Internet Research

Breadth, depth, and speed: diffusion of advertising messages on microblogging sites

Lun Zhang Tai-Quan Peng

Breadth, depth, and speed: diffusion of advertising messages on microblogging sites

Lun Zhang
Department of Journalism & Communication, University of Chinese Academy of Sciences, Beijing, China, and
Tai-Quan Peng
Wee Kim Wee School of Communication and Information, Nanyang Technological University, Singapore

Received 23 January 2014
Revised 6 February 2014
16 June 2014
17 August 2014
18 August 2014
Accepted 1 September 2014

Abstract

Purpose – The purpose of this paper is to present an empirical assessment of the diffusion of advertising messages on microblogging sites. The diffusion properties of advertising messages are quantified based on the following three aspects: diffusion breadth, depth, and speed. Furthermore, this study examines the influence of message- and advertiser-level factors on the diffusion of advertising messages.

Design/methodology/approach – The study data comprises 20,000 advertising messages that are randomly drawn from a popular microblogging web site in China. Five message-level factors and four advertiser-level factors are constructed based on the information retrieved from the microblogging web site. Generalized linear modeling is adopted to examine the effects of such factors on the diffusion properties of advertising messages.

Findings – The positive driving forces underlying the diffusion of advertising messages on microblogging sites include message length, the advertisers' in-degrees, and their reputation. The diffusion of advertising messages is hampered by typicality, affectivity, the completeness of the information of the advertising messages, and advertisers' out-degrees.

Practical implications – To achieve optimal diffusion on microblogging sites, advertisers should select the appropriate time windows for releasing advertising messages. Moreover, advertisers should actively increase the number of fans, use less typical and less emotional words in advertising messages, and eliminate unnecessary URLs in such messages.

Originality/value – This study contributes to the diffusion theory by identifying the mixed effects of different information attributes on the diffusion of advertising messages on microblogging sites, and examining the roles of advertisers' structural characteristics in the diffusion of advertising messages. Furthermore, the results illustrate how consumers cope with the advertisers' sales presentations on microblogging sites.

Keywords Information diffusion, Microblogging sites, Social advertising, Structural characteristics, Advertising messages

Paper type Research paper

The emergence of microblogging sites as one of the most popular forms of social media has considerably transformed advertising practices (Hanafizadeh *et al.*, 2012; Mangold and Faulds, 2009). First, microblogging sites provide users with access to information sources (Zhang *et al.*, 2011) and empower users to participate in the diffusion of

The authors would like to thank the editor and anonymous reviewers for their valuable comments. The study was supported by Start-up Grant (M4081281.060) and Academic Research Fund (AcRF) Tier 1 Grant (M4011299.060) from Nanyang Technological University.

Internet Research
Vol. 25 No. 3, 2015
pp. 453-470

1066-2243
DOI 10.1108/IntR-01-2014-0021

advertising messages (Steyn *et al.*, 2011). Second, unlike conventional advertising media, microblogging sites enable real-time communication among users (Harris and Rae, 2009). Hence, the spread of information to target consumers can be accelerated within hours. Third, the effort required for information sharing among users has substantially decreased among microblogging sites (Park *et al.*, 2013); thus, users can disseminate advertising messages with a simple click of a mouse.

Given the promising features of microblogging sites, advertisers have used such sites to improve brand awareness, promote products/services, and enhance their reputation (Wood and Burkhalter, 2014). Owing to the low cost of information generation on microblogging sites, advertising messages have increasingly saturated microblogging sites. However, the successful diffusion of advertising messages on microblogging sites heavily depends on the response of users to such messages (Hoffman and Novak, 1996; Kozinets *et al.*, 2010; Mangold and Faulds, 2009).

Users of microblogging sites have selective attention, considering the complex and overloaded information environment on such sites (Bennett and Iyengar, 2008). As such, advertising practitioners should identify the effective methods in grabbing users' attention and in soliciting responses to their advertising messages to attain optimal diffusion on microblogging sites. In this regard, the current study will empirically assess the diffusion of advertising messages on microblogging sites by quantifying the diffusion properties based on three aspects, namely, diffusion breadth, depth, and speed. Subsequently, the study will examine what types of advertising messages and advertising messages from which advertisers can attain optimal diffusion on microblogging sites.

1. Literature review and hypotheses development

Diffusion is a communication process in which information (i.e. advertising messages) "is communicated through certain channels over time among the members of a social system" (i.e. users on microblogging sites) (Rogers, 1995, p. 5). In this study, the effectiveness of the diffusion of advertising messages is examined based on its three dimensions, namely, breadth, depth, and speed. Diffusion breadth refers to the capacity of advertising messages to generate offspring reposts on microblogging sites. Diffusion depth refers to the length of the advertising messages' diffusion path on microblogging sites. Finally, diffusion speed refers to the efficiency of the information diffusion process. Messages diffused at rapid rates are more efficient than messages diffused at slow rates (Van den Bulte, 2000).

Diffusion theory states that several sets of factors can influence the diffusion of an innovation, such as innovation attributes, communication channels of the diffusion process, and promotional efforts from information sources (Rogers, 1995). Information attributes (also called "information quality"), which include the completeness of information, relevance, security, accessibility, and timeliness, substantially affect the information diffusion process (Alexander and Tate, 1999; Katerattanakul and Siau, 1999; Parker *et al.*, 2006; Strong *et al.*, 1997; Van Zeist and Hendriks, 1996).

Unlike traditional advertising channels on mass media, microblogging sites allow advertisers to spread information in a quasi-interpersonal way via the "followee-and-follower" networks built on the same platform (Chu and Kim, 2011). The structural positions of advertisers in such networks can determine the size of their potential audience when diffusing advertising messages (Weng *et al.*, 2014). If an advertiser is embedded in a disconnected "star network" (i.e. the advertiser serves as a

central actor, to which all other users are only connected to the advertiser), advertising messages can be diffused myopically to a small group of audience by only one step. By contrast, if an advertiser is embedded in a "small world network" characterized by large clustering coefficient and short network diameter (Watts and Strogatz, 1998), advertising messages can be diffused to the entire network within several steps. Therefore, the structural characteristics of the advertisers on microblogging sites are critical in determining the diffusion properties of the advertising messages.

Similarly, the investment of the advertisers in promotional activities has a significant role in facilitating the diffusion of advertising messages. The advertisers' promotional efforts can foster positive perceptions toward the advertised products or services among consumers (Kirmani and Wright, 1989). In online advertising, promotional efforts pertain to the advertisers' efforts to strengthen the values embedded in their online accounts and to enhance the efficacy of the information diffusion. To promote the audience's trust in advertising messages and reduce uncertainty (Goldberg and Hartwick, 1990), advertisers have to invest time and effort to maintain their active presence on microblogging sites, particularly by initiating or engaging in various activities on the platform. Thus, this study explores three sets of factors as antecedents, namely, characteristics of advertising messages, structural characteristics of advertisers, and promotional efforts of advertisers. These factors are expected to affect the diffusion of advertising messages on microblogging sites.

1.1 Effects of messages characteristics

The success of advertising messages' diffusion on microblogging sites heavily depends on the persuasive strength of advertising messages (Bhattacherjee and Sanford, 2006). Several important linguistic factors of advertising messages that enhance the persuasive strength and leverage the purchasing motivation of consumers have been identified in the literature on persuasion communication (Gelb *et al.*, 1985; Wyer, 2002). In the present study, we include the characteristics of interactivity, affectivity, typicality, length, and completeness of information (i.e. the availability of supplementary link), all of which are crucial to the persuasive strength of advertising messages.

The buzzword "interactivity" has gained extensive attention in advertising research. In conventional advertising campaigns, interactivity refers to "the degree to which two or more communication parties can act on each other" (Liu *et al.*, 2012, p. 54). However, in the context of advertising campaigns on microblogging sites, interactivity refers to the feature of advertising messages that directly engages the audience in its diffusion, in consideration of the introduced elements of the messages (i.e. the mentioning function of microblogging posts). Advertising on microblogging sites can be distinguished from traditional advertising in terms of the degree of consumer-to-message interactivity. Advertising campaigns that have been implemented on microblogging sites can draw users' attention by mentioning the account names of specific users in their messages. By consequence, these mentioned users will be encouraged to participate in the diffusion process, thus avoiding the negative feeling of being ignored (Liu and Shrum, 2002; McMillan and Hwang, 2002). A high degree of interactivity can increase the perceived relevance of advertising messages to users, reduce relationship uncertainty, increase the users' involvement, and develop a satisfying communication experience for users (Ching *et al.*, 2013; Huang, 2012; Sundar *et al.*, 2003). Therefore, the users' response to advertising messages are enhanced (de Vries *et al.*, 2012). In addition, mentioning the specific target consumers in advertising messages will help synchronize communication between

advertisers and consumers (McMillan and Hwang, 2002), and accelerate the diffusion process of advertising messages. Therefore, we hypothesize as follows:

H1. The interactivity of messages facilitates the diffusion of advertising messages on microblogging sites.

Affectivity refers to the degree of emotional or sentimental expression in advertising messages (Gelb *et al.*, 1985). Sentiment-laden advertising messages attract the attention of users and induce behavioral responses (Chandy *et al.*, 2001; Holbrook and Batra, 1987). Emotional elements in advertising messages convey personalized and user-oriented feelings, which promote the development of positive attitudes toward the messages among users (Chandy *et al.*, 2001), provide a greater recall of advertising messages (Wyer *et al.*, 2002), and induce positive behavioral responses (i.e. more "likes" on Facebook) (Swani *et al.*, 2013). Therefore, we hypothesize as follows:

H2. The affectivity of messages positively influences the diffusion of advertising messages on microblogging sites.

Typicality refers to the amount of normative and easily recognized persuasion words (e.g. "promotion" and "sale") conventionally integrated into advertising messages (Fowler, 2012). The typicality of advertising messages increases with the number of persuasion-related words in the message. As a result, users can easily recognize such messages as advertisements. In general, users avoid advertising messages that are considered irritating, intrusive, and disruptive (Chang *et al.*, 2013; Rotfeld, 2006). Typical advertising messages activate a counter-argumentative mindset among users, which ultimately renders the advertisements ineffective (Xu and Wyer, 2012). Users on microblogging sites are less likely to act on a message if the message is identified as an advertisement. Therefore, we hypothesize as follows:

H3. The typicality of messages negatively influences the diffusion of advertising messages on microblogging sites.

Large advertisements capture and retain more visual attention from consumers compared with smaller ones (Pieters and Wedel, 2004; Rosbergen *et al.*, 1997). In addition, longer messages are considered to be more persuasive compared with shorter ones (Chaiken, 1980; Liu *et al.*, 2012) because the length of the messages represents the amount of information conveyed and the strength of the arguments embedded in the message (Sundar *et al.*, 2003; Wood *et al.*, 1985). Thus, social media users are more likely to pay attention to or act upon longer advertising messages compared with shorter ones. Hence, we hypothesize as follows:

H4. The length of messages positively influences the diffusion of advertising messages on microblogging sites.

The completeness of information is another important feature that can affect the diffusion of advertising messages. Although most microblogging sites impose a constraint on the number of characters to be included in a message (e.g. the 140-character limit on Twitter), such limitation can be circumvented by attaching an external link that provides additional details to potential audiences. Users prefer messages with complete information, which subsequently affects the users' behavioral intentions toward the messages (Hu and Sundar, 2010). The completeness of information that can be acquired from advertising messages on microblogging sites is further enriched by adding a

supplementary link, which also induces the users' attention and response to those messages. Thus, we hypothesize as follows:

H5. The completeness of information positively influences the diffusion of advertising messages on microblogging sites.

1.2 Effects of advertisers' structural characteristics

The structural positions of advertisers on microblogging sites indicate their ability to reach potential audiences in spreading advertising messages. The flow of information on microblogging sites is determined by the direction of established social connections. For example, if User A follows User B, but User B does not follow User A, messages could only be transferred from B to A, and not vice versa.

In this study, we focus on "out-degrees" and "in-degrees" as the two key structural characteristics of advertisers. Such characteristics are expected to affect the diffusion of the advertising messages on microblogging sites (Wasserman and Faust, 1994). An advertiser's in-degree characteristic refers to the advertiser's number of subscribers (i.e. "fans") that an advertiser has, which reflects their popularity within a network (Hodas *et al.*, 2013). Meanwhile, out-degree refers to the number of users that an advertiser subscribes to. On microblogging sites, advertisers can function as regular users and freely follow other existing customers, opinion leaders, or relevant target audiences. Having a high out-degree indicates their activeness in building connections with other users on microblogging sites (Lipponen *et al.*, 2003).

The "following-followee relationship" (Hodas *et al.*, 2013) could be reciprocated on social media (Golder and Yardi, 2010; Java *et al.*, 2007) where advertisers can adopt the "tit-for-tat" strategy in building online relationships with their potential customers. Specifically, advertisers can reinforce the relationships they have established by assuming that other users would follow them back in the future. Thus, initiating outgoing links would indirectly lead to an increase in incoming links, which further increases the diffusion likelihood of advertising messages. As such, we hypothesize the following:

H6. The advertisers' in-degree characteristic positively influences the diffusion of advertising messages on microblogging sites.

H7. The advertisers' out-degree characteristic positively influences the diffusion of advertising messages on microblogging sites.

1.3 Effects of advertisers' promotional efforts

This study considers the advertisers' level of experience and reputation (Barry, 1994) as indicators of their promotional efforts to facilitate information diffusion on microblogging sites. On the one hand, users' experience on a particular medium is positively related to their mastery of utilization techniques (Curran *et al.*, 2011). On the other hand, the advertisers' level of experience with microblogging sites determines their competence in using such sites for advertising purposes (Krishnamurthy and Dou, 2008). By frequently and regularly interacting with their target audiences, advertisers can use microblogging sites to pursue long-term consumer-marketer relationship. Consequently, such relationship facilitates the diffusion of advertising messages (Friestad and Wright, 1994). Therefore, we hypothesize as follows:

H8. The advertisers' level of experience in using microblogging sites positively influences the diffusion of advertising messages on such sites.

Given that web-based communication lacks physical contact, the reputation of advertisers has become increasingly important in attracting the attention of the audience (Rowley, 2004). Advertisers and marketers can enhance their reputation by employing symbols (e.g. names, terms, and signs), which further improves the recognition of the advertised products and differentiates themselves from competitors (Kotler and Pfoertsch, 2010). Advertisers can migrate their offline reputation to microblogging sites by adding a credential mark to their microblogging accounts[1]. Such credential marks can represent the accumulated reputation of advertisers. Specifically, messages posted by reputable brands or advertisers (e.g. users with credential marks) are more likely to receive positive responses (i.e. reposts or comments) from users than posts from other ordinary users (Zhang *et al.*, 2014). Therefore, we hypothesize the following:

H9. The reputation of advertisers positively influences the diffusion of advertising messages on microblogging sites.

2. Research methods

2.1 Data collection

Data were extracted from a popular microblogging site in China in 2011. At that time, the microblogging site had two major forms of advertisement, namely, brand display advertising (e.g. banner advertising) and ordinary post advertising[2]. Considering that display advertisements on microblogging sites were similar to the advertisement on portal web sites in the Web 1.0 era, we focused only on advertising messages published as ordinary posts.

First, we randomly selected 1,000 messages from the microblogging site and manually coded these messages to determine whether they were advertisements or not. Two coders were trained to perform manual coding and identified the advertising messages based on the presence of the advertising elements (e.g. persuasive attempts, services, or products that tend to be promoted) (Bovee, 1992). The coding reliability was adequate, with Cohen's Kappa equal to 0.862.

Second, a class-based Hidden Markov Model (HMM) approach (Zhang *et al.*, 2003) was adopted to segment and extract keywords from the messages which have been identified as advertisements. Keywords were extracted based on the ranking of their discriminant scores, which pertains to the "term-frequency inverse document-frequency (TFIDF)" value (Aizawa, 2003). The top 50 extracted keywords (e.g. "sales," "free shipping," and "percent off") were retained based on their TFIDF values. To assess the validity of the selected 50 keywords in identifying advertisements on the microblogging site, another independent sample comprising 1,000 messages was randomly drawn from the site, which was based on the top 50 keywords extracted previously. All 1,000 messages were manually reviewed. It was found that the accuracy rate of the retrieved advertising messages reached 90 percent. Finally, an independent sample of 20,000 advertising messages was randomly extracted from the microblogging site based on the 50 extracted keywords.

2.2 Measurement

The diffusion of advertising messages was measured in terms of breadth, speed, and depth of information diffusion (Yang and Counts, 2010). Breadth was quantified as the number of people reached by an advertising message at first degree (i.e. for each message, how many users repost it at first degree child nodes). Depth was calculated as

the maximum length of the diffusion chain of an advertising message (i.e. the number of intermediaries or the number of steps in the diffusion chain). Speed refers to the duration from the publication of an advertising message to the time of its first diffusion when users repost or share the message[3].

In this study, five characteristics of advertising messages were considered, which include interactivity, affectivity, typicality, length, and completeness of information. Interactivity was measured by the advertisers' use of recognizable signs (i.e. "@username") to directly communicate with certain microblogging site users. Affectivity was quantified as the degree of sentiment incorporated in advertising messages. Specifically, the messages' affectivity was measured by the proportion of modal particles, emoticons, exclamations, and sentimental words to the total number of words in an advertising message. Sentimental words were obtained from the dictionary HowNet[4]. Typicality was calculated by the number of words that are conventionally used in advertising messages. Length referred to the total number of words in advertising messages. Finally, completeness of information was dichotomized as whether URLs are included in advertising messages or not.

Furthermore, two structural characteristics of advertisers were considered in this study, namely, in-degree and out-degree. In-degree was measured by the number of an advertiser's followers on the microblogging site (i.e. the number of subscribers). Out-degree was measured by the number of users followed by an advertiser on the site.

The advertisers' level of experience was measured by the duration (i.e. months) from the date of registration until the user's latest post within the study period. Unlike other studies that employed traditional Likert-type scale measurements (McCroskey and Young, 1981), this study dichotomized advertisers' reputation: whether the credentials of an advertiser's account is verified (i.e. a "V" appears after the account name).

Owing to the 24/7 accessibility of social media, the time constraint of advertising campaigns on microblogging sites has eased. Nevertheless, this feature does not guarantee that advertising messages posted at any time slot will be equally effective. Therefore, two control variables on the timing of advertising messages are considered. First, we consider the publication time of advertising messages based on a 24-hour cycle. We categorized the publication time of the advertising messages into early morning (0:00-7:59), morning (8:00-11:59), afternoon (12:00-17:59), and evening (18:00-23:59). Second, we consider the publication date of advertising messages as a control variable, which is based on a seven-day cycle. In particular, we categorize the publication date of the advertising messages into the following: weekdays (i.e. Monday to Friday) and weekends (i.e. Saturday and Sunday).

3. Analytical findings

3.1 Diffusion properties of advertising messages on microblogging sites

Table I lists the descriptive statistics of diffusion breadth, depth, and speed of advertising messages on the microblogging site. The distributions of the three metrics are highly skewed, therefore suggesting the significant variation in the diffusion of advertising messages.

Many advertising messages are diffused by a small number of people. The median of diffusion breadth is 2 and the mean is 16, implying that 50 percent of the advertising messages reach fewer than two users. Moreover, the median of diffusion depth equal to 1 proves that most advertising messages are diffused via very few steps. More than half of the advertising messages fail to produce offspring after first-degree diffusion.

Nonetheless, some advertising messages are diffused across large and deep chains. Table I shows that maximum breadth is 8,889, indicating that an advertising message is retweeted 8,889 times in its first degree of diffusion. A small proportion of the advertising messages are diffused by more than ten steps within the network. The maximum depth is 28.

Half of the advertising messages are diffused within 1 hour since their publication on the microblogging site, whereas very few advertising messages (i.e. 55 out of 20,000) experience first-degree diffusion more than ten days after the message's initial publication. The maximum speed is 3,650 hours.

The diffusion breadth of advertising messages positively correlates with their diffusion depth (Pearson $r = 0.23$, $p < 0.001$). Therefore, advertising messages that spread to a larger pool of users in the first diffusion step will likewise experience a longer diffusion chain. Diffusion depth is negatively correlated with diffusion speed (Pearson $r = -0.03$, $p < 0.01$). Therefore, advertising messages that spread via a longer diffusion chain will also have a more rapid diffusion speed.

3.2 Factors affecting the diffusion of advertising messages

Generalized Linear Model (GLM) is adopted in the study to examine the effects of messages characteristics, structural characteristics of advertisers, and their promotional efforts on diffusion breadth, depth, and speed of advertising messages. The analytical results of GLM are listed in Table II. GLM accounts for 10, 5, and 5 percent of total variances of diffusion breadth, depth, and speed, respectively.

Effects of messages characteristics. Table II shows that messages' *interactivity* broadens ($b_{breadth} = 0.04$, SE = 0.02, $p < 0.05$) and deepens ($b_{depth} = 0.03$, SE = 0.003, $p < 0.001$) the diffusion of messages but reduces diffusion speed ($b_{speed} = 0.16$, SE = 0.03, $p < 0.001$). Therefore, *H1* is partially supported.

The diffusion of advertising messages is impeded by *affectivity* through the latter's reduction of the number of people reached at the first step ($b_{breadth} = -0.01$, SE = 0.005, $p < 0.05$), which reduces both the length of the diffusion path ($b_{depth} = -0.001$, SE = 0.0003, $p < 0.001$) and the diffusion speed ($b_{speed} = 0.02$, SE = 0.01, $p < 0.01$). Therefore, *H2* is not supported.

The typicality of advertising messages impedes their diffusion on the microblogging site. The more typically a message is presented as advertising, the less users are reached ($b_{breadth} = -0.02$, SE = 0.009, $p < 0.05$) and the shorter the diffusion path ($b_{depth} = -0.006$, SE = 0.002, $p < 0.001$). However, typicality does not affect diffusion speed significantly ($b_{speed} = 0.03$, SE = 0.02, ns). Therefore, *H3* is partially supported.

Messages' length positively affects diffusion breadth ($b_{breadth} = 0.001$, SE = 0.0001, $p < 0.001$) and the depth ($b_{depth} = 0.0002$, SE = 0.00001, $p < 0.001$). Likewise, messages' length speeds up the diffusion of advertising messages by reducing the lag between the

Table I. Descriptive statistics of diffusion breadth, depth and speed of advertising messages

	Mean	SD	Median	Min	Max	Correlation		
						Breadth	Depth	Speed (Hours)
Breadth	16	136	2	0	8,889	1	0.23***	−0.02
Depth	2	1.1	1	1	28			−0.03**
Speed (Hours)	5	67.2	0	0	3,650			1

Notes: *$p < 0.05$; **$p < 0.01$; *** $p < 0.001$

Independent variables	Diffusion breadth Coefficients	SE	Diffusion depth Coefficients	SE	Diffusion speed Coefficients	SE
Messages characteristics						
H1. Interactivity	0.04*	0.02	0.03***	0.003	0.16***	0.03
H2. Affectivity	−0.01*	0.005	−0.001***	0.0003	0.02**	0.01
H3. Typicality	−0.02*	0.009	−0.006***	0.002	0.03	0.02
H4. Length	0.001***	0.0001	0.0002***	0.00001	−0.001***	0.0001
H5. Completeness of Information	−0.19***	0.02	−0.04***	0.003	0.21***	0.03
Advertisers' structural characteristics						
H6. In-Degree (Log Transformed)	0.21***	0.01	0.01***	0.001	−0.21***	0.01
H7. Out-Degree (Log Transformed)	−0.06***	0.01	−0.01***	0.001	0.05***	0.01
Advertisers' promotional efforts						
H8. Advertisers' Experience	−0.002	0.001	0.001***	0.0002	0.005*	0.002
H9.Advertisers' Reputation	0.23***	0.02	0.01***	0.003	−0.30***	0.03
Control variables (time factors)						
Time1 (0 = morning, 1 = early morning)	−0.07*	0.03	0.01	0.006	0.48***	0.06
Time 2 (0 = morning, 1 = afternoon)	0.03	0.02	0.01*	0.003	0.01	0.03
Time 3 (0 = morning, 1 = evening)	−0.06***	0.02	0.01***	0.003	0.30***	0.03
Date (0 = weekday, 1 = weekend)	−0.08***	0.02	0.01***	0.003	0.13***	0.03
Adjusted R^2	10%		5%		5%	

Notes: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table II. Generalized Linear Model analytical results

time of publication and first-step diffusion ($b_{speed} = -0.001$, SE = 0.0001, $p < 0.001$). Hence, long advertising messages are likely to induce response from microblogging users. *H4* is thus fully supported.

Surprisingly, completeness of information (i.e. availability of supplementary link) hampers the diffusion of advertising messages. A supplementary link results in narrow diffusion breadth ($b_{breadth} = -0.19$, SE = 0.02, $p < 0.001$), short diffusion depth ($b_{depth} = -0.04$, SE = 0.003, $p < 0.001$), and slow diffusion speed ($b_{speed} = 0.21$, SE = 0.03, $p < 0.001$). Thus, *H5* is not supported.

Effects of advertisers' structural characteristics. Advertisers' in-degrees on the microblogging site facilitate diffusion of advertising messages. Specifically, more fans result in wider ($b_{breadth} = 0.21$, SE = 0.01, $p < 0.001$), deeper ($b_{depth} = 0.01$, SE = 0.001, $p < 0.001$), and faster ($b_{speed} = -0.21$, SE = 0.01, $p < 0.001$) diffusion. By contrast, advertisers' out-degrees impede diffusion ($b_{breadth} = -0.06$, SE = 0.01, $p < 0.001$; $b_{depth} = -0.01$, SE = 0.001, $p < 0.001$; $b_{speed} = 0.05$, SE = 0.01, $p < 0.001$). *H6* is thus supported, but *H7* is not.

Effects of advertisers' promotional efforts. Table II shows that the advertisers' level of experience on the microblogging site significantly improves the diffusion depth of advertising messages ($b_{depth} = 0.001$, SE = 0.0002, $p < 0.001$) and reduces diffusion speed ($b_{speed} = 0.005$, SE = 0.002, $p < 0.05$). However, the advertisers' level of experience does not affect diffusion breadth ($b_{breadth} = -0.002$, SE = 0.001, ns). Thus, *H8* is partially supported.

Advertisers' reputation is conducive to diffusion breadth ($b_{breadth} = 0.23$, SE = 0.02, $p < 0.001$), depth ($b_{depth} = 0.01$, SE = 0.003, $p < 0.001$), and speed ($b_{speed} = -0.30$, SE = 0.03, $p < 0.001$) of advertising messages. The messages published by advertisers

with verified credentials diffuse to a wider audience, undergo longer diffusion paths, and disseminate within shorter periods. Therefore, *H9* is supported.

Effects of control variables. Three dummy variables are generated in GLM for publication time, with the morning category as the baseline and the other three (i.e. early morning, afternoon, and evening) as categories for comparison. Results show that advertising messages posted in the early morning ($b_{breadth} = -0.07$, SE = 0.03, $p < 0.05$) and evening ($b_{breadth} = -0.06$, SE = 0.02, $p < 0.001$) are less diffused than messages posted in the morning. The diffusion depth of advertising messages posted in the afternoon ($b_{depth} = 0.01$, SE = 0.003, $p < 0.05$) and evening ($b_{depth} = 0.01$, SE = 0.003, $p < 0.001$) are both greater compared with those posted in the morning. The diffusion speed of advertising messages posted in the early morning ($b_{speed} = 0.48$, SE = 0.06, $p < 0.001$) and in the evening ($b_{speed} = 0.30$, SE = 0.03, $p < 0.001$) are slower compared with advertising messages posted in the morning.

A dummy variable is generated for the publication date, with weekdays as the baseline and weekends as the category for comparison. The advertising messages posted in the weekend have less audience reach ($b_{breadth} = -0.08$, SE = 0.02, $p < 0.001$) and slower diffusion speed ($b_{speed} = 0.13$, SE = 0.03, $p < 0.001$) compared with messages posted on weekdays. However, messages posted in the weekend have greater diffusion depth ($b_{depth} = 0.01$, SE = 0.003, $p < 0.001$) compared with those posted on weekdays.

4. Conclusions and discussion

Based on diffusion theory, the study proposes several hypotheses to determine the driving forces underlying the diffusion of advertising message on microblogging sites. Diffusion is measured in terms of three dimensions: diffusion breadth, depth, and speed. Three sets of factors are incorporated as antecedents of the diffusion process, namely, messages characteristics, advertisers' structural characteristics, and advertisers' promotional efforts. The theoretical, methodological, and practical implications of the present study will be discussed in the subsequent sections.

4.1 Combined effects of messages characteristics, advertisers' structural characteristics, and advertisers' promotional efforts

The study contributes to existing literature by simultaneously examining the roles of message- and advertiser-level factors in the diffusion of advertising messages. The results can broaden our understanding of the driving forces that underscore the diffusion of advertising messages on microblogging sites. Such concepts can be generalized to the diffusion of other types of information, such as rumors, health information, and political information.

First, the study determines the mixed effects of messages characteristics on the diffusion of advertising messages on social media. The length of the messages facilitates diffusion in terms of breadth, depth, and speed, whereas typicality reduces diffusion breadth and shortens the diffusion depth of advertising messages. Interactivity has conflicting roles, broadening diffusion breadth and depth but retarding diffusion speed.

Contrary to our hypotheses, the affectivity of advertising messages and information completeness hamper diffusion in all three dimensions. Messages with emotional appeal and external URLs will be diffused to fewer users, with smaller diffusion steps, at a slower rate, compared with advertisements without emotional appeal. Although sentiment-laden advertising messages can engage more users, messages with rational

appeal will be perceived to possess better information quality compared with messages with emotional expressions (Albers-Miller and Stafford, 1999). Therefore, advertising messages on microblogging sites characterized by strong emotional expressions may be perceived by users to have poor information quality, which may prevent further diffusion of such messages. Moreover, external URLs embedded in advertising messages may divert users' attention from the message *per se* to the external webpage. For this reason, external URLs negatively affect the diffusion of advertising messages on microblogging sites.

The results can elucidate how consumers cope with sales presentations on microblogging sites, as proposed by the persuasion knowledge model (PKM) (Friestad and Wright, 1994). PKM, a conceptual framework explaining how people cope with persuasion attempts, maintains that consumers can build up their persuasion knowledge, which will be used to compensate for the advertisers' attempts at persuasion and refine user attitudes toward advertisers and advertised products. The negative effects of advertising messages' typicality, affectivity, and completeness of information provide empirical support to the arguments of PKM. Microblogging users develop persuasion knowledge based on their experience with advertisements on other media platforms. Such acquired persuasion knowledge enables users to recognize, interpret, and assess persuasion efforts on microblogging sites. Therefore, microblogging users tend to avoid messages with typical advertising terms, as well as those messages that appeal to emotion and have additional elaborations. Managers of microblogging sites and advertising practitioners need to provide users with new persuasion knowledge that fits the technological features of microblogging sites to make such sites an efficient platform for diffusing advertising messages.

The study highlights the role of the advertisers' structural characteristics in the diffusion of advertising messages. Advertisers' in-degrees facilitate the diffusion by expanding the pool of potential audiences, whereas out-degrees hinder the diffusion. Advertisers cannot acquire structural priority by initiating more relationships with other users. Microblogging sites that deviate from other social media platforms (e.g. social networking sites) showed a low level of reciprocity among following-followed relationships. For example, mutual relationship accounted for only 22 percent of all social ties on Twitter, whereas the other 78 percent were one-way connections (Kwak *et al.*, 2010). Arguably, reciprocity is not required for the formation of ties on microblogging sites (Boyd *et al.*, 2010). Establishing reciprocal relationships would be more difficult for advertisers because other users may consider connections initiated by online advertisers as spam invitations. Therefore, establishing online out-degrees with other users do not contribute to the dissemination of advertising messages on microblogging sites.

Furthermore, the current study enriches our understanding of the role of advertisers' promotional efforts in the diffusion of advertising messages. Advertisers can enhance the diffusion of advertising messages by managing their online reputation. Considering the virtual nature of microblogging sites, advertisers lack physical contact with users. The audiences may use the advertisers' reputation as indicators of their credibility, corporate performance, and the quality of their products or services (Chun, 2005). Thus, advertisers have to highlight online activities and make them recognizable to audiences. The findings can provide suggestions on how microblogging site managers can refine their platform design to serve advertising practitioners better. For example, managers can develop additional functions to empower advertisers to declare their expertise on and/or their degree of activity on (e.g. the frequency of use) the platform.

Explicit promotional efforts can be used as cues by ordinary users to assess the quality of advertising messages, which will lead to further diffusion of advertising messages (Chaiken, 1980).

4.2 New metrics to quantify the diffusion of advertising messages

The present study contributes to literature by observing the diffusion of advertising messages in terms of breadth, depth, and speed. Such framework can be used as a yardstick to assess the effectiveness of social advertising campaigns. For years, scholars and advertisers have depended heavily on click-through rates to measure the effectiveness of online advertising (Shankar and Hollinger, 2007). Meanwhile, reposting, which is a form of user response behavior on microblogging sites, is a new metric for the performance of social media advertising. Reposting behavior is decomposed into the aforementioned three diffusion dimensions to achieve a comprehensive measure of effectiveness.

The advantages of the new metrics are threefold. First, traditional measures of advertising effectiveness typically use self-reported data (e.g. audiences' attitudes toward advertising and perceived purchase intentions). In general, self-reported data are highly biased because of self-selection and social desirability. Respondents tend to react according to what they believe is expected of them (Nederhof, 1985). Unlike traditional measures of advertising effects, breadth, depth, and speed of reposting as behavioral measures can substantially reduce subjective bias embedded in self-reported measurements.

Second, breadth-depth-speed measurement enhances the validity and accuracy in forecasting future purchase behavior. Lavidge and Steiner (1961) reported that as a persuasion activity, advertising has to elevate people through a series of steps toward the final purchase behavior. The steps include awareness, knowledge, attitudes, conviction (i.e. desire), and actual purchase decision. The breadth-depth-speed of diffusion, which refers to the behavioral acceptance of advertising messages, corresponds to the conviction stage, and is therefore closer to the "purchase" stage (Lavidge and Steiner, 1961). Through the diffusion of advertising messages, users engage in word-of-mouth activities with more commitment involved (Gruen *et al.*, 2006). Therefore, the diffusion breadth-depth-speed metrics may be a better indicator of the users' future purchase decision compared with their knowledge/attitude/intention.

Finally, the breadth-depth-speed measurement can capture the unique features of social advertising on microblogging sites, which is different from the yardsticks in assessing the advertising effectiveness in the Web 1.0 era (e.g. click-per-impression/click-per-action and click-through rate). The unique features of such advertising include large audience pool, extensions of traditional word-of-mouth, and real-time communication. Such measures can help marketing and advertising practitioners to better understand the effectiveness of social media advertising on microblogging sites.

4.3 Potential of microblogging sites to be mined as advertising platforms

In addition, the results have several practical implications. Diffusion breadth, depth, and speed of advertising messages on microblogging sites follow a heavy-tailed distribution. Many messages receive little attention and do not lead to widespread consumer-to-consumer interaction, whereas very few go viral. Advertising messages are actually diffused to only a few people connected to the advertisers, and few messages spread virally beyond advertisers' networks. Furthermore, social media

users are potentially against advertising messages, as evidenced by the negative effect of messages typicality on their diffusion. Thus, users tend to avoid advertisements containing common advertising keywords.

Our results are consistent with previous studies on the dissemination of product recommendation messages through online word-of-mouth (Leskovec *et al.*, 2006). However, the findings do not suggest that online advertising campaigns cannot be performed on microblogging sites. Conversely, advertisers should mine the potential of microblogging sites strategically to achieve success. As observed, posting time is a factor that contributes to success. Advertising messages posted during work hours have higher chances to be diffused, as shown by messages published in the afternoon or on weekday, which reach larger audiences at a faster speed compared with messages published in the evening or on weekends. The result implies that the diffusion of advertising messages is time-variant. Information could be popular at certain periods. Information spread pathways change over time (Gomez Rodriguez *et al.*, 2013). Advertisers must carefully select the optimal time window during which their message should be posted in order to optimize the diffusion on microblogging sites.

Furthermore, to attract the attention of target consumers and increase the chance of advertising messages to be diffused, advertisers should maximize the length of their messages by taking full advantage of the 140-character limit on microblogging sites. Likewise, advertisers could facilitate diffusion by enhancing interactivity (i.e. mentioning specific consumers in messages), which engages users in the diffusion process. Moreover, a high degree of interactivity helps reduce relationship uncertainty between users and advertisers. Advertisers on microblogging sites should cautiously use typical advertising keywords, emotional language, and external URLs to optimize the diffusion of advertising messages.

4.4 Limitations

In this study, the sampled advertising messages were obtained using the keyword extraction method, which can skew the sample toward more typical advertisements. The method adopted achieved a relatively high accuracy rate (up to 90 percent) in data collection at the expense of coverage rate. Future studies should use a more representative sample that includes different types of advertising messages (e.g. in-stream advertising and original posts) to further examine their effectiveness on microblogging sites.

The study's model yields a relatively small R^2, primarily attributed to information homogeneity that limits the topics of advertising messages and severely unequal distribution of dependent variables. Content homogeneity, in terms of messages length and choice of words, limited the variances of diffusion properties.

Finally, the study is contextualized in a single microblogging site in China. Different microblogging platforms may offer various ways to support advertisements. For example, Twitter has privacy settings that require potential followers to gain permission prior to following focal users if the latter opt to keep tweets private[5]. By contrast, users on the microblogging site, the Chinese counterpart of Twitter, can follow other users without prior permission. Furthermore, advertisers on Twitter can purchase "promoted tweets" for online campaigns and help advertising messages get wider distribution since 2010. "Promoted tweets" are ordinary tweets that could be retweeted, replied to, or favored, but labeled as "promoted." However, the microblogging site under study only made this service available in 2012. Before that time, social marketing agencies had to post non-manifested advertising messages

similar to ordinary messages to launch online advertising campaigns. These factors may result in different diffusion mechanisms for advertising messages on different microblogging sites. Thus, further studies are required to determine whether the driving forces underlying advertising message diffusion vary across sites.

Notes

1. On several microblogging sites, such as those included in the study, the corporate credentials of the enterprises can be validated by submitting business licenses to web site administrators. If successfully verified by the web site, corporate credentials are usually indicated by a "V" after the account name.
2. In-stream advertising (i.e. sponsored-story timeline advertising) was launched in January 2013, approximately one year after data collection.
3. Given that speed is measured as the duration from the time of publication of the message to the time of first diffusion, a positive regression coefficient in GLM indicates that the independent variable has a negative effect on speed, whereas a negative regression coefficient indicates a positive effect.
4. HowNet (www.keenage.com/), the Chinese equivalent of WordNet, provides Chinese subjective words, including 3,730 positive opinion words (e.g. pretty) and 3,116 negative opinion words (e.g. ugly), 2,090 affective words (e.g. love and sad), and 219 degree adverbs (e.g. very).
5. Please visit the privacy settings on Twitter at: https://support.twitter.com/articles/14016-about-public-and-protected-tweets#.

References

Aizawa, A. (2003), "An information-theoretic perspective of TFIDF measures", *Information Processing & Management*, Vol. 39 No. 1, pp. 45-65.

Albers-Miller, N.D. and Stafford, M.R. (1999), "An international analysis of emotional and rational appeals in services vs goods advertising", *Journal of Consumer Marketing*, Vol. 16 No. 1, pp. 42-57.

Alexander, J.E. and Tate, M.A. (1999), *Web Wisdom: How to Evaluate and Create Information Quality on the Web*, Lawrence Erlbanm Associates Publishers, Hillsdale, NJ.

Barry, C.L. (1994), "User-defined relevance criteria: an exploratory study", *JASIS*, Vol. 45 No. 3, pp. 149-159.

Bennett, W.L. and Iyengar, S. (2008), "A new era of minimal effects? The changing foundations of political communication", *Journal of Communication*, Vol. 58 No. 4, pp. 707-731.

Bhattacherjee, A. and Sanford, C. (2006), "Influence processes for information technology acceptance: an elaboration likelihood model", *MIS Quarterly*, Vol. 30 No. 4, pp. 805-825.

Bovee, C.L. (1992), *Contemporary Advertising*, McGraw Hill Publishers, New York, NY.

Boyd, D., Golder, S. and Lotan, G. (2010), "Tweet, tweet, retweet: conversational aspects of retweeting on twitter", paper presented at System Sciences (HICSS), 5-8 January, 2010 43rd Hawaii International Conference on IEEE, pp. 1-10.

Chaiken, S. (1980), "Heuristic versus systematic information processing and the use of source versus message cues in persuasion", *Journal of Personality and Social Psychology*, Vol. 39 No. 5, p. 752.

Chandy, R.K., Tellis, G.J., MacInnis, D.J. and Thaivanich, P. (2001), "What to say when: advertising appeals in evolving markets", *Journal of Marketing Research*, Vol. 38 No. 4, pp. 399-414.

Chang, H.H., Rizal, H. and Amin, H. (2013), "The determinants of consumer behavior towards email advertisement", *Internet Research*, Vol. 23 No. 3, pp. 316-337.

Ching, R., Tong, P., Chen, J.-S. and Chen, H.-Y. (2013), "Narrative online advertising: identification and its effects on attitude toward a product", *Internet Research*, Vol. 23 No. 4, pp. 414-438.

Chu, S.-C. and Kim, Y. (2011), "Determinants of consumer engagement in electronic word-of-mouth (eWOM) in social networking sites", *International Journal of Advertising*, Vol. 30 No. 1, pp. 47-75.

Chun, R. (2005), "Corporate reputation: meaning and measurement", *International Journal of Management Reviews*, Vol. 7 No. 2, pp. 91-109.

Curran, K., O' Hara, K. and O'Brien, S. (2011), "The role of twitter in the world of business", *International Journal of Business Data Communications and Networking (IJBDCN)*, Vol. 7 No. 3, pp. 1-15.

de Vries, L., Gensler, S. and Leeflang, P.S.H. (2012), "Popularity of brand posts on brand fan pages: an investigation of the effects of social media marketing", *Journal of Interactive Marketing*, Vol. 26 No. 2, pp. 83-91.

Fowler, J. (2012), "6 common advertising phrases to be wary of", available at: www.investopedia.com/financial-edge/0712/6-common-advertising-phrases-to-be-wary-of.aspx (accessed May 15, 2014).

Friestad, M. and Wright, P. (1994), "The persuasion knowledge model: how people cope with persuasion attempts", *Journal of Consumer Research*, Vol. 21 No. 1, pp. 1-31.

Gelb, B.D., Hong, J.W. and Zinkhan, G.M. (1985), "Communications effects of specific advertising elements: an update", *Current Issues and Research in Advertising*, Vol. 8 No. 2, pp. 75-98.

Goldberg, M.E. and Hartwick, J. (1990), "The effects of advertiser reputation and extremity of advertising claim on advertising effectiveness", *Journal of Consumer Research*, Vol. 17 No. 2, pp. 172-179.

Golder, S.A. and Yardi, S. (2010), "Structural predictors of tie formation in twitter: transitivity and mutuality", paper presented at Social Computing (SocialCom), 2010 IEEE Second International Conference on IEEE, pp. 88-95.

Gomez Rodriguez, M., Leskovec, J. and Scholkopf, B. (2013), "Structure and dynamics of information pathways in online media", paper presented at Proceedings of the sixth ACM International Conference on Web Search and Data Mining ACM, February 4-8, pp. 23-32.

Gruen, T.W., Osmonbekov, T. and Czaplewski, A.J. (2006), "eWOM: the impact of customer-to-customer online know-how exchange on customer value and loyalty", *Journal of Business Research*, Vol. 59 No. 4, pp. 449-456.

Hanafizadeh, P., Behboudi, M., Ahadi, F. and Varkani, F.G. (2012), "Internet advertising adoption: a structural equation model for Iranian SMEs", *Internet Research*, Vol. 22 No. 4, pp. 499-526.

Harris, L. and Rae, A. (2009), "Social networks: the future of marketing for small business", *Journal of Business Strategy*, Vol. 30 No. 5, pp. 24-31.

Hodas, N.O., Kooti, F. and Lerman, K. (2013), "Friendship paradox redux: your friends are more interesting than you", paper presented at the 7th International AAAI Conference on Weblogs and Social Media, July 8-10.

Hoffman, D.L. and Novak, T.P. (1996), "Marketing in hypermedia computer-mediated environments: conceptual foundations", *The Journal of Marketing*, Vol. 60 No. 3, pp. 50-68.

Holbrook, M.B. and Batra, R. (1987), "Assessing the role of emotions as mediators of consumer responses to advertising", *Journal of Consumer Research*, Vol. 14 No. 3, pp. 404-420.

Hu, Y. and Sundar, S.S. (2010), "Effects of online health sources on credibility and behavioral intentions", *Communication Research*, Vol. 37 No. 1, pp. 105-132.

Huang, E. (2012), "Online experiences and virtual goods purchase intention", *Internet Research*, Vol. 22 No. 3, pp. 252-274.

Java, A., Song, X., Finin, T. and Tseng, B. (2007), "Why we twitter: understanding microblogging usage and communities", paper presented at Proceedings of the 9th WebKDD and 1st SNA-KDD 2007 Workshop on Web Mining and Social Network Analysis ACM, August 12, pp. 56-65.

Katerattanakul, P. and Siau, K. (1999), "Measuring information quality of web sites: development of an instrument", paper presented at Proceedings of the 20th International Conference on Information Systems Association for Information Systems, December 12-15, pp. 279-285.

Kirmani, A. and Wright, P. (1989), "Money talks: perceived advertising expense and expected product quality", *Journal of Consumer Research*, Vol. 16 No. 3, pp. 344-353.

Kotler, P. and Pfoertsch, W. (2010), *Ingredient Branding: Making the Invisible Visible*, Springer-Verlag, Berlin, Heidelberg.

Kozinets, R.V., De Valck, K., Wojnicki, A.C. and Wilner, S.J.S. (2010), "Networked narratives: understanding word-of-mouth marketing in online communities", *Journal of Marketing*, Vol. 74 No. 2, pp. 71-89.

Krishnamurthy, S. and Dou, W. (2008), "Note from special issue editors. Advertising with user-generated content. A framework and research agenda", *Journal of Interactive Advertising*, Vol. 8 No. 2, pp. 1-4.

Kwak, H., Lee, C., Park, H. and Moon, S. (2010), "What is twitter, a social network or a news media?", paper presented at Proceedings of the 19th International Conference on World Wide Web ACM, pp. 591-600.

Lavidge, R.J. and Steiner, G.A. (1961), "A model for predictive measurements of advertising effectiveness", *Journal of Marketing*, Vol. 25 No. 6, pp. 59-62.

Leskovec, J., Singh, A. and Kleinberg, J. (2006), "Patterns of influence in a recommendation network", in Ng, W.-K., Kitsuregawa, M., Li, J. and Chang, K. (Eds), *Advances in Knowledge Discovery and Data Mining*, Springer, Berlin Heidelberg, pp. 380-389.

Lipponen, L., Rahikainen, M., Lallimo, J. and Hakkarainen, K. (2003), "Patterns of participation and discourse in elementary students' computer-supported collaborative learning", *Learning and Instruction*, Vol. 13 No. 5, pp. 487-509.

Liu, Y. and Shrum, L. (2002), "What is interactivity and is it always such a good thing? Implications of definition, person, and situation for the influence of interactivity on advertising effectiveness", *Journal of Advertising*, Vol. 31 No. 4, pp. 53-64.

Liu, Z., Liu, L. and Li, H. (2012), "Determinants of information retweeting in microblogging", *Internet Research*, Vol. 22 No. 4, pp. 443-466.

McCroskey, J.C. and Young, T.J. (1981), "Ethos and credibility: the construct and its measurement after three decades", *Communication Studies*, Vol. 32 No. 1, pp. 24-34.

McMillan, S.J. and Hwang, J.-S. (2002), "Measures of perceived interactivity: an exploration of the role of direction of communication, user control, and time in shaping perceptions of interactivity", *Journal of Advertising*, Vol. 31 No. 3, pp. 29-42.

Mangold, W.G. and Faulds, D.J. (2009), "Social media: the new hybrid element of the promotion mix", *Business Horizons*, Vol. 52 No. 4, pp. 357-365.

Nederhof, A.J. (1985), "Methods of coping with social desirability bias: a review", *European Journal of Social Psychology*, Vol. 15 No. 3, pp. 263-280.

Park, J.Y., Lee, K.-W., Kim, S.Y. and Chung, C.-W. (2013), "Ads by whom? ads about what?: exploring user influence and contents in social advertising", paper presented at Proceedings of the first ACM Conference On Online Social Networks ACM, October 7-8, pp. 155-164.

Parker, M.B., Moleshe, V., De la Harpe, R. and Wills, G.B. (2006), "An evaluation of information quality frameworks for the world wide web", paper presented at the 8th Annual Conference on WWW Applications, Bloemfontein, September 6-8.

Pieters, R. and Wedel, M. (2004), "Attention capture and transfer in advertising: brand, pictorial, and text-size effects", *Journal of Marketing*, Vol. 68 No. 2, pp. 36-50.

Rogers, E. (1995), *Diffusion of Innovations*, Free Press, New York, NY.

Rosbergen, E., Pieters, R. and Wedel, M. (1997), "Visual attention to advertising: a segment-level analysis", *Journal of Consumer Research*, Vol. 24 No. 3, pp. 305-314.

Rotfeld, H.J. (2006), "Understanding advertising clutter and the real solution to declining audience attention to mass media commercial messages", *Journal of Consumer Marketing*, Vol. 23 No. 4, pp. 180-181.

Rowley, J. (2004), "Online branding", *Online Information Review*, Vol. 28 No. 2, pp. 131-138.

Shankar, V. and Hollinger, M. (2007), "Online and mobile advertising: current scenario, emerging trends, and future directions", available at: www.venkyshankar.com/wp-content/uploads/2012/10/Shankar_Hollinger_MSl_2007.pdf (accessed May 14, 2014).

Steyn, P., Ewing, M.T., van Heerden, G., Pitt, L.F. and Windisch, L. (2011), "From whence it came: understanding source effects in consumer generated advertising", *International Journal of Advertising*, Vol. 30 No. 1, pp. 133-160.

Strong, D.M., Lee, Y.W. and Wang, R.Y. (1997), "Data quality in context", *Communications of the ACM*, Vol. 40 No. 5, pp. 103-110.

Sundar, S.S., Kalyanaraman, S. and Brown, J. (2003), "Explicating web site interactivity impression formation effects in political campaign sites", *Communication Research*, Vol. 30 No. 1, pp. 30-59.

Swani, K., Milne, G.R. and Brown, B.P. (2013), "Spreading the word of likes on facebook: evaluating the message strategy effectiveness of fortune 500 companies", *Journal of Research in Interactive Marketing*, Vol. 7 No. 4, pp. 269-294.

Van den Bulte, C. (2000), "New product diffusion acceleration: measurement and analysis", *Marketing Science*, Vol. 19 No. 4, pp. 366-380.

Van Zeist, R.H.J. and Hendriks, P.R.H. (1996), "Specifying software quality with the extended ISO model", *Software Quality Journal*, Vol. 5 No. 4, pp. 273-284.

Wasserman, S. and Faust, K. (1994), *Social Network Analysis: Methods and Applications*, Cambridge university press, New York, NY.

Watts, D.J. and Strogatz, S.H. (1998), "Collective dynamics of 'small-world'networks", *Nature*, Vol. 393 No. 6684, pp. 440-442.

Weng, L., Menczer, F. and Ahn, Y.-Y. (2014), "Predicting successful memes using network and community structure", available at: http://arxiv.org/pdf/1403.6199.pdf (accessed May 14, 2014).

Wood, N.T. and Burkhalter, J.N. (2014), "Tweet this, not that: a comparison between brand promotions in microblogging environments using celebrity and company-generated tweets", *Journal of Marketing Communications*, Vol. 20 Nos 1/2, pp. 129-146.

Wood, W., Kallgren, C.A. and Preisler, R.M. (1985), "Access to attitude-relevant information in memory as a determinant of persuasion: the role of message attributes", *Journal of Experimental Social Psychology*, Vol. 21 No. 1, pp. 73-85.

Wyer, R.S. Jr (2002), "Language and advertising effectiveness: mediating influences of comprehension and cognitive elaboration", *Psychology and Marketing*, Vol. 19 No. 7, pp. 693-712.

Wyer, R.S., Adaval, R. and Colcombe, S.J. (2002), "Narrative-based representations of social knowledge: their construction and use in comprehension, memory, and judgment", *Advances in Experimental Social Psychology*, Vol. 34, pp. 131-197.

Xu, A.J. and Wyer, R.S. Jr (2012), "The role of bolstering and counterarguing mind-sets in persuasion", *Journal of Consumer Research*, Vol. 38 No. 5, pp. 920-932.

Yang, J. and Counts, S. (2010), "Predicting the speed, scale, and range of information diffusion in twitter", paper presented at ICWSM, Washington, DC, May 23-26.

Zhang, H.-P., Liu, Q., Cheng, X.-Q., Zhang, H. and Yu, H.-K. (2003), "Chinese lexical analysis using hierarchical hidden markov model", paper presented at the Second SIGHAN Workshop on Chinese Language Processing, Sapporo, July 11-12.

Zhang, L., Peng, T.-Q., Zhang, Y.-P., Wang, X.-H. and Zhu, J.J.H. (2014), "Content or context: which matters more in information processing on microblogging sites", *Computers in Human Behavior*, Vol. 31, pp. 242-249.

Zhang, M., Jansen, B.J. and Chowdhury, A. (2011), "Business engagement on twitter: a path analysis", *Electronic Markets*, Vol. 21 No. 3, pp. 161-175.

About the authors

Dr Lun Zhang is an Assistant Professor at the Department of Journalism & Communication, University of Chinese Academy of Sciences. Her research focusses on social advertising, human behavior on social media, information diffusion, and technology adoption. Her research has appeared in peer-reviewed journals, such as *Computers in Human Behavior*, and *New Media & Society*.

Dr Tai-Quan Peng currently is an Assistant Professor at the Wee Kim Wee School of Communication and Information, Nanyang Technological University, Singapore. His research outputs have appeared in SSCI/SCI-listed journals, including *Communication Research, Journal of Informetrics*, *IEEE Transactions on Visualization and Computer Graphics*, *Information, Communication & Society*, *Journal of the American Society for Information Science and Technology*, *New Media & Society*, and *Scientometrics*. Dr Tai-Quan Peng is the corresponding author and can be contacted at: winsonpeng@gmail.com