An Analysis of Image Use in Twitter Message

트위터 상의 이미지 이용에 관한 분석

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ABSTRACT

Given the context that users are actively using social media with multimedia embedded information, the purpose of this study is to demonstrate how images are used within Twitter messages, especially in influential and favorited messages. In order to achieve the purpose of this study, the top 200 influential and favorited messages with images were selected out of 1,589 tweets related to "Boston bombing" in April 2013. The characteristics of the message, image use, and user are analyzed and compared. Two phases of the analysis were conducted on three data sets containing the top 200 influential messages, top 200 favorited messages, and general messages. In the first phase, coding schemes have been developed for conducting three categorical analyses: (1) categorization of tweets, (2) categorization of image use, and (3) categorization of users. The three data sets were then coded using the coding schemes. In the second phase, comparison analyses were conducted among influential, favorited, and general tweets in terms of tweet type, image use, and user. While messages expressing opinion were found to be most favorited, the messages that shared information were recognized as most influential to users. On the other hand, as only four image uses – information dissemination, illustration, emotive/persuasive, and information processing – were found in this data set, the primary image use is likely to be data-driven rather than object-driven. From the perspective of users, the user types such as government, celebrity, and photo-sharing sites were found to be favorited and influential. An improved understanding of how users' image needs, in the context of social media, contribute to the body of knowledge of image needs. This study will also provide valuable insight into practical designs and implications of image retrieval systems or services.

초 록

이용자들은 최근 소셜 미디어를 활발하게 이용하고 있으며, 소셜 미디어는 이미지와 같은 멀티미디어 정보의 배태가 주요한 특징이다. 본 연구는 트위터 상에서 이미지 이용 행태를 규명하고자 하였다. 이를 위하여 2013년 4월에 발생한 "보스턴 마라톤 대회 테러" 사건과 관련된 1,589건의 이미지 포함 트윗 메시지를 수집하여 이 중에서 영향력 있는 트윗 메시지 200건과 선호하는(favorite) 트윗 메시지 200건, 무작위로 선택된 일반 트윗 메시지 200건을 각각 선정하여 데이터 분석을 실시하였다. 데이터 분석은 두 단계의 분석과정과 세 그룹의 데이터 셋을 대상으로 수행하였다. 첫 번째 단계에서는 기존 선행연구를 바탕으로 개발된 코딩 체계를 활용하여 세 그룹의 데이터에 대해서 트윗 메시지, 이미지 이용, 이용자에 관하여 각각 수행되었다. 두 번째 단계는 세 그룹의 데이터 셋(일반 트윗, 영향력 있는 트윗, 선호하는 트윗)의 코딩 결과를 비교 분석하였다. 이러한 분석과정을 통해서, 의견을 표현하는 트윗이 가장 선호되었으며, 정보를 공유하는 트윗이 가장 영향력이 있는 것으로 나타났다. 이미지 이용 관점에서는 정보배포, 일러스트레이션, 감정적/설득적, 정보처리 이용목적이 가장 두드러지게 나타났다. 이러한 이미지 이용은 기존의 이미지 이용 패턴과 달리 이미지를 데이터로서 이용하는 목적이 객체 중심으로 이용하는 목적보다 높은 것으로 나타났다. 이용자 분석에서는 정부기관, 유명인, 이미지 사이트가 가장 선호되고 영향력 있는 것으로 나타났다. 이러한 연구결과는 이용 맥락 관점의 차세대 이미지 정보 검색 패러다임을 위한 이용자 관점의 이해 증진에 기여할 수 있을 것으로 기대한다.

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1. INTRODUCTION

In this digital age, information users have experienced dynamic changes as they search, use, (re-)create, and disseminate information. In the users' information environment, two changes have been recognized in the use of multimedia information and roles of information users. Due to the advanced digital information and network technologies, professionals in specialized areas are not the only users of multimedia; general public users interact with multimedia when they communicate with others. A great portion of Web searching activities is comprised of multimedia searching (ComScore 2010), and image is one of top multimedia formats in use (St. Jean et al. 2012). In addition, with the popularity of social media service, users have played multiple roles, from information consumer to information creator and information distributor, as they chat daily, converse actively, share information, and even report news through various social media services. When users dynamically use social media services for their daily lives, the information resource formats in which users engage has been shifted from text-only to also including multimedia in their digital information environment.

With the changes taking place in the information environment, it would be a worthwhile effort to gain a better understanding of the growing information phenomenon that embraces users' new roles (as information creators and disseminators) and investigates multimedia information being used as a main source of information. This study attempts to specifically examine Twitter messages containing images.

Twitter, one of the fastest growing social media applications, is a new form of communication in which people share information, assert personal opinions, request actions from the public, promote organizations' activities, and engage in conversation. These various Twitter activities can be categorized into two main purposes: sharing information and wielding influence. These purposes create unique aspects of Twitter messages and activities. First, Twitter users share information, whether it is news, personal updates, marketing, and so on; therefore, compared to other social media services, Twitter can be characterized as an information-oriented social media service (boyd, Golder, and Lotan 2010). Second, Twitter messages - or tweets - can be retweeted by other users. When users broadcast tweets in this manner, the messages can spread to a wider audience and can potentially influence large populations and public opinions. Finally, a tweet is a short message limited to 140 characters, but users can embed images, videos, and URLs. In other words, on Twitter, multimedia information is actively used for disseminating information. Considering these features, the authors assume that Twitter offers a unique opportunity to study the dynamics of the information environment including its active information users and multimedia information.

With the purpose of understanding the characteristics of tweets, image use, and users in Twitter communication, this study examined tweets with images addressing the topic of the Boston Marathon Bombing on April 2013. By analyzing tweets, the purpose of the study is to demonstrate an understanding of

how people use images when communicating with others in the context of social network services.

More specifically, the following research objectives will guide the direction of this study:

- To characterize the Twitter messages containing images in terms of influential and favorited tweets.
- To characterize the image uses in the Twitter messages in terms of influential and favorited tweets.
- To characterize the users using images in terms of influential and favorited tweets.
- To compare the general, influential, and favorited tweets in terms of message, image use, and user.

2. RELATED STUDIES

As Twitter has gained popularity worldwide, several lines of research have been conducted in order to understand tweeting behaviors and information diffusion through Twitter. For the current study, related studies are classified into two lines of research: image use for image information needs, and Twitter use for information.

2.1 Image use

There have been substantial research endeavors to identify users' image needs through various approaches. One of prominent approaches to users' image needs is to analyze image requests and search queries for images. One direction of this approach is to focus on users' image needs in terms of special collections and specific user groups such as art history, history, illustration, and news journalism (Choi and Rasmussen 2003; Armitage and Enser 1997; Chen 2001; Enser and McGregor 1992; Hastings 1995; Jörgensen and Jörgensen 2005; Westman and Oittinen 2006). The other is to understand general users' image needs in terms of a vast range of image collections and users' daily lives, mostly from data collected through web search logs (Goodrum and Spink 2001; Jansen 2008; Cunningham Bainbridge and Masoodian 2004; Panofsky 1955; Chung and Yoon 2011; Chung and Yoon 2009). A recent trend in understanding users' image needs is to identify the needs in context. While there have been a wide variety of contexts for image needs, image use has been recognized as one of crucial factors to users' image needs (McCay-Peet and Toms 2009). Fidel (1997) defined the two extreme ends of image use as object pole and data pole, Conniss, Ashford, and Graham (2000) identified seven image uses: illustration, information dissemination, information processing, learning, aesthetic, idea generation, and emotive and persuasive uses using Fidel's two poles. A considerable amount of research has been conducted utilizing the two frameworks provided by Fidel and Conniss, Ashford, and Graham. This line of research has shown that image uses in the object pole, including aesthetic, idea generation, and emotive and persuasive uses, are not limited to everyday life image seeking (Westman and Oittinen 2006; Chung and Yoon 2011) but are also used in journalism and history fields (McCay-Peet and Toms 2009). Clearly, image use is

indicated as one of the significant indicators for users' image needs (McCay-Peet and Toms 2009; Chang and Lee 2001; Coutright 2007; Johnson 2003). Recently, as the environment for image use has changed and expanded to include social media services, understanding how users use images in the context of social media is valuable to identify users' image needs.

2.2 Twitter use

Twitter can be defined as a microblogging service which allows a user to send a brief 140 character message, called a "tweet", to others. Depending on users' preferences, tweets can be sent to only specific users or to public users. Several functions are available such as responding with "@", retweeting, and hashtags (#) to send information specific users and designate specific topics for their messages. As Twitter gains popularity worldwide, there have been research efforts to understand users' behaviors and information diffusion through Twitter. Several distinctive lines of research are recognized in the line of this current research. The first line of research focuses on the characteristics of Twitter in terms of quantitative analyses such as content analysis of Twitter messages and users. The studies in this focus have demonstrated the growth of Twitter, hashtag and @ usages, geographic distributions of users and messages, message categorizations, and users' characteristics (Java et al. 2007; Krishnamurthy and Arlitt 2008; Naaman, Boase, and Lai 2010; Westman and Freund 2010). Second, by focusing on information diffusion through retweeting behaviors, research has attempted to understand retweeting behaviors, including retweet practices, the characteristics of retweeted messages, the reasons for retweeting, editing behaviors during the retweeting procedure, affecting factors on retweeting, and usage patterns of the @ symbol in Twitter (boyd, Golder, and Lotan 2010; Honeycutt and Herring 2009; Mustafaraj and Metaxas 2011; Nagarajan, Purohit, and Sheth 2010; Suh et al. 2010; Yang et al. 2010). Another line of research in Twitter is related to visualization of Twitter network in terms of users and messages (Bruns 2012; Lerman and Ghosh 2010). Finally, there have been endeavors to identify Twitter behaviors among specific user groups such as police user groups (Crump 2011), Congress member user groups in the U.S. (Golbeck, Grimes, and Rogers 2010), and local government user groups in the U.K. (Panagiotopoulos and Sams 2012). These lines of research attempted to understand users' behaviors and characteristics of information diffusion through Twitter. However, although image use in the context of social media is highly relevant information for identifying users' image needs, image use within tweets has had little examination.

3. RESEARCH METHOD

3.1 Data collection

In order to understand image use in the context of tweets, the messages containing images were collected for data analysis. Most of images in the Twitter messages have URLs starting with "pic.twitter.com",

so the messages were retrieved from the Twitter website (www.twitter.com) with the keywords "pic.twitter.com" AND "Boston" during the period between April 15 and April 30, 2013 for collecting the data set. By default, the Twitter website provides an option of 'Top' or 'All' tweets and tweets with 'Top' option were selected. For this study, the total number of collected tweets was 1,589. To characterize and compare the features of message, image use, and user among influential Twitter messages (i.e., highly retweeted messages), favorited Twitter messages (i.e., highly favorited messages by users), and general Twitter messages (i.e., random Twitter messages), three sets were selected from 1,589 tweets.

(1) influential Twitter message data set: the top 200 most retweeted messages were selected and 192 messages were used for analysis since there were deleted images and accounts.

(2) favorited Twitter message data set: the top 200 favorited messages were selected and 189 messages were used for analysis since there were deleted images and accounts.

(3) general Twitter message data set[1]: 200 messages were randomly selected and 174 messages were used for analysis since there were deleted images and accounts.

3.2 Data analysis

In order to identify the characteristics of tweet, image use, and user, two phases of analysis were conducted. In the first phase, categorical analyses were performed for messages, image uses, and users for the data sets of this study. In this phase, coding schemes were adopted and modified from previous studies. For types of tweets, the coding scheme developed in Yoon and Chung (2013) was adopted. In Yoon and Chung (2013)'s study, initial categories were synthesized from previous studies; categories of Twitter messages were summarized from several previous studies (Honeycutt and Herring 2009; Java et al. 2007; Naaman, Boase, and Lai 2010; Westman and Freund 2010) and eight types of messages were recognized as shown in Table 1.

〈Table 1〉 Categories for Twitter message

Type of message	Note
Call for action	To ask for social action
Information sharing	To share information
Reporting news	To report news
Information seeking	To seek information
Opinion	To express his/her opinion
Self-promotion	To promote himself/herself or organization
Anecdote-me	To describe an anecdote of himself/herself
Anecdote-other	To describe an anecdote of others

1) Yoon, J. and E. Chung. 2013. How images are conversed on Twitter? *The Proceedings of the American Society for Information Science and Technology*, ASIST Conference 2013.

On the other hand, for the categories of image use, the seven image uses from Conniss, Ashford, and Graham (2000)'s study were selected and were shown in Table 2. As Fidel (1997) pointed out, as the image uses include aesthetic, emotive/persuasive, illustration, and generation of idea purposes were identified from the object poles, information dissemination, information processing, and learning were identified from the data pole.

For analyzing the types of users, the categories for user types were adopted and slightly modified from the study of Yoon and Chung (2013) as shown in Table 3.

In the second phase of analysis, comparisons among the three data sets (general, influential, and favorited Twitter messages) in terms of types of message, image uses, and types of user were made. In a comparative analysis, the features of image use in Twitter messages are able to be identified.

4. RESULTS

4.1 Overview of Twitter messages

From the data set with 1,589 messages addressing "Boston bombing", the numbers of messages per day were shown as shown in Figure 1. Two peaks

〈Table 2〉 Categories for image use[2]

Image use	Note
Aesthetic value	simply for aesthetic purposes or enjoyment
Emotive/persuasive purpose	a means of stimulating or conveying emotion or persuasion
Illustration	a means of representing what is being described
Generation of idea	a means of provoking thought patterns or an inspirational means
Information dissemination	a piece of information
Information processing	the use of data contained within the image
Learning	gaining knowledge from the image

〈Table 3〉 Categories for user type

User type	Note
Government	Government authorities (e.g.) Boston Police Department
Media/Journalist	Journalists and media (e.g.) CNN
Commercial org.	Commercial organizations (e.g.) NHL
Individual	Individual persons (e.g.) John Doe
Celebrity	Celerity people (e.g.) Mia Farrow
Photo-Sharing	Photography sharing websites (e.g.) Realphotobombs

2) Modified from Chung, E. and J. Yoon. 2011. Image needs in the context of image use: An exploratory study. *Journal of Information Science*, 37(2): 163-177.
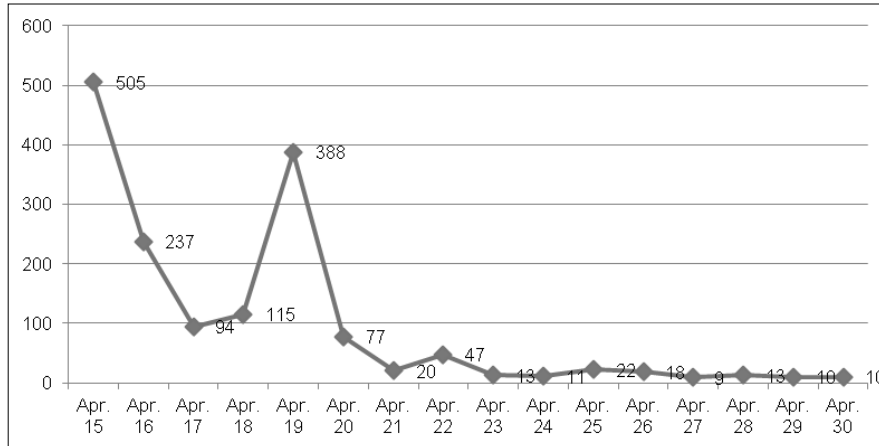
〈Figure 1〉 "Boston bombing" Twitter message distribution by date

(505 Twitter messages and 388 Twitter messages per day) of Twitter messages in Figure 1 are noted on April 15 and April 19. According to a chronological account of developments regarding Boston Marathon bombing,3) on April 15, there were two consecutive explosions in the event of Boston Marathon. After the explosions on April 15, two suspects for the explosion were either dead or captured by police on April 19.

As shown in Table 4, for 1,589 Twitter messages on "Boston bombing", a total number of retweets for these messages is 663,002 and 449.5 on average. The highest number of retweets is 19,854 times, that is a single Twitter message was retweeted 19,854 times, which is considerably influential to others. In addition, a total number of the 'favorite' feature for these messages is 205,040 and 139 on average. The highest number of 'favorite' is 5,579 times. The data set of the top 200 tweet messages accounts for 66% and 67% of the total numbers of retweets and favorites compared to the data set of 1,589 messages, respectively.

〈Table 4〉 The number of retweet and favorite for data sets

	# of retweet	# of favorite
All data (1,589 tweets)	663,002	205,040
Influential data (Top 200 tweets)	435,772	125,210
Favorited data (Top 200 tweets)	372,653	136,912
# of retweet/favorite compared to all data	66%	67%

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3) Timeline: The Boston Marathon bombing, manhunt and investigation
   (source: CNN News http://www.cnn.com/2013/05/01/justice/boston-marathon-timeline)

4.2 Characteristics of Twitter message

The categorical results from the data sets are shown in Table 5. Among ten categories of tweets, three categories are found to be primarily common in three data sets, namely: opinion, information sharing, and reporting news. These three categories account for approximately 89%, 91% and 93%, respectively.

Yet, as shown in Table 5 and Figure 1, two characteristic differences among general, influential, and favorited Twitter messages emerge. First, there is a group of tweet categories from influential and favorited tweets which are more dominant compared to general tweets. The category of 'call for social action' tends to appear more in influential messages rather than in favorited and general messages. Similarly, influential messages and favorited messages contain more in the categories of 'information sharing' and 'opinion' rather than in general tweets. When the categories of information sharing and opin-ion are compared, the 'opinion' category is found more in favorited and influential tweets than general tweets. In addition, the category of 'anecdote-me' is found mostly in favorited and influential tweets, rather than in general tweets. Furthermore, the category of 'asking retweeting' is found only in influen-tial tweets and favorited tweets. The second finding shows that a group of categories appears more in general compared to the influential and favorited Twitter messages. The category of 'reporting news' is more in general tweets rather than in influential and favorited tweets. The 'self-promotion' and 'other' categories are found only in general tweets, not in influential and favorited tweets.

4.3 Characteristics of image use

Users use images when they create, modify, dis-seminate, and express opinions. Image uses were cate-gorized in terms of general, influential and favorited

〈Table 5〉 Categorical distribution by message types

| Type of message	General		Influential		Favorited	
	freq.	%	freq.	%	freq.	%
Call for Social Action	4	2	8	3	5	2
Info Sharing	51	29	72	31	66	31
Reporting News	43	25	49	21	34	16
Info Seeking	1	1	1	0	0	0
Opinion	61	35	90	39	100	46
Self-Promotion	11	6	0	0	0	0
Anecdote me	2	1	4	2	9	4
Anecdote others	0	0	0	0	0	0
Ask retweeting	0	0	8	3	2	1
Other	1	1	0	0	0	0
Total	174	100	232	100	216	100
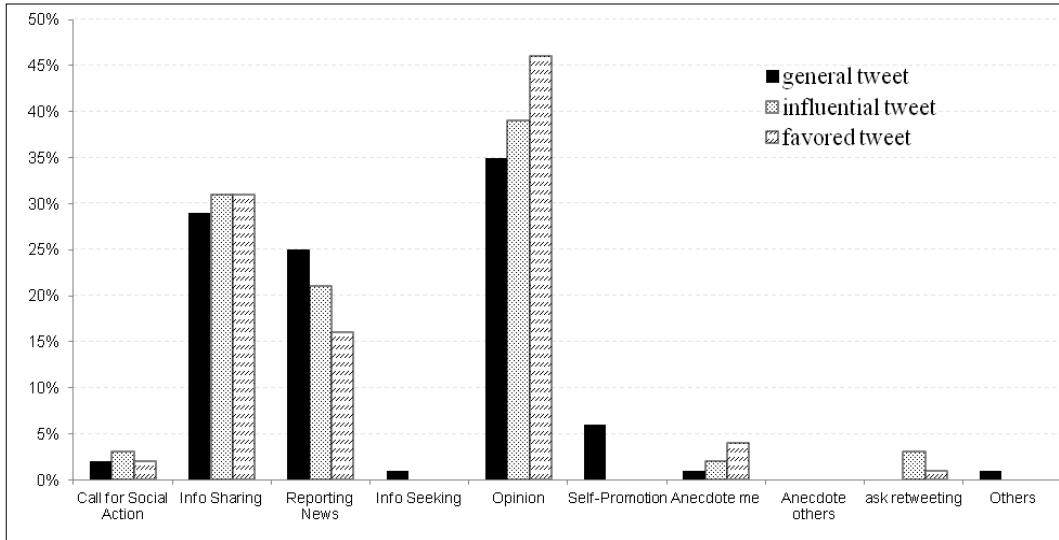
〈Figure 2〉 Comparison of general, influential and favorited Twitter messages by message types

tweets as shown in Table 6. For the data sets, image uses of information dissemination, emotive, persuasive, and illustration were found to be dominant. This result seems to be related to the dominant message types, which are information sharing, reporting news, and opinion. With the purposes of sharing information, reporting news, and expressing their opinions, users use images to disseminate information, invoke emotion, and persuade.

When the distribution of image uses is compared in terms of the three data sets, general, influential, and favorited tweets in Table 6 and Figure 3, several characteristics are recognized. First, illustration image use is found mostly in general tweets, rather than influential and favorited tweets. On the other hand, persuasive image use is found more in influential and favorited tweets than general tweets. Emotive and Information dissemination were dominant in all

〈Table 6〉 Categories of image uses in terms of influential and favorited tweets

Image use	General		Influential		Favorited	
	freq.	%	freq.	%	freq.	%
Illustration	20	11	8	4	16	7
Emotive	52	30	67	30	78	36
Persuasive	9	5	34	15	22	10
Information processing	4	2	1	0	1	0
Information dissemination	88	51	115	51	97	45
Other	1	1	0	0	0	0
Total	174	100	225	100	214	100
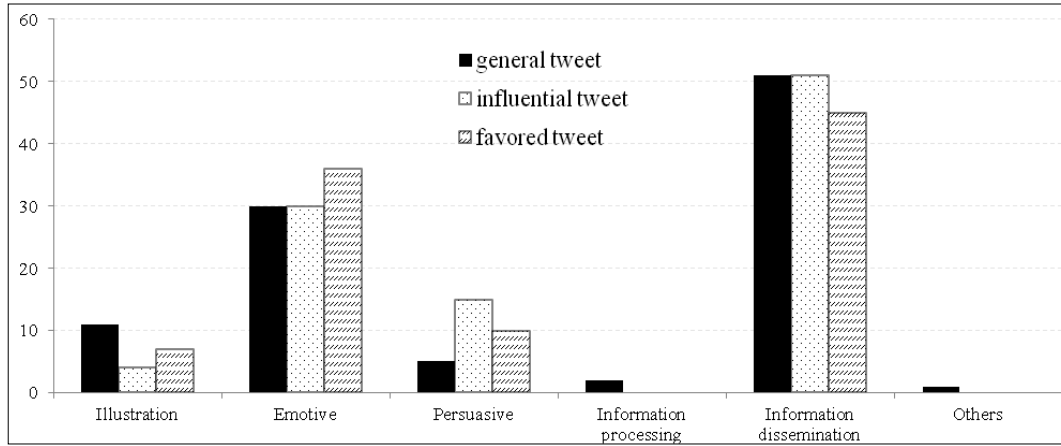
〈Figure 3〉 Comparison of general, influential and favorited Twitter messages by image uses

three datasets. However, while emotive image use occurs more in favorited Twitter messages compared to the data sets of general and influential Twitter messages, the image use of information dissemination occurs more in general and influential tweets rather than favorited tweets. Information processing image use is found only in the data set of general tweets.

4.4 Characteristics of user

The types of user of Twitter messages are catego-rized in Table 7. As shown in Table 7, users such as media/journalist, individual, celebrity, and govern-ment were primarily found. In general, celebrities are found more frequently in favorited tweets than influential and general tweets.

When the three data sets are compared as shown in Table 7 and Figure 4, each data set shows distinctive features depending on the types of user. For instance, the types of users of media/journalist, commercial organization, and individual appear more in general tweets rather than influential and favorited tweets.

〈Table 7〉 Categorical distribution of users

Type of agent	General		Influential		Favorited	
	freq.	%	freq.	%	freq.	%
Government	6	3	21	11	20	11
Media/Journalist	74	37	59	31	56	25
Commercial org.	16	10	11	6	16	8
Individual	58	37	64	31	47	25
Celebrity	15	10	32	16	43	23
Photo-Sharing	5	3	10	5	12	6
Other	0	0	0	0	4	2
Total	174	100	192	100	189	100
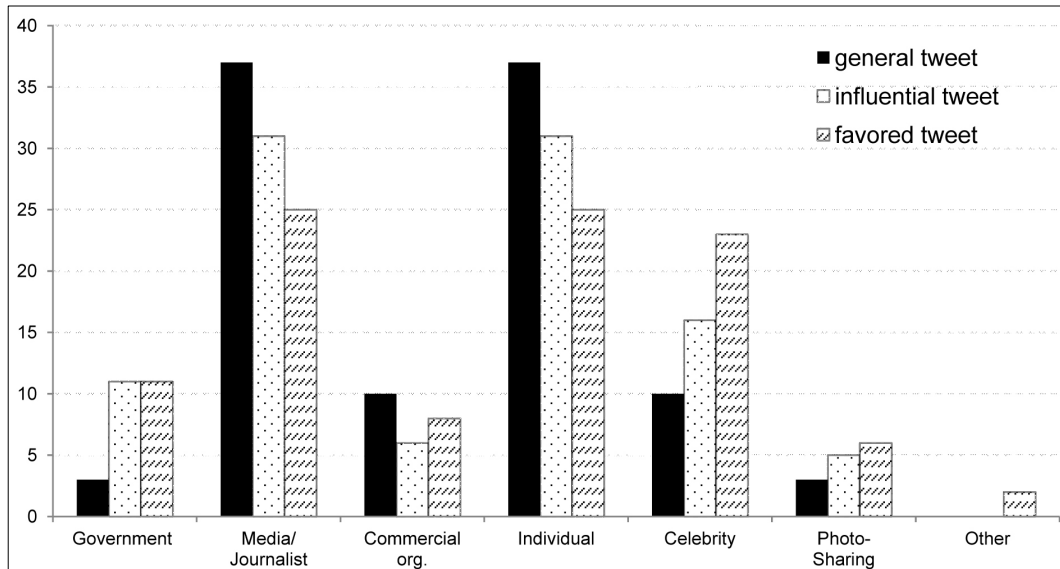
〈Figure 4〉 Comparison of general, influential and favorited Twitter messages by user types

On the other hand, government, celebrity, and pho-to-sharing are found more in influential and favorited tweets than general tweets.

5. DISCUSSION

The Twitter phenomenon has gained popularity worldwide since its introduction in 2006. Twitter mes-sages containing images related to the term "Boston bombing" in April 2013 were categorically analyzed and compared among three data sets: general, influen-tial, and favorited tweets. The results demonstrate some of the features of tweets, image uses and users from the perspective of different data sets.

Twitter messages with images are characterized into two aspects. First, as Zhao and Rosson (2009) recognized "information from people" as one of the unique characteristics of Twitter messages, among favorited Twitter messages, there was found to be a phenomenon of favoriting for information from real people. For instance, the opinion category was found to be in high proportion among the data set of favorited Twitter messages. When users express their personal opinions in their Twitter messages, those tweets tends to be favorited by other users. From the data set of current study, the images used in this category of messages are characterized as high-ly emotional. For instance, when users express their personal opinions on two suspects of "Boston bomb-ing" event, artificial or fabricated pictures with emo-tional textual inscription were added for demonstrat-ing the emotions of their opinions. In addition, in-formation from people, such as personal update and the anecdote-me category, is more favored by users. The other aspect relates to the characteristics of influ-

ential Twitter messages. Influential messages are likely to be characterized in terms of information sharing with others. As one of notable features of Twitter is the function to disseminate and share information in a timely fashion (Dumbrell and Steele 2012), the information sharing message type was found to be substantial.

When images are used in the context of Twitter messages, characteristic features are recognized. First, four image uses were dominant in the data sets among seven categories of image use proposed by Conniss, Ashford, and Graham (2000) and were different from the findings of previous studies on image uses in different contexts. Although this finding needs to be supported by broader and larger sets of data, the results may indicate that the image uses in tweets are likely to be highly constrained into specific uses of images which include information dissemination, illustration, emotion and persuasion. Second, the image use shows unique characteristics in the context of Twitter messages since previous research has reported that object-driven image use is more dominant compared to the use of images from data-driven image use (Westman and Oittinen 2006; Chung and Yoon 2011). Previous studies have showed that aesthetic, idea generation, and emotive / persuasive image use (which are object-driven) were found to be more prominent than information dissemination, information processing, and learning (which are data-driven). This finding can be understood in relation to the nature of Twitter, which is for users to (re-)send and respond to information from other users. While media / journalists and individuals were identified as major types

of users for sharing information, in this specific data set with respect to the term "Boston bombing", government, celebrity and photo-sharing sites are influential and favorited.

6. CONCLUSION

In the context of social media, users communicate with others. When this communication occurs through various recent information communication technologies, visual information resources such as images have gained the popularity (ComScore 2010; St. Jean et al. 2012). Because users tend to interweave tweets with relevant images to be clear and powerful in their messages, this study aims to explore the characteristics of messages, image uses, and users. To identify how people converse with each other through messages and images on Twitter, this study reported the analysis results of the "Boston Bombing" related tweets. In terms of the comparative analyses on three different data sets (influential, favorited, and general tweets), the features of messages, image uses, and users were established. For the types of messages, the three primary types were identified as opinion, information sharing, and reporting news. The tweets containing users' opinions were more dominant among favorited Twitter messages compared to general and influential Twitter messages. The messages with the purpose of sharing information with others were found to occur more frequently among influential Twitter messages. However, the messages for reporting news were found to occur more frequently in general Twitter

messages compared to influential and favorited Twitter messages. When image uses were identified in three data sets, two major uses were discovered as information dissemination and emotive purposes. When using images for information dissemination, more were found among the influential tweets compared to the favorited tweets. When used for emotional purposes, more image uses were identified in the favorited Twitter messages, rather than general and influential Twitter messages. In terms of user types, the three primary types of users were recognized as media / journalist, individual, and celebrity. Depending on the type of user, some distinctive features were found. In the types of media / journalist and individual, there was a similar pattern; they were found more in general and influential tweets rather than in favorited. By contrast, the celebrity type of user was found more in favorited tweets compared to general and influential tweets.

The findings suggest a few possible future research agendas. This current study revealed major tweet types, image uses, and user types based on three data sets, and future research could look into the relationships of three aspects. For example, certain message types such as information sharing and opinion may be associated with specific image uses. That is, emotional / persuasive use of image might be more frequently observed in a certain type of tweet. Thus, a future study conducted on the relationship with the three aspects can further examine the Twitter behaviors with image uses. Another line of future undertaking can examine Twitter behavior on the societal level. For example, using a comparative study approach, a future study could examine whether the findings of this current study is in fact linked to a certain culture and society or if it is a universal phenomenon. The findings of a comparative study could provide valuable insights and guidelines to local image retrieval services and system designs and implementations.

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