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Tweeting transport

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Tweeting transport: Examining the use of Twitter in transport events

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Abstract
This paper describes work undertaken to evaluate how a social media platform (in this case Twitter) was used over the course of the 2014 Commonwealth Games hosted in Glasgow, Scotland to provide and share transport-related information, and respond to information requests. Previous studies have identified factors of interest in evaluating the use of social media in various contexts, including social ties and trust, information seeking behaviours, and the possibility of using social media data as predictors of mobility behaviours. These studies incorporate elements of behavioural psychology in relation to the practical use of social media – how different types of people use social media for different purposes and what can be ascertained from this use. In this study, we provide a more holistic approach to the evaluation of social media, incorporating contextual characteristics of users, patterns of use, and practical applications of the findings as applied in a transport context. In this paper we focus on methods of evaluation as a stage-setting exercise for further analysis.

Over the course of the Games (23rd June to 3rd August 2014), roughly 9 million tweets were collected by a purpose-built monitoring infrastructure using a combination of transport-related keywords, hashtags, and account holders (for example, @GamesTravel2014). In our analysis, we focus, in particular, upon the following aspects of a selected subset of this data:

- 'Retweets' (or original tweets that are shared by other users):
    o Types of users retweeting information
    o Types of information in retweets

By assessing these factors and adopting 'retweets' and 'messages to' as markers of the utility and perceived reliability of the information posted, we hope to evaluate both how transport information disseminates through a network, and how this may reflect issues of trust and reliability by different actors for different transport-related purposes.

Keywords: social media, transport disruptions, large events

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Introduction

Social media has begun to have dramatic impacts upon the ways we communicate, seek information, and go about our day-to-day activities. The ability to communicate directly and in a timely manner with friends, organisations, and information providers has had particular impact on how we experience transport – including regarding disruptions on our regular routes (such as commute trips), or in the context of 'novel' travel (such as that surrounding large events). In this paper, we describe work undertaken to evaluate how a social media platform (i.e. Twitter) was used over the course of the 2014 Commonwealth Games hosted in Glasgow, Scotland to provide and share transport-related information and respond to information requests.

A number of factors have been identified as being of interest in evaluating the use of social media in various contexts, including social ties and trust (Gilbert and Karahalios, 2009), information seeking behaviours (Kim et al., 2013), and the possibility of using social media data as predictors of mobility behaviours (Alesiani et al., 2014). These studies incorporate elements of behavioural psychology in relation to the practical use of social media – how different types of people use social media for different purposes, and what we can ascertain from this use. In this study, we initiate a process of providing a more holistic approach to the evaluation of social media, incorporating contextual characteristics of users (both those who Tweet and those who respond to/share Tweets), patterns of use, and practical applications of the findings.

The overarching areas of interest in this research are: 1) What types of Twitter users are interested in transport event information on Twitter during big events; and 2) What types of transport-related information is included in Tweets surrounding these events. Over the two week course of the Games, roughly 9 million Tweets were collected using a combination of transport-related keywords, hashtags, and account holders (for example, @GamesTravel2014). In this analysis, we focus, in particular, upon the following aspects of a subset of @GamesTravel2014 'Retweets', or original Tweets that were in turn shared by other users:

- Types of information in retweets (i.e. current and future transport disruptions, general travel information, alternative transport options, etc.)
- Temporal nature of disruption Tweets (i.e. whether they refer to upcoming, current, or end of disruption)
- Types of users retweeting information (i.e. individuals, companies, transport providers, etc.)
- Tweets directed to the @GamesTravel2014 account via 'replies-to'

By treating retweets and replies as a proxy for the perceived usefulness and reliability of the information included in the original Tweet, we use these factors to evaluate, using analysis of Tweet content and Tweeter type, both how issues of trust and reliability contribute to the use of social media by different actors for different transport-related purposes, and to assess for what type of information sharing Twitter is most conducive. Findings from this analysis are used to discuss mechanisms by which social media data may be evaluated in the context of disruptive transport events, as well as to provide recommendations to transport service providers on how social media may be most effectively leveraged to provide and disseminate relevant transport information through a network of social media users.

About Twitter and setting the scene for this research

The social microblogging site Twitter is now being widely used for purposes of both information querying and information gathering. In this network, users send out messages ('Tweets') of up to 140 characters on any topic of interest. Tweets may be stand-alone, or can be further directed via the use of usernames (e.g. directing a Tweet to @GamesTravel2014) or hashtags (e.g. #Glasgow2014). Furthermore, the Twitter network may be searched using keyword search options such as "Glasgow disruption". These features make Twitter unique among available social media platforms and more

straightforward to use to "report/follow" real-time events, despite a traffic flow of roughly 500 million Tweets per day (Internet Live Stats, 2014).

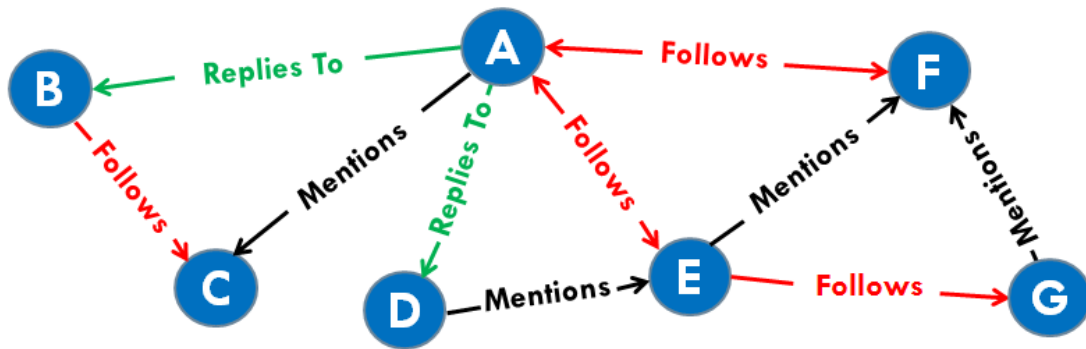Twitter's propagation through a large and diverse set of users (ranging from celebrities and media personalities to agencies, organisations, and individual users) has also enhanced its use as a mechanism for studying characteristics of information diffusion through a network, including such topics as sentiment, credibility, and opinion mining (Pak and Paroubek, 2010), (Castillo et al., 2011), (Wu et al., 2011). Of particular interest for purposes of this research is the manner in which relationships and areas of interest may be revealed not only through the content of a Tweet itself, but also how users interact with their network via such actions as mentions, retweets, and replies. For instance, Adali et al. (2010) found that, "Short of interviewing people and asking who they trust, a retweet (a true propagation) is the next best construct within Twitter for users to explicitly indicate trust in another user (p. 4)." This finding was reiterated by Sacco and Breslin (2014), who found retweeting to be the Twitter action that best captures user trust perceptions. Such proxy indicators are useful for evaluating the underlying relationships of users within the Twitter network via their interactions. We use the proxy indicators of retweets and replies-to in this research to study how people look for and respond to information on travel disruption related to large events, taking into account issues related to information diffusion and the role of diffusers through the Twitter social network.

Due in large part to the rapid take-up of Twitter, along with the ability to quickly provide updated information, large event organisers are now using Twitter as a means of communicating up-to-date information to their followers and other interested parties. Via the use of embedding and following Tweets on organisation homepages, and providing information about their Twitter accounts on branded advertisements, agencies and organisations are directing customers to Twitter to stay apprised of current information (Figure 1).
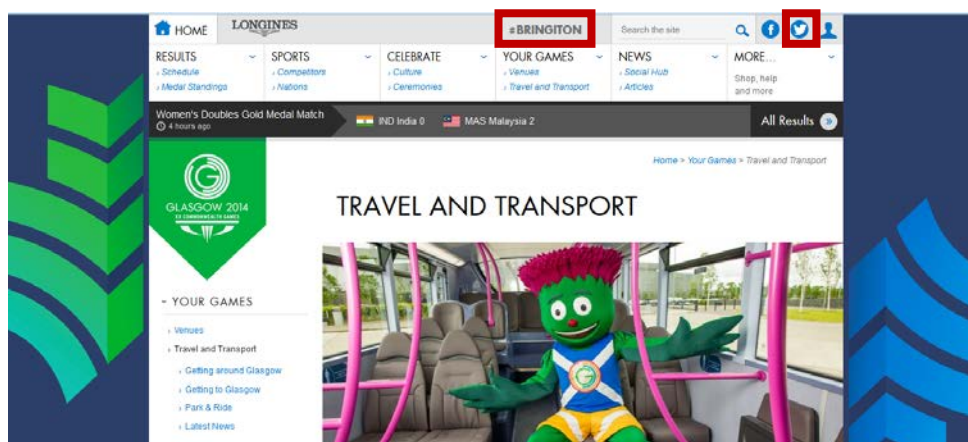

Figure 1: Screenshot of Commonwealth Games 2014 official website showing Twitter branding (Source: http://www.glasgow2014.com/your-games/travel-and-transport)

The directed nature of the Twitter network, in which it is not necessary for two users to mutually follow one another in order to interact (i.e. one can find other people on Twitter and "follow/mention/retweet/reply to" their Tweets whether or not both have directly added the other to their network), makes it particularly beneficial for information sharing purposes (Kwak et al., 2010). As shown in Figure 2, for example, where the Twitter user functions as a node and the relationship type as an edge, Tweeter A mutually follows Tweeters E and F, replies to B and D, and mentions C. These types of relationships continue among Tweeters and form the foundation of a Twitter network. Information shared by A will diffuse through the network of nodes depending upon who follows whom, the content of the Tweet, and how it is shared. For an agency or organisation to diffuse information through the network, it is not necessary for them to follow every interested party; rather, those users may follow the Tweeters whose information they may find timely or beneficial.

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Figure 2: Diagram showing Twitter network (Source: Authors)

The context shown in Figure 3 provides the basic structure of information that is studied in this research. We examine the Tweeter, the timing of Tweets and the content of the Tweets.
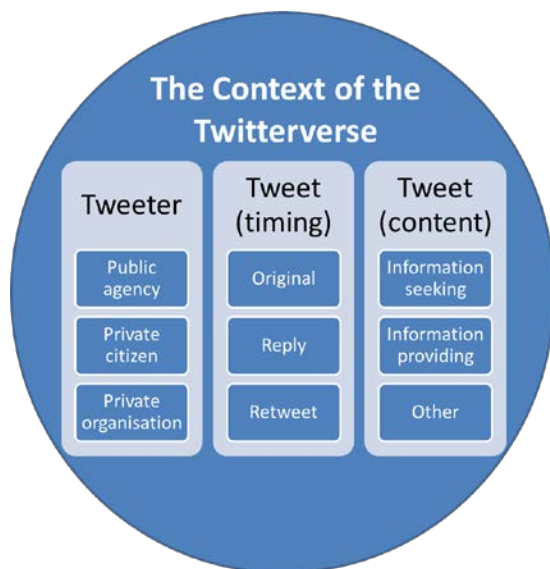
Figure 3: The context of the 'Twitterverse' for this research (Source: Authors)

Study event and data collection

The recently held 2014 Commonwealth Games event in Glasgow, Scotland was used as a case study for this research. The event is international in nature and comprises several multi-sport activities performed by athletes from the Commonwealth Nations – an intergovernmental organisation made up of 53 member states that mostly constituted territories of the former British Empire. The Commonwealth Nations represent some of the world's smallest, largest, richest and poorest countries spanned over the globe, and comprise a population of about 2.2 billion citizens with roughly 60% under the age of 30 years (Commonwealth, 2014). According to the *Business Ready Guide* (Glasgow City Council, 2014) the Games event was expected to attract over 160,000 spectators on peak days, along with 6,500 athletes and officials. In total, 260 event sessions were held over eleven consecutive days in 9 venues in Glasgow; 1 Athlete's Village located in 3 'clusters' (West, East and South of Glasgow); Edinburgh (Royal Commonwealth Pool for the diving) and Carnoustie (Barry Buddon Shooting Range) (GetReadyGlasgow, 2014).

Over the course of the Games, from 23rd June to 3rd August 2014, roughly 9 million Tweets were collected using a combination of transport-related keywords (61%), hashtags (29%), and usernames (10%) or account holders (for example, @GamesTravel2014). These keywords, hashtags and usernames (a total of 339 items) were drawn from the Glasgow

2014 website[1] and available relevant documents as well as potential transport disruption keywords from literature (Dehkharghani et al., 2014; Gal-Tzur et al., 2014; GetReadyGlasgow, 2014; Khan et al., 2014; Mai and Hranac, 2013; Rudat et al., 2014; Shires and Barber, 2014; Ukkusuri et al., 2014). The defined keywords, hashtags, and usernames were input into a Twitter Monitoring Infrastructure (TMI) platform purposely developed for the research by a team of computer scientists from the dot.rural Digital Economy Research Hub at the University of Aberdeen. In this paper, we provide descriptive statistics using the @GamesTravel2014 account as a sample case. The @GamesTravel2014[2] Twitter account served as the official Twitter travel feed during the Games, providing travel information and advice to help attendees plan travel in advance and alert followers to transport changes or disruptions.

Analysis and results

This section presents descriptive statistics, thematic clustering, and content analysis of retweets and Tweets from the @gamestravel2014 account, one of the key channels for travel information and advice from the Games organisers. An interview with the manager of the team behind this account revealed that three groups co-ordinated activity in order to provide a single trusted source of travel information: the travel demand management team, a virtual operators group and the transport co-ordination centre. The travel demand management team were responsible for pushing messaging out to help make sure passengers were being directed to different services in order to ease congestion on the transport network. The virtual operators group were made up of employees from the individual transport operators who were all brought together to focus solely on providing travel information relevant to the Games. The transport co-ordination centre was comprised of the operators that were responsible for the on-ground provision of actual transport services, and so could provide information about how these were actually running and if any disruption was occurring. Situating these three groups physically in the same room helped ensure all the information provided through the @GamesTravel2014 was consistent, with its accuracy verified for further dissemination to the travelling public.

The total number of Tweets captured during the event for the @gamestravel2014 account was 1067, with 865 as retweets and 96 "reply to @gamestravel2014" Tweets. The 865 retweets included 446 individual Tweets, which were retweeted between 1 and 9 times each. For information content coding purposes, only the original Tweet was considered, though all retweets were used when evaluating type of user retweeting.

Thematic clustering and content analysis of Retweets

Each unique Tweet was coded by one researcher in the first instance using thematic analysis, allocating a primary and up to two secondary codes to each. This involved ascribing a category description to the issue(s) or topic(s) contained in the message, and at times noting the timeline being referred to (see Table 1). Our initial content analysis of the retweets looks at the primary category of Tweet as shown in Table 1. Categories were determined using a modified version of the approach described in (Naaman et al., 2010), with one member of the team assigning initial codes to a subset of Tweets. Two additional members of the project team then coded the Tweets based on this categorization, which resulted in overall moderate agreement. Following discussion and evaluation, categories were re-defined and reduced and participants took part in a second round of coding. In the recoding exercise, the level of agreement reached, as computed using Fleiss Kappa implementation in the R software package (Gamer et al., 2012), was substantial agreement (i.e. 0.61 – 0.80) with z-value of 39.4, p-value of 0 and a kappa value of 0.65.

Table 2 shows the categories and count of all Tweets for which all three coders were in agreement. Of note here is that coders primarily agreed on Tweets regarding Disruptions, Travel Information, and Active Transport. Two of three coders were in further agreement on 30% of Tweets, as shown in Table 3.

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[1] www.glasgow2014.com

[2] https://twitter.com/GamesTravel2014

Code	Primary Category	Description	Temporal Category	Sample Tweet
D	Disruption	Any Tweet that indicates a specific disruption or time of disruption	Upcoming (UD): Indicates that the disruption is expected, but has not yet occurred.	RT @GamesTravel2014: Remember the Closing Ceremony tomorrow. Don't drive or park near Hampden if attending. If not attending, please avoid
			Current (CD): Indicates that the disruption is currently ongoing	RT @GamesTravel2014: Congestion on M77 northbound at Junction 2. Avoid the area if possible in order to avoid delay
			End (ED): Indicates that the reported disruption has ended and travel conditions are returning to "normal"	RT @GamesTravel2014: End of Clyde Road Race - Bath Street now open
TI	General travel information	Second-lowest on the Tweet hierarchy; A general "catch-all" category for tweets; to be used when the tweet doesn't fit in another category		RT @GamesTravel2014: All Park and Ride Bus operations have been running as scheduled today.
E	Entertainment	Pertains to tweets referring to events off-site, contests, etc.		RT @GamesTravel2014: #GRG What about heading to a live site after work? http://t.co/J4pacimimm
GI	General information	The lowest category in the hierarchy of tweets; to be used if the tweet fits in no other category		RT @GamesTravel2014: 2/2 Going to Hampden tonight? Remember large bags and golf umbrellas are not allowed into the venue
AT	Alternative transport options, especially walking and cycling	The tweet's key characteristic is the suggestion of a mode of travel other than driving or taking the train		RT @GamesTravel2014: Walk from SECC to Central under half an hour - nice walk! Maybe a better option than queuing for train.
IS	Information seeking	Involves the initial tweet requesting stories or other information from users		RT @GamesTravel2014: #GRG First sports sessions in play now. Let us know about your journey to work this morning.
SR	Specific reply	Tweet involves an @... response.		RT @GamesTravel2014: @[_____] For up to date rail infomation visit @scotrail spectator page at http://t.co/0Lhf5hBP13

Table 1: Types of information in Tweets being retweeted

Category	Count of Coded Tweets	% of Coded Tweets
AT	51	17%
D	166	56%
E	4	1%
GI	7	2%
IS	1	0%
SR	4	1%
TI	64	22%
Total	**297**	100%
	67% of all retweets	

Table 2: Count of Tweets for which all coders agreed on category

Categories	2 of 3 Coders Agree	% for which 2 of 3 Coders Agree
AT	10	8%
D	55	42%
E	4	3%
GI	5	4%
IS	3	2%
TI	55	42%
Total	**132**	100%
	30% of all retweets	

Table 3: Count of Tweets for which 2 of 3 coders agreed on category

Here, again, Disruption, Travel Information, and Active Transport Tweets show the greatest degree of agreement. While further testing will be needed (as discussed below) it is possible that this is the case due to the primary volume of retweets being those containing information that is of immediate/timely interest to followers. This was tested, in part, by evaluating the temporal category of disruption Tweets – i.e. whether they concerned upcoming disruptions, current disruptions, or the end of disruptions. Coders were asked to assign a sub-code to each retweet coded "Disruption", classifying each into one of these times. All three coders identified 166 Tweets as "Disruption", with the temporal sub-codes assigned shown in Table 4.

Disruption - Temporal Category	2 of 3 Agree		All Agree		Total	
Current (CD)	15	9.0%	52	31.3%	67	40.4%
Ending (ED)	0	0.0%	22	13.3%	22	13.3%
Upcoming (UD)	27	16.3%	50	30.1%	77	46.4%
Total	**42**	**25.3%**	**124**	**74.7%**	**166**	**100.0%**

Table 4: Coder agreement on temporal classification of "Disruption" Tweets

As seen here, there was general agreement between coders on the majority (nearly 75%) of temporal classification of those Tweets agreed upon as indicating Disruption. Of note is that all coders agreed on all Tweets indicating the end of disruption. Differentiating between "Current" and "Upcoming" disruptions was less consistent, though still reasonably similar. Tweets indicating current and upcoming disruptions were the most frequently occurring, which could indicate a primary concern for alerting travellers to the need to modify or cancel travel plans given current or expected conditions. For upcoming disruptions, the potential for repeated reminders over time maximises the likelihood that affected travellers will be able to prepare alternative travel arrangements, while timely notification of current disruptions may both reassure currently affected users with acknowledgement of the situation and alert potential users to the need to make journey modifications.

User Type and Tweet Content

In addition to categorising Tweets by type, we also wished to evaluate what types of users were disseminating what types of information via retweets. In Table 5, we indicate the type of user that has retweeted specific categories of Tweets (based on those Tweets for which all three coders were in agreement). Users were classified according to the following system:

- Agency: Twitter account associated with a government agency, excluding those associated with the provision or monitoring of transport services or information
- Company: Twitter account associated with a for-profit business
- Individual: Twitter account associated with an individual account user who has not branded the account to reflect commercial interests
- Media: Twitter account associated with a media outlet or personality who has branded the account to reflect that association
- Transport: Twitter account associated with an agency or organisation officially tasked with provision of transport services or information

Tweeter Type	Tweet Category							
	AT	D	E	GI	IS	SR	TI	Total
Agency	7	54	0	4	0	0	6	71
	10%	76%	0%	6%	0%	0%	8%	100%
Company	0	18	0	0	0	0	9	27
	0%	67%	0%	0%	0%	0%	33%	100%
Individual	1	29	0	2	0	1	8	41
	2%	71%	0%	5%	0%	2%	20%	100%
Media	7	35	0	1	0	1	13	57
	12%	61%	0%	2%	0%	2%	23%	100%
Transport	60	231	5	10	1	2	93	402
	15%	57%	1%	2%	0%	0%	23%	100%
Total	75	367	5	17	1	4	129	598
	13%	61%	1%	3%	0%	1%	22%	100%

Table 5: @GamesTravel2014 retweets by user & Tweet category

Here, again, it is evident that the majority of retweets for all user types fall into the 'disruption' category, with roughly 61% of all retweets attributed to this category. Table 5 reveals interesting differences between the user types, however. Firstly, the over-representation of 'Transport' users must be considered (representing 67% of all Tweeters in our sample). Transport users were also most likely to Tweet about Disruption, but were gerenally responsible for a much broader content of messages. Users classified as 'Individuals', 'Agencies', or 'Companies' were more likely to retweet information related to disruptions, and

less likely to retweet information related to active travel than 'Media' or 'Transport' users. This may reflect an interest in sharing information within the social network that is seen of possible immediate value to persons within one's network.

Thematic clustering and content analysis of Tweet 'conversations'

Tweets directed to @GamesTravel2014 during the Games were also selected, resulting in 96 Tweets for analysis. Similar to Table 5 these Tweets were then coded according to Tweet content, as shown in Table 6.

Code	Category	Description
IS	Information seeking	The Tweeter is requesting information from @GamesTravel2014
TR	Thanks response	The Tweeter has received a response to a query and has sent a reply in thanks
GC	General comment	Neutral comment
IP	Information Provision	Tweeter has provided information to @GamesTravel2014
PC	Compliment	General positive comment
NC	Complaint/criticism	General negative comment
UC	Unclear	Intent of Tweet is unclear

Table 6: Content category of Tweets to @GamesTravel2014

As above, Tweets were coded by three members of the project team and compared using Fleiss's Kappa. Significant agreement was reached (Kappa = 0.796, z = 27.5, p-value = 0), with all three coders agreeing on 76 Tweets (79%). Table 7 shows the overall purpose categories obtained. Information seeking Tweets were the most common type sent to @GamesTravel2014 (44.7%), followed by thanks response (22.4%). Of note is that both positive and negative comments were relatively infrequent in occurrence.

Tweet type	#	%
IP	11	14.5%
IS	34	44.7%
NC	6	7.9%
PC	5	6.6%
TR	17	22.4%
UC	3	3.9%
Total	76	100.0%

Table 7: Tweets directed to @GamesTravel2014 by purpose

Table 8 shows the Tweets directed to @GamesTravel2014 by User type & Purpose. Individual account holders were most likely to Tweet to @GamesTravel2014, and were the only account holders to send Tweets primarily reflecting positive or negative comments. Other users such as Agencies and Transport users primarily entered into conversations in order to offer information.

Tweet type	User Type					
	Agency	Company	Individual	Media	Transport	Total
IP	3		2		6	11
IS		2	27	3	2	34
NC			6			6
PC			5			5
TR			13	1	3	17
UC			3			3
Total	3	2	56	4	11	76

Table 8: Tweets directed to @GamesTravel2014 by User type & Purpose

Discussion, conclusion and future work

In this work, we have examined the types of information being disseminated via Twitter through the use of retweets, as well as examining a set of Tweets displaying types of interaction around a large event with concomitant transport impacts. The overarching interest of the research was to examine: 1) types of Twitter users who are interested in transport event information on Twitter during big events; and 2) types of information in transport events in Tweets during big events. By evaluating the content of Tweets (both retweets and Tweets directed toward a specific user account) in the context of user type, we demonstrate that specific user types use Twitter for diverse purposes, and reflect an ingrained degree of trust in or concern with different types of information. In the retweet analysis, individual users demonstrated a high degree of retweeting of disruption Tweets, revealing both a desire to spread information about current or planned disruption with other users in their social networks, and a willingness to indicate trust in the content of the message (and, by extension, in the original Tweeter). As such dissemination may have knock-on effects for the reputation of the retweeter (i.e. the accuracy of information retweeted may impact upon how others will view subsequent shared information), the degree to which the user trusts the Tweet originator will aid in the decision to share these Tweets. Trust is also revealed in the information seeking behaviour of individuals with respect to Tweets directed towards @GamesTravel2014. As Twitter conversations occur on a public platform, a user's willingness to approach an entity via Twitter for information that may impact upon or influence future decisions reveals an inherent willingness to trust the information that will be provided, and to do so in a manner that may additionally impact that user's reputation. Such interaction also displays the user's trust that the information provided will be both reliable and provided in a timely manner. Such indications are relevant to how transport operators should view Twitter as a means not only of sharing information with users, but also of building relationships based on accurate, timely, and personalised attention.

The themes identified here will be explored further in future work by examining the corpus of Tweets collected from Twitter accounts, hashtags and keywords using the themes presented in this paper. Further refinement of the Tweet categorisation exercises presented here will contribute to the possibility of exploring key terms and phrases that indicate Tweet type – an exercise that may better allow for the construction of useful and informative Tweets that will further cement their benefits in conversations between transport providers and users. The outcome will provide further evidence to what we already know about transport event Tweets from big events.

Acknowledgements

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