Social Media for Earthquake Response: Unpacking its Limitations with Care

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When a 7.8 intensity earthquake caused widespread disaster in Ecuador on April 16, 2016, citizens across the country self-organized to gather, mobilize, and distribute supplies to affected populations, assuming the role of *ad hoc* humanitarian logisticians. Drawing on ethnographic findings, we present a situated perspective of how these citizens straddled the boundaries of online and offline activity for earthquake relief. In doing so, we offer an enriched understanding of how various social media channels might support informal, on-the-ground, crisis response, but also where they fall short in the process. Studying the emergence of care where social media fell short allows us to make recommendations for technology design to improve the effectiveness of logisticians in crisis response. By examining the bodily engagement of our participants at crisis sites, their efforts to deal with material convergence, and how they interacted with social media for technology-mediated care, we also contribute an understanding of the sociomateriality of care that emerges amidst efforts towards crisis relief.

CCS Concepts: • **Human-centered computing** → *Empirical studies in HCI*;

Additional Key Words and Phrases: Crisis Informatics; Earthquake; Social Media; Non-Use; Care; Post-Disaster Humanitarian Logistics

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1 INTRODUCTION

The rapidly growing research domain of Crisis Informatics (CI) has examined, in great depth, the adoption and use of social media by local citizens before, during, and after various crises [45, 46, 50, 59, 72]. Much of this research, however, depends heavily on what social media use renders visible. This dependence has been emphasized by Wulf et al. [74], Kow et al. [32], and Dailey et al. [7], calling attention to how the knowledge of events occurring outside of public digital records can offer a greatly enhanced view of the crisis at hand. At the same time, much research on the sociology of disaster has examined offline, emergent behavior of citizens as well [2, 11, 13, 37, 52]. We focus on the less understood meeting point of the two to offer a situated account of citizens straddling online-offline boundaries as they take on post-disaster humanitarian

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logistics (PD-HL) work in *ad hoc* fashion. In particular, we investigate how ordinary local citizens with no prior experience or training reconcile their online and offline activities to collaboratively meet highly uncertain and dynamically changing demands for mobilizing crisis relief.

In April 2016, a 7.8 intensity earthquake off the coast of Ecuador killed more than 650 people, displaced approximately 30,000 from their homes, and resulted in an overall cost of USD 3 billion in material damages [54]. This earthquake hit the regions of Manabi and Esmeraldas, exacerbating the living conditions of vulnerable populations in rural and urban parts of affected provinces. As is typical of post-disaster socially integrative responses [16, 65], citizens across the country emerged in self-organized groups to gather critical supplies and distribute them to vulnerable communities. Working independently of formal crisis response efforts, they devised mechanisms for bringing aid to victims in need, engaging with a variety of social media to bring order amidst chaos. In the instances where social media was not helpful, these citizens enacted care towards victims, other volunteers, and various material supplies in order to articulate effective crisis response. The details of how citizens chose and combined various communication media channels—including social media, the ways in which social media limitations shaped technology use for crisis relief efforts, and the emergence of care to work around these limitations form the crux of our research. We focus particularly on the efforts of post-disaster humanitarian logisticians, that is, local citizens who informally self-organized to gather, mobilize, and distribute supplies for crisis relief.

Our research offers a situated account of crisis response efforts organized informally by local citizens straddling the boundaries of online-offline activity. With this account, we highlight the limitations of public social media and their impact on crisis response. Additionally, we adopt care as an analytical lens to offer design recommendations for extending the capacity of social media to address this response. Finally, we contribute a deeper understanding of the sociomateriality of care that emerges in the crisis relief landscape as we examine the bodily engagement of citizens at crisis sites, their efforts to grapple with material convergence, and the ways in which they might interact with social media for provision of technology-mediated care.

2 RELATED WORK

Our research extends prior work on social media and crisis response, particularly citizen-led crisis relief efforts, and introduces the lens of care to these bodies of work.

2.1 Social Media & Crisis Response

Social media has progressively come to play a critical role in how citizens participate in times of crisis and disruption [8, 61]. The growing body of CI research has demonstrated that social media can support citizen participation to fulfill distinct individual and collective practices, such as seeking crisis-relevant information [44, 50], providing status updates [69, 70], disseminating information [30], coping with the crisis [50], and organizing relief efforts [64, 67]. Most of this prior research, however, has focused on understanding the role played by social media use, failing to examine the role of the *offline* context in shaping social media use and vice versa (with some exceptions [7, 8, 32, 73, 74]). Further, there is a prominent focus on information exchanges that take place in one or two social media platforms only (*e.g.,* Facebook and microblogging platforms such as Twitter) [55, 63, 69, 72]. For example, White and Palen [72] studied how online pet advocates used a Facebook page to self-organize and manage challenges to create a cooperative work environment. Along similar lines, Qu et al. [50], Starbird [63], and Sarcevic et al. [55] relied on digital traces on microblogging platforms to examine decentralized coordination efforts of regular citizens, digital volunteers, and on-the-ground personnel, respectively.

These studies have generated insights into the potentialities and constraints of social media use, but less is known about how social media helps or hinders offline relief work. Wulf et al.

assert the need for social computing to better understand social media use in relation to citizens' on-the-ground, offline work so we have a more complete picture of citizen-led initiatives [74]. Schmidt and Bansler also explain that overall behavior of computational artifacts, such as social media, is driven by the integration of aspects of the artifact and activities of the *practice* in which they are used [57]. In the *practice* of relief work, this would entail examining social media in relation to how relief workers manage contingencies and variations, coordinate distributed activities, devise plans, etc. [56].

White and Palen [73] and Dailey et al. [7] are among few CI studies that explore the connection between online and offline relief activity. White and Palen's research describes how social media casts a wide net to gather expertise and how the improvisation work carried out online culminates in offline work [73]. Dailey et al.'s on-the-ground work on community responders found that these citizens relied on face-to-face communication and the use of *"real simple"* technologies for meaningful information exchanges [7]. Drawing on the notion of multiplex approaches for understanding collaborative environments [21], we extend prior work by examining how citizens make use of a variety of communication media, including different social media channels, to fulfill their responsibilities as post-disaster humanitarian logisticians, paying special attention to how these channels are integrated in emergent relief work.

2.2 Citizen-Led Crisis Response

Citizen-led crisis response efforts are invariably characterized by convergent behavior, that is, "the informal, spontaneous movement of people, messages, and supplies towards the disaster area"[14, 16]. Amongst the people who converge are citizens who come together in pursuit of common, collective goals for crisis relief, described by Dynes and Quarantelli as extending and emergent organizations [13, 51]. These organizations rely on different working structures (extending groups have a prior structure while emergent ones must create one) but both lack formal crisis relief training. Therefore they follow a learn-by-doing model of coordinated problem solving [37, 42] to engage in a wide range of relief activities, including post-disaster humanitarian logistics (PD-HL). PD-HL, or the management of the flow of supplies and equipment sent to crisis sites by donors of all kinds—also known as *material convergence* [16] is a complex and arduous endeavor. It involves managing large quantities of donated items, some inappropriate or useless, and navigating high levels of uncertainty regarding the flow of materials and the availability of space and resources [23]. It also requires decision-making on how best to distribute supplies to those in need [24].

Research on the sociology of collective behavior and humanitarian logistics has studied these groups' motivation to act [35], organization [52, 62], management of social networks [10, 12, 25], and challenges encountered [24, 37, 71]. However, there is a dearth of computational solutions specifically designed for supporting these organizations' emergent PD-HL work. The few that have been proposed are either rarely used (*e.g.,* the National Donations Management Network Program [1, 23]) or have been designed based on the experiences of emergency service personnel rather than citizens' direct accounts [36, 49, 53].

This paper contributes to the design of crisis management technologies for extending and emergent organizations focusing primarily on PD-HL. Based on our study of how these groups navigate the potentialities and constraints of social media for their work, we derive a set of design implications for social computing platforms that can be useful for citizens' PD-HL *practice* [57]. We refer to our participants as *ad hoc* post-disaster humanitarian logisticians to clearly signal both their untrained backgrounds and lack of expertise as well as their focused engagement with the demands of material convergence.

2.3 Sociomateriality of Care

Care for self, family, and community is a key motivator for the emergent, repairing behavior of self-organized citizens [11, 35]. Moreover, practices of care take place across different domains of social life, cutting across boundaries [5]. We use care as a lens to unpack the practice of PD-HL citizens engaging across online and offline social domains. Our understanding of care builds on existing theories of care ethics [15, 31, 68] as well as work in Science and Technology Studies (STS) [41, 48]. For Bellacasa, care is often motivated by the perception that things around us are being neglected [48]. Authors such as Korth and Mol highlight that care goes beyond dyadic human interactions [31, 40]; it is instead a collective engagement, *"a matter of various hands working together"*[40]. Fisher, Tronto, and Mol et al. also signal that care always entails repairing actions leading to a result, or interventions we engage in *to make our world as livable as possible* [15, 41, 68]. Finally, we draw on Heuts and Mol's as well as Dalmiya's perspective of care as an *ongoing*, dynamic process of cognition and reflection, in which an action goes back and forth, involving *change and adaptation* [9, 22]. Thus, we define care as ongoing interactions among the different actors of the crisis landscape (*ad hoc* logisticians, victims, and non-affected citizens), social media, supplies, and the sites themselves, that take place when the crisis landscape is perceived as being neglected or becoming more vulnerable, aiming to improve the conditions of said landscape.

Previous work in CSCW-related fields has highlighted that care can be directed towards both living and non-living entities and be framed by different kinds of material interactions in the world. Mol et al.'s work on diabetes management illustrates that care can entail collaborative efforts between a group of caretakers and a person (*e.g.,* a patient) and be shaped by materials such as wheelchairs, ventilators, and oxygen tanks. These materials mediate and shape caretakers' and care-receivers' actions such as helping a patient move or checking the level of oxygen in the tank [41]. By contrast, Toombs et al.'s work on makerspaces showcased care as a driver to maintain the work of an entire community, not necessarily just one person [66]. Their work describes how physical organization of a space, such as the way tools were available to all members, can systematize care. Houston and Jackson's work on the repair of mobile devices highlights that care can be directed towards things [26] and mediated by digital and physical materials such as software repair tools and soldering irons. Finally, Jack and Jackson's research demonstrates how information systems can mediate care towards a global humanitarian logistics network [27]. Our research extends this body of work, highlighting the sociomaterial aspects of care as it engages with various overlapping themes of person-to-community care as well as materially- and technology-mediated care that are deeply intertwined in the crisis landscape. The lens of care allows us to see how breakdowns in social media impact the work of *ad hoc* logisticians, the engaged actions they take in response to those breakdowns, and the role of social media in shaping these acts of repair.

3 METHODOLOGY

We conducted ethnographic research 1.5 months after the earthquake. All data was collected by Marisol and Cristina, who are both Ecuadorian. At the time of the earthquake, Marisol was located in Guayaquil, 225 miles from the epicenter.

3.1 Participants

We recruited participants who were engaged in relief work as members of emergent, extending (*e.g.,* church, NGOs), and established (*e.g.,* local governments) crisis response initiatives [14]. Our goal was to obtain diverse perspectives regarding the challenges citizens faced in managing the flow of supplies. We recruited 23 participants from 17 different relief initiatives, including 13 citizen-led ones. They fell into the typology of organized response proposed by Dynes and Quarantelli [14]

as follows: 14 participants belonged to (10) emergent initiatives and had no prior experience with crisis relief, 4 participants were associated with (3) extending initiatives and also had no prior experience with relief work, and 5 participants came from (4) established initiatives that were formal operations.

We recruited 10 women and 13 men, all professionals with access to their own transportation, critical social capital, and a mobile internet connection. Their ages ranged from 22 to 62 with an average age of 43. They resided in major urban locations such as Guayaquil (16) and Manta (7). All participants undertook PD-HL after the earthquake hit.

We initially recruited participants using snowball sampling [19], starting with small groups of citizens in Guayaquil who were conducting relief work in affected provinces. Rather than stemming from our observation of online activity, this initial snowball sample emerged from our knowledge of people who had been in touch with emergent and extending groups of relief workers. As our research progressed, we identified citizens whose involvement in PD-HL was prominent on social media such as Twitter, Facebook and WhatsApp, or had been recognized by the Ecuadorian news media. We also contacted members of organizations that traditionally participate in crisis response (*e.g.,* religious and/or humanitarian organizations, and local governments). We were not members of any of the groups we interviewed.

All participants were involved in the logistics of mobilizing supplies and equipment to the affected zone but the nature of these activities was varied. Out of 17 initiatives, 5 focused exclusively on managing the flow of donations, 10 managed donations and a mix of other activities that also required logistics management (*e.g.,* bringing emotional aid, providing medical services, and building shelters), and 2 managed logistics of non-donation related activities (*e.g.,* building new homes). While 15 initiatives required participants to travel to affected locations, 2 operated remotely from Guayaquil.

3.2 Data Collection and Analysis

We collected data using a combination of qualitative methods for appropriate triangulation of data. Right after the earthquake, we observed online activities of citizens and formal emergency responders for a preliminary understanding of the responsibilities citizens were taking on and challenges they were facing. A month and a half after the earthquake, we conducted semi-structured interviews with aforementioned participants. We also traveled to Manta—Manabi's capital city and among the worst-affected locations—to validate our findings and better understand our participants' contexts.

Immediately after the quake, Marisol and Cristina engaged with the social networks of WhatsApp, Facebook, and Twitter to identify emerging mechanisms for donating supplies and financial resources to affected areas. We observed and annotated the types of information being exchanged on their social networks that had connections with the earthquake. We collected archives of WhatsApp, Facebook, and Twitter data as well as online news and articles to understand the flows of information (and challenges therein) involved in citizen-driven humanitarian logistics. The data collected in this phase informed our recruitment process and was later triangulated with observations in the field and interview data.

Between May and September 2016, we carried out in-depth semi-structured interviews using an interview protocol that focused on *(1)* the technology practices of participants before and after the earthquake, *(2)* the logistical information they managed or lacked after the earthquake, *(3)* the challenges they faced in conducting their humanitarian logistics work, and *(4)* the information-based strategies they used to solve those problems. Marisol conducted all interviews (in Spanish). Interviews lasted from 1.5 to 2.5 hours. Twenty interviews were conducted in person and three

over the phone. Four participants were interviewed more than once due to their time constraints. We audio-recorded and transcribed every interview in Spanish, translating to English for analysis.

At the end of May 2016, a month and a half after the earthquake, the first author conducted a three-day field visit to Manta, one of the worst-affected cities, to conduct interviews with participants from that location, and observe the on-the-ground work they were still conducting. In addition to interviews, she took detailed field notes and photographs during this visit so as to inform our collective understanding of the context in which the humanitarian logistics work took place.

We undertook an inductive, interpretive process to analyze all our data [39]. Open coding was the first step in our analysis, wherein we assigned short phrases to serve as codes to summarize relevant content we read in the interview transcripts. We proceeded to code line-by-line to better assign codes that reflected the meaning of the data. Examples of the first round of coding included *"avoiding the use of public social media"*, *"making sure only those in need will get help"*, and *"using familiar technological platforms"*. We then analyzed these codes to extract themes that could aid in conceptual understanding, resulting in the identification of second-level categories, *"social media use: types of preferred channels of communication"*, *"social media use: limitations and impact"*, and *"overcoming limitations: actions of care"*. The research team met regularly to analyze the data in iterative fashion, going back and forth between categories to reveal patterns and subject data to further scrutiny. This analytic process led us to focus on the larger themes of the limitations of social media in supporting citizen-led humanitarian logistics and the emergence of care in the work of logisticians that allowed them to suitably respond to constraints imposed by social media.

4 FINDINGS

We provide in-depth accounts of the online and offline activities our participants engaged in to navigate their responsibilities as *ad hoc* humanitarian logisticians. We report on the following novel findings regarding their social media interactions amidst this navigation: *(1)* the criteria used to select and combine different social media channels, including a preference for private channels of communication, as well as the reasons underlying these criteria, *(2)* the effect that social media limitations had on citizens' perceptions of the crisis landscape and use of these technologies, and *(3)* the emergence of care towards addressing the afore-mentioned limitations.

4.1 Social Media: Public vs. Private

Our multiplex approach of examining how multiple media mobilize a collaborative environment [21] revealed that our participants' PD-HL efforts involved an ecology of tools such as social media channels (Facebook, Indiegogo, WhatsApp, etc.) as well as traditional communication channels such as email and phone calls (SMS was expensive). These channels were used for requesting supplies, self-organizing, and coordinating logistics with those beyond their own initiatives. This use is consistent with prior work on citizen participation during crises and political movements [8, 32, 47]. We extend previous findings by highlighting the factors that shape citizens' selection of social media channels and the details of the exchange of information across these different channels.

Initiatives that appeared to rely on Facebook (4 of 17, all emerging) did so to have access to members of their social networks they were not regularly in touch with. Victor[1], a citizen who emerged as an *ad hoc* logistician traveling back and forth to several locations in Manabi, explained:

> *"Facebook helped me reach friends I had not seen in years. I did not use WhatsApp because I did not have the phone number of many of them. After seeing my post requesting for donations, they contacted me on Messenger. From there, we would exchange phone numbers*

[1] All names have been anonymized.

and either engage in phone calls or in Messenger-based conversations."
(Victor, Guayaquil, Male, 52 y/o)

Although Twitter and Facebook are the main applications investigated in CI [3, 55, 59, 63, 69, 72], our study did not find them to be as popular. Most participants preferred channels that would afford them privacy while tapping into their close networks, a finding similar to Dailey et al.'s [7]. Accounts such as Victor's, however, help extend their work by showing how logisticians transferred logistics-related information from public channels such as Facebook/Twitter to private ones such as email, WhatsApp, Messenger, or phone calls. In addition, our findings uncover the type of information *ad hoc* logisticians would rather manage via private channels, such as defining when and where to receive donations, agreeing on when and where to travel, agreeing on stops and routes to take through the trip, and asking other members of the team (who were also on the ground) for specific supplies. Fatima, the leader of a non-profit that joined an emerging relief initiative, explained the flow of information from public to private channels:

"We used the NGO social media channels—Facebook, Instagram—to reach out to more people for requesting donations. Often times, however, people who wanted to donate called us to let us know they had donations but they could not go to the place we had set up for collecting goods. When that happened, we had to use WhatsApp and phone calls quickly, get appropriate transportation to go over to donors' houses, and pick up the donations ourselves." (Fatima, Guayaquil, Female, 23 y/o)

A key finding we derived from our participants' use of social media was that there were two main criteria that influenced how citizens selected tools for their logistical undertakings: a non-existent learning curve and easy access to the social networks they needed to achieve their goals. Tamara, for example, worked with the church to request supplies and said she did not use any social media for the work. However, her decision to use WhatsApp for coordinating logistics came from her familiarity with the tool; all her contacts used it and she used it to manage more than 10 work-related groups. All 96 members of a neighborhood-based initiative used the neighborhood WhatsApp group to self-organize, with each neighbor branching out to different social media (*e.g.,* Facebook, WhatsApp, Snapchat, Instagram) to actively request supplies from their different social networks. Another key factor that determined the selection of tools for citizen-led logistics was the potential alignment with personal values, in that posting on public channels was seen as discomfiting by some. As Valeria, a member of an emergent initiative, mentioned:

"We never posted our work on public social media. Instead, we reached out directly to those closest to us who were willing to collaborate. We felt posting on Facebook would banalize both our help and the needs of the people we were helping."
(Valeria, Manta, Female, 40 y/o)

As shown by our participants' accounts, there was no significant difference between how extending and emerging groups chose tools for supporting their efforts. Rather, we found that the choice of tools depended more on a mix of the values driving the initiative (*e.g.,* if it wished to be private vs. public), needs of the initiative at the time (*e.g.,* if it wanted to broadcast to broader audiences a request for donations vs. coordinating with specific actors in private), and which social media provided quicker access to participants' social capital.

4.2 The Limitations of Social Media

Public media such as Facebook and Twitter afford an overflow of content (relevant and irrelevant) that can exacerbate material and people convergence towards sites of crisis, affecting coordination of relief efforts [18, 33]. Also, the large amounts of content generated cause human recipients excessive cognitive load, in turn affecting the efficiency of relief efforts [18, 49]. This deluge of

content can drive citizens responding on site to restrict their communication channels and contacts, for example, by turning off cellphones [7].

Our findings shed light on the aspects where social media platforms fall short in supporting *ad hoc* PD-HL initiatives. Moreover, they uncover how existing gaps in social media support shape participants' articulation work. Limitations of social media that emerged from our data included the management of flow of people/materials to crisis sites, the management of relief-related notifications on private channels, the communication between participants and victims from underserved communities, support of on-the-ground work, and trust-building with potential donors. We present these in detail now.

4.2.1 Challenges in Controlling Convergence. Social media are especially apt for supporting fast spread of information [17, 60] and opening up opportunities for help that citizens can explore. Our data unearthed, however, that information shared on social media quickly lost touch with needs on the ground, highly contributing to the excessive convergence of people and material to the crisis site. The speed of how Facebook posts that asked for help in the town of Jaramijo spread, helped Jaime, a citizen who created an emergent initiative, find out about that location. Jorge, a member of an extending group, shared with us how the same velocity contributed to exacerbating convergence:

> *"When Karina [leader of a non-profit] found out that what we had felt was an earthquake, she tweeted to let people know she was going to leave that same night with one truck carrying humanitarian aid for the affected provinces. She added 'those who can, please join me'. That tweet ended up flooding Karina's neighborhood (with people and supplies), and it was then that we realized a simple tweet was powerful enough to push an entire country to empty entire supermarkets so as to get items as donation. Our goal was to leave with one truck, but we ended up leaving with 2 convoys, one with 8 trucks and the other with 5." (Jorge, Guayaquil, Male, 27 y/o)*

Although participants initially perceived people's eagerness to donate and travel as a positive reaction, they soon realized the implications of such convergence. Most participants recalled how the excess of volunteers and donations triggered the emergence of *sapos* (or freeloaders) who were constantly trying to grab supplies to sell them to the victims. For real victims, getting to the places where volunteers were distributing donations was challenging because they could not leave their belongings unattended. Further, the quantity of donations was so great and the types of items received so varied that matching them with victims' needs was a great challenge.

> *"At the beginning, the level of support was so strong that in some places there was an overflow of supplies. For example, you would find a large number of mattresses arriving to places that had served as shelters, but where there were no more people left. Or you would see mattresses arriving to places where a thousand mattresses had arrived days ago. Or you would see a warehouse full of mattresses where there was a desperate need to find a place to store water bottles."*
> *(Camila, Guayaquil, Female, 34 y/o)*

The desire to avoid this kind of convergence influenced our participants' use of public social media. For example, Valeria and Jaime, both members of emergent initiatives, used WhatsApp instead to reach out to a selected group of friends and family members who could help with a specific list of items they knew a group of victims needed. Other participants realized they could not use Twitter for requesting supplies:

> *"We got a truckful of IV, but we did not have the equipment to administer it with. We could not use Twitter to ask for the missing equipment because, if we did, suddenly all the*

drugstores in Guayaquil would run out of those supplies."
(Camila, Guayaquil, Female, 34 y/o)

Understanding the impact of excessive convergence also shaped our participants' notions of where they could contribute amidst the crisis relief landscape. In some cases, the limitations of social media we discussed above indicated to participants that there were other areas they could focus their efforts on. For Eduardo, for example, watching the deluge of donations mobilized to affected areas helped him and his friends decide to take their relief efforts in a different direction:

"…we talked about it in our group and reached the conclusion that […] we wanted to do something different that […] to have a stronger impact. We thought …everybody needs water …let's work on a sustainable water solution for those most in need." (Eduardo, Guayaquil, Male, 42 y/o)

Thus, social media use contributed to exacerbating the excessive convergence and shaped participants' efforts in multiple ways, by adding complexity to their work but also by signaling (by *not* signaling) emerging areas of need, as in Eduardo's case.

4.2.2 Challenges in Managing Personal Social Media Use. Private social media such as WhatsApp and Facebook Messenger also imposed limitations, particularly with the management of excessive flow of messages and notifications [34]. Our findings shed light on the online information management practices participants established to navigate such deluge. The problems they faced with the overflow of information included not remembering to reply to important messages, getting confused about which messages they had replied to, and quickly losing context of group conversations. The flow of messages also felt disruptive—messages kept arriving, often times from strangers. This also raised safety concerns. Camila, a member of an emergent initiative from Guayaquil, recalled:

"I still have goosebumps when I remember that WhatsApp messages never stopped arriving. I still remember having conversations at 1AM with people I had never met before who kept asking me to help them get water 'cos they knew the next day they wouldn't have any to drink." (Camila, Guayaquil, Female, 34 y/o)

To navigate these constraints, participants such as Victoria and her friends tried to avoid information overload by using pointed online messages to discuss relief-related topics or by moving to new, smaller groups of people who collaborated closely. Miranda explained how her emergent initiative did the latter:

"With 92 people in a WhatsApp group, you lose your mind! So we created another one, only for managing logistics. We named it 'Organizandonos' (Let's Organize). There were only 10 of us in the group and it helped us work very efficiently […] The larger group generated too much noise, and it really wasn't letting us get things done."
(Miranda, Guayaquil, Female, 41 y/o)

Other participants decided to mute all their groups and turn off their cellphones at night so they could sleep. In addition, to minimize safety concerns, some participants such as Victor and Valeria, avoided sharing personal information on public social media. Valeria explained other ways she used to tackle safety concerns:

"Every time somebody I did not know called me or sent me a WhatsApp message, I asked who had given them my number. For example, a girl who contacted me told me she was friends with a cousin of mine, so I contacted my cousin and double-checked with him, just to be safe." (Valeria, Manta, Female, 40 y/o)

Not only was it challenging to exercise control over convergence, it was also hard for participants to control the impact that social media use for crisis relief had on them personally.

4.2.3 Challenges in Reaching Underserved Communities. In contrast to findings that show how community members enact relief work through Facebook interactions, our research unearthed that access to social media cannot be taken for granted. Participants' interviews highlighted that citizens bringing help to underserved sections of affected communities did not use social media to communicate with victims. Given victims' lack of resources to begin with and high costs of data plans, logisticians preferred to communicate with victims via phone calls, initiating the communication themselves. Tamara explained:

> *"They usually have 'little' [basic] cellphones, and not all of them have cellphones. I'd say …one member per family has a cellphone. Sometimes they call me, or we exchange texts, but I really don't like them to do that because I don't want them to spend money. They really have so little…" (Tamara, Guayaquil, Female, 62 y/o)*

Although victims from underserved communities had more limited access to social media than our participants, we found that there were some cases in which they managed to have limited access to the internet and WhatsApp:

> *"We used cellphones to communicate with victims, but they do not have megas (data). When they do, it's because they buy $1 of internet connection and then they write to me, but they do that only when there is an emergency." (Mario, Guayaquil, Male, 41 y/o)*

> *"Her (one of the victims') Dad has WhatsApp. Also a boy over there [in Pedernales], who helps me a lot with everything, has WhatsApp. He sends me pictures of how things are there, letting me know how everyone is doing." (Tamara, Guayaquil, Female, 62 y/o)*

During crises such as earthquakes, underserved communities are worst-affected and infrastructural challenges exaggerated, as we saw in rural parts of Manabi. Mario's and Tamara's examples suggest there may be opportunities for expanding online participation of victims from these communities.

4.2.4 Taking Away from On-the-Ground Work. Even after communication and power infrastructures were restored to order, our participants made little use of social media on the ground; the use of both private and public media was higher when participants were remote. We found safety and proximity were the main reasons why social media was not considered an effective support for on-the-ground work. This extends work that suggests citizens engaged in relief work do not use social media while on the ground because they are busy doing things [7]. Ana explained that, beyond being busy with physical tasks, concern for personal safety also made her avoid using her cellphone on the crisis site:

> *"After the electricity came back it was still hard for me to use the cellphone because, although there were places I could plug it in to charge it, I could not sit there while it was charging. I had a lot of things to do; there was no time to waste. I definitely couldn't leave my cellphone by itself while it was charging because somebody could easily steal it. I had already heard of a lot of cases where that had happened. So I kept it with me all the time, but I could barely use it." (Ana, Guayaquil, Female, 38 y/o)*

Eduardo explained that, on the ground, relief work seldom required cellphone communication. He felt that most issues could be resolved by directly talking to the locals:

> *"During our visits to Manta, we were able to talk to a lot of people from local and national governments. We got to them just by directly asking locals if they had seen people from the government around. One person led us to another. We went to the places locals recommended us to go and then waited until the people we were looking for arrived." (Eduardo, Guayaquil, Male, 42 y/o)*

Not only did engaging in social media eat away time from engaging with on-the-ground efforts, it also meant that participants felt less safe and/or more burdened. This was only partially because this engagement depended squarely on mobile communication and power infrastructures.

4.2.5 Trust-Building for Gathering Supplies. As in prior research, many participants reported tapping into their private networks for gathering donations [10, 52]. While they often used social media for that purpose, when in need of highly specialized items (*e.g.,* a loan of trucks/airplanes) or large quantities of supplies, as well as money, they often resorted to ways of interacting with donors that would elicit higher levels of trust than social media, such as face-to-face communication:

> *"There were many times where I had to deal personally with potential donors to ask them for help. Not for the majority of donations, but definitely for important donations. For example, I used WhatsApp to set up an appointment with a friend who could lend us trucks, but I only asked for help when we met." (Jaime, Guayaquil, Male, 42 y/o)*

Likewise, Eduardo explained that he used face-to-face and cellphone communication with his business partners (strong social ties [20]) to access potential funding sources:

> *"We started a crowdfunding campaign right from the start. We used Indiegogo and decided to manage the campaign through Facebook and Twitter. However, asking for money online needs time because you need to build trust. We needed the money right away so, in the meantime, we accessed our own contacts, people who already trusted us, to directly ask them for money. That money was super useful to buy tanks of water and start our work right away. " (Eduardo, Guayaquil, Male, 42 y/o)*

4.3 Enacting Care to Articulate Crisis Relief

Our findings strongly indicate that participants enacted care as a response to the material convergence that was exacerbated on account of social media. Care, in this case, highlights the resourceful and ingenious actions of *ad hoc* logisticians for gathering relevant information and optimizing PD-HL work. It also reveals how our participants reconciled online-offline activities for their practice and the values that shaped their actions. This allows us to identify aspects to consider for supporting information management for PD-HL.

4.3.1 Efforts to Identify those in Real Need. On realizing that many donations were not reaching those most in need, participants perceived a neglect of the relief environment that could hurt victims as well as donors and volunteers. As Tronto explains, this realization entails the first phase of care enactment [68]. They then enacted care in different ways. One way was by engaging in a search for those most marginalized, for which remotely located participants resorted to a mix of online and offline activities. For example, Jaime learned about Jaramijo through Facebook but, once he got there, Facebook was no longer helpful. He then sought the help of a local policeman who took him to the most needy communities in town. In Tamara's case, social media did not even feature in her efforts to reach those in need.

> *"While in Pedernales, we sought the priest and he gave us the list of victims (70 families) we are helping now. Then we looked for another priest and asked him to take us to the place he felt needed more help than others. He took us to Punta de Mico y Nuevo Pedernales. When we got there, we realized that, of all the places we had visited before, those were indeed the locations that needed us the most." (Tamara, Guayaquil, Female, 62 y/o)*

Once participants (especially those who traveled frequently to affected locations) found a place to help, they enacted care by developing a relationship with members of affected communities. These members became key informants for relief work; they kept the logisticians constantly informed and updated about the community's evolving needs. Staying informed allowed these logisticians to

plan and strategize appropriately. They used social media for requesting donations and calculating precisely how many donations needed dispatch weekly.

> *"We now have a relationship with them… they call us by phone and let us know what they need. 'Don't bring us food, we need mattresses, etc.' We then use WhatsApp to send a specific list of needs to our possible donors and to ask them to help us with anything on that list." (Valeria, Manta, Female, 40 y/o)*

Further, these informants allowed logisticians to distinguish real victims from *sapos*. Access to informants thus became instrumental for distributing help more effectively.

> *"To avoid the 'sapada' (cunning, in Ecuadorian slang), whenever somebody else called me telling me they needed help for a specific area, I called my informants back and they were always able to tell me, 'No ma'am, those people who called you are not from here, their house is fine, etc.'" (Liliana, Manta, Female, 62 y/o)*

In the cases above, we note that when public and private social media fell short—whether in targeting worst-hit populations, offering accurate and updated information about them, and/or ensuring that help reached the right people, it was our participants' efforts to remain engaged with people and locations within the crisis landscape that fostered enactment of care. Through care, they obtained meaningful information for repairing what they saw as broken. Tronto asserts that physical presence and action are central to care. In the case of *ad hoc* logisticians, our findings revealed closeness (both social and physical) as an important driver for efficient distribution of supplies that social media could not support effectively.

4.3.2 Adapting Relief Initiatives To Victims' Real Contexts. Although community-based informants were undoubtedly an important information resource for our logisticians, they could not always convey detailed information about the real contexts of victims. For example, informants told Valeria that members of the community were in dire need of mattresses. After securing a donation of mattresses, Valeria visited the community to distribute them, only to find that mattresses were not enough; victims also needed pillows, blankets, and more importantly, a surface to place the mattresses on. Our interviews indicated that participants engaged in care as a dynamic practice that involved change and adaptation [22]. They sought to collect missing information by interacting closely with victims, visiting them at their shelters, sharing meals with them, observing how they were living, and conversing with them to know their state of mind. Such close, back and forth interactions were key to shaping participants' relief efforts.

Mario, as mentioned earlier, was unable to reach affected communities due to their inability to afford social media access. So he traveled twice a week to take donations to different communities in Manabi. In each visit, he would learn something new about the community's needs that would trigger ideas for making his help more effective. In other words, he engaged in care through attentiveness and, as Dalmiya explains about processes of care, through an ongoing process of cognition and reflection that enabled him to consider what others were experiencing [9]. Mario noticed people needed to forget about their tragedy for a while, so he periodically used Facebook to request donations for organizing *palo encebado* and *matinee* (parties for victims and their children). Further, after realizing the struggles of victims with disabilities, he started a new relief initiative to address this population's needs:

> *"In one of my trips, I met an elderly couple who survived the falling of their house thanks to the woman's wheelchair. After I came back from my trip, I used Facebook to ask for a wheelchair. I got 20 wheelchairs and, one by one, I delivered them to victims. I first visited towns, identified people who needed wheelchairs, then traveled back to deliver them. I did that until there were no wheelchairs left." (Mario, Guayaquil, Male, 41 y/o)*

Our participants' interest in understanding the context around them rather than in consequences (*consequentialist ethics*) or rules (*deontological ethics*) confirm that our participants' actionable decisions were driven by an ethics of care [15, 68]. Initiatives such as Mario's show that participants valued collecting and sharing meaningful information that went beyond the questions of who, when, and where to distribute donations. While public and private media were useful to reach out to possible donors, these tools were not able to offer information as the *"things of value"* that can fuel an ethics of care for effectively managing material convergence [40]. Our findings uncover, thus, that detailed information about victims' contexts is as (or more) important for effective response efforts than precise information regarding the number of donated items needed in a specific location. As Eduardo's account suggests, having meaningful information can also highlight the need for developing long-term solutions towards building back better.

> *"During our trip across Manabi, we realized that relief efforts were negatively impacting many families. In Manta, there were barrios (neighborhoods) that were not as affected by the earthquake as others. However, they were facing water scarcity even before the earthquake. They only got water three times a week from water trucks. After the earthquake, these families ended up not getting any water; all the water trucks were taking water to other regions of the province. We realized that lack of water was not a problem created by the earthquake but aggravated by it. Now we want to create an NGO to come up with initiatives to deal with water scarcity all across the country."*
> *(Eduardo, Guayaquil, Male, 42 y/o)*

4.3.3 Making the Most of Available Supplies. As mentioned, social media played an important role in driving people to donate, particularly right after the crisis. This exacerbated material convergence. Participants' accounts revealed that they navigated through the excess movement of supplies by trying to make the most of donated items, even ones that did not seem useful at the moment. For most, their personal and cultural values led them to perceive the waste of donations as neglect towards the relief environment. However, given the limited resources, keeping too many supplies was not an option either. As a result, they enacted care through creative online and offline strategies that closed the gap between convergence of materials and victims' actual needs, making the relief environment more livable [15, 68]. All participants reported receiving items that did not seem usable. Valeria received equipment for administering IV that only trained health personnel could use. Mario received a donation of 6,000 bottles of water and did not have enough space in his car to take them to the victims. Participants, regardless of the extending or emerging nature of their initiatives, resorted to private social media to connect with their strong ties [20] and explore how they could make the most of donations they received. Liliana explained how the yards of fabric she received (and did not know what to do with) were repurposed:

> *"I got a call from the city hall of Portoviejo asking for help. They had a lot of dead bodies and had no idea what to do with them. I remembered I had yards of fabric and offered those to them so they could cover the bodies. That fabric turned out to be one of the things that was most needed at the time." (Liliana, Manta, Female, 62 y/o)*

Another mechanism participants reported using to maximize usefulness of donations was exchanging resources with other initiatives. They managed to access information on what others had by tapping into their private WhatsApp groups:

> *"We exchanged supplies with other centers in the area. For example, they needed water, we needed cereal, so we traded items with them. We stayed in touch through WhatsApp, so we always knew what they needed." (Miranda, Guayaquil, Female, 41 y/o)*

Participants' accounts revealed how their care for maximizing benefits from donations as an affect-driven force drove them to a "material remaking of the world" [48] to transform seemingly non-useful supplies into productive ones:

> *"Used clothes... we managed them by getting 10 of our people to classify them and take out all the pieces that were impossible to give (because of how bad they were). We only kept what we felt we could give the victims, the rest ... we tore to create rags. That process took us about one week." (Liliana, Manta, Female, 62 y/o)*

> *"We got containers packed with clothes, coming from outside the country. We did not know what to do with so many clothes, we did not want them here anymore. So we came up with the idea of a flea market, and gave the money we got to two foundations working in the area." (Miranda, Guayaquil, Female, 41 y/o)*

A convergence-related problem that our participants faced due to their lack of formal training was learning the most optimal way to package supply kits. As Miranda explained, care for material supplies as well as human victims enabled participants to gradually devise effective packing strategies. Care, in the words of Heuts and Mol, evolved over time as did the skill associated with it [22]. However, most participants agreed that this work could have been easier if they had had information about conducting logistics beforehand.

> *"At the beginning, we did a really poor job packaging food kits. We included almost an entire bag of sugar in each. Later on, we realized that, in order to reach more people, we needed to come up with a more effective distribution. Little by little we learned to adapt our distribution so that we could help as many people as possible."*
> *(Miranda, Guayaquil, Female, 41 y/o)*

Our participants' accounts highlight, once again, the relevance of private social media tools for managing material convergence through interactions with existing social networks. They also reveal the high value Ecuadorian *ad hoc* logisticians give to avoiding wastage of supplies. More importantly, our findings allow us to identify three aspects to consider for supporting the work of these logisticians: *(1)* their preference for exchanging items with those they trust and know, *(2)* their limited perception of those in their social network who could help, and *(3)* their need for relevant information to speed up their learning process about supply distribution.

4.3.4 Using Technology Outside of Social Media. Our interviews uncovered that experiencing convergence led *ad hoc* logisticians to care deeply about improving how information was harnessed by organizations within the relief landscape. This is consistent with Tronto's description of care entailing reaching out beyond the self [68]. For example, Viviana and Camila from Guayaquil quickly realized that manually matching the needs and offers of supplies they learned about was not optimal for the relief environment. As a result, they devoted time to creating better tech support:

> *"We realized that there were too many initiatives going on and there was no information about existing initiatives ... some friends led us to a group of mobile app developers that had an app for inventory-keeping in banana farms. They offered to tailor their app so we could know what collection centers had and needed all the time. The goal was to reflect needs more accurately, so if a center received IV, everyone would know that the center did not need IV anymore." (Camila, Guayaquil, Female, 34 y/o)*

Viviana, Valeria, and Camila all mentioned simple websites that Ecuadorians (with technical know-how) had created to help with managing the deluge of relief-related information. Many of these initiatives were based on Twitter feeds with hashtags proposed by groups of citizens. Despite the noble intent underlying these initiatives, our data indicated that none of them had lasting impact on citizen-led efforts. Most participants did not know of these initiatives and the three who

did know admitted to not using them due to lack of time. The emergence of these online efforts, however, highlights two aspects of the limitations of social media in supporting citizen-led relief efforts: first, that social media is unable to provide the information organization logisticians need for their efforts, and second, that there is a large disconnect between digital communities such as crisis-mappers' and citizens trying to help, online or offline.

5 DISCUSSION

We now discuss the main takeaways of our research. Before focusing on the materialities of care and making design recommendations for social computing platforms that support citizen-led relief work, we note *(1)* how the particularities of place shape information needs during crisis relief, *(2)* the temporal complications that result from social media-supported crisis response, and *(3)* the impact of distance (from technology, people, and location) on the ecology of social media tools that support the work of *ad hoc* logisticians.

5.1 The Particularities of Place

In contrast to the general emphasis of CI on social media activity observed at a distance, our research stresses the importance of situatedness. We highlight that examining the "invisible work" of citizens who engage directly in relief efforts allows us to appreciate the particularities of the place—the social, historical, cultural, political, and geographic factors, among others—that shape information needs during crisis relief.

The nature of destruction caused by a crisis impacts the adoption of and participation on social media. If we compare the case of Ecuador to that of Haiti, for example, research notes that (in Haiti) local citizens were so affected that they could do little to help each other. The response, thus, was mostly international and there was a need to use public social media to beacon requests for help [55]. In Ecuador, on the other hand, local actors were involved in shaping crisis response, including citizens from the private sector and both within and outside affected regions. These actors already had social resources in place that enabled them to help without necessarily resorting to public social media channels. Social media use for crisis response is shaped thus by the extent to which relief workers are local to the region or outsiders.

Geographic terrain of crisis-affected regions also impacts adoption of social media for information-seeking. As mentioned, the earthquake in Ecuador impacted rural areas across two provinces, many of which were already quite poor. Many victims were located in *caserios* (shanty towns) up in the mountains that were not accessible via roads and not located on official maps. One of our participants reported leaving supplies in places that were only accessible via donkey paths. Information regarding the locations of these victims and ways of accessing them was not easily available on social media and our participants turned to establishing relationships with locals for this information instead.

The proclivity of citizens to work with or without the government to bring relief to affected areas also impacts citizen response and, in turn, how they appropriate technology to support their work. In the case of the Ecuador earthquake, and similar to the response in other crises [62], we observed a strong desire among the citizens to deliver aid themselves instead of relying on formal aid organizations or the government. Although a few of our participants did operate in collaboration with the government, most chose to act independently and, in fact, showed little desire to communicate or collaborate with the government via social media channels. This highlights that digital technologies that support citizen participation in crisis relief work cannot always assume that citizens will be willing to share information with the government.

Crisis research has pointed out the role of culture in shaping emergent behavior during crisis response operations [11, 38]. Cultural values also shape the use of social media for citizen-led crisis

response, as we found. In particular, participants tried to make the most out of the supplies that were found to be in excess so that even "unwanted" or "useless" donations were usable in some form. They washed dirty clothes, put unusable fabrics to use, tried to be economical with useful donations, drawing on the value they place on repair and reuse instead of wastage [28]. These values, in turn, determined the information needs of our *ad hoc* logisticians; they sought quick information about what items could be transformed and how, who would want similar kinds of donations, etc.

5.2 The Speed of Social Media: "Too Fast, Too Slow"

We uncovered a general mismatch between the demands on the ground and the response on social media. In some cases, social media spread too much information too quickly (as discussed previously [17, 60]), while in others, it did not afford enough celerity. Our findings indicated that it contributed to the traditionally excessive convergence of people and materials on the ground, in addition to discomfiting participants with too many cellphone notifications. On other occasions, however, social media was too slow to adapt to the changing needs of crisis sites. For example, right after the earthquake, there was a deluge of messages from affected citizens asking for food and water. With time, the messages began to ask for canned goods instead (and no more water). However, participants reported receiving food, water, and canned goods much after online responses had explicitly asked citizens to stop sending these. We challenge prior work that stressed social media's ability to help citizens self-regulate inaccurate information [60] by showing that online self-regulation does not happen at the pace needed for supporting logistic efforts during a crisis. Our findings reveal that while social media helped spread messages quickly, it was too slow, or simply unable, to keep up with dynamic needs on the ground.

There were limitations to social media's capacity of aligning with the pace of *ad hoc* logistics and this contributed to disrupting an already disturbed environment. For example, by enabling the massive exchange of messages motivating people to donate and to travel to affected provinces, social media exacerbated the overflow of materials and people to these zones. This overflow allowed *sapos* to take advantage of the situation. Realizing that their help was not reaching those who needed it but that many people were trying to make money from donated supplies was a major breakdown from the perspective of our participants. Receipt of supplies that had no apparent use during a crisis, such as yards of fabric or dirty clothes, further complicated relief efforts.

While social media's capacity to spread news rapidly could be an asset, this feature was not always helpful in supporting specific objectives within logistics relief work. In some cases, that speed made it challenging to inspire trust among citizens soliciting supplies and resources from their social networks. For procuring critical donations thus, participants rejected public social media and turned to meeting in person or sending emails to request and close an agreement for supplies. Reports to donors with pictures of how and when supplies were distributed were sent via email or WhatsApp messages. Thus, public social media activity would provide, at best, a limited understanding of crisis relief work since citizens recognized it as more effective, practical, and reliable to engage in private rather than public digital exchanges.

5.3 Distance: From Technology, People, and Location

Prior work shows people do not resort to only one mechanism to manage and communicate information [58]; they select [4]. Our multiplex approach allowed us to find *distance* to be a key driver for selecting communication channels when faced with disruption. In general, participants chose tools they were familiar with (as found in [59]), that they could quickly adapt to their needs, and that allowed them to reach out to ties they considered vital for their efforts. Our data also revealed that a sense of closeness was not linked only to the tool but to how it was used before the

crisis. In Ecuador, Facebook (and not WhatsApp) is the most popular social networking site [6]. However, many citizens, especially middle-class Ecuadorians, prefer WhatsApp for coordinating activities and communicating with close social networks of friends, family, and even business partners, in more intimate fashion. Our findings confirmed what other studies of technology appropriation have shown: Facebook (even with the introduction of the widely used Facebook Messenger) simply did not invoke the requisite sense of closeness [29].

In the same vein, most participants perceived Twitter as a tool that invoked a sense of distance in communication between them and their social networks. This was due to three reasons. First, Twitter is not widely adopted in Ecuador yet and participants perceived it as a tool for the elite, where only those with a large number of followers could impact how others perceived information. Second, most participants' social networks were on Facebook and WhatsApp, not Twitter. Finally, the small number of participants who did have a large Twitter following reported that they felt unable to control information spread on the platform. For these reasons, Twitter was not the preferred choice for citizen-led crisis relief initiatives during the Ecuador earthquake.

Physical distance also played a role. When participants were conducting work at a distance from the site of crisis, they were more inclined to choose private social media tools for communication. On the ground, however, citizens' use of social media fell significantly and they chose face-to-face interactions to foster the sense of closeness necessary for collecting the information they sought. Identifying distance as a factor that influences social media activity for crisis relief draws attention to the importance of better understanding social media use *and non-use* across regions and cultures as well as underlying reasons for this use. This is a growing body of research that must be further developed and drawn on by CI researchers [43, 59, 75].

6 IMPLICATIONS FOR DESIGN

We used the lens of care to give meaning to the crisis response efforts our participants carried out as they grappled with social media for managing material convergence. This allowed us to identify the sociomaterial aspects that shaped (and were shaped by) our logisticians' enactment of care, understand the type of information and interactions they found valuable and imagine ways in which technologies could support and extend their work. While an instrumental design approach—one that serves as a means to an end by, say, mapping relief data during a crisis—is important, we found that, for *ad hoc* logisticians sustaining a social and bodily engagement with the relief environment was as (or more) important. In what follows, we highlight key aspects for the design of technologies that foster such engagement, in lieu of a platform for reporting and sharing objective facts. In line with participants' preference for familiar technologies as they engage in relief efforts, we focus on extending existing social media features, instead of proposing the design of new technologies. Our goal is not to force social media into becoming the central component of crisis response but to identify opportunities for it to better address the needs of *ad hoc* logisticians.

6.1 Information as a "Thing of Value"

To counteract material convergence (exacerbated by social media), logisticians—driven by an ethics of care—learned how to make best use of resources through the gathering and sharing of meaningful information. Social computing platforms could mediate this care by providing what Mol calls "things of value" [41], that is, information that relates to citizens' intentions and temporal needs for engaging in PD-HL. For example, social media platforms could extend their existing features beyond asking if citizens are safe or wish to donate post-crisis and play a more proactive role in engaging with and/or supporting potential logisticians. They could ask citizens questions such as *"would you like to help?"* If the answer came in the affirmative, it could use further prompts to collect more information to build a knowledge base that could subsequently inform actions of

other citizens (*"e.g., how are you planning to help?, where are you traveling?"*). These prompts can keep collecting information as citizens engage in relief endeavors (*"e.g., How would you describe the situation on the ground to other volunteers?"*). Based on the information provided by citizens, these platforms could offer contextual information regarding how to help (*e.g., "these are the people from your social network who are also thinking of helping", "these are the items that your friends at the site of crisis have suggested that you take"*). Further, based on historical information about crisis management or on the inputs of experts, these tools could offer information on how to optimize donations (*e.g., "sending the following kit of items will be useful for a family of 4 members, would you like to see a video on how to best assemble a kit?"*) or on the impact that donating certain products could have over time (*e.g., "Donated perishables will only last 4 days without refrigeration"*). Through these mechanisms, social media could be tailored to help citizens develop strategies for better responding to the demands of the crisis landscape.

6.2 Social Closeness

The caring behaviors observed revealed that our participants sought social closeness. They trusted close members of their social network for engaging in the exchange of supplies, resources, and information about where to help. They developed close relationships with key informants at the sites of the crisis. Further, due to Ecuadorian cultural values, our participants were frequently keen on keeping their altruistic efforts private within a small network of close friends. Social computing tools could help different citizen-led relief initiatives expand the possibilities of those they could collaborate with while fostering trust and privacy through a sense of closeness. For example, it could show logisticians the relief activities that citizens outside (but close to) their social networks had reported, including details of the friends they have in common and degrees of separation. In addition, it could provide information required to *physically and remotely* connect with those citizens (*e.g.,* through phone numbers, email, or GPS locations). Further, in order to foster a sense of privacy, these tools could better support citizens' agency to define how visible their relief actions would be to the general public as well as to members of other initiatives. Creating an environment that fosters trust and privacy through a sense of closeness can enable members of the relief environment to collaborate for quickly optimizing their management of material convergence.

6.3 A Sense of Bodily Engagement

Besides social closeness, we found our participants valued their physical closeness—bodily engagement—to the areas impacted by the crisis. Accessing information through sensory perceptions allowed them to deepen their understanding of needs of both victims and the relief landscape. Instead of providing only quantitative information regarding material supplies, logisticians engaged in efforts could be prompted by social media to provide audio/visual information to quickly (and perhaps approximately) share their perceptions with other citizens/relief initiatives. Often, this can give other *ad hoc* logisticians, especially those located remotely, a more vivid assessment of the situation and the needs of the hour (even if imprecise). Our participants reported that the articulation work among logisticians was a process they learned on the go, often while on-site (*e.g.,* learning how to assemble donation kits more efficiently). Social media could thus prompt logisticians to quickly record and transmit these lessons management stories (using videos, for example, of how donation kits could be more efficiently assembled) to other initiatives involved in similar relief work. This information could be presented to other *ad hoc* logisticians in ways that resonate with their current learning needs, either as search results or as suggestions, so as to provide new ideas of how to efficiently manage issues of material convergence.

7 CONCLUSION

We studied Ecuadorians' response to the earthquake that took place in Ecuador on April 16, 2016. Citizens across the country self-organized to gather, mobilize, and distribute supplies to affected populations, assuming the role of *ad hoc* humanitarian logisticians. We presented an ethnographically-informed perspective of how these citizens straddled the boundaries of online and offline activity for earthquake relief. This allowed us to offer an enriched understanding of how social media might have supported informal, on-the-ground, crisis response, but also where it fell short in the process. We studied the emergence of care-in-action where social media fell short, using our findings to make recommendations for technology design to improve the effectiveness of logisticians in crisis response. By examining the bodily engagement of our participants at the crisis site, their efforts to deal with material convergence, and the ways in which they interacted with social media for technology-mediated care, we also offered a deeper understanding of the sociomateriality of care that emerges in the crisis relief landscape.

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