COLLECTIVE BEHAVIOUR, SOCIAL MEDIA, AND DISASTERS: A SYSTEMATIC LITERATURE REVIEW

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COLLECTIVE BEHAVIOUR, SOCIAL MEDIA, AND DISASTERS: A SYSTEMATIC LITERATURE REVIEW

Research

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Abstract
The widespread availability and use of social media has drastically altered disaster response in the last few years. Although a considerable amount of empirical research addresses social phenomena enabled by social media in response to disasters, the field still lacks a clear-cut knowledge base. We conduct a systematic literature review to illustrate the state of the art with respect to collective behaviour in social media in disaster situations. We find that social media have the potential to alter well-known patterns of collective behaviour, such as the distribution of activities undertaken by different types of actors over the disaster management lifecycle. Social media furthermore loosen the structural relationships between actors as they facilitate addressing wider audiences and enable communication to unspecified receivers. We conclude that future research should specifically address the causal relationship between collective behaviour in social media and the characteristics of disasters. Furthermore, research should pay particular attention to adapting existing theories and frameworks to, and developing new theoretical approaches for, the emerging digital world.

Keywords: Collective Behaviour, Social Media, Disaster, Crisis.

1 Introduction
There can be little doubt that the late 20th century has seen a rapid increase in both human-made and natural disasters (Coleman, 2006; Eshghi and Larson, 2008). The emergence of new information and communication technologies and particularly social media has significantly altered disaster response in recent years (Veil et al., 2011). It has also attracted the attention of the information systems (IS) discipline. Beginning with the seminal paper of Palen and Liu (2007), a new focus on IT usage in disaster response has evolved in IS and the social sciences.

Investigating social phenomena in the social media environment is exceedingly promising, as these technologies allow for exploring behavioural patterns that were once invisible (Kleinberg, 2008). The pervasiveness of such technologies and the convergence of digital and social networks enable scholars to adopt new perspectives on well-established theories and assumptions that emerged when the world was more analogue (Agarwal et al., 2008; Lazer et al., 2009).

Although in disasters social media are often used simply as information dissemination tools (Lindsay, 2011), there is evidence that they also promote distinct social phenomena such as digital convergence (Hughes et al., 2008) and digital commemoration (Liu, 2011; Walter, 2015). The most prominent social phenomenon refers to so-called digital volunteers, that is, groups of people who engage in disaster relief on a nonprofessional basis, emerging and carrying out their activities mainly online.
Starbird and Palen (2011), for instance, describe the resources and constraints faced by digital volunteers. St. Denis et al. (2012) outline merits and drawbacks of digital volunteers, whereas Starbird (2011) relates their crowdsourcing potential. Others address interactions between digital volunteers, non-digital volunteers, and relief professionals (Hughes and Tapia, 2015; Reuter et al., 2013). While these studies contain valuable insights into disaster-related behaviours, they do not provide a complete picture of social phenomena in social media in disasters. Our particular interest is on phenomena termed collective behaviour that emerge when individual actions are embedded into a social context through social media (Goldstone and Gureckis, 2009). The purpose of our research is to gain a more general view on collective behaviour in social media in disasters. Our research question is:

RQ: What disaster-related collective behavioural phenomena have been observed in social media so far?

We investigate the knowledge base of collective behaviour in disasters in social media by means of a systematic literature review (Kitchenham and Charters, 2007; Webster and Watson, 2002). This enables us to address questions that cannot be answered in isolated studies, particularly those that explain the findings of previous research within the framework of theory (Rowe, 2014).

The remainder of our review is structured as follows: Section 2 provides a theoretical background on collective behaviour in disasters and introduces an analytical framework. Section 3 details our research method. Section 4 summarises the key findings on collective behaviour in social media in disasters, and section 5 discusses the implications of these findings. Section 6 is our concluding remarks.

2 Theoretical background

2.1 Collective behaviour in disasters

Our assessment of collective behaviour in social media takes place against the background of disasters, defined as “serious disruption[s] of a community or society involving widespread human, material, economic or environmental losses and impacts, which exceed […] the ability of the affected community or society to cope using its own resources” (United Nations Office for Disaster Risk Reduction, 2009, p. 9). Disasters share the attributes of common crises in that they are harmful and disruptive situations of high magnitude that occur suddenly and demand prompt response, but stand outside the affected actors’ typical operating framework (Reilly, 1993). They are regarded as “crises gone bad”, that is, as crises collectively framed as having bad endings (Boin, 2005).

It would be shortsighted, however, to restrict disaster phenomena to the physical realm. They do not only affect communities physically, but are in equal measure social phenomena (Quarantelli and Dynes, 1977). Having a significant impact on the functioning of the social order, disasters cannot be viewed independently of social perception (Kreps, 1984). Hence, we assume disasters are shaped by the affected community’s or society’s percipience, which also affects their responses to the observed disruption (Blumer, 1971).

Given that disasters are inherently disruptive, it follows that they are disposed to remove or at least shift mechanisms of social control. While individuals’ behaviour is typically bounded by a variety of social institutions, these instances of supervision can easily be renegotiated by extreme events such as disasters. This gives way to emergent patterns of collective behaviour that may otherwise be unthinkable (Coleman, 1990). According to Coleman (1990), collective behaviour is characterised by three key features: it involves more than one individual taking similar action at the same time; it is by nature transient and instable, and hence lacking stable equilibria of action; and it requires that the individual actions of which it is constituted be in some way interdependent.

Although collective behavioural phenomena are not restricted to disasters, they are particularly distinct in this context. Previous research concludes that relevant collectives in disasters usually lack common features of their counterparts in other situations, especially regarding hierarchical organisation. Those that do match basic organisational requirements, however, typically lack other constituent features of
organisations, particularly with regard to their size. Finally, disaster situations frequently manifest emergent group phenomena (Quarantelli and Dynes, 1977); that is, groups of citizens otherwise not involved in disaster management emerge around perceived needs or problems associated with the disaster (Stallings and Quarantelli, 1985).

The ubiquity of social media technologies does not stop at those collective behavioural phenomena in disasters (Veil et al., 2011). People – disaster victims, observers, and volunteers alike – are taking up the new technology’s potential to connect with each other, participate in events, and seek and provide disaster-related information (Palen, 2008). Social media affect collective responses to disasters with respect to the coordination of disaster management activities, communication of disaster management to the public, and communication between and among citizens (Latonero and Shklovski, 2011). Additionally, social media have enriched disaster response through so-called virtual emergent groups, that is, emergent groups that originate and carry out their activities mainly online (Reuter et al., 2012).

In the following, we provide a state-of-the-art overview on collective behaviour in disasters observed in the social media environment. In particular, we seek to expose the patterns of collective behaviour in social media implicit in current disaster research. Furthermore, we transfer the themes of collective behaviour identified in the literature to the analytical framework of collective behaviour in disasters presented below. In doing so, we hope to extend the theoretical foundations of collective behaviour in disasters in the social media environment.

2.2 Analytical framework

According to Kreps (1984), there are four structural dimensions of disasters along which their features can be classified: the disaster event, its impacts, the social units affected by these impacts, and the responses taken up by the affected social units. The disaster event describes the physical specification of a disaster. Its impact includes both physical and social disruptions and losses provoked by the disaster. Accordingly, the social units affected by the disaster can be found at various levels of aggregation, ranging from individuals to entire societies. The response includes all types of behaviour by the affected social units in order to adapt to the disaster.

We argue that the affected actors’ responses take place interdependently in a system of interaction brought forth by the disaster-related social disruptions. These mutually dependent individual actions, in turn, add up to collective patterns of behaviour (Morgeson and Hofmann, 1999). Following again from Kreps (1984), collective behaviour is taken to comprise a sequence of activities, resources, tasks, and domains. This implies that it is triggered by activities by the social units in response to perceived disaster-related social disruptions (e.g., spontaneously searching for victims). Subsequently, the human and material resources available to the actors (e.g., previous training), as well as the particular tasks they perform over the course of their activities (e.g., scanning a specific area), affect the emergence of collective behaviour. In the last step, the domain – that is, the superordinate disaster-related function into which the task is embedded (e.g., general search and rescue actions) – determines the final shape of collective behaviour (Kreps, 1984).

Accordingly, collective behaviour in response to a disaster, as described by the sequence of activities, resources, tasks, and domains of behaviour, is shaped by 1) the physical disaster event, 2) its impacts, 3) the affected social units, and 4) these units’ responses that ultimately result in collective behaviour. Figure 1 is an overview of the analytical framework. Although we focus on collective behaviour in social media, it is noteworthy that the social units’ responses can take place offline as well as online.

Figure 1. Framework of collective behaviour in response to disasters (following Kreps (1984)).
With respect to the physical disaster event, the type of a disaster has proven highly relevant in disaster research. It describes whether disasters are natural, human-made, or both (Shaluf, 2007). Natural disasters, which include both natural phenomena such as earthquakes and landslides and biological phenomena such as infestations and epidemics, are beyond human control. Human-made disasters, by contrast, are consequences of human decisions and include socio-technical and warfare disasters (Shaluf, 2007). These categories are not mutually exclusive, but allow for hybrid cases (Shaluf, 2007).

The four phases of disaster impact are commonly regarded as the major distinctive feature of the impact dimension. This aspect is related to the chronology of disaster events (Lettieri et al., 2009). The first two phases, mitigation and preparedness, take place prior to the actual disaster event. Mitigation describes the time during which efforts are made to prevent a disaster, minimise its impacts, and reduce vulnerability. Preparedness, which follows, is the phase during which concrete actions are taken to prepare the affected population and responders for post-disaster activities. The third phase, response, begins when disaster strikes; it is when actions are taken to manage the disaster impact and control its effects, with the aim of minimising losses and damage. Finally, recovery takes place after the physical disaster event. During this phase, efforts are made to bring the affected area and population back to its normal state (Lettieri et al., 2009). These phases are known as the “lifecycle of disaster management”; they can be thought of as a circle, with post-disaster activities blending into subsequent mitigation efforts (Moe and Pathranarakul, 2006).

Several secondary features of the disaster impact are not directly dependent on the disaster phase. Kreps (1995), for instance, elaborates on the duration, scope, and magnitude of disaster impact. The duration relates to the temporal extent of a disaster impact, that is, the time lag between the onset of social disruption and physical harm and its conclusion. The scope of impact refers to the social and geographic boundaries of disaster impact, whereas the magnitude describes its severity (Kreps, 1995). With regard to the magnitude of impact, we are particularly interested in the dimension of personal impact, that is, the severity of a disaster’s impact on disaster victims (Berren et al., 1982).

The literature has also elaborated upon a functional classification of actor types to describe the social units affected by a disaster. Any of them can be involved directly or indirectly in disaster response management. For example, the population – that is, the common people on the ground – and the media reporting on the disaster are typically involved only indirectly. Conversely, official agents – public and private organisations, as well as volunteer agencies – and researchers are usually involved directly (Lettieri et al., 2009).

As we aim for an overview of collective behaviour in social media, we restrict our argument to behaviours that can be observed in the respective environment. Social media platforms are defined in terms of technology as Web 2.0 platforms open to modification, participation, and collaboration by all users, and in terms of usage as providing a forum for user-generated content created by non-professional contributors (Kaplan and Haenlein, 2010). At present, various social media platforms are used in disaster-related communication, including popular platforms such as Facebook, Twitter, and Flickr (Briones et al., 2011; Liu et al., 2008), but also disaster-specific applications (Ludwig et al., 2015; Reuter et al., 2015). Because specific social media platforms are subject to frequent conceptual and technological changes (Oinas-Kukkonen et al., 2010), we focus instead on their general features.

According to Kane et al. (2014), social media platforms can meaningfully be described in terms of four stable features, namely whether and to what degree a platform: provides unique user profiles (“digital profile”); allows users to access digital content through and protect it from various search mechanisms provided by the platform (“search and privacy”); provides mechanisms for users to articulate a list of other users with whom they share a connection (“relational ties”); and allows users to view and traverse their connections and those of others on the platform (“network transparency”).

The focus of our study is collective behaviour in such social media platforms in disasters. While offline collective behaviour in disasters includes well-known phenomena such as looting, episodes of mass hysteria, and spontaneously organised search and rescue groups (Weller and Quarantelli, 1973), its specific shape in social media is less clear. Therefore, our purpose is to investigate patterns of collective behaviour in social media and their relation to disaster characteristics in the literature.
3 Method and procedures

3.1 Systematic literature review

We investigate the knowledge base on disaster-related collective behaviour in social media in disasters by means of a systematic literature review. This method provides the means to identify, evaluate, and interpret the available research on collective behaviour in social media in disasters (Kitchenham and Charters, 2007). The goal of our review is explanatory in nature, as we seek to expose how findings on social media usage in disasters relate to the theory of collective behaviour in those situations. In pursuing this goal, we follow the recommendations and guidelines described by vom Brocke et al. (2009) and summarise research outcomes and particular findings of existing work around the analytical framework presented in section 2.2.

In the first step, we conducted a systematic literature search to capture a comprehensive and complete set of relevant primary studies on disaster-related collective behaviour in social media, following the guidelines by Kitchenham and Charters (2007). In doing so, we drew a representative sample of highly relevant papers to provide the reader with a meaningful overview of the current state of the art (vom Brocke et al., 2009). We derived search terms from the two main aspects of our research question, that is, disasters providing the context of research and social media as mediating technology (Kitchenham and Charters, 2007). We did not restrict our search to particular forms of collective behaviour to gain a broad picture of current research. We applied “disaster” and “crisis” (both in their singular and plural forms) as relevant synonyms for the context, as these terms are often used interchangeably (Shaluf et al., 2003). To capture research on social media, we used the term “social media” as a keyword. Following Berger et al. (2014), we also included the keyword “social network”, which is often used in the same context. In summary, we used the terms “social media” and “social network” (both in their singular and plural forms) as keywords. This led to the following search terms:

Search terms: Title, abstract, keywords: (disaster* OR cris*s) AND (“social media” OR “social network” OR “social networks”)

As systematic literature reviews should cover not only the IS discipline, but also related fields of research (Webster and Watson, 2002), we conducted a keyword-based search in seven IS and social sciences literature databases. We included the ACM Digital Library, AIS Electronic Library, EBSCOhost online research databases, IEEE Xplore Digital Library, JSTOR, ScienceDirect, and the Social Science Citation Index. We used the databases’ Web interfaces to search the title, abstract, and keywords of indexed manuscripts. Our final search, conducted on 29 October 2015, yielded 3,746 hits across all databases.

After removing duplicate entries within the databases, we applied a series of exclusion criteria to remove all papers that did not contain direct and relevant evidence on our research question (Kitchenham and Charters, 2007). Table 1 shows the number of papers that remained after each step. We elaborate on our screening procedure in the paragraphs that follow.

<table>
<thead>
<tr>
<th>Database</th>
<th>Overall hits</th>
<th>Unique hits</th>
<th>Relevance screen</th>
<th>Format screen</th>
<th>Research design screen</th>
<th>Quality screen</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACM</td>
<td>150</td>
<td>150</td>
<td>51</td>
<td>45</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>AISeL</td>
<td>33</td>
<td>33</td>
<td>19</td>
<td>17</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>EBSCO</td>
<td>2,250</td>
<td>1,845</td>
<td>407</td>
<td>218</td>
<td>49</td>
<td>27</td>
</tr>
<tr>
<td>IEEEXPliore</td>
<td>293</td>
<td>276</td>
<td>39</td>
<td>38</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>JSTOR</td>
<td>66</td>
<td>55</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ScienceDirect</td>
<td>238</td>
<td>236</td>
<td>65</td>
<td>53</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>SSCI</td>
<td>716</td>
<td>716</td>
<td>146</td>
<td>138</td>
<td>35</td>
<td>18</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,746</strong></td>
<td><strong>3,311</strong></td>
<td><strong>728</strong></td>
<td><strong>510</strong></td>
<td><strong>126</strong></td>
<td><strong>78</strong></td>
</tr>
</tbody>
</table>

Table 1. Number of search results in the systematic search process.
In the first screen, we excluded all content not related to the research question based on title and abstract (relevance screen). More specifically, we excluded papers that did not concentrate on disasters in the sense of serious disruption with widespread impacts (e.g., personal crises), social media (e.g., social support networks), and collective behaviour as relating to activities, resources, tasks, and domains addressed by social units in disaster situations (e.g., event detection algorithms).

In the second iteration, we excluded all research that did not explicitly qualify as peer-reviewed, completed research. Thus, we excluded book chapters, book reviews, dissertations, and research-in-progress papers. Furthermore, we excluded all papers written in languages other than English (format screen).

In a third iteration, we excluded papers not primarily empirical (research design screen). Most of the excluded papers at this stage had a theoretical focus or presented advice rather than describing behaviours. In this step, we identified five literature reviews on social media usage in disasters: Crowe (2011) investigates the opportunities of social media systems for emergency management professionals; Houston et al. (2015) present a framework of social media usage in disasters; Simon et al. (2015) elaborate on utilisation of social media by various actors; Veil et al. (2011) present best practices of social media usage for practitioners; and Wybo et al. (2015) explore the merits and drawbacks of social media in disasters. We did not regard these reviews as source material, but still included them as additional bases in the subsequent forward and backward search.

Finally, we assumed that the major contributions would be published in leading journals and conference proceedings (Webster and Watson, 2002). We consulted the ERA 2010 journal and conference ranking (Australian Research Council, 2011a, 2011b) and excluded all papers ranked in category C or lower; that is, we kept all papers in the categories A*, A, and B (quality screen). We decided against including highly cited papers in lower-ranked outlets, as screening those publications revealed they contained little if any further evidence on the topic. We did not apply additional quality criteria to keep as much evidence as possible.

Subsequently, we conducted an additional forward and backward search based on the references retrieved in the systematic literature search (Webster and Watson, 2002). In the forward search, we identified papers that cited the literature we had identified in the systematic search using the Web of Science Citation Index and Google Scholar. In the backward search, we screened the references of our selected papers for sources contributing to our own research.

Overall, the systematic literature search yielded relevant 78 hits, resulting in 52 distinct papers across all databases. An additional 16 papers that met our selection criteria were identified in two rounds of forward and backward search. This led to a total of 68 papers that served as a basis for data analysis.

### 3.2 Data extraction and analysis

To extract findings from the literature, we applied a qualitative content analysis based on deductive categories (Mayring, 2000). Categories are based on the concepts introduced in the analytical framework in section 2.2.

With regard to the disaster event, we recorded the specific event being investigated and specifically took note of the type of event, following Shaluf (2007). For the disaster impact, we noted the phase of event that was studied (Lettieri et al., 2009), as well as the duration, scope, and magnitude of the event as specified by the respective authors (Kreps, 1995). With respect to the social units, we evaluated the type of actors and whether they were involved directly or indirectly in disaster management as specified by Lettieri et al. (2009). Finally, we noted the characteristics of the actors’ response in social media. Therefore, we recorded the specific social media platforms utilised by the relevant actors and in what ways, as described in the texts. To assess the usage of social media by various actors, we applied as a coding scheme the functional framework proposed by Houston et al. (2015). Furthermore, we detailed the structure of these social media in question with regard to the structural characteristics proposed by Kane et al. (2014).
We then evaluated specific patterns of collective behaviour evident in the texts. Although none of the papers we examined referred explicitly to collective behaviour, we found that all patterns of behaviour we identified are adequately described by this concept as they were typically pursued simultaneously by a number of individuals and the actions were typically taken interdependently but without a recognisable equilibrium of action (Coleman, 1990). We followed Morgeson and Hofmann (1999) in assuming that collective behaviour has both a structural and a functional component. In this context, structure describes the individual actions and interactions of which collective behaviour is comprised, whereas function relates to the causal outcomes of behaviour. While the structural component yielded information on activities and resources of collective behaviour, the functional element represented the tasks and domains addressed by collective behaviour in a structured and evaluable form. In particular, we extracted individual behaviours as described in the texts, plus, if available, relevant social norms, relationships between the actors, structures of interactions, dynamic developments, and contexts of interaction. With regard to the function of collective behaviour, we took note of the specific behavioural outcomes as specified by the studies’ authors, and of the relationships between the individual actors’ goals and the collective outcomes (Morgeson and Hofmann, 1999).

Subsequently, we analysed how different configurations of disaster dimensions led to differences in the reporting of the structure and function of collective behaviour. Overall, we identified seven irregularities we could ascribe to systematic differences in disaster events, impacts, social units, and responses. The findings as well as the underlying literature are reported below.

4 Findings

We inferred seven key findings from the literature that illustrate the state of knowledge regarding the relationship between disaster characteristics and collective behaviour in social media in response to these very characteristics. Table 2 shows how our findings relate to the model categories presented in section 2.2. The first column contains the dimension of the framework to which the respective findings refer. We assigned a numerical indicator to each of the findings to aid the discussion that follows the table; these are enumerated in the second column and described briefly in the third column.

<table>
<thead>
<tr>
<th>Framework</th>
<th>Finding</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event</td>
<td>Finding 1</td>
<td>Sharing and obtaining factual information is the primary function of social media usage consistently across all disaster types, but the secondary functions vary.</td>
</tr>
<tr>
<td>Impact</td>
<td>Finding 2</td>
<td>Disaster management activities are not restricted to individual phases of the disaster management lifecycle in social media.</td>
</tr>
<tr>
<td></td>
<td>Finding 3</td>
<td>The duration, scope, and magnitude of disasters influence the extent of social media usage in a disaster, but not necessarily the structure and function of usage.</td>
</tr>
<tr>
<td>Social units</td>
<td>Finding 4</td>
<td>Different actor types make use of social media in similar ways, but perceive different conditions and restrictions for social media usage in disaster situations.</td>
</tr>
<tr>
<td></td>
<td>Finding 5</td>
<td>Social media enable members of the population to reach formerly inaccessible actors, but do not ensure two-way communication.</td>
</tr>
<tr>
<td></td>
<td>Finding 6</td>
<td>Social media integrate unspecified and wider audiences into disaster communication, which can lead to group emergence.</td>
</tr>
<tr>
<td>Response</td>
<td>Finding 7</td>
<td>The features of social media platforms determine the structure and function of collective behaviour on these platforms in disasters.</td>
</tr>
</tbody>
</table>

Table 2. Affiliation of findings to framework dimensions.

Finding 1: Sharing and obtaining factual information is the primary function of social media usage consistently across all disaster types, but the secondary functions vary.

The literature indicates that the type of disaster affects the initial activities undertaken by the social units. The function of social media usage in disasters mentioned most often is to document and learn
what is happening. In disasters, be they natural or human-made, actors often perceive a lack of timely and locally relevant information in times of uncertainty and rapidly changing demands (Brengarth and Mujkic, 2016; Huang et al., 2010; Sarcevic et al., 2012; Shklovski et al., 2008). Traditional media and other communication channels are often unavailable (Jung, 2012; Jung and Moro, 2014; Procopio and Procopio, 2007; Tagliacozzo and Arcidiacono, 2015). In some cases, media coverage is simply deemed insufficient given the urgent needs of those seeking information (Chen et al., 2014; Huang et al., 2015; Kaewkitipong et al., 2012; Kaewkitipong et al., 2016; Leong et al., 2015; Monroy-Hernández et al., 2013; Ostertag and Ortiz, 2015). Receiving factual information on disasters from social media enables actors not only to learn what is happening but also to make sense of events (Palen and Vieweg, 2008; Shaw et al., 2013).

The relevance of other social media functions varies across different disaster types. In natural disasters such as earthquakes and floods, providing and receiving information about disaster response activities and opportunities is highly cited (Brengarth and Mujkic, 2016; Chatfield et al., 2014b; Chen et al., 2014; Hughes et al., 2014; Kaewkitipong et al., 2012; Kaewkitipong et al., 2016; Leong et al., 2015; Muralidharan et al., 2011b; Sarcevic et al., 2012; Takahashi et al., 2015). Social media are also used to provide and receive disaster warnings (Ahmed and Sargent, 2014; Ahmed and Sinnappan, 2013; Carter et al., 2014; Chatfield et al., 2014a; Chatfield and Brajawidagda, 2013; Hughes et al., 2014) and preparedness information (Ahmed and Sinnappan, 2013; Chatfield et al., 2014a; Chatfield and Brajawidagda, 2013), raise awareness of the disaster and promote fundraising (Ahmed and Sinnappan, 2013; Brengarth and Mujkic, 2016; Smith, 2010; Takahashi et al., 2015), and seek and provide emotional support (Ahmed and Sinnappan, 2013; Al-Saggaf and Simmons, 2015; Procopio and Procopio, 2007; Recuber, 2012; Takahashi et al., 2015).

These findings, however, do not hold for other types of disasters. If the event is biological in nature, such as an epidemic, the reported focus of activity is on providing and receiving preparedness information (Kim and Liu, 2012; Tirkkonen and Luoma-aho, 2011), and furthermore on discussing causes and consequences (Gaspar et al., 2014). Things are different again if disasters have a human or social cause, as in school shootings and terror attacks. In these cases, social media are used more to express emotions and memorialise victims (Huang et al., 2015; Kaufmann, 2015; Mazer et al., 2015; Neubaum et al., 2014; Recuber, 2012), establish connections between geographically remote community members (Kaufmann, 2015; Mark et al., 2009; Semaan and Mark, 2012), and engage in conversations and discussions about response and recovery efforts (Kaufmann, 2015; Mazer et al., 2015). If the cause of a disaster is technical in nature, social media are used to discuss causes and implications of the event (Muralidharan et al., 2011a; Yin et al., 2015), and to implement traditional disaster communication activities (Diers and Donohue, 2013; Muralidharan et al., 2011a).

Finding 2: Disaster management activities are not restricted to individual phases of the disaster management lifecycle in social media.

We found evidence that social media contribute to relieving resource restrictions on collective behaviour, which widens the scope of observed behavioural outcomes in social media. Disaster response is basically cyclic, which means that recovery efforts in the post-disaster phase tend to intermix with mitigation activities at the beginning of the lifecycle of the subsequent event (Moe and Pathranarakul, 2006). The literature suggests, however, that in social media the activities associated with the disaster phases not only blend into each other, but occur irrespective of the lifecycle phases. Specifically, the literature suggests that providing and receiving preparedness and warning messages often occurs in the response and recovery stages. In natural disasters, for instance, regular preparedness messages such as weather updates and general education are distributed independently of the ongoing event (Ahmed and Sinnappan, 2013; Chatfield and Brajawidagda, 2013). Warnings in the response or recovery phase can be triggered by fear of secondary impacts such as aftershocks or severe weather (Ahmed and Sargent, 2014; Acar and Muraki, 2011; Ahmed and Sinnappan, 2013; Chen et al., 2014; Jung and Moro, 2014; Kaewkitipong et al., 2012; Kaewkitipong et al., 2016; Leong et al., 2015). In biological disasters, preparedness messages regarding preventive measures are sent out during the response phase to prevent further spreading (Kim and Liu, 2012; Tirkkonen and Luoma-
aho, 2011). In cases of ongoing violence, warnings are directed at those not already aware of the events (Ems, 2014; Huang et al., 2015; Mark et al., 2009; Omilion-Hodges and McClain, 2016). Furthermore, there is evidence that response activities take place in the recovery phase in social media if the duration of the disaster event is relatively short. This is, for instance, the case for earthquakes that last only minutes but that have a long-term impact on the affected social units. The literature suggests that in those cases actors perform typical response activities – such as asking for and providing help and asking for and sharing information on one’s wellbeing – after, rather than during, the disaster event (Acar and Muraki, 2011; Tagliacozzo and Arcidiacono, 2015; Qu et al., 2011).

Conversely, we also identified post-disaster activities that occur particularly in the mitigation phase. The most striking example describes community building efforts typically attributed to the recovery phase (Houston et al., 2015), but that actually take place during mitigation in social media. Relief agencies in particular are said to appreciate that social media allow for establishing a community of stakeholders before a disaster actually strikes, thus ensuring that there is a community on which these agencies can rely in case of disaster (Liu et al., 2012; van Gorp et al., 2015).

Finding 3: The duration, scope, and magnitude of disasters influence the extent of social media usage in a disaster, but not necessarily the structure and function of usage.

Research findings indicate that the secondary characteristics of disaster impact – its duration, scope, and magnitude – influence the extent to which actors utilise social media in disasters. We find that higher impacts on any of these dimensions lead to higher degrees of disaster-related activity observed in social media.

There is evidence for this relationship across all types of disasters. For natural disasters, where we found the most variation in secondary impact characteristics covered by the literature, a high level of social media activity is reported in geographically disperse earthquakes with severe consequences (Acar and Muraki, 2011; Jung and Moro, 2014), wide-scale and long-term floods (Ahmed and Sinnappa, 2013; Chen et al., 2014; Kaewkitipong et al., 2012; Kaewkitipong et al., 2016; Shaw et al., 2013), and highly destructive and distributed weather events (Chatfield et al., 2014b; Hughes et al., 2014). Less communication is mentioned in locally restricted earthquakes (Tagliacozzo and Arcidiacono, 2015), floods in isolated areas (Al-Saggaf and Simmons, 2015; Sutton et al., 2015; Starbird et al., 2010), and short-term and local weather events (Carter et al., 2014; Lachlan et al., 2016).

This finding, however, is accompanied by a lack of insights regarding the structure and function of interaction conditional on the disaster impact. So far, we see no systematic deviations in social media usage depending on the secondary characteristics of disaster impact. On the contrary, a wide variety of interaction structures and functions is described in both major and minor disasters. We conclude that the literature does not report consistent patterns of qualitative impact on collective behaviour.

Finding 4: Different actor types make use of social media in similar ways, but perceive different conditions and restrictions for social media usage in disaster situations.

Literature indicates that social media influence the resource restrictions perceived by different types of social units. While different types of actors make use of social media platforms in basically similar ways in disasters, they perceive different conditions and restrictions of access. For example, populations on the ground rarely experience barriers to social media usage in disasters. On the contrary, the widespread adoption and use of social media is often seen as a reinforcing factor for this actor type (Al-Saggaf and Simmons, 2015; Huang et al., 2010; Monroy-Hernández et al., 2013). Similarly, the easy access to social media platforms (Al-Saggaf and Simmons, 2015; Chatfield and Brajewidaga, 2013) and the possibility to participate in communication passively (Austin et al., 2012; Neubaum et al., 2014) and to some degree anonymously (Al-Saggaf and Simmons, 2015; Kaufmann, 2015) contribute to the popularity of social media usage in disasters by members of the population. In fact, the literature reports only confining measures taken by governments as restrictions pertaining to members of the population (Chatfield et al., 2012; Ems, 2014).
However, disaster agents such as government agencies, private business organisations, and relief agencies are ascribed an initial barrier to recognise the necessity to communicate at all in social media (Bygstad and Presthus, 2013; van Gorp et al., 2015). Furthermore, various actors, including official agents, media, and research agencies, are said to face resource restrictions to utilising social media in disasters. In particular, scarcity of time, staff, and training are repeatedly mentioned (Brengarth and Mujkic, 2016; Bygstad and Presthus, 2013; Majchrzak and More, 2011; van Gorp et al., 2015).

This finding strongly resembles the technology acceptance model in its basic form (Davis, 1989). There is evidence that the degree of technology distribution and secondary platform features affect conditionally perceived usefulness and ease of use as they diminish or reinforce access barriers for different types of users. Therefore, they influence the technology acceptance of social units confronted with social media adoption in disaster situations.

Finding 5: Social media enable members of the population to reach formerly inaccessible actors, but do not ensure two-way communication.

While it is a major function of social media in disasters to connect or reconnect community members (Houston et al., 2015), their integrative potential transcends the population level. Social media establish direct communication channels between the population and other actors from whom they were formerly separated. In regimes that underlie general restrictions on public communication, social media provide the means for members of the population to address the government (Al-Saggaf and Simmons, 2015; Qu et al., 2009; Qu et al., 2011). Similarly, social media constitute an alternative communication channel for governments and business organisation if the public discussion of disaster shifts from offline to social media platforms (Bygstad and Presthus, 2013; Diers and Donohue, 2013; Tirkkonen and Luoma-aho, 2011). Therefore, social media diminish personal resource constraints that otherwise apply to collective behaviour in disasters.

It is noteworthy, though, that social media do not ensure two-way communication between these actors. Apparently, social media are used as an additional channel for information distribution rather than for dialogue. For instance, members of the population may well be heard if they call for a government response, but they rarely receive attention in social media (Al-Saggaf and Simmons, 2015; Qu et al., 2009; Qu et al., 2011). Conversely, the government may utilise social media to disseminate information, but not engage in dialogue with the population (Carter et al., 2014; Tirkkonen and Luoma-aho, 2011). And although there is evidence that business organisations do indeed engage in disaster communication in social media (Bygstad and Presthus, 2013; Chewning et al., 2013; Diers and Donohue, 2013), they may fail to recognise the shifting locus of communication (Yin et al., 2015).

Finding 6: Social media integrate unspecified and wider audiences into disaster communication, which can lead to group emergence.

While communication between formerly inaccessible actors would also be possible in traditional communication channels, social media enable actors to share information with an unspecific and diffuse audience (Hughes et al., 2014). Thus, social media again diminish the perceived resource constraints in collective behaviour.

Not all content is actually untargeted. There is evidence that actors may try to reach related others of whose personal identity they are ignorant (Yates and Paquette, 2011). In other cases, it is possible to attribute seemingly undirected communication to the actors’ intention to raise the awareness of a wider, possibly international audience (Ahmed and Sinnappan, 2013; Ems, 2014; Jung and Moro, 2014; Morris, 2014; Smith, 2010). This implies that social media have the potential to open up the audience in disaster response to social units not affected (directly or indirectly) by a disaster.

In other cases, however, actors are not at all interested in targeting their messages. Muralidharan et al. (2011b) and Sarcevic et al. (2012), for instance, indicate that relief agencies often send out information into the broad social media to be read by anyone who happens to stumble across it. Similarly, research agencies and governments utilise social media to reach unspecified audiences, as
when they issue preparedness and warning messages (Acar and Muraki, 2011; Chatfield and Brajawidagda, 2013; Jung and Moro, 2014; Toriumi et al., 2013; Chatfield et al., 2014b).

There is evidence that social media thus lead to group emergence in various forms and functions. For example, the literature mentions members of the population establishing institutions of civilian life in war environments (Al-Ani et al., 2010; Mark et al., 2009; Semaan and Mark, 2012), forming civil self-defence groups in civil wars (Monroy-Hernández et al., 2013; Savage and Monroy-Hernández, 2015), coordinating protest movements (Chatfield et al., 2012; Ems, 2014; Morris, 2014; Smith et al., 2015), and establishing bottom-up relief activities (Dailey and Starbird, 2014; Leong et al., 2015; Majchrzak and More, 2011; Starbird and Palen, 2011). Although not all of these groups are virtual in the sense that they carry out their activities online (Reuter et al., 2012), they do include formerly unrelated citizens organising around perceived needs of disasters (Stallings and Quarantelli, 1985).

Finding 7: The features of social media platforms determine the structure and function of collective behaviour on these platforms in disasters.

Finally, there is evidence that features of the social media platforms affect the tasks that can be addressed by collective behaviour in disasters. According to Liu et al. (2012) and van Gorp et al. (2015), Twitter is highly useful for disaster relief professionals as it is easy to use and monitor, facilitates quick information dissemination, and can be updated from anywhere. Facebook, however, is seen as more static, but is still appreciated as it offers a broader audience base and enables longer messages. Our references reveal this pattern is robust. Twitter is the social media platform referred to most often in our sample of papers (36 times), followed by Facebook (21 times). Since there is little empirical evidence on other platforms, we restrict our argument to these two.

The literature documents that Twitter is often used to exchange disaster-related information by all types of social units in all disaster categories. In particular, this includes warnings (Acar and Muraki, 2011; Ahmed and Sargent, 2014; Chatfield and Brajawidagda, 2013; Chatfield et al., 2014a; Chatfield et al., 2014b; Ems, 2014), situational updates (Ahmed and Sargent, 2014; Chatfield et al., 2014b; Ems, 2014; Gaspar et al., 2014; Hughes et al., 2014; Jung, 2012; Lachlan et al., 2016; Sinnappan et al., 2010; Smith et al., 2015), and awareness information (Brengarth and Mujkic, 2016; Denef et al., 2013; Toriumi et al., 2013). There is evidence, however, that Twitter is also used for functions that require personal relations and two-way communication, such as for inquiring about another’s wellbeing (Acar and Muraki, 2011; Jung, 2012; Jung and Moro, 2014) and discussing events and their consequences (Gaspar et al., 2014; Jung, 2012; Kaufmann, 2015; Pang and Ng, 2016).

Facebook is clearly preferred for functions that require longer text messages and active communication. On this platform, the functions that prevail include relief coordination (Brengarth and Mujkic, 2016; Chen et al., 2014; Kaewkitipong et al., 2012; Kaewkitipong et al., 2016; White et al., 2014), keeping in touch with others (Jung, 2012; Kaufmann, 2015; Tagliaoczzo and Arcidiacono, 2015), discussing events and consequences (Al-Saggaf and Simmons, 2015; Jung, 2012; Kaufmann, 2015; Schwarz, 2012), and seeking and giving advice (Ahmed and Sinnapann, 2013; Chen et al., 2014; Kaewkitipong et al., 2012; Kaewkitipong et al., 2016; Savage and Monroy-Hernández, 2015).

Relating these patterns to the work of Kane et al. (2014), we recognise that social media characteristics help explain the structure and functions of interactions that take place on the particular platforms. Twitter, for instance, has enhanced possibilities to share short messages and publish direct and indirect updates. Users can “follow” other users of interest and receive automatic notifications of their messages (Huberman et al., 2009). Therefore, the platform facilitates access to digital content, establishing relational ties between users, and retracing these ties in a transparent way. It provides easy mechanisms for distributing and receiving short and precise messages to and from a wide target group. Still, discussion and private communication is possible due to the platform’s relational properties. On Facebook, users can also express preferences and publish status updates, but one of its outstanding features is that the platform allows users to connect with each other, which facilitates establishing and preserving relationships (Wilson et al., 2012). Facebook’s potential to share and access digital content is not as great as that of Twitter, yet users’ ability to create a unique digital profile and establish a list
of “friends” with whom they are related is noteworthy. Thus, on Facebook it is typical to communicate in depth with a more restricted target audience.

5 Discussion

The systematic literature review presented above addresses disaster-related collective behaviour that has been observed in social media. As Palen (2008) points out, social media are frequently used by a variety of actors facing disaster-related social disruptions, including relief organisations, victims, and volunteers. Yet current research on social phenomena in social media, such as digital volunteers (e.g., St. Denis et al., 2012), digital commemoration (e.g., Walter, 2015), and digital convergence (e.g., Hughes et al., 2008), rarely goes beyond the context of specific behaviours, which is symptomatic of the fragmented nature of disaster research (Tierney, 2007). We show, however, that collective behaviour in social media can be quite different from its offline counterparts and therefore should be regarded as a phenomenon in its own right.

Our contribution to the field is threefold. First, we draw from established theories to develop an analytical framework to guide our research. Second, we conduct an extensive, systematic literature review to identify core papers on the topic, which we analyse on the foundation of our framework. Third, we synthesise the results of our analysis and derive seven central findings that summarise the state of the art in the investigated line of research. In doing so, we demonstrate that existing social theory is suitable to explain findings on social phenomena in social media.

We present evidence that disaster characteristics do, in fact, influence collective behaviour in social media in response to the respective disasters. Although information-sharing activities are of primary relevance in all types of disaster, we conclude that the type of a disaster affects the secondary activities pursued in social media. Additionally, the literature indicates that social media relax resource restraints on collective behaviour, which includes restrictions regarding both the disaster impact phases and the social units affected by the disaster. Finally, our findings suggest that the social media platforms available to the social units shape the tasks they perform in disaster situations. Absent further evidence, we presume that the specific domains of collective behaviour in disaster, that is, the main functions performed by the social units, are untouched by social media. Therefore, we conclude that social media technologies influence the activities taken by social units in disasters as well as the resource constraints faced by and the tasks aimed at by these actors.

Our findings show that social media have the potential to diminish established relationships between collective behaviour and disaster characteristics. On the one hand, we see that traditional functions are detached from specified actors and disaster impact phases. Disaster-related activities can be performed by anyone and at any time in social media. On the other hand, structural patterns of interaction between social units tend to resolve in social media. There is evidence that social media platforms connect audiences that are affected directly by a disaster with others that are at most concerned indirectly. At the same time, it has become possible to disseminate messages to whomever might be interested, rather than having to address any particular audience.

Although there is considerable empirical evidence that social media affect collective behaviour in disasters, to the best of our knowledge the underlying causal mechanisms remain unexplored. For example, we can infer from the literature that established social structures are expanded to formerly excluded as well as to wider audiences in social media. Furthermore, social media enable users to connect to unspecified receivers. Yet we cannot be sure whether social relationships are indeed obsolete in social media, or whether we are rather facing disinterest on the part of researchers.

Similarly, we might ask whether the established assignments of functions to actors and phases are subject to change rather than dissolution. Consider, for instance, the relation between the secondary characteristics of disaster impact and the structure and function of social media usage. We might suppose that major disasters lead to a higher degree of social media usage because they affect a greater number of social units, or because they awaken the interest of a wider audience attracted due to the increased severity of impact. Likewise, major disasters might lead to a higher degree of damage in other communication channels, which may in turn cause an increased reliance on social media. Future
research should explore how impact characteristics relate causally to collective behaviour and whether traditional variables remain valid in the social media environment.

Additionally, existing work suggests a correlation between social media characteristics and collective behaviour observed in these platforms. Again, though, we lack insights into the underlying causal mechanisms. It is highly plausible that actors use particular social media platforms because they offer certain advantages that favour the actors’ purposes. At the same time, observed behaviour could be a consequence of those social media characteristics, that is, actors pursue certain paths of action because they are facilitated by the technology at hand. Further research is needed to investigate the causal mechanisms behind specific patterns of collective behaviour and social media characteristics.

As readers will have noticed, our review relies on a framework published in 1984. As disaster research is often conducted independently of theoretical developments, seminal work from this era remains highly relevant (Drabek and McEntire, 2003; Tierney, 2007). However, there is little research on the relevance of this work for digital social phenomena. Therefore, we encourage future research to investigate the transfer of existing social theory to, and develop new approaches for, the emerging digital context.

Our findings are limited further by the scope of the literature search. Relying on a representative sample of relevant texts, we systematically neglected evidence from low-ranked publication outlets, which also include expert fora. Although screening these papers did not reveal further insights, research aiming at in-depth analyses should definitely consider these sources. Additionally, our sample of text includes multiple evidence on major disasters, such as the Haiti earthquake in 2010, the Thailand floods of 2011, and the Tohoku earthquake in 2011. Less dramatic events are addressed sporadically, but are generally underrepresented. Thus, future research should consider systematic mapping studies in this field to assess the actual transferability of findings on social media usage in disasters.

6 Conclusion

Social media do not have direct impact on physical disasters, but they do shape how people respond to disasters. Considering the extensive influence on disaster response of widespread social media availability and use, our research addresses collective behavioural phenomena affected by disasters but also, to a considerable extent, framed by social media. We investigated the impact of social media on disaster-related collective behaviour by means of a systematic literature review covering 68 articles in leading IS and social science outlets. To structure our findings, we utilised an analytical framework based on Kreps’ (1984) remarks on collective behaviour. Our findings shed light on how key characteristics of disasters influence collective behaviour in social media. We propose that future research should evaluate the causal relationships between disaster characteristics and collective behaviour, and furthermore contribute to the theoretical foundations of social phenomena specifically in social media. In doing so, we contribute to a growing and promising line of research that investigates the interplay between social media and social phenomena in the context of disasters.
References


