Link Sharing on Twitter during Popular Events: Implications for Social Navigation on Websites

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Abstract

The goal of this research is to explore how social media data can be used to help users find information on websites. This paper presents the first stage in this line of research and focuses on the characteristics of links (i.e. website URLs) shared on social media to recommend relevant and popular web pages within the website to others. Specifically, the paper reports on a study of Twitter messages ("tweets") during four different events. Tweets were collected and those containing links were analyzed. The findings from this study encourage us to proceed to the next stage of the research which is to develop and test a social navigation tool on websites incorporating information from social media in order to improve navigation within a website.

1. Introduction

Today there are estimated to be over 14 billion web pages [35] and 600 million websites [21]. Information seekers arrive at websites in a number of different ways by typing a website URL into web browser or by following a link from search engine results, social media sites, emails, documents, etc. Once they are on a website, navigation mechanisms such as menus, search functions, and tag clouds are used to navigate a website in order to search and retrieve information, as shown in Figure 1. Even though websites offer different navigation mechanisms to assist with search and retrieval, navigation within a website remains one of the main causes of a user's frustrations on the web [16, 36].

Current website navigation mechanisms are, most commonly, links predefined by website authors such as menus, or automatically derived from website content including tag clouds and search functions [23, 28, 33]. However, menus generally provide access to first and second level pages within a website, which limits access to content located deeper within a site (i.e. those pages requiring two or more clicks). Whereas, with a search function, users are required to form and enter a query in the search text box, which can be time consuming and may lead to irrelevant results.

Figure 1. Navigation tools on the Many Eyes website: Search, Menu, and Tag Cloud [19]

Social tagging is another approach to website navigation that has recently gained popularity across the web [24, 27]. It allows website users to define categories by which to organize the content of a website and thus create new access points to the content that is popular in the eyes of a community of users, and not just website administrators. Such community-created access points are often dynamic (they change over time) and are commonly organized as tag clouds. Social tagging has been studied extensively over the past few years with emphasis on both the tagging process [12, 20, 24, 25, 28, 32, 37] and the presentation of tagged information [15, 17, 26]. Although popular, website navigation with user-defined tags has its own limitations. Specifically, tags can become ambiguous as more people contribute to them, making tag clouds less informative and thus less useful as a "within website" navigation mechanism.

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Due to the limitations of the current website navigation mechanisms, we seek to develop and evaluate alternative approaches to website navigation. In particular, we are exploring if and how social media data can be used to recommend relevant and/or popular web pages within the website to its visitors (regardless of whether or not the visitors are actually using social media themselves).

Social media users frequently share links (URLs) to various web pages on social media sites such as Twitter and Facebook. Our design proposition is to capture publicly available data about links to particular websites shared through social media and then use it to discover and recommend popular and relevant pages to anyone who visits that website. The idea of re-purposing social media data for various recommender systems is not entirely new [6, 25], but what is novel here is how the data is organized and presented to its end users (in our case, website visitors).

We expect that this approach may not work well for all websites. For example, the proposed approach will not be effective for unpopular websites and thus are not being discussed on social media since there simply will not be much link sharing data to analyze. Therefore, one of the main goals of this paper is to determine the types of websites that can benefit from the proposed navigation approach. As a starting point, in the exploration of the design space, we used link sharing data from Twitter, a microblogging website, due to its popularity and international reach. In future research, data from other social media sites will also be considered.

2. Background

To understand how social media data can be used to improve website navigation, first we need to review current integration practices between websites and social media. There are the three main mechanisms:

1) Creating and sharing links (URLs) to web pages on social media,
2) Featuring popular web pages on websites based on how often they are shared on social media,
3) Embedding a web widget/feed on a website that shows relevant messages from social media.

There are a number of different ways to create and share web page links (URLs) on social media. Users can post messages directly from the social media site, such as Twitter. Likewise, they can enter or copy and paste a URL into their messages. As well, users can post messages containing URLs

through third party applications, such as Tweetdeck. Many websites, especially news websites, such as CNN [7] and Huffington Post [13], incorporate social media plugins to allow users to create and share tweets of website content, as shown in Figure 2. Once the user clicks on a social media icon, it automatically pre-populates the message with the web page URL, as shown in Figure 2 and allows the user to post directly onto their own social media account. The user's followers then have the ability to re-post or comment and share the URL among their followers.
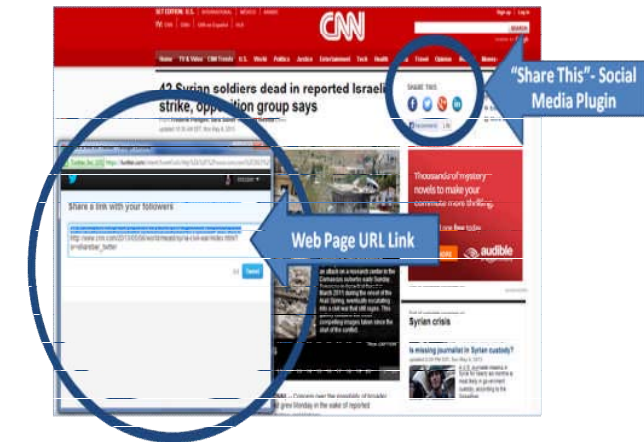

Figure 2. "Share This" social media plugin and "share a link with your followers" pop-up on CNN website [7]

Some websites, such as Huffington Post [13], display their most popular (i.e. most liked) web pages from Facebook, as show in Figure 3. Although this information is usually based on internal website statistics or collected from their accounts or hashtags in social media, it does not mine social media data from a large range of sources.

Figure 3. Most popular articles based on Facebook Likes - Huffington Post website [13].

Finally, some websites, such as CBC Sports [5], display a widget (list of messages from newest to oldest) from their social media account. The integration of a widget can generate more dynamic content into the website. Twitter allows website designers to incorporate a Twitter Widget. Similarly, Facebook with over 1.15 billion monthly active users [9] allows website designers to incorporate an Activity Feed from their Facebook account. Although these widgets include all tweets and activities from an account, they seldom point people to specific web pages within a website. Furthermore, website designers may discourage the use of these widgets as it takes up valuable webpage space and can create clutter, as shown in Figure 4.
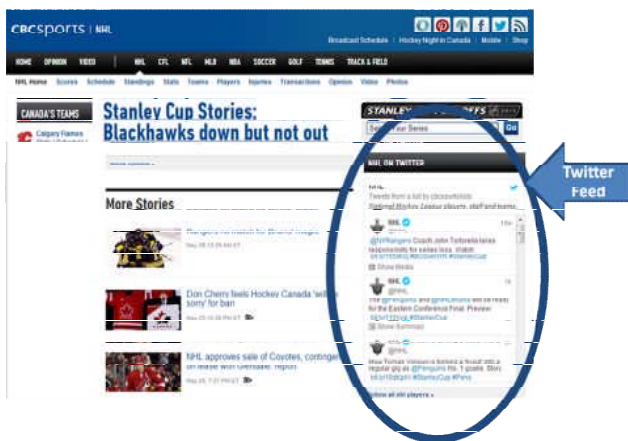

Figure 4. Twitter Feed on CBC Sports website [5]

The three mechanisms described above demonstrate the integration of data between websites and social media. Our research builds on these current integration practices as we propose an alternate mechanism to recommend popular pages to website visitors.

3. Study Objectives

The overall research objective is to improve navigation within websites using social media data. The first step towards achieving this objective is to examine social media data, specifically the characteristics of links that are shared on social media, and determine whether there is value in bringing such information forefront on websites to assist website visitors find information more effectively and/or efficiently.

This study examines the links shared on Twitter surrounding four specific recurring events, on four different websites. Two of these websites concentrate on information pertaining to sporting events (London

Olympics 2012 and World Junior Hockey) while the remaining two focus on entertainment events (The Big Bang Theory and Golden Globe Awards).

These four events were selected for this study due to their popularity. For instance, the London Olympics 2012 attracted 20 million spectators from around the world over a two week period. In addition, the 37th World Junior Ice Hockey Championships (WJHC) was hosted over a 10 day period in Ufa, Russia. It began on December 26, 2012 and ended with the gold medal game on January 5, 2013. Furthermore, the Big Bang Theory is a popular weekly sitcom which airs on CBS television network. It is one of the most popular shows in US, ranking as the #1 sitcom during the 2012/13 season. Likewise, the Golden Globe Awards is an annual ceremony which honors talent in film and television. January 13, 2013 marked the 70th presentation of the Golden Globe Awards. These four recurring events vary in duration, ranging from two weeks to a day, as well, these events were of different periodicity (4 years cycle (Olympics), 1 year cycle (World Junior Hockey, Golden Globe Awards) and weekly cycle (The Big Bang Theory)). These events were chosen to see if there is any correlation between the duration of the event and links shared on social media.

We investigated the following occurrences: how often links were shared which linked back to these websites; how many of these were unique links; how deep the links were from the website's home page; and what type of web content was shared which pointed to the official website as well as external websites.

4. Methodology

4.1. Sampling

In order to examine the characteristics of links shared on social media, and knowing that displaying popular pages based on links shared on social media may not be beneficial for all websites, we focused on a sample of websites related to four different events that met these broad characteristics:

1. A website with high volume of social media traffic on various social networks such as Twitter, Facebook, Google+, and/or Pinterest.

2. A website containing at least 100 pages.

The goal of this research is to further refine the characteristics of websites which would likely benefit from links shared on social media. Based on the above characteristics, four websites representing four

Table 1. Four events, websites, data collection period and hashtags

Events	Event Dates	Official Website URL	Total # of Pages	Data Collection Period	Hashtag(s)
Event Duration: Over a week & Sports					
London Olympics 2012	July 27, 2012 - August 12, 2012	www.london2012.com	5350	July 27, 2012 5:24:00 PM – August 5, 2012 5:04:00 PM	#London2012
World Junior Hockey	December 26, 2012 – January 5, 2013	www.worldjunior2013.com	169	Dec 7, 2012 10:21:53 AM – January 5, 2013 4:58:30 PM	#WJC2013, #2013WJC, #worldjunior, #worldjunior2013
Event Duration: Over a day & Entertainment					
The Big Bang Theory	Dec 6, 2012, Dec 13, 2012, Jan 3, 2013, Jan 10, 2013	www.cbs.com/shows/big_bang_theory/	1061	Dec 12, 2012 5:10:22 PM – Jan 10, 2013 11:58:33 PM	#BigBangTheory
Golden Globe Awards	Jan 13, 2013	www.goldenglobes.org/	9801	Jan 10, 2013 4:21:49 PM – Jan 15, 2013 7:58:46 AM	#GoldenGlobes

popular sports-related or entertainment-related events were selected, as shown in Table 1.

The total number of web pages for each website was determined using a sitemap generator called XML-Sitemaps.com (www.xml-sitemaps.com/). The two websites with the duration of one day (i.e. The Big Bang Theory and Golden Globe Awards) allowed users to post/share content on Twitter from within the website, whereas the other two websites (London Olympics 2012 and World Junior Hockey) lacked this feature at the time of the study.

4.2. Data Collection

For the purposes of this research, we selected Twitter as the source of the social media data. Twitter is one of the fastest-growing social media platforms in the world with over 288 million monthly active users [29]. The use of Twitter has evolved into a platform to share and disseminate information [11]. Early adopters of Twitter began providing links to outside content by including the URL in their tweets [2]. This is useful as the 140 character limit can be restricting for those who want to convey large amount of information. Because URLs are generally long, people used URL shortener services (e.g., http://bit.ly) to abbreviate URLs, which, when clicked, redirected to the desired web page.

Researchers have investigated Twitter from many different angles: from examining properties of tweets [6] and tracking the increased use of URLs in tweets [14] to comparing communication patterns on Twitter [3, 4] and developing credibility ranking algorithms for tweets during high impact events [11]. White et. al. examined the types of links on Twitter and found that a majority of the #tarsands tweets contained links

to articles (29.2%) and websites (22.6%) [34]. Similarly, Hughes and Palen found that 25% tweets normally includes a URL, however it is higher, around 40-50%, during emergencies such as hurricanes as well as mass convergence events [14]. Lovejoy et. al. discovered that a majority of the nonprofit tweets (68%) included links to external information [18]. The evidence of link sharing on Twitter is highlighted by these studies while further analysis illustrates the importance of link sharing as an effective marketing strategy for driving traffic to a web page [30, 31].

Our research builds on these findings and focuses on the effects of aggregating links shared on social media by a community of users, as a way of creating opportunities for community-driven navigation systems to emerge. We are then interested in presenting popular pages within a website to help website visitors find information more effectively and efficiently.

We used Netlytic [8] - a web based system for automated text analysis and the discovery of social networks – to collect a sample of tweets associated to the four events. These tweets were collected over a six month period, from July 2012 to January 2013. At the time of the data collection, Netlytic relied on the public Twitter Search API 1.0. In the future, we will consider Twitter's Streaming API to give a broader coverage of the sample. Table 1 presents the duration of data collection along with the hashtags used for the four events. These hashtags were chosen for this study as they were the official hashtags created by the event organizers.

In addition to the actual Twitter message ("tweet"), the resulting datasets included the following metadata: id, tweet URL, publication date, username (author), and source (the device/application

used to generate the tweet). URLs from all the tweets were extracted using a PHP script. Shortened URLs were un-shortened using the PHP Client URL Library (cURL). The un-shortened URLs were then analyzed using Microsoft Excel.

5. Results

A total of 264,647 tweets were collected over the four events. Table 2 presents the number of tweets collected, number of tweets containing links, and number of tweets containing links from the official website. Data from London Olympics 2012 showed that 47% of the tweets contained a link, out of which 48% were links to the official website. 25-37% of the tweets contained links for the other events, out of which less than 6% were links to the official website.

The pattern observed for London Olympics 2012 was notably different from the other events. For instance, analysis revealed the highest number of tweets containing a link, highest number of tweets containing a link to the official website and lowest number of tweets containing links to other websites. These results indicate a noticeable difference, wherein there is a dependence on the official website for the other events. Perhaps the London Olympics 2012 website was the primary source for up-to-date information for this event. Also, the Olympics attract a large community both physically and through an online presence. It is probable that the density of individuals within the geographic location contributed to an increase in tweets, which gave individuals an opportunity to participate and contribute to the event.

Table 2. Tweets and tweets with links (URLs)

Events	London Olympics 2012	World Junior Hockey	Big Bang Theory	Golden Globe Awards
# of tweets collected	77142	49624	86302	51579
# of tweets containing a link	36279 (47%)	12455 (25%)	24945 (29%)	19109 (37%)
a) # of tweets containing official website links	17257 (48%)	163 (1.3%)	1757 (7%)	80 (0.4%)
b) # of tweets containing other links	19022 (52%)	12292 (98%)	23188 (93%)	19029 (99.6%)

Tweets containing links from the four official websites were further analyzed and the results are described in section 5.1 to 5.4. Tweets containing links to other websites were also analyzed and the results are described in section 5.5.

5.1. Unique Links

The number of unique links shared in tweets are shown in Table 3. Tweets from the sports-related events (London Olympics 2012 and World Junior Hockey) contained the highest percentage of unique links (8% and 19%). This indicates that people shared many unique pages on Twitter for the two sports-related events which means that more pages within that website contained popular content. It is also interesting to note that the size of the website does not effect the number of tweets generated which contained links, and furthermore, that not all pages within an official website were tweeted. Therefore, our initial criterion, that a website must contain at least 100 pages, is not important (at least based on our small sample of the four websites). Instead, we proposed a revision, that while websites we observed may be small, they must contain content which has the potential to be popular on social media. These types of websites would likely benefit from the links shared on social media.

Table 3. Unique links shared in tweets

Events	London Olympics 2012	World Junior Hockey	Big Bang Theory	Golden Globe Awards
Total # of official website links	5350	169	1061	9801
# of unique links to official website in tweets	439 (8%)	32 (19%)	16 (1.5%)	14 (0.14%)

5.2. Profile of Top 10 Links

All tweets containing links to the official websites were sorted to determine the top 10 most tweeted links (URLs) for the four events. Table 4 presents the top 10 most tweeted links along with the number of times they appeared in tweets.

Table 5 shows the percentage of tweets which represents the top 10 most tweeted links among all tweets collected. We noticed a difference between the London Olympic 2012 event (the top 10 links make up 22% of all tweets containing links) and the others (the top 10 links make up 71%, 99%, and 95% for World Junior Hockey, Big Bang Theory and Golden Globe Awards tweets respectively). This indicates that the London Olympics 2012 website had a wider

1749

distribution among all their pages that got shared (i.e. more unique pages got shared and therefore, the top 10 tweeted links only make up 22% of their total distribution). Therefore, the London Olympics 2012 website contained a wide range of popular pages and not just the top10.

Table 4. Top 10 links during four events and the number of times they appeared in tweets

URLs	# of Occurances in Tweets
London Olympics 2012	
http://www.london2012.com/	644
http://www.london2012.com/news/articles/lochte-blasts-past-phelps.html	519
http://www.london2012.com/athletics/event/men-400m/index.html?v=20120804-103226924	440
http://www.london2012.com/football/event/men/index.html	355
http://www.london2012.com/schedule-and-results/	349
http://www.london2012.com/athletes/birthdays/index.html	339
http://www.london2012.com/cycling-track/event/men-team-sprint/index.html?v=20120802-185053806	299
http://www.london2012.com/swimming/	296
http://www.london2012.com/rowing/event/women-pair/phase=row021100/index.html?v=2012-08-01115503Z	295
http://www.london2012.com/athletics/	292
World Junior Hockey	
http://www.worldjunior2013.com/en/channels/2013/wm20/top/news/cze-usa-14/	22
http://www.worldjunior2013.com/en/channels/2013/wm20/top/news/ger-lat/	19
http://www.worldjunior2013.com	11
http://www.worldjunior2013.com/en/channels/2013/wm20/top/news/5th-6th/	11
http://www.worldjunior2013.com/en/channels/2013/wm20/top/news/fin-ger-rele/	11
http://www.worldjunior2013.com/en/channels/2013/wm20/top/news/finns-pound-slovaks/	11
http://www.worldjunior2013.com/en/channels/2013/wm20/top/news/bronze/	9
http://www.worldjunior2013.com/en/channels/2013/wm20/top/news/swe-preview/	8
http://www.worldjunior2013.com/en/channels/2013/wm20/top/news/where-does-canada-go-now/	8
http://www.worldjunior2013.com/en/channels/2013/wm20/top/news/ufa-best-ever/	6
Big Bang Theory	
http://www.cbs.com/shows/big_bang_theory/video/	630
http://www.cbs.com/shows/big_bang_theory/photos/191123/golden-globe-nominations	480
http://www.cbs.com/shows/big_bang_theory/photos/192941/season-6-episode-4	347
http://www.cbs.com/shows/big_bang_theory/photos/1000046/season-6-episode-12/33417	142
http://www.cbs.com/shows/big_bang_theory/photos/111112/season-5-episode-24/10123	59
http://www.cbs.com/shows/big_bang_theory/video/D6582F3E-6F5A-07DF-41B1-91B9E9C3CE62/the-big-	43
http://www.cbs.com/shows/big_bang_theory/photos/192104/season-6-episode-3/14833	20
http://www.cbs.com/shows/big_bang_theory/video/5AA75DBE-20FB-DE93-A0C7-028C7D386593/the-bi	20
http://www.cbs.com/shows/big_bang_theory/photos/193668/season-6-episode-5/193668	6
http://www.cbs.com/shows/big_bang_theory/video/31059D97-FE03-66D5-EA78-048635195235/the-big-ba	3
Golden Globe Awards 2013	
http://www.goldenglobes.org/2012/12/nominations-2013/	31
http://www.goldenglobes.org/photo-gallery-2013/	20
http://www.goldenglobes.org/2013/01/globes-fashion-on-the-red-carpet/	10
http://www.goldenglobes.org/history/	4
http://www.goldenglobes.org/	3
http://www.goldenglobes.org/symposium2013-1/	3
http://www.goldenglobes.org/2013/01/for-globes-night-a-menu-fit-for-stars/	2
http://www.goldenglobes.org/2012/01/the-keepers-of-the-secret/	1
http://www.goldenglobes.org/2012/11/jodie-foster-is-psyched-to-receive-the-cecil-b-de-mille-award/	1
http://www.goldenglobes.org/2012/12/tina-fey-and-amy-poehler-are-ready-for-the-70th-golden-globe-award	1

Table 5. Distribution of top 10 links among all tweets containing links

Events	London Olympics 2012	World Junior Hockey	Big Bang Theory	Golden Globe Awards
# tweets containing official website links	17257	163	1757	80
# of total tweets for top 10 links	3828 (22%)	116 (71%)	1750 (99%)	76 (95%)

These findings are important as we build a new website navigation system which will show popular pages from social media. We now know that showing just the top 10 popular pages would only represent a subset of popular pages and therefore, we would need to offer website visitors the ability to view more than just the top 10 popular pages. Perhaps a presentation of all popular pages in the order of most popular to least popular would be required in the new website navigation system.

5.3. Depth of Links from Website's Home Page

The number of clicks required to get to the linked web page from the home page was determined manually for all links to the official website pages. Over 80% of the links were accessible within 1-2 clicks from the home page of World Junior Hockey, Big Bang Theory and Golden Globe Awards websites. For London Olympics 2012 website, 70% of links were 3-4 clicks away from the home page and 8% were 5 clicks away from the home page, as shown in Figure 5. This demonstrates that users do share pages on social media that are located deep within the website (i.e. requiring multiple clicks to get to from the website's home page) which allows others to view these pages through social media by just one click. Therefore, bringing these pages to the home page would allow quick access to content, in the case where users do not use social media sites but are visitors of the website. This observation contributes directly to our website selection criteria as it indicates that the new navigation mechanism, which would provide access to popular pages through one click, would potentially benefit those websites that contain popular pages requiring two or more clicks from the home page.
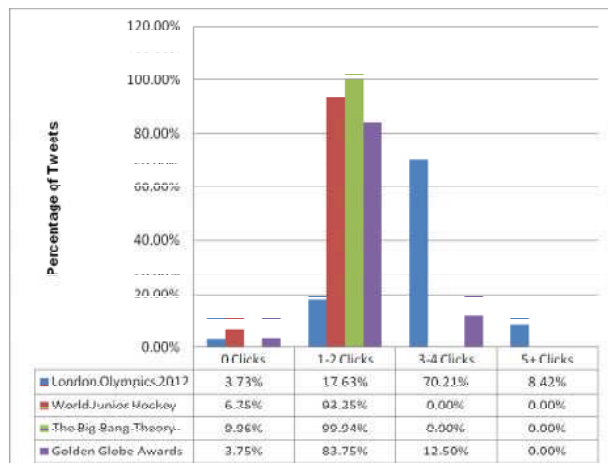

Figure 5. Depth of links from the official website's home page

5.4. Types of Links

All tweets containing links to the official websites were manually analyzed to determine the type of web content and information they provided. These were then divided into five different categories: home page, articles (news stories), photos, videos and schedules/scores. Users mostly shared links containing news stories during the three events (London Olympics 2012: 28%, World Junior Hockey: 93% and Golden Globe Awards: 14%), as shown in Figure 6. Links pointing to schedules/scores was noticeable for London Olympics 2012 (59%) and Golden Globe Awards (39%) only. Links pointing to photos (Big Bang Theory: 60% and Golden Globe Awards: 25%) and videos (Big Bang Theory: 40% and Golden Globe Awards: 19%) were mostly used during entertainment-related events, as shown in Figure 6. Few links pointed others to the home page (London Olympics 2012: 4%, World Junior Hockey: 7% and Golden Globe Awards: 4%) which means that users on social media sites are interested in pointing others directly to the web page containing the relevant information, rather than the home page. The results highlight that, in many cases, sites with frequently updated pages, especially those containing news stories as well as photos and videos, would most likely benefit from the new navigation system.
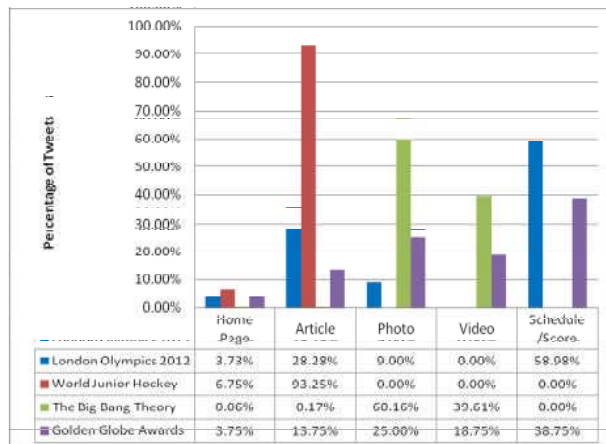

Figure 6. Types of web content on tweeted links

5.5. Tweets Containing Links to Other Websites

A significant number of tweets contained links which did not direct individuals to the official websites, as shown on Table 2. We wanted to investigate these links, in particular the top 10 most tweeted links, as it may guide future implementations of the prototype design. Table 6 presents the tweets containing links to other websites, along with the percentages of tweets containing the top 10 most tweeted links.

For the two sports-related events (London Olympics 2012 and World Junior Hockey), the top 10 most tweeted links represents 22% and 43% of all tweets containing links to other web pages (i.e. not official web pages). This indicates that the majority of tweets containing links to other websites were represented among the top 10 most tweeted links for these two events. This was in contrast to the two entertainment-related events (Big Bang Theory and Golden Globe Awards), wherein the top 10 most tweeted links represented only 9% and 10% of all tweets containing links to other pages. This indicated that the other links for these two events were more scattered and that users shared links to various unique web pages. In the future, if we consider displaying popular pages that are not part of the website (i.e. external web pages) then our algorithm needs to be robust enough to handle a large volume of unique web pages.

Table 6. Total tweets containing other links (i.e. not to official website)

Events	London Olympics 2012	World Junior Hockey	Big Bang Theory	Golden Globe Awards
# of tweets containing other links	19022	12292	23188	19029
# of total tweets to top 10 links	4148 (22%)	5323 (43%)	2126 (9%)	1833 (10%)

Further, we analyzed the type of web content shared on the top 10 most tweeted links, especially considering the large representation of links to other web pages during London Olympics 2012 and Golden Globe Awards. We manually analyzed the links and placed them into four categories: articles, photos, videos and spam (i.e. unrelated information). Tweets containing links to photos were common among all four events (London Olympics 2012: 22%, World Junior Hockey: 12%, Big Bang Theory: 4% and Golden Globe Awards: 5%), as shown in Figure 7. Tweets containing links to articles were common among the three events (World Junior Hockey: 3%, Big Bang Theory: 3% and Golden Globe Awards: 4%). Tweets containing links to spam was found mostly during World Junior Hockey (28%). Tweets containing links to videos was found only for Big Bang Theory (3%).

As expected, people shared photos during all four events. It is also interesting to note that during World Junior Hockey, 28% of tweets redirected to

1751

pages that were not relevant (i.e. spam). Therefore, if in the future we consider displaying popular pages that are not part of the website (i.e. external pages) then our algorithm needs to be robust enough to detect spam and not display those pages to the website visitors.
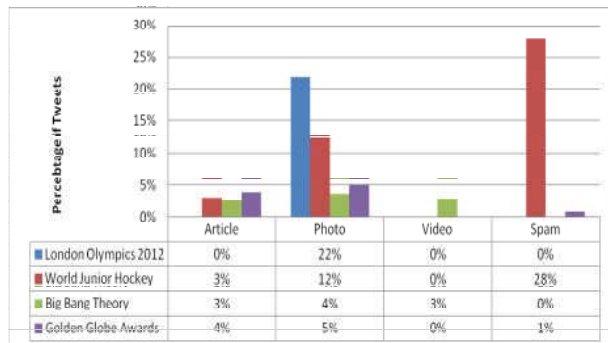

Figure 7. Type of web content on top 10 links to other websites

	Article	Photo	Video	Spam
■ London Olympics 2012	0%	22%	0%	0%
■ World Junior Hockey	3%	12%	0%	28%
■ Big Bang Theory	3%	4%	3%	0%
■ Golden Globe Awards	4%	5%	0%	1%

A similarity between the type of web content shared on links pointing to the official website (section 5.4) and the type of web content shared on links pointing to external web pages, is that they all point users to either articles, videos or photos. A difference between the type of web content shared on links pointing to the official website and the type of information shared on links pointing to external web pages, is in links which pointed to articles. Users shared links to articles that were on the official website more than on external web pages. Perhaps

users share articles and they find it credible coming from the official website than external websites.

6. Study Implications and Prototype Design

This study examined the characteristics of links shared on Twitter for four events and their official websites. 25-47% of tweets contained links. This indicates that there is enough social media data to implement a prototype and test whether and how social media data can be used to recommend relevant and/or popular web pages to website visitors.

The differences observed when analyzing London Olympics 2012 data was interesting as it contained tweets with the highest number of links (47%), tweets with the highest number of links to the official website (48%) and tweets with a high number of unique links to the official website (8%). This demonstrates that the type of the event and the characteristics of the website are important factors to consider when implementing a community-driven navigation mechanism on websites. This study helped us to refine the characteristics of websites and/or events that could benefit from using links that are shared in social media.

1. Websites featuring content that has the potential to be popular on social media sites, such as Twitter.
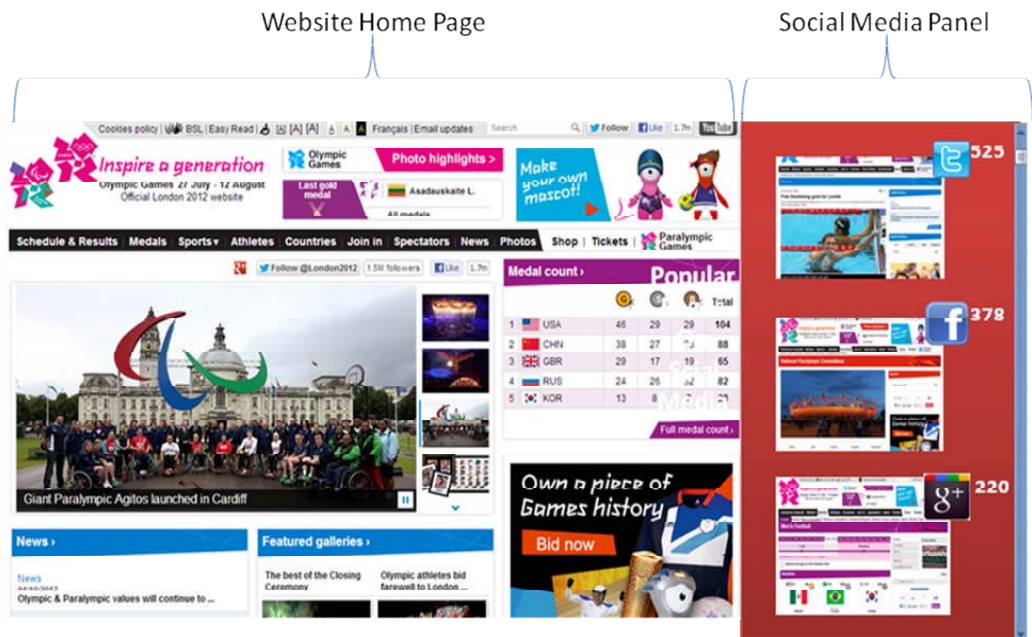2. Websites with popular pages requiring two or more clicks from the home page.

Figure 8. Prototype showing a Social Navigation Panel on London Olympics website.

1752

3. Websites that are updated on a regular basis and contains content, such as articles, schedule/ scores, photos and videos.
4. Websites with social media plugins allowing users to post messages to social media from within the website.

Future work entails developing and testing a prototype for websites that includes information from social media sites like Twitter to improve navigation within websites. Figure 8 shows a prototype of a "Social Media Panel" on the London Olympics 2012 website. Web pages within the website that are currently popular in social media will appear as page thumbnails inside the "Social Media Panel". Only three page thumbnails are shown in Figure 8, however, users will be able to use the scroll bar to see all pages that are popular on social media sites. These pages will be ranked in the order of popularity and will also indicate the number of times the page has been shared on social media sites. These page thumbnails, when clicked, will take users directly to the web page that is displayed on the thumbnail. The Social Media Panel would display page thumbnails in real-time so that users get up to date information when they visit the website.

The results and findings presented in this paper are useful for website designers, website owners and users who share information on social media sites. We do not anticipate that a community-driven navigation mechanism would replace current navigation mechanisms on websites. For example, our previous study explored the use of three navigation tools on websites and concluded that the website needs multiple navigation tools to aid users in finding information [23]. Thus, we perceive this as an alternate mechanism for finding information on websites. Future research will require an investigation as to how community-driven navigation mechanism will work in conjunction with other navigation mechanisms on websites.

7. Study Limitations

Four events and their websites were considered for the first stage of this study. This was not representative of all websites and events. Furthermore, we used the Twitter Search API to collect the sample. In future work, we will consider using the Twitter Streaming API to capture a broader sample of twitter messages.

8. Conclusions and Future Work

We collected data from Twitter during four different events and analyzed the tweets that contained links. The results from this first stage of research provide insight on the links shared during the four events, in particular unique links, profile of top 10 links, depth of links from the website's home page, type of web content on links and tweets containing links to other web pages. The initial findings have helped us refine the types of websites and/or events where an aggregated view of links shared on social media is likely to be most useful. In addition, a prototype design has been created to display popular pages on social media on to websites. Our future work comprises of developing this prototype and testing it on 10 event websites. We will test the viability of the tool through a user study and compare this with existing navigation mechanisms on websites, such as menus and search functions. We will further examine the types of task and events this tool will be most useful for including fact finding and serendipitous. We will also conduct a comparative study between the proposed navigation tool and current navigation mechanisms, such as the most popular articles widget on some websites. Furthermore, we will explore the potential benefits of this navigation tool in assisting website visitors discover and connect to other social media users who are interested in the same topics, which, could possibly lead to the formation of topic driven online communities.

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