Engage Early, Correct More: How Journalists Participate in False Rumors Online during Crisis Events

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ABSTRACT
Journalists are struggling to adapt to new conditions of news production and simultaneously encountering criticism for their role in spreading misinformation. Against the backdrop of this "crisis in journalism", this research seeks to understand how journalists are actually participating in the spread and correction of online rumors. We compare the engagement behaviors of journalists to non-journalists—and specifically other high visibility users—within five false rumors that spread on Twitter during three crisis events. Our findings show journalists engaging earlier than non-journalists in the spread and the correction of false rumors. However, compared to other users, journalists are (proportionally) more likely to deny false rumors. Journalists are also more likely to author original tweets and to be retweeted—underscoring their continued role in shaping the news. Interestingly, journalists scored high on "power user" measures, but were distinct from other power users in significant ways—e.g. by being more likely to deny rumors.

Author Keywords
Social media; news production; journalism; rumoring; rumor; Twitter.

ACM Classification Keywords
H.5.3 Information Interfaces & Presentation (e.g. HCI): Groups & Organization Interfaces: Collaborative computing, Computer-supported cooperative work; K.4.2 Social Issues.

INTRODUCTION
Technological changes in recent decades have radically altered how news is produced and consumed. Against a backdrop of ever-evolving audience expectations and structural changes in the news industry, journalists have had to reinvent their role and reshape their practices—while somehow holding steadfast to their core professional mission, value, and ethics [1,11,33].

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The challenges inherent in striking a balance between adhering to old values and practices and adapting to new conditions is particularly evident at the intersection of breaking news events and misinformation. Balancing the competing goals of getting information out in a timely way while assuring its accuracy is both a daily challenge for individual journalists and a perennial one within the profession. In the print era, when the rhythm of publishing was considerably slower, that balance was most often struck through careful vetting of information and sources [7,22]. Though this process sometimes failed, the pace of information production and diffusion put structural limits on the spread of misinformation through news media.

The ability to maintain the practice of "verify, then publish" began to erode with the advent of cable TV news and "the 24 hour news cycle" [33]. The challenge of verification has only grown with the widespread adoption of social media [11], where information is produced in vast quantities and in a distributed fashion. News now breaks from anywhere at anytime. And it can be shared by anyone. These factors, accompanied by shrinking newsroom staff and resources, put great pressure on journalists to "publish first, verify later" [11,27].

Adopting this practice has led to notable examples of journalists participating in the spread of false rumors during crisis events. For example, after the 2013 Boston Marathon bombing, a rumor misidentifying the bombing suspect circulated widely on Twitter [30]. This rumor originated within the collaborative sensemaking of the online crowd—its early roots trace to both Twitter and Reddit, where users speculated about the involvement of a missing university student. Evidence suggests that the rumor's massive spread was catalyzed by the participation of journalists, through both original tweets and retweets of others, as their large numbers of followers began to circulate rumor-related tweets [30].

This instance and others [e.g. 43] highlight the challenge of curbing misinformation in the era of hyper-connected news. They also raise existential questions for the field of journalism: What, if any, distinct role do they play in the production of breaking news and, consequently, the propagation and correction of false rumors?

This research explores how journalists engage in online rumors, asking if and in what ways their participation differs from that of non-journalists and specifically of other "power

users"—i.e. accounts with relatively high numbers of followers. For this analysis, we examine Twitter user engagement in five false rumors from three crisis events. We first distinguish journalists from other users by manually categorizing all Twitter accounts in these rumor collections. We then compare the tweet behaviors of journalists with those of other users across the five rumors.

Examining raw numbers of rumor-related tweets, we do see evidence of journalists participating in the spread of false rumors. However, our analyses also show journalists (on average, as a group) displaying distinct behaviors from non-journalists. Aligning with professional expectations, journalists issued more original tweets and were more likely to deny false rumors. Additionally, journalists' activity tends to cluster early in both the initial affirmations and initial denials of the rumors. Though our research provides limited evidence of journalists employing a "publish now, correct later" strategy, it does show them engaging earlier and correcting more than others.

BACKGROUND

Rumoring on Social Media During Crisis Events

Recent breaking news events, including several prominent crises, have demonstrated that social media are changing the information landscape. Individuals turn to these channels to obtain, discuss and challenge information, and pass along what they have heard to others [8]. New technologies have expanded the pathways for participation in crisis response and recovery activities. Citizen reporters can share information from ground zero, posting photos and eyewitness accounts to a global audience. The online crowd re-posts content they feel might be helpful or interesting to others, spreading information along the social network of platform participants and amplifying the content produced. The crowd also works to verify and determine which information and stories are credible [40,50].

The complex process of communication and interaction—information sharing and curation— is often conceptualized as one of collective sensemaking, where people come together to make sense of available information in a constantly changing environment [10,49]. Expressions of collective sensemaking take many forms; one, which has been studied extensively in the social sciences, is rumoring. Rumors often arise in the crisis context due to high levels of anxiety and uncertainty, as well as when official sources are insufficiently timely [2,20,49]. Rumors in this setting are defined as unverified information at the time of discussion—and can turn out to be true or false. False rumors spread misinformation, which can be detrimental due to potential influence on decision-making and protective actions taken.

Researchers have begun to explore the phenomenon of online rumoring [e.g.10,34,44,50]. Some have called out widespread rumoring as a threat to the utility of social media during emergency response [28]. Others have noted a potentially productive role for "the crowd" in identifying misinformation [26]. However, little work has looked empirically at the role of journalists in online rumoring.

In one recent attempt to unscramble the role of different kinds of users in spreading online rumors, Zubiaga et al. [52] compared users with high follower to friend ratios to other users, finding those with high ratios (i.e. those with large audiences, but few subscriptions) to play an outsize role in diffusing information on Twitter. Interestingly, they found users with low ratios were more likely to deny rumors while users with higher ratios were more likely to affirm them. These researchers also observed that a high number of those with "substantially higher ratios" in their sample were news organizations. Borrowing this followers-to-friends ratio as a measure of *power user* status, our work further explores and adds insight into these relationships between power users, journalists, and rumors.

The Blurry Boundaries of Online Journalism

The nature of journalism, who does it, and who does not, has always been contested [19]. By shifting the boundaries between those who produce news and those who consume it, digital convergence has amplified the debate. Amidst the backdrop of online convergence and crowd participation, the role of the journalist is changing. Networked ICTs have been a disruptive force in how journalism is done and by whom. These technologies are alternatively viewed as enabling citizens to either supplant professional journalists [47] or complement or augment their work in some fashion [13,16,37]. Depending upon circumstance, there is evidence for all of these arrangements in recent years. For example, citizens are said to have filled important gaps in election coverage in South Korea [36] and Australia [21]. They have played a complementary role in crisis coverage via social media [16,37].

The immediacy of social media puts strong pressure on journalists to post first, fact-check later [1,11,27]. As the volume of available news has grown, increasingly, "alternative truths, misinformation and false information compete for attention" [29]. And the traditional boundaries between journalist and citizen have been "scrambled" [18]. By comparing the activity of all users who participated in several false rumors, this research contributes to understanding the interplay between journalists and other members of the connected crowd.

The Role of Journalists in Spreading and Correcting Misinformation

Curbing misinformation is a core task of journalism, as explained in one popular primer: "*[Journalism] attempts to get at the truth…by first stripping any misinformation, or self-promoting bias and then letting the community react with the sorting-out process to ensue"* [32]. Journalists, their professions, and their practices are often key entities invoked in discussions of curbing misinformation. These invocations often link journalistic practices to general best practices for mitigating misinformation. For example, Alastair Reid, managing editor of First Draft, an organization that promotes

fact-checking for social media writes: "*Online verification follows the same basic principles established over decades of newsprint*" [46]. Conversely, those who "lack journalistic norms" are said to contribute to the spread of misinformation online [41].

However, with many positive and negative examples about the roles of journalists in misinformation propagation, evidence can be found to support another view. Some see journalists as responsible for misinformation—or at least no different from the rest of us in their propensity to propagate misinformation. Critics can cite evidence showing that their coverage can be biased [38]; they misinterpret science [23]; they omit information on important issues [12]; and sometimes they just lie [43]. Such critiques support the call for citizen journalism [12] and give fuel to accusations of "fake news." By looking directly—through the digital record—at the participation of journalists within the propagation of false rumors on Twitter during crisis events, this research adds nuance to the debate about the role of journalism in propagating and correcting misinformation.

The goal of this research is to better understand how journalists are performing their role in the space of online breaking news, and particularly in relation to the spread and correction of false rumors. By comparing the activity of journalists to that of the rest of the online crowd, we hope to identify what (if any) distinct role journalists play in the propagation and correction of rumors—and to shed light on how journalists are adapting their practices to these new information production conditions.

RESEARCH QUESTIONS

There is a growing body of research examining the evolving practices of journalists, including several studies focused on changing practices and the spread of misinformation [e.g. 15,17,]. However, most of this work is based on interviews and case studies. In this study, we empirically test hypotheses emerging from this body of research on trace data of users' actual social media participation in rumoring. We frame our inquiry in terms of four research questions, each with associated hypotheses. Research questions are designed to address a broader aim of understanding how journalists behave (perhaps differently from other users) in terms of their participation in false rumors on Twitter.

RQ0: How do journalists compare with other power users?

This research attempts to understand how the behavior of journalists differs from or aligns with the behavior of other social media users. One type of social media user that may be very similar to journalists is the power user—i.e. other influential users such as celebrities and other public figures who have relatively large follower counts. We therefore first explore the correlation between journalist status and two measures of power user status: the number of followers (H0a) and the ratio of followers to friends (H0b). Research [52] suggests that the latter measure may correlate strongly with media sites, which would suggest 1) distinctions between journalists and other users would disappear if we controlled for power user status; and 2) the measure could be used as a proxy for journalist classification. To test this assumption—i.e. to see the separate effects of journalist status and power user status—we include this power user measure in several of the subsequent analyses as an independent variable.

RQ1: How do journalists' posting behaviors (e.g. number of posts) differ systematically from non-journalists?

RQ1 seeks to better understand general social media behaviors, such as the volume of rumor-related posts and the propensity to post original content (versus repost others' tweets). Although journalists engage with Twitter differently depending on who they are and their kind of reporting [6,39,48], it is an important platform for journalists to disseminate news. Numerous studies find Twitter has become a normal part of journalists' work routines [14,25,31,35,45]. Essentially, this work argues that journalists are professional tweeters. As such we expect they would, on average, tweet more than non-journalists. We therefore hypothesize (H1a) that when journalists do participate in a rumor, they will engage more (in terms of tweet volume) than non-journalists.

Next, we examine whether journalists are more likely than non-journalists to be content producers, as opposed to content amplifiers. These are two important yet distinct roles in the spread of misinformation. Do the roles of authoring original tweets and amplifying a tweet by retweeting align with traditional roles of news production (by journalists) and news consumption (by non-journalists)? We hypothesize that the traditional role of journalists is one of information production and it is likely that this extends to social media activity. Our second hypothesis (H1b) is that journalists will tend to produce more original content (vs. retweets) than non-journalists.

RQ2: How do journalists' rumor-correcting behaviors differ from the general population?

RQ2 addresses whether and how journalists engage in rumor-correcting behaviors. One aspect of this involves correcting the rumor. Several studies focus on how journalists attempt to adhere to established norms (including those pertaining to verification) while engaging in social media [e.g. 15,24,35]. Others focus on the emerging gap between current practices and traditional norms [11,27]. This has led some scholars to call for a rethinking of the journalist's relationship with the public in the verification process [e.g. 13,16,17,26]. Regardless of these different positions, these analyses all start from the assumption that journalists are actors in the process of verifying facts and correcting misinformation. Aligned with this assumption, we hypothesize (H2a) that tweets from journalists will be more likely to deny a rumor than tweets from non-journalists. Approaching the same question from a user- rather than tweet-based perspective, we also hypothesize (H2b) that journalists will be more likely than others to engage in a rumor purely through denying tweets.

A second aspect of correction involves correcting oneself. Issuing public corrections is said to be a long-standing norm in the profession [7], taught to novice journalists as a best practice [e.g. 22] We therefore hypothesize (H2c) that, after posting a rumor-affirming tweet, journalists will be more likely than non-journalists to correct themselves.

RQ3: How do the temporal characteristics of journalist behavior differ from the general population?

RQ3 looks at *when* journalists engage with rumors—their temporal participation. Though balancing the tension between timely reporting and adequate verification has always been a challenge for journalists [7], the digital age has placed increasing pressure on journalists to engage with breaking news in real-time [1,11,33]—to publish now, and correct later [11,27]. We hypothesize that journalists engage earlier in Twitter rumors, both to affirm the rumor (H3a) and to deny it (H3b). Similarly, we hypothesize that both affirming (H3c) and denying (H3d) tweets from journalists will occur earlier in a rumor's lifecycle than the same time of tweets from others.

RQ4: Are tweets from journalists more likely to be retweeted?

This final research question examines what (if any) influence journalists have on rumor conversations. 59% of Twitter users report using it to follow breaking news [8] and journalists are a strong presence on the platform. For example, they are the largest group of Verified Users [42]. If journalists are indeed influential users in breaking news events, it is likely that their crisis-related (and rumor-related) tweets would be retweeted more often than those of other users. Our final hypothesis (H4) is that tweets from journalists and other power users will be more likely to be retweeted (one or more times) than tweets from non-journalists.

DATA AND METHODS

In this section, we describe our method for collecting, scoping, and categorizing the data that we utilize in this analysis. To briefly summarize, we first collected Twitter data during three distinct crisis events. Then, we identified rumors within those collections and created subsets of tweets related to those rumors. Next, we coded each tweet as affirming or denying the rumor. We then coded each account as journalist or non-journalist.

Twitter Collection, Rumor Scoping and Tweet Coding

Collecting Crisis-Related Data in Real-Time

Data used in this study are rumor-related tweets sent during three distinct crisis events. Using the Twitter Streaming API, we collected tweets in real-time for specific crisis events using keyword-based queries. Queries were designed to produce datasets that captured a comprehensive set of event-related posts with low amounts of noise (tweets unrelated to the crisis event). Limitations in the data collection method, including a lag between the event start and collection start as well as rate-limiting by Twitter, result in some data loss, typically concentrated in the first few minutes to hours of an event. Two of our rumors are missing data from the first few minutes of their propagation.

Scoping Rumors from Crisis Events

Within each crisis event dataset, researchers identify salient rumors and then "scope" these rumors to subsets of rumor-related tweets using keyword-based queries. For this research, we utilized rumors drawn from three crisis events: three rumors from the 2014 Sydney Siege, one from a rumored airplane hijacking, and one from the 2015 Paris Attacks.

Event	Rumor	Total Tweets	Affirm	Deny	Neutral
	Total	32347	19283	11214	1850
WestJet	WestJet	17515	8438	8064	1013
Paris Attacks	Les Halles	4658	4418	211	29
Sydney Siege	Lakemba	1338	514	822	2
Sydney Siege	Suicide Belts	2583	1842	82	659
Sydney Siege	Airspace	6253	4071	2035	147

Table 1. Tweet Counts by Rumor & Tweet Type

The **WestJet** rumor concerned a false report that a WestJet airplane was highjacked in 2015. Spurred on by breaking news sites, this rumor spread quickly. It was also rapidly corrected by the official @WestJet account, which set off a strong wave of denial tweets. At 17,515 tweets, this rumor has far more tweets than the other rumors we analyze.

The **Les Halles** rumor emerged from false reports that a shooting was occurring at the Les Halles shopping mall during the 2015 Paris Terror Attacks. This rumor was characterized by high uncertainty and, though it disappeared rapidly, it did not experience a significant, explicit correction. Though our initial collection included a large number of French (and other) language tweets, we scoped this rumor (and all of the rumors in this analysis) to English language tweets only.

The other three rumors occurred during a 2014 hostage crisis in Sydney Australia that was coined "Sydney Siege" at the time. The **Lakemba** rumor, the smallest one we analyze (at 1338 tweets), concerns false reports that police were conducting home raids in the Lakemba (mostly Muslim) neighborhood of Sydney. This rumor was first shared by a "shock jock" radio personality in Australia, and experienced a strong correction (catalyzed by a local police account) after its initial spread. The **Suicide Belts** rumor concerns false reports that hostage takers were seen wearing explosive devices. This rumor had considerable uncertainty and was only explicitly challenged or corrected a few times in our data. The **Airspace** rumor concerns false reports that Sydney airspace was closed to all air traffic during the crisis. This rumor spread quickly, but was also challenged from very

early on and experienced a strong correction within minutes of its peak. Detailed analyses of the context and spread of WestJet [3,4], Les Halles [4], Lakemba [3,5], and Suicide Belts [5] are given in previous publications.

Coding Tweets as Affirming or Denying the Rumors

Each rumor-related tweet was coded according to a classification scheme of tweet's stance towards the rumor's veracity. Tweets unrelated to the rumor or those that were uncodable were marked and removed. In this study, we focus primarily on two categories of tweets: affirms and denies. Affirming tweets explicitly or implicitly (through subtext or context) endorse a rumor. Denying tweets either dispute or refute a rumor.

Affirm (Explicit): `4th Shooting attack Reported at Les Halles Shopping Mall #Paris`

Affirm (Implicit): `Ah God. I've walked through Les Halles so many times. Terrifying`

Deny: `All quiet here, Les Halles news seems a bit unfounded.`

All tweets were coded independently by two coders; disagreements were resolved by a third. These data collection and coding methods, along with four of five datasets, have been explicated in prior work [3,4,5].

Table 1 provides tweets counts (across coders) for the five rumors. Though all of these rumors were ultimately determined to be false, the selected rumors are diverse in that each has a different pattern of affirmations and denials. Comparing the relative number of affirms to denies in each rumor, three of these rumors have a reasonably strong denial signal: WestJet, Lakemba and Airspace. In contrast, the Les Halles and Suicide Belts rumors have comparatively weak denial signals (<5% of tweets in those rumors are denials).

Identifying Journalists in the Social Media Crowd

Acknowledging the dynamic and contested nature of journalism, for this research we worked inductively toward a definition that fits the spectrum of activity visible on Twitter from clearly journalism to clearly not, forcing us to directly address edge cases we encountered. Through manual analysis, we categorized all accounts that sent a rumor-related tweet as *journalist*, *non-journalist*, or *ambiguous*. Researchers assigned the *journalist* label if they deemed the account made a credible association with the professional community of practice of journalism. This category includes current, former, and student journalists, news producing organizations, and professional journalism associations. *Non-journalist* includes accounts that make no identity claims associating with professional journalism, media accounts that are not associated with news production, and news aggregators that purport to be "news" but simply curate content produced by someone else.

The coding protocol involved two researchers independently reviewing Twitter account information as preserved at the time of collection. When both researchers determined the account information was insufficient to make a determination or when disagreements occurred, a third researcher arbitrated.

In making these categorizations, researchers identified and then relied upon a set of cues (primarily keywords) associated with the community of practice of professional journalism that are identifiable in Twitter account data. Our list of cues was developed through several iterations of inductive and deductive coding. Cues were derived from account name, account description, and account statistics that are visible to Twitter users in normal use.

For the analyses described here, among 21,429 rumor-participating accounts, coders categorized 19,299 as *non-journalists* and 2038 as *journalists*. However, the lines between professional journalism, "amateur journalism", "para-journalism", and "pseudo-journalism" [18] can be hard to distinguish. This is reflected in account cues that shift subtly and incrementally from high status professionals to citizen journalists and news consumers. Therefore a categorization of journalist or non-journalist was not always achievable. Reflecting the genuine messiness of news dissemination on Twitter—and the difficulty information consumers have in making judgments about source credibility—researchers categorized 85 accounts as *ambiguous*. These accounts give mixed signals about their relation to journalism. As they represent a separate category of user, resembling journalists in some ways but not others, we exclude them from the current analysis (though plan to explore their role in future work).

Methods of Analysis

In the analysis that follows, to determine if rumoring behavior of journalists differs from non-journalists, our analyses use descriptive statistics, such as tweet volume and time of first tweet, comparing observed values between user groups. We also use standard hypothesis tests to evaluate if observed relationships provide evidence of statistically significant differences in the behavior of journalists and non-journalists; where appropriate—due to characteristics of the empirical data (e.g. skewed distributions)—we apply non-parametric tests.

FINDINGS

RQ0: Journalists Score Higher on Power User Measures

Our initial research question looked at potential correlations between journalist status and two measures of power user status: log(followers) and log(followers/friends). For the remainder of this paper, we refer to the latter measure as the *power user score*.

H0: Journalists (who participate in rumors) score higher on measures of power user status than non-journalists.

We found consistent support for H0, using both measures, across all five rumors. For followers count, the distribution for journalists and non-journalists is approximately log-normal. To compare the two groups, we conducted a t-test on the mean of log(followers), finding that journalists have

significantly ($p < 0.0001$) higher numbers of followers than non-journalists for all five rumors.

For power user score, the distribution is approximately normal for most rumors, though there is a spike in each distribution of values near 0 (i.e. accounts cluster around having the same number of followers as friends). To compare the two groups, we conducted a t-test on the mean of power user score, finding that journalists score significantly ($p < 0.001$) higher than non-journalists on this power user measure for all five rumors.

Rumor	Journalist	Non-Journalist
WestJet ***	0.2584	-0.1166
Les Halles ***	0.3187	-0.08542
Lakemba ***	0.3057	-0.1665
Suicide Belts ***	0.4341	-0.07345
Airspace ***	0.371	-0.07963

Table 2. Mean Power User Score for Journalists vs. Non-Journalists. Log(Followers/Friends). Significance, T-Test: *** p<0.001

Summarizing the results from these analyses, journalist status is correlated with high power user status; journalists score higher (on average) on power user measures than non-journalists. Throughout the remainder of this paper, we attempt to distinguish between these two groups (by controlling for power user score), to better understand if and how journalists differ from other power users.

RQ1 Results: Journalists Send More Original Tweets; But Number of Tweets Varies across Rumor

Across the five false rumors we analyzed for this research, 86% of tweets were retweets. This suggests that most rumor participation takes the form of amplification rather than generation—with commensurately fewer user producing original content. RQ1 asks how journalists' rumor engagement differs from non-journalists in terms of volume and the type of content—original content vs. retweets.

H1a: When journalists engage in a rumor, they send more tweets (on average) than other users.

To address H1a, for each rumor, we first calculated the number of rumor-related tweets that each user sent. Because tweets per user is not normally distributed, we converted that measure into an ordinal outcome variable and conducted an ordinal logistic regression with journalist status and power user score as independent variables.

For two rumors (WestJet and Airspace) journalists sent significantly more rumor-related tweets ($p<0.001$). For power user status, there was a positive effect ($p<0.01$) for WestJet and Airspace and a negative effect ($p<0.001$) for Les Halles. We did not find strong support for H1a. These results suggest instead that the volume of participation by both journalists and power users varies across rumors.

Rumor	Journalist		Non-Journalist	
	Mean	Median	Mean	Median
WestJet ***	2.25	2	1.81	1
Les Halles	1.03	1	1.09	1
Lakemba	1.11	1	1.12	1
Suicide Belts	1.10	1	1.08	1
Airspace ***	1.34	1	1.23	1

Table 3. # Tweets per User, Journalists vs. Non-Journalists Significance, Ordinal Logistic Regression: *** p<0.001

H1b: Original rumor tweets are more likely (than retweets) to be contributed by journalists and power users.

For this analysis we conducted logistic regressions (for each rumor) with whether a tweet is an original as the dependent variable. For Model 1 we used journalist status as a single independent variable. For Model 2 we examined the separate effects of journalist status and power user score, with one independent variable for each. [For all subsequent regressions in this paper we conduct two tests using a similar distinction between the two models.]

Power user score is consistently predictive of a tweet being an original tweet. This effect is significant ($p < 0.001$) for all rumors in our set. Journalist status alone is predictive ($p < 0.001$) for four of five rumors (all but Les Halles). The difference for Les Halles may be due to our sample being focused on English tweets—it is likely that many of the journalists in our sample were participating remotely by retweeting others, rather than generating their own content. For three rumors (WestJet, Suicide Belts, and Airspace), the predictive power for journalists holds even when we control for power user score. Journalists and power users are more likely to contribute original tweets (as opposed to retweets) than non-journalists and accounts with lower power user scores, respectively. Journalists are therefore participating more as information producers and less as information amplifiers than other participants in crisis-related rumors.

RQ2 Results: Journalists More Likely to Deny Rumors

RQ2 asks whether rumor-participating journalists are more likely to correct a rumor and/or to correct themselves. Table 4 shows the number of affirm vs. deny tweets by journalist role as well as the percentage of total tweets (which includes neutral tweets).

H2a: Journalist status and high Power User scores will both be predictive of Deny tweets.

For this analysis we focused on tweets that are labeled either affirm or deny. For each rumor, we conducted two logistic regressions with whether a tweet denies the rumor as the dependent variable. Model 1 has journalist status as a single independent variable. Model 2 has journalist status and power user score as independent variables. In both models, H2a holds for journalists for four of five rumors—the results are very significant ($p < 0.001$) for all but Suicide Belts, which had very few deny tweets. To summarize this finding, rumor-related tweets from journalists were more likely (than

tweets from non-journalists) to deny the rumor, even when we control for power user status.

Rumor	Journalist		Non-Journalist	
	Affirm	Deny	Affirm	Deny
WestJet ***	427 (27.4%)	1023 (65.7%)	7970 (50.2%)	7002 (44.1%)
Les Halles ***	252 (87.2%)	31 (10.7%)	4153 (95.4%)	179 (4.1%)
Lakemba ***	68 (27.8%)	176 (71.8%)	444 (40.8%)	643 (59.1%)
Suicide Belts	140 (68.0%)	9 (4.4%)	1692 (71.5%)	73 (3.1%)
Airspace ***	496 (50.2%)	457 (46.3%)	3562 (67.9%)	1572 (30.0%)

Table 4. Number of Tweets by Tweet Type & Journalist Role (Percentage of Total Tweets by Journalist Role) Model 2 Significance for Journalists: *** p <0.001

Interestingly, we do not see consistent evidence for power user score being predictive of denial tweets. The positive effect of power user score was only significant for one rumor. For two other rumors, the effect for power user score was negative (though it was not significant). In other words, power users were not significantly more likely to send denial tweets (as opposed to affirms). This is an important difference. Journalists stand out from other non-journalist power users in that their crisis rumor-related tweets are more likely to deny a false rumor.

For the next set of analyses we looked at differences in the user patterns (of affirming and denying tweets) across the lifecycle of a rumor. Table 5 shows the number of users in each category for each rumor. Proportions of users in each pattern vary widely across the different rumors. For three rumors (Les Halles, Suicide Belts, Airspace), though their activity compares favorably with other non-journalist rumor participants, more journalists affirmed the rumor than denied it. The Affirm-Deny pattern is not the dominant pattern for any of the rumors.

H2b: Journalists will be more likely than non-journalists to engage in a rumor only through denials (Deny-Only vs. other patterns).

Across all of the rumors, journalists were more likely than non-journalists to participate solely through denials (Deny-Only) compared to either Affirm-Only or Affirm-Deny. For this analysis we ran logistic regressions with Deny-Only status as the dependent variable. We again explored two models, one with journalists as the single independent variable, the other controlling for the effect of power user status. For both models, the effect for journalist status is very significant ($p<0.001$) for four rumors (all but Suicide Belts). This provides strong support for H2b for journalists. Power user score was also somewhat significantly predictive ($p<0.01$) of the Deny-Only pattern for two rumors (Les Halles and Airspace).

Rumor	Journalist			Non-Journalist		
	Affirm-Only	Affirm-Deny	Deny-Only	Affirm-Only	Affirm-Deny	Deny-Only
WestJet	134 20.0%	188 28.1% ***	347 51.9% ***	4123 48.3%	1932 22.6%	2488 29.1%
Les Halles	243 88.7%	2 0.7%	29 10.6% ***	3758 99.2%	11 0.3%	18 0.5%
Lakemba	53 24.1%	11 5% *	156 70.9% ***	377 39.1%	36 3.7%	551 57.2%
Suicide Belts	127 93.4%	0 0.0%	9 6.6%	1540 95.7%	7 0.4%	63 3.9%
Airspace	340 51.2%	107 16.1% ***	217 32.7% ***	2819 67.6%	361 8.7%	988 23.7%

Table 5. Number of Users in Each Pattern by Journalist Status (Percentage of Total Users by Journalist Role) Model 2 Significance for Journalists: * p < 0.05; *** p <0.001

H2c: After sending a rumor-affirming tweet, Journalists and users with high Power User scores are more likely than other users to correct themselves.

Here, we wanted to know if journalists and power users are more likely to correct themselves than other users. We limited this analysis (for each rumor) to users who sent at least one affirm tweet, comparing those who only sent rumor-affirming tweets (Affirm-Only) to those who eventually sent a denial (Affirm-Deny). Our results show weak and somewhat inconsistent support for H2c.

We ran two logistic regressions with the Affirm-Deny pattern as the dependent variable and, Model 1) journalist status alone; and Model 2) journalist status and power user score as independent variables. For journalist status (in both models), the results were very significant ($p<0.001$) for two rumors (WestJet, Airspace) and slightly significant ($p<0.05$) for one (Lakemba). The other two rumors had very few denial tweets overall, which limited the statistical power of those tests. Power user score was only predictive of the Affirm-Deny pattern for two rumors: WestJet ($p<0.05$) and Airspace ($p<0.001$).

These results suggest that, for crisis-related rumors where there is eventually a strong denial, among users who initially shared the rumor, journalists (and to a lesser extent power users) are more likely to correct themselves than non-journalists. However, the effect is not significant for some rumors. This suggests the need for future research on more rumors to confirm these trends, and underscores the variation across rumors—highlighting the importance of taking into account a rumor's context and lifecycle when interpreting quantitative findings.

RQ3 Results: Journalists Engage Earlier in False Rumors

The third research question speaks to *when* journalists engage in crisis-related rumors. To understand temporal participation we conducted visual and quantitative analysis of tweets over time. Figure 1 shows the temporal signature (volume of tweets over time) for the Lakemba rumor. In this graph, the signatures are separated by tweet type and by the journalist status of the author. Reflecting the small percentage of accounts identified as journalists in these rumors, the solid lines representing journalists' activity cluster toward the bottom of the graphs.

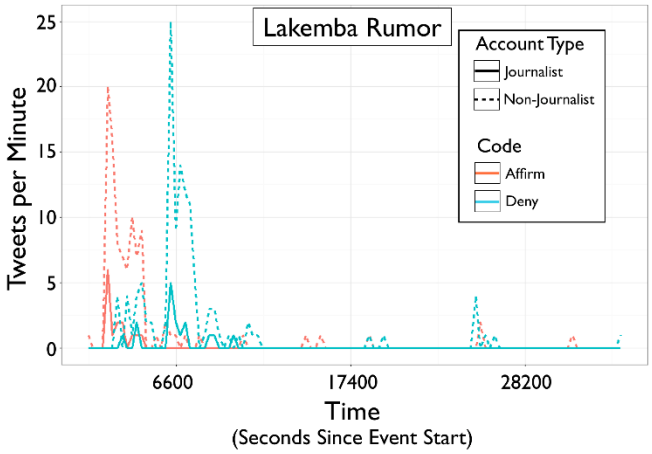

Figure 1. Tweets that affirm or deny the Lakemba rumor over time as tweeted by either journalists or non-journalists.

We chose the Lakemba rumor because it had a relatively strong deny signal (along with a typically strong affirm signal) that allows us to clearly show the temporal engagement in both types of rumoring behavior.

Both rumors contain a prominent wave of affirming tweets, followed by a burst of denial tweets. This graph shows that, for both the affirming and denying signals, the rate (volume of tweets over time) of journalists' participation peaks earlier and fades away sooner than that of non-journalists. We use quantitative analysis to confirm this observation and to examine those trends across the other rumors.

H3a. For those who participated in propagating (affirming) the rumor, journalists engaged earlier than non-journalists.

H3b. For those who participated in correcting (denying) the rumor, journalists engaged earlier than non-journalists.

In comparing the timing of initial engagement with the rumor, we looked separately at the first affirm tweet each account sent (for those that sent one) and the first deny tweet each account sent. This distinction was necessary because journalists send a higher proportion of denial tweets and denies tend to happen much later in a rumor's lifecycle.

We used the Wilcoxon Rank Sum test to compare, between journalists and non-journalists, the rank order of each user's first affirm tweet and first deny tweet. Unfortunately, multiple independent variables cannot be used for this test, so we did not control for power user status in this case.

H3a was supported for all five rumors, significant at $p<0.0001$ for WestJet, Les Halles, Suicide Belts and Airspace, and at $p<0.01$ for Lakemba. H3b was supported for four of five rumors, significant at $p<0.0001$ for WestJet, Les Halles, Suicide Belts and Airspace. For the most part, journalists engage earlier in a rumor's lifecycle than other rumor participants. This applies to both affirming and denying tweets. In other words, during crisis events, journalists are earlier to spread a rumor and earlier to correct a rumor than others.

H3c. Affirming tweets from journalists will occur earlier in a rumor's lifecycle than affirming tweets from non-journalists.

H3d. Denying tweets from journalists will occur earlier in a rumor's lifecycle than denying tweets from non-journalists.

In a similar, but distinct, analysis we compared the timing of all affirming (and then denying) tweets by journalist status. We again used the Wilcoxon Rank Sum test to compare the rank order of tweet time. We find that H3c is supported for all five rumors, significant at $p<0.0001$ for WestJet, Les Halles, Suicide Belts and Airspace, and at $p<0.01$ for Lakemba. H3b is supported for four of five rumors, significant at $p<0.001$ for WestJet, Lakemba, Suicide Belts, and Airspace.

Looking more generally at the timing of all affirms and all denies, our data shows both affirming and denying tweets from journalists are posted earlier than tweets of the same types by non-journalists. This finding supports other evidence showing journalists engaging earlier than other users in both rumor-spreading and rumor-correcting.

RQ4 Results: Rumor Tweets from Journalists are More Likely to be Retweeted

H4 Rumor-related tweets from journalists and accounts with higher power user scores are more likely to be retweeted than tweets by others.

For this analysis, we used a logistic regression with journalist status and power user score as independent variables and whether or not a tweet is retweeted (one or more times) as the dependent variable. H4 holds for both journalists and power users for all rumors. For journalists in the Les Halles rumors, the effect is significant ($p < 0.05$). For journalists in the other rumors and for power user score across all five rumors, it is very significant ($p < 0.001$). To summarize, tweets from people with higher power user scores (which is correlated with higher numbers of followers) are more likely to be retweeted (at least once). Additionally, even when we control for power user score, rumor-related tweets from journalists are still more likely to be retweeted than tweets from non-journalists. This demonstrates that journalists' tweets have more impact on a rumor's propagation and correction, in terms of downstream retweets, than tweets from others in the crowd.

DISCUSSION

By comparing the Twitter activity of journalists to non-journalists in five false rumors from three crisis events, we

find discernable differences between the two groups in terms of content, corrective behavior, and temporal patterns of participation. Taken together, these differences suggest that the role of journalist remains discernable from within the rest of the social media crowd—i.e. journalists engaged in and contribute to online rumoring during crisis events in somewhat different ways. However, some best practices from the profession were less distinctive than others.

How Journalists Engage Differently in Twitter Rumors

Differences in Content

Aligned with views of journalists as content producers, rumor-related tweets contributed by journalists were more likely to be original tweets (and less likely to be retweets) than tweets contributed by non-journalists. This suggests that journalists who engage in false rumoring do so within their professional role as those who produce content or reframe it. Resonating with recent discussions of citizen-journalist interactions [12], we see here the once-clear distinction between news producer and news consumer is blurred, but not erased.

Differences in Corrective Behavior

Reflecting a core task that in part defines the profession, journalists were significantly more likely to issue tweets that denied false rumors. For four of five rumors in our set, journalist status was predictive of deny tweets and of a user participating solely through rumor-denying tweets. These effects held even when we controlled for power user status, suggesting that journalists are, relative to other users, participating in false rumors in more constructive ways—by correcting.

For the three rumors in our set that had relatively strong corrections (at least 30% of tweets were denials), journalists were significantly more likely than non-journalists to correct themselves after passing along a rumor-affirming tweet. However, this affirm-deny (or publish first, correct later) pattern was never the most prominent pattern overall. More often, individual journalists participated either through only affirming or through only correcting a rumor.

Differences in Temporal Patterns of Participation

We did consistently see journalists engaging earlier (on average) in a rumor's lifecycle. Though not always first to affirm or deny a rumor, journalists in general tend to engage earlier than non-journalists in both rumor-affirming and rumor-denying behaviors. The former was significant for all five rumors; the latter for four of five. This shows that journalists are, as a group, responding quickly to emerging stories within a breaking news event, and leading the curve in reporting both the story itself and its correction.

Differences between Journalists and Other Power Users

Our research expands upon Zubiaga et al.'s findings regarding rumor participation by accounts with high follower to friend ratios [52]. Aligned with observations in that work, our data show that journalists who engage with false rumors score higher on two power user measures—log(followers) and log(followers/friends)—than other rumor participants. However, our findings also suggest important distinctions between journalists and other power users. In particular we find that journalists are more likely than other users to post rumor-denying tweets and to participate only by correcting a false rumor, an effect that does not consistently hold for power users (those with higher power user scores). This suggests that journalists are, to some extent, still playing a verification role within the information space that sets them apart from other users.

Additionally, original tweets from journalists are more likely to be retweeted than tweets from non-journalists, even when we control for power user score. This finding suggests that journalist status still signals something about the quality of information—it could indeed be better information, or simply perceived by downstream tweeters as more credible or less risky to share. It also suggests that journalists play a significant role in spreading and correcting online rumors during crisis events.

Finally, our findings shed additional light onto previous findings about how power users participate in rumors. Zubiaga et al. found that users who deny rumors have a *lower* power user score than users who affirm rumors [52]. Our findings do no conflict with those findings (though we did not find a significant, consistent effect in either direction). However, we did find the opposite effect for journalists—that users who deny rumors are *more likely* to be journalists (both with and without controlling for power user score).

Engage Earlier, Correct More

Examining the raw tweet numbers for some of the rumors in our set—e.g. the hundreds of rumor-affirming tweets sent by journalists in the WestJet, Les Halles, and Airspace event—we can see that criticisms of journalists for participating in the spread of misinformation are not entirely unwarranted. However, by comparing the activities of journalists and non-journalists across the lifecycle of five false rumors, we add nuance to the debates about the role journalists play in the spread of online misinformation.

First, it is important to note that journalists, like other users, engage differently in different rumors. For some, they were active rumor-spreaders; for others, most journalists engaged only through corrections. Interestingly, the affirm-deny pattern was not the predominate pattern of engagement for journalists in any of the rumors we studied.

One goal of this research was to assess, through the digital trace evidence, the idea that journalists have adopted a "publish first, correct later" practice. Though the practice remains controversial, in a 2014 survey of journalists, 80% reported publishing without first verifying at least some of the time [27]. Our evidence on this is mixed. As enacted in the affirm-deny pattern, this strategy was only prominent (>15% of users) in two rumors, WestJet and Airspace. Interestingly, both rumors spread rapidly and then were corrected quite quickly (within one hour, compared with

several hours in the other rumors). Previous research [4] indicates that rumor correction strategies are shaped by considerations such as time—e.g. people are less likely to correct if some time has passed before they learn the truth. This again underscores how the specific features of individual rumors shape participation by journalists and others.

Our findings do show that when journalists engage, whether in rumor-affirming or rumor-denying behaviors, they do so *earlier* (on average) than other users. They also produce more original content and are retweeted more. And they are consistently more likely to deny rumors than other rumor participants. Taken together, though our evidence does not support a "publish first, correct later" strategy, it does support an "engage earlier, correct more" one.

Aligning with other research [11,13,17,26,27], our findings show that under pressure to respond to fast-moving crisis events in an always-on media environment, journalists' practices for verifying and sharing information are shifting. Journalists were a proportionally small slice of the crowd diffusing these rumors, and though there is evidence that their content is more influential than other content (in terms of being retweeted), it is also clear that they were not able to play their traditional role as gatekeepers curbing the spread of misinformation. Rather, the journalists who engaged in these rumors stepped into a messy process of "collaborative verification" [26], performing a somewhat distinctive, yet inter-connected role as part of the larger crowd. Those who participated solely through denials could be viewed as performing a "gatewatcher" role [13,16,17]. These corrective actions make journalists (as a group) distinct from other members of the crowd. However, not all journalists participated so constructively—indeed, many journalists helped to spread the false rumors in our study and a substantial portion of those did not correct themselves later. This study therefore contributes additional case studies that highlight the messiness of journalistic work in the online realm, the changing practices of real-time reporting, and some of the problematic behaviors that are contributing to reduced trust in journalism as a profession.

Limitations and Future Work

Our data is subject to limitations associated with collecting tweets through the Twitter Streaming API. Due to a lag between event start and initiating our collections, we have data loss in the early propagation window of three rumors (WestJet, Airspace, and Les Halles). Additionally, there is evidence of rate limiting within Les Halles. Therefore, there are likely tweets missing in those collections, which would affect some of our overall counts and could have an impact on some of the analyses. For example, there may be additional users in the Affirm-Deny pattern for Les Halles for which we missed one of their early tweets. Though it is impossible to fully account for this missing data, we have presented analyses of multiple rumors with different data limitations. As with any research study of this kind, we acknowledge the need for future work on more rumors to provide additional evidence into the insights we present here. Additionally, our analyses fall short of determining a clear causal relationship between the actions of journalists and the spread of these rumors, as our data is not an appropriate vehicle for such analyses.

This research looked for overall behavioral differences between journalists and non-journalists in false rumors. One limitation is that we did not consider rumors that turned out to be true. It is possible that journalists stand out in distinct ways in true rumors—something we recommend for future research. Additionally, online rumoring behaviors vary between proximate and non-proximate [10, 51] and there may be interesting and important differences between journalists and non-journalists along that dimension.

CONCLUSION

In this research, we compare the rumoring behaviors of journalists and non-journalists. Our analyses revealed that journalists and non-journalists differ in terms of the content they produce, their propensity to correct false rumors, and their temporal patterns of participation. Journalists produced significantly more original tweets than non-journalists. Journalists were more likely to deny a false rumor, an effect that held up even when we controlled for power user status. Journalists also tended to engage in both affirming and denying a rumor earlier than other users. These findings suggest that journalists remain a distinct professional community of practice within the social media crowd. Though we did not find consistent evidence to support journalists utilizing the "publish first, then correct" strategy (or the more traditional "confirm first, then publish" one), when compared with other users we did see an "engage earlier, correct more" strategy. These findings demonstrate journalists both struggling to adapt to the new conditions of real-time news reporting and continuing to serve a distinguished role in reporting breaking news and helping to correct misinformation.

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