this data. To our knowledge, there is no previously published study of a health search system enhanced with social tags and MeSH terms. The goal of this research is to investigate use of such a system guided by the questions:

- How does an interface enhanced with MeSH and social tags support user health information seeking tasks? Do users prefer to use tags or MeSH terms as filters while searching?
- Do users prefer resources retrieved provided by the NLM or Yahoo! when answering health questions?

4. DESIGN OF THE SEARCH SYSTEM

We used Web services from the NLM and Yahoo! to collect search results along with MeSH terms and Delicious tags. User-submitted queries were sent from our system to an NLM Application Programming Interface (API) and the Yahoo! Build your Own Search Service (BOSS) search API. The APIs returned up to the top 50 search results (the maximum allowed in a single Yahoo! API call) for each query. The response included the page title, URL, short abstract, and any MeSH or Delicious tags.

4.1 MeSH and Delicious Tags

MeSH terms and Delicious tags were extracted from the XML response and stored in a combined array which we called “filters.” The Yahoo! API returned the most popular public Delicious tags for each result while the NLM APIs had no limit on the number of MeSH terms returned.

The array of filters was compared against a stop list of the most common MeSH terms- "humans", "female", "male", "animals", "adult", "middle aged", "adolescent", "mice", "child". (In our study these terms equaled 24% of all MeSH retrieved by the system.) These terms were not displayed in the user-interface nor used to report results in this work. Filters and their frequencies were written to the screen as clickable HTML hyperlinks. Clicking a filter “AND’ed” that term to the previous search then returned a new set of results for the query. We showed up to the 15 most frequent filters in descending order, additional filters were displayed by clicking a “Show More” link.

The user interface was intentionally designed to be simple and familiar to users. The left column displayed MeSH and Delicious tags, and the right showed search results (figure 1). Several users remarked that the simplicity of the interface was one of its strengths. Search results from the 2 systems were alternated in the display, starting with a Yahoo! result, then NLM, and so on.

Below each title was a short abstract of up to 155 characters. Two expert users performed pilot testing of the interface prior to the study and the design was adjusted in response to their comments.

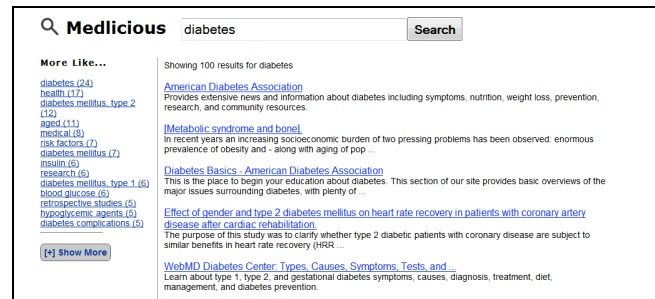


Figure 1. The prototype user interface.

5. EXPERIMENTAL DESIGN

20 participants evaluated the prototype search system during an initial study conducted in a usability lab at Drexel University. 10 participants, the “lay-user group,” had no medical training and 10 had the equivalent at least 2 terms of medical education at Drexel University – the “medically trained group.” It was expected those with no training and thus a low exposure to medical terminology would be attracted to Delicious tags, while the participants with knowledge of medical terminology would prefer MeSH terms. These participants viewed a system that used the NLM’s PubMed as the source of MeSH terms and search results.

After examining results from the initial study, we ran a second remote study with 20 additional lay-users. In this second study PubMed was replaced with the consumer-friendly MedlinePlus as the NLM resource. This “follow-up group” study was performed because both initial groups overwhelmingly chose MeSH as filters and Yahoo! results to answer questions. Our primary goal in the follow-up was to explore if MeSH terms and results from a consumer-friendly website like MedlinePlus would be more attractive than those from the more professional PubMed.

Transaction log data was collected while participants answered questions in three health-related search scenarios: 1) *Please find 2 medications that can be used in the treatment of the disease Multiple Sclerosis.* 2) *A friend is considering gastric bypass surgery. You want to help explain the risks and benefits to him. Please find two potential risks of having the surgery and two potential medical benefits.* 3) (Initial Study) *An acquaintance thinks he might have celiac disease. Can you find out how he would get tested for the disease? What are 2 common symptoms?* (Follow-up) *Use the interface to explore a health-related topic of your own choosing. Please spend no more than 5 minutes on this task, but try to gain some in-depth understanding of the topic as best you can.*

Participants provided a short answer with source for the three health scenarios. In the second scenario participants rated the relevancy of the top 10 search results, and then chose a filter to load a second screen of results. They again rated the results and then clicked a second filter to load a third screen of results. Participants rated this third screen before answering the question. During the initial study, participants were encouraged to “think aloud,” audio and screen were captured using the program Camtasia studio. All participants completed a short exit survey and provided final thoughts or comments to complete the session.

6. RESULTS

Participants used the prototype to answer questions in three search scenarios. They were observed clicking search results in the first five to ten URLs on the search results page, consistent with previous findings [3]. MeSH terms were preferred to social tags as search filters, and Yahoo! results to NLM results when answering questions. 75% of the participants reported the filters were helpful and they found terms that helped refine searches.

Table 1. Transaction log data.

Action	Lay-user	Medically trained
Delicious tag filters selected	0	0
MeSH term filters selected	20	20
Yahoo! results viewed	109	67
PubMed results viewed	33	78
Yahoo! results used to answer question	30	28
PubMed results used to answer question ¹	0	1

6.1 MeSH and Social Tag Filters

Both the lay-user and medically trained user groups preferred MeSH terms to Delicious tags when utilizing filters. In the second of our three scenarios, we instructed participants to use search filters and rate three successive screens of results for relevancy. Fully 100% of the filters selected by the lay-user and medically trained user groups in this scenario were MeSH terms (table 1). Participants rated the relevancy of the top ten results from 1-not relevant, to 5-extremely relevant for each screen, as shown in figure 2.

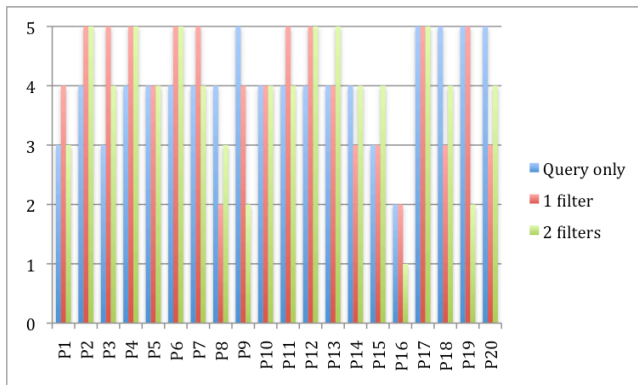


Figure 2. Lay-user (P1-10) and medically trained (P11-20) relevancy ratings for three successive search result sets.

After completing the three scenarios, participants responded to the question, “How helpful or not helpful did you find the filters?” on a scale of one to five, from extremely helpful to extremely not-helpful. 15 participants rated filters helpful or extremely helpful. Participants in the follow-up did not find the search filters as helpful as those in the initial study. Four follow-up participants reported the filters helpful, seven neutral, and nine not helpful.

17 participants responded yes to the statement *I found terms that helped me refine the search*, although these results were not

¹ One medically trained participant did not answer one question due to time constraints.

followed in the follow-up study where only seven participants responded yes, 11 no, and two neither.

Table 2. Reported helpfulness of search filters.

Response	Lay-user	Medically trained
<i>Q: How helpful or not helpful did you find the filters?</i>		
Extremely helpful	2	3
Helpful	6	4
Neutral	2	2
Not helpful	1	1
Extremely not-helpful	0	0
<i>Q: I found terms that helped me refine the search</i>		
Yes	8	9
No	1	1
Neither	1	0

6.2 PubMed and Yahoo! Search Results

As shown in table 1, lay-user and medically trained participants used Yahoo! results to answer 98% of the questions in the study. These findings are supported by results in the follow-up study where participants selected Yahoo! results for 92% of the answers. While there was a small increase in the use of MedlinePlus in the follow-up study over PubMed in the initial study, Yahoo! provided the answer source for over 90% of questions in both the initial and follow-up studies.

6.3 Overall Satisfaction

Users of the prototype search system were satisfied with the user interface. We asked the following in the exit survey: *Please rank your overall satisfaction with the search interface*. Table 3 shows 19 of 20 participants were at least satisfied with the interface.

Table 3. Participant satisfaction with search interface.

Rating	Lay-user	Medically trained
Extremely satisfied	1	5
Satisfied	9	4
Neutral	0	1
Unsatisfied	0	0
Extremely unsatisfied	0	0

Users in the follow-up study were less satisfied with the interface. Eight reported they were satisfied or extremely satisfied, seven neutral, and four dissatisfied or extremely dissatisfied.

7. DISCUSSION

In this work we tested a health search system supported with a controlled vocabulary MeSH, and an uncontrolled vocabulary, social tags from Delicious.com. Unexpectedly, medically trained users and laypersons performed similarly in our study. Both groups used the professional vocabulary MeSH to modify their searches and preferred resources returned by the consumer oriented Yahoo! when answering health questions. Interviews suggested the information architecture of Yahoo! provided websites made them more usable for our participants than NLM

resources, while the number and quality of MeSH terms was considered superior to those provided by social tags.

Participants were satisfied with the search interface, and search filters were reported helpful during search sessions “*I liked the system a lot, great resources and I like the filters a lot!*” (P11). An examination of filters selected showed that 75% added new information (new terms) to the initial query and expanded a search, as demonstrated in following transcript, “*I would click on laparoscopy just because even though I’m not sure what that is, I saw that word here and I think it might be like a term, the actual name of the procedure, gastric bypass... I didn’t know that the actual term was laparoscopy. I think that would help*” (P14).

Comments revealed participants liked seeing health terms in the interface, even when not actively using them as filters. Their presence reinforced the health-focus of the interface, distinguishing it from general search engines. While not all tasks in the study required extensive research, participants liked knowing the filters were available for more in-depth searches, “*I actually like what they’re trying to do, to get similar searches, like if you haven’t thought of something*” (P02). Some participants viewed terms in the filter column, then recognized those terms while scanning search results. When asked about this scanning behavior, one participant responded, “*it’s nice. It gives you an idea of what it is that you need to look out for*” (P20). One participant was observed highlighting filter terms with her cursor while scanning results. These behaviors suggest users benefited from the filters even when not actively clicking them. Eye tracking data may be useful to explore this type of scanning behavior [9].

The lay-user and medically trained groups that used the interface in the usability lab were more satisfied than users in the remote study. Although the presence of a moderator may have biased the participant, the use of PubMed as a source of MeSH is a likely explanation for the difference. PubMed supplied many more MeSH terms than did MedlinePlus, thus users in the follow-up study were provided fewer filters. Participants commented the scarcity of filters was a problem in the follow-up, the filter list “*was not as rich with options as I would have liked*” (P23), and “*not all of my searches gave me filter words.*” (P30).

8. CONCLUSION AND FUTURE WORK

Our results suggest that while MeSH terms are assigned to PubMed articles and social tags to Web documents, assigning controlled vocabulary terms to Web documents may be beneficial for searchers. In future work we intend to test this hypothesis through continued development of the prototype search system as a search system available at www.husearch.com. We will also investigate additional sources of social tags, and methods to identify useful tags and MeSH terms for exploratory search.

In this study we demonstrated a search interface that displayed MeSH terms and Delicious tags to support health information searches. Search filters were reported helpful, suggesting health information retrieval interfaces could be successfully improved with advanced search features. Participants were satisfied with the user-interface, and several stated they would like to see health-search systems like the one described in this study as alternates to existing general search engines. We are encouraged to continue development by comments like “*I would love to use this system for researching my health concerns.*” (P24).

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