

A multiplatform investigation of law enforcement agencies on social media

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Abstract. Social media plays an important role in the era of e-government. Facebook and Twitter are now widely used by law enforcement agencies to inform the public, communicate and establish partnerships. In this paper, we present a multiplatform investigation of law enforcement agencies on Facebook and Twitter. More specifically, we collected 26,490 Facebook posts and 41,277 Twitter tweets made by 40 U.S. municipal police agencies in 2015. We classified these posts and tweets according to topics related to three social media strategies, i.e., *Push*, *Pull* and *Networking*. We applied quantitative methods to examine the patterns of agencies' posting behavior and user interactions both within and across the two platforms. Our findings provide empirical evidence of how police agencies applied different social media strategies on Facebook and Twitter in their daily practice. We also contribute new knowledge of different public interactions with these agencies on the two platforms and discuss the practical implications.

Keywords: Community policing, social media, Facebook, Twitter, multiplatform investigation, law enforcement

1. Introduction

Social media plays an important role in the era of e-government [1]. Approximately 96.4% of law enforcement agencies surveyed in 2015 by the International Association of Chiefs of Police (IACP) reported that they used social media [2]. Social media platforms inherently allow agencies to quickly share information; they also foster multi-directional communication. They can therefore be used to facilitate crime investigations and improve agencies' communication with the public [3,4]. Since the primary goal of community policing is to establish partnerships with community members so that the members can become active in problem-solving [5–7], social media can be an effective tool for improving community policing as well.

Though success stories exist regarding the positive ways in which law enforcement agencies have utilized social media for community policing efforts [8], social media is still relatively new territory for many of them [9,10]. Until recently, law enforcement agencies have been found to use social media mainly for investigative purposes and for keeping the public informed [11,12]. For example, Canadian police departments used Twitter to send out two types of tweets, i.e., Informational tweets to inform public about crimes, police work and traffic, etc. and interactive tweets to ask the public to attend events, etc. [11]. However, government organizations in general face difficulties innovating their digital interaction on social media [13,14]. Some see part of the issue as being that these organizations have either de-emphasized the engagement potential of social media in favor of satisfying organizational transparency

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needs, or they simply have not yet developed the capacity to capitalize on the public engagement aspect [9].

Currently, Facebook and Twitter are the social media platforms used most frequently by law enforcement agencies [2]. Facebook is the largest social network site (SNS) with 1.13 billion daily active users reported on average for June 2016 [15] and is hugely popular for online socializing. Twitter, on the other hand, is more popular for opinion- and information-sharing [16]. Most existing studies focus on agencies' posting or tweeting preferences, including topic choice and post frequency, on just one platform, e.g., Facebook [17] or Twitter [18]. For example, in our prior work, we manually annotated 6,825 Facebook posts made by four police agencies in 2014 and developed a two-tier code scheme to identify the purpose of a post as well as its topic [10]. We also analyzed user engagement (i.e., likes, shares, and comments) with different post types (i.e., photos, videos, status, and link posts) and post topics (e.g., *Crime*, *Traffic*, etc.). Our results provided practical insights for police administrators regarding how to better engage the public on Facebook; for instance, results showed posts regarding particular police officers received more likes [10]. Because these platforms have their own unique features and different characteristics, it was suggested to conduct multiplatform investigations in social media research to gain a better understanding of how to engage the public more effectively on different platforms [19].

In this paper, we studied how 40 municipal police agencies in the U.S. posted and tweeted differently and in turn received different user responses and interactions across two social media platforms, i.e., Facebook and Twitter. Specifically, we collected 26,490 Facebook posts and 41,277 Twitter tweets made by 40 U.S. municipal police agencies in 2015. We classified the collected posts and tweets using the two-tier code scheme proposed in our prior work [10] and employed a suite of statistical methods to examine various patterns of the messages and their received interactions. Our findings provide practical implications for ways where these agencies can leverage each social media platform differently for increased public interaction.

2. Related work

In this section, we review relevant research from three perspectives: (1) law enforcement agencies' increasing uses of social media; (2) public relations theory and agencies' social media strategies; (3) various factors that can affect user interaction on social media. We also propose our hypotheses given the existing literature.

2.1. Law enforcement agencies on social media

The unique characteristics of law enforcement agencies inform and impact their day-to-day social media usage [20]. First, law enforcement agencies operate in a complex institutional milieu that is framed by federal, state, and local laws, policies, and legal guidance. Second, much of what they do requires gathering, not sharing, information. As such, law enforcement agencies often follow a "need-to-know" information sharing paradigm: agencies publicize operation updates when obligated by law in order to inform and educate the public or when in need of public collaboration to respond to public safety issues [21]. These updates usually appear in the form of press releases, after-action reports, or other formal statements, all of which go through a multi-step vetting process before being shared with the public [22,23].

However, as they increase their use of social media, law enforcement agencies must adapt rather quickly to the instantaneous and multi-directional open-dialog environment that this new media type

encourages, e.g., [24]. Meanwhile, given the potential for two-way communication, they must consider how to respond to the public [25]. Agencies were also found to be at varying stages of adopting social media in their daily practices; some already had social media policies and some were still developing theirs [26].

After investigating the top 10 U.S. municipal police departments' social media usage over three months, Brainard et al. showed that police agencies tweeted more frequently on Twitter than they posted on Facebook or YouTube [25]. Considering Twitter, popular for information sharing [16], provides law enforcement agencies an opportunity to propagate accurate and timely information to a large Internet audience [27,28], we propose our first hypothesis as follows:

H1. Police agencies use Twitter more often than Facebook.

2.2. Public relations theory and social media strategies

Social media is an efficient way to cultivate and maintain successful relationships for organizations [29]. In literature, the management of communication between an organization and its public is discussed as public relations [30]. There are four models of public relations management: (1) press agency, one-way communication using persuasion and manipulation to influence audiences so that they behave as the organizations desire; (2) public information, another one-way communication strategy, focusing on distributing an organization's information to the public; (3) two-way asymmetrical, aiming to collect information that can be useful for an organization; and (4) two-way symmetrical, which uses communication to enhance understanding or resolve conflicts. The excellence theory of public relations emphasizes that two-way legitimate conversation would be more effective to promote the relationship [31]. However, government agencies mainly employed one-way communication to distribute information [32].

Similar to the models of public relations, researchers also identified three social media strategies agencies commonly used in their daily practice, i.e., *Push*, *Pull*, and *Networking*, which correspond to one-way communication in terms of public information, two-way asymmetrical and two-way symmetrical respectively, with the intent being to use different combinations of these strategies [14,33]. The one-way press agency model serves a function of persuasion or propagating the belief of an organization by using misrepresented or emotional information [34], which may not be aligned with the interest of law enforcement agencies who aim to provide legitimate services.

More specifically, in a *Push* strategy, social media channels are used as an extension of the existing Internet properties (e.g., static websites) and traditional public relations techniques (e.g., press releases or conferences). Here, social media sites are used as an additional communication channel to get the message out. This tactic is most often used to publicize information that the organization is obliged to share with the public [14,35].

In a *Pull* strategy, the organizations specifically add a call to action in posts and request that the public either directly interact with the organizations or amongst themselves. Social media applications are used to bring audiences back to an organization's website, where the news is aggregated to avoid losing control over the information. For example, these messages will include a call to like a Facebook page, share updates with others, or even for direct input (such as information regarding an active AMBER Alert or the identification of a suspect in a robbery). *Pull* tactics actively involve audiences using some degree of interaction that typically results in several comments on Facebook walls and a few shares [14,35].

A *Networking* strategy aims for a more informal interaction with social media users and highlights the "human" side of the organization; it also promotes trust, manages conflicts and builds up a long-term

relationship between the public and agencies. Our work provides empirical evidence showing which topics the agencies post about on Facebook when using these three different strategies [14,35].

Studies prior to 2013 found that crime related information (one-way and *Push*) was posted more frequently on Facebook [17] and Twitter [18] than other types of topics, whereas a more recent study [36] pointed out that there was a shift from posts containing crime related information to posts that could foster public (*Networking*) interactions on Facebook. This transition happened along with the effort of these agencies in building community policing [37] so as to promote legitimacy, which was defined as “the rightful exercise of authority or use of power” [38]. However, when we case studied four municipal police agencies using their Facebook posts in 2014, three of the four agencies had more *Push* posts than *Networking* posts [10], albeit the sample data was too small to claim whether the difference was significant. The finding would also have been limited to one social media platform, i.e., Facebook. In this study, we compare agencies’ application of different strategies on both Facebook and Twitter. The above literature suggested and led to us developing the following hypothesis:

H2. Agencies employ the *Push* strategy more frequently than *Networking* and *Pull* strategies both on Facebook and Twitter.

2.3. User interaction on social media

Extensive studies have been conducted to understand how different factors could impact user interaction on social media [39,40]. For example, on Facebook, prior work found that police agencies’ Facebook posts that contain pictures received more interactions from public users [10]. On Twitter, features such as content length, URLs, hashtags, and pictures included in the message have been identified as factors influencing the received interactions from users, e.g., a tweet with URLs or hashtags is more likely to be retweeted [39,40]. Velde and colleagues found that including URLs, mentions and hashtags or writing longer tweets increased the probability of being retweeted [41].

The impacts of content characteristics on user interaction were also investigated. Berger et al. found that the effects of online information transmission were associated not only with emotions (i.e., positive content had a greater likelihood of diffusion than negative content) but also with the extent to which the content invoked strong emotions (i.e., the content that invoked awe or anger emotions was more likely to be share than the content that invoked sad emotions) [42]. For advertising, more persuasive content (i.e., emotional and philanthropic content) on Facebook received more user engagement in terms of the number of likes and comments; however, informative content (i.e., prices, availability and product features) had a negative impact on engagement [43]. Zavattaro et al. found that the U.S. local governments who used positive tones in tweets (e.g., utilizing exclamation points, creative hashtags, retweeting positive tweets) were more likely to promote citizen participation than those who only used neutral tones when sharing information in a *Push* manner [44]. This was also suggested by a prior qualitative study, where an interview study was conducted to examine the purposes of different agencies’ social media strategies; *Push* messages were not expected to receive as many interactions as the other strategies [45]. In this paper, we apply quantitative methods to test the following hypothesis:

H3. *Pull* and *Networking* social media messages receive more user interactions than *Push* messages.

Public users’ interactions with agencies on social media, in terms of likes, favorites, shares, retweets or comments, are indicators of public users’ engagement and responsiveness towards police-initiated content on social media [17,46]. Likes and favorites indicate emotional, social or even habitual engagement [47]; shares and retweets denote the level of information diffusion of police-initiated social media

content; and retweets and comments represent public users' level of conversational engagement [48]. Using 10 municipal police agencies' social media data, more interactions were found on Facebook than on Twitter, and Facebook was more likely to trigger dialogue interaction between police agencies and residents [25]. A similar observation was made by researchers who investigated social media usage of Canadian and American public transportation agencies, where notably higher counts of likes, shares and replies were found on Facebook than their counterparts on Twitter [49]. In this study, we are able to test the following hypothesis by comparing Facebook likes with Twitter favorites, and Facebook shares with Twitter retweets received by the same message that was sent by the same agency:

H4. When the agency sends the same message on both Twitter and Facebook, the message on Facebook receives more interactions from the public.

3. Method

To test the proposed hypotheses, we searched for municipal police agencies' Facebook and Twitter accounts in cities that were either ranked among the top 50 most populated cities in the U.S. or ranked among the top 10 cities for high crime rates [27]. We chose from these types of accounts due to the consideration that there would likely be more safety-related events and related topics that the agencies would post about on Facebook or Twitter in a more populated city or a city with higher crime rates than one that is less populated with low crime rates. However, not all the agencies had official Facebook accounts. We were able to find 40 agencies that had both Facebook and Twitter accounts.

3.1. Data collection

The data was collected using Facepager [50]. For each post and tweet, both the Facebook API and the Twitter API provided the text, the count of interactions (i.e., likes, comments, and shares for Facebook, favorites and retweets for Twitter), creation time, etc. The data was collected in February, 2016. Eventually, a total of 26,490 Facebook posts sent by the 40 agencies during the year of 2015 were collected. They received 10,767,117 likes, 715,901 comments, and 2,726,192 shares. For the same 40 agencies, we collected a total of 41,277 tweets sent in 2015. They received 607,758 favorites and 944,909 retweets.

3.2. Coding

In our prior work, we developed a code scheme for classifying police agencies' Facebook posts [10]. The first level, post category, contains three codes (*Push*, *Pull* and *Networking*), which describe the general purpose of a post. The three categories were developed based on the previous work [14,35]. The second level includes eight codes representing different post topics. *Push* contains 3 topics: *Traffic*, *Crime*, and *Announcement*. *Networking* contains 4 topics: *Tip*, *Personnel*, *Information*, and *Appreciation*. Since the *Pull* posts are about requests for various types of information (e.g., missing persons or criminals wanted) and there were very few *Pull* posts in total, we combined them into one topic: *Request*. Below we show the definitions of the codes and their sample posts.

Push: Agencies use social media as an additional broadcasting channel to perform their obligatory missions [14,35]. Three topics are identified: (1) *Crime*: explicitly conveying information about a crime incident. The crime incident can be related to shootings, homicides, arrests, victims, guns, drugs, etc. (e.g., "*Stabbing: [redacted], dispatched at 12:59 am. Adult male was stabbed and later died.*" – BPD);

(2) *Traffic*: information related to road conditions, such as real-time traffic, road construction alerts, and expected traffic delay alerts (e.g., “*The Cleveland Division of Police is reporting that traffic signals are out in the area of Superior, Chester, Carnegie & Euclid from E. 55th to E. 89th. Cleveland Police are responding to the area in connection with traffic.*” – LAPD); (3) *Announcement*: communicating non-Crime and non-Traffic information (e.g., “*The Cleveland Division of Police First District is conducting a DUI Checkpoint in the area of Rocky River and Puritas tonight, November 11, 2014.*” – CPD).

Pull: Agencies leverage social media platforms to acquire information from the public [14,35]. All posts sent with this strategy are classified into one topic, *Request*: asking the public to provide information about urgent issues, such as identifying a crime incident, finding a missing person, or obtaining critical feedback (e.g., “*Help us identify a person of interest in a robbery investigation: Jan 14th [redacted]. Call [redacted] w/info.*” – BPD).

Networking: Agencies try to build long-term relationships and benign interactions with the public [14, 35]. Four topics are identified. (1) *Tip*: communicating suggestions to improve community members’ lives and well-being (e.g., “*Very high temperatures expected throughout the region this week. Remember to properly care for pets!*” – Cleveland Police); (2) *Personnel*: information that addresses individual names of police department employees (e.g., “*My name is Officer Brown. I’ve worked for the BPD for 24-years. I’m currently assigned to the Southern District.*” – BPD); (3) *Appreciation*: information that expresses gratitude and appreciation (e.g., “*In honor of all who have served and those who continue to serve our country. We take pause to reflect on your commitment and dedication. Thank you*” – CPD); (4) *Information*: including all other non-*Tip*, non-*Personnel*, and non-*Appreciation* information (e.g., “*Plz Support/Follow our partners at @LAPDHQ*” – BPD).

We then applied a similar coding process and annotated the Twitter data. We first randomly selected 500 tweets from the collected tweets. We reviewed each tweet and classified the 500 tweets into three categories (i.e., *Pull*, *Push*, and *Networking*). Then within each category, we extracted the topics to develop the second level of code. We analyzed emerging topics and created a list accordingly. Finally, we merged similar topics and produced a final list of mutually exclusive topics from each category. As a result, the final coding scheme contains the same 8 topics as we had developed using the Facebook data.

Once the coding scheme was finalized, we hired 3 coders and trained them to understand the coding rules and concepts. After the training, two coders started to independently code the rest tweets. They first labeled these tweets into the first coding level. We computed the Cohen’s Kappa to evaluate the inter-coder agreement, defined by Viera et al. [51]. The results showed almost perfect agreement (0.81~0.99) for each category, and topics had substantial agreement (0.61~0.80). We then asked the third coder to label the posts that the first two coders had disagreed on independently and resolved the disagreement with the first two coders together using the “majority rule” approach. Three coders then labeled the posts into the second coding level using the same methodology. The Cohen’s Kappa value for each code is above 0.80.

Using 6,823 manually annotated Facebook posts, we executed the SVM algorithm in Scikit-learn method to classify 26,490 posts sent by 40 agencies, and the accuracy was 76.66%. We also manually annotated 9,837 tweets by using the same code scheme, and classified 41,277 tweets sent by 40 agencies; the accuracy was 80.35%.

3.3. Statistical methods

After classifying all the agencies’ messages, we employed different statistical methods to analyze the data for different purposes. First, we performed a Grubbs’ test to examine whether there were any outlier posts in terms of likes, comments, shares, favorites and retweets that may skew our analyses [52]. We then excluded the outlier posts/tweets before conducting subsequent analyses.

Table 1
Daily post frequency and received interactions per message for each agency

Police departments	Facebook		Twitter	
	Count	Post frequency	Count	Tweet frequency
Albany Police Department	635	1.7	404	1.1
Augusta Maine Police Department	672	1.8	693	1.9
Austin Police Department	2,684	7.4	2,969	9.6
Baltimore Police Department	3,091	8.5	2,908	10.5
Baton Rouge Police Department	499	1.5	42	0.1
Bismarck Police Department	372	1.0	134	0.4
Boise Police Department	324	0.9	1,245	3.4
Cheyenne Police Department	156	0.4	136	0.4
Chicago Police Department	390	1.1	2,336	6.4
City of Atlanta Police Department	1,499	4.1	2,720	11.7
City of Charleston Police Department	391	1.1	1,476	4.0
City of Phoenix Police Department	286	0.8	719	2.0
City of Spokane Police Department	205	0.6	639	1.8
Cleveland Police	228	0.6	538	1.5
Columbia Police Department, Tennessee	315	0.9	311	0.9
Concord Police Department	22	0.1	110	0.3
Denver Police Department	797	2.2	2,868	11.9
Des Moines Police	200	0.5	241	0.7
Detroit Police Department	1,120	3.1	396	1.1
Dover Police Department	395	1.1	529	1.4
Frankfort Police Department	111	0.3	133	0.4
Honolulu Police Department (Official Site)	1,390	3.8	1,473	4.0
IMPD News	840	2.3	2,457	6.7
Juneau Police Department	349	1.0	115	0.3
Lincoln Police Department	203	0.6	168	0.6
Little Rock Police Department	777	2.1	1,275	3.5
Madison Police Department	303	0.8	1,445	4.0
Metropolitan Nashville Police Department	766	2.1	453	1.2
NYPD	328	0.9	2,790	9.4
Oakland Police Department	110	0.3	503	1.4
Oklahoma City Police Department	945	2.6	428	1.2
Portland Police Bureau	1,874	5.1	3,000	8.2
San Francisco Police Department	276	0.8	533	1.5
Santa Fe Police Public Information Officer (PIO)	571	1.6	744	2.0
Scottsdale Police Department	212	0.6	289	0.8
St. Louis Metropolitan Police Department (OFFICIAL)	224	0.6	970	2.7
St. Paul Police Department	256	0.7	962	2.6
Stockton Police Department	1,941	5.3	1,406	5.7
Topeka Police Department	427	1.2	367	1.0
Virginia Beach Police Department	306	0.8	352	1.0
Average of all	662	1.8	1,032	3.2

4. Findings

In this section, to test the proposed hypotheses, we present our findings regarding agencies' posting behavior and user interaction using statistical measurements. Our reflections on how to interpret the results for each hypothesis and their practical implications will be discussed in the discussion section.

4.1. Agencies' posts and tweets

As an overview, Table 1 shows the agency names, the average number of daily posts and tweets each agency made on Facebook and Twitter.

4.1.1. Post and tweet frequency

Finding 1. The agencies tweeted on Twitter significantly more than they posted on Facebook, but their Facebook posts are usually longer than their Twitter tweets (*H1 Supported*).

The post/tweet frequencies of the 40 agencies varied significantly. We used the Euclidean clustering method to cluster the agencies based on their daily post/tweet frequency. We summarized their post/tweet frequencies in groups: (1) 4 agencies (10% of the total agencies, including the Austin Police Department, the Baltimore Police Department, the Portland Police Bureau, and the Stockton Police Department) were very active on both Facebook and Twitter, posting and tweeting more than 5 times every day; (2) 15 agencies (37.5%, including the Chicago Police Department, the City of Atlanta Police Department, the Denver Police Department, etc.) were active on both Facebook and Twitter, with an average of one or more posts and tweets per day; (3) 10 agencies (25%, including the Boise Police Department, the Madison Police Department, the NYPD and the Oakland Police Department) were active on Twitter but less active on Facebook, tweeting more than one time on Twitter but posting on Facebook less than one time on average per day; (4) only 3 agencies (7.5%, including the Baton Rouge Police Department, the Bismarck Police Department and the Juneau Police Department) were active on Facebook but less active on Twitter, posting more than one time but tweeting less than one time on average per day; (5) 8 agencies (20%) were less active on both Facebook and Twitter, posting or tweeting less than once on average every day.

To compare the same agency on two platforms, we calculated each agency's daily post/tweet frequency on Facebook and on Twitter, and ran the Welch Two Sample T-test to compare post frequency and tweet frequency. Facebook post frequency ($Mean = 72.58$, $SD = 28.27$) was significantly smaller than tweet frequency ($Mean = 113.09$, $SD = 52.88$, $t = -12.91$, $df = 556$, $p < 0.001$, and 95% Confidence Interval (CI): $[-46.6, -34.35]$).

We also compared the message lengths of posts and tweets. The result showed that agencies posted much longer messages on Facebook ($Mean = 330.88$, $SD = 584.57$) than tweets on Twitter ($Mean = 111.49$, $SD = 31.75$) in terms of message length. For example, Cleveland Police sent a message about looking for help regarding robbery suspects on both Facebook and Twitter. The post on Facebook was provided with much more details, e.g., “Police Seek the Public Help in Identifying Aggravated Robbery Suspects the Cleveland Division of Police Fourth District Detective Bureau is currently investigating an Aggravated Robbery incident which occurred on March 16, 2015 at approximately 1:45 pm at the Metro PC store at 4090 East 71st Street. Two males entered the store and robbed the cashier at gunpoint. Anyone with information regarding the identity of these suspects is asked to contact Fourth District Detectives at 216-623-5418.”, receiving 26 likes and 9 comments, and 36 shares. On Twitter, the agency also tweeted about the same request “Police Seek the Public Help in Identifying Aggravated Robbery Suspects <http://t.co/PJ0wQqoQGd>”, receiving 2 favorites and 4 retweets.

4.1.2. Social media strategies used

Finding 2. The agencies posted significantly more *Push* posts on Facebook and significantly more *Networking* tweets on Twitter. There were very few *Pull* posts or tweets on either platform, and some agencies did not use the *Pull* strategy at all (*H2 Partially Supported*).

After annotating and clustering the posts and tweets using our two-tier code scheme, we calculated the topics' distribution of all agencies (as shown in Table 2), and the topic distribution of each agency (as shown in Table 3).

First, one agency (the Boise Police Department) did not use the *Pull* strategy on either of the social media platforms, and three agencies (the Albany Police Department, the Concord Police Department,

Table 2
Topic distribution of all agency messages on Facebook and Twitter

Category	Topic	Facebook			Twitter		
		Posts	Percentage	Posts/day	Tweets	Percentage	Tweets/day
Pull	Request	1,092	4.1%	3	2,668	6.5%	7
Push	Announcement	11,241	42.4%	31	5,769	14.0%	16
	Crime	2,461	9.3%	7	5,067	12.3%	14
	Traffic	778	2.9%	2	3,277	7.9%	9
Networking	Appreciation	850	3.2%	2	1,883	4.6%	5
	Information	7,374	27.8%	20	21,914	53.1%	60
	Personnel	993	3.7%	3	392	0.9%	1
	Tip	1,701	6.4%	5	307	0.7%	1

and the Juneau Police Department) did not use the *Pull* strategy on Facebook. Second, 15 agencies applied the three strategies consistently on both Facebook and Twitter. For example, 5 agencies (12.5%, including the Baltimore Police Department, the City of Charleston Police Department, the Denver Police Department, etc.) used the *Push* strategy more on Facebook and Twitter; 9 agencies (22.5%, including the Detroit Police Department, the Indianapolis Metropolitan Police Department, etc.) posted and tweeted more *Networking* messages on Facebook and Twitter; and only 1 agency (the Scottsdale Police Department) applied *Networking* and *Push* in a more balanced manner on both Facebook and Twitter (i.e., the ratio between *Networking* and *Push* daily posts is within the range of 0.9 and 1.1). The rest of the 25 agencies did not apply the three social media strategies in a consistent manner. For example, 19 agencies (47.5%, including the Baton Rouge Police Department, the Chicago Police Department, the NYPD, etc.) posted more *Push* messages on Facebook but tweeted more *Networking* messages on Twitter.

We also calculated the total daily *Push* and *Networking* posts and tweets. On Facebook, there were significantly more *Push* posts ($Mean = 41.37$, $SD = 14.56$) than *Networking* posts ($Mean = 31.19$, $SD = 11.75$) made by the 40 agencies each day ($t = 10.18$, $df = 668$, $p < 0.001$, 95% CI: [8.21, 12.14]). On the other hand, on Twitter, there were significantly more *Networking* tweets ($Mean = 67.11$, $SD = 39.22$) than *Push* tweets ($Mean = 38.67$, $SD = 15.95$) each day ($t = -12.84$, $df = 481$, $p < 0.001$, 95% CI: [-32.80, -24.09]).

Agencies rarely sent *Pull* posts or tweets on either of the platforms. The *Pull* posts mainly contained two types of Requests: seeking information about missing people or witnessing Crimes. For example, *Detroit Police Department* sent a post about a missing child on Facebook, “*Serious Missing; Callie Collier was last seen in the 3000 block of E. Lafayette, by her Mother on April 16, 2015. Callie is described as a B/F/15, 5'11", 135 lbs., light complexion, brown eyes hair, wearing black and white tide jeans, black jacket and black fringe boots. If anyone has seen Callie Collier, please contact the Seventh Precinct's Detective's Unit at (313) 596-1140.*” This post received 57,000 likes and 1,874 comments and was shared for 40,539 times. A couple days later, a follow-up post was announced to inform the public, “*Missing Callie Collier Has been found safely*”, which received 57,411 likes and 1,884 comments and was shared for 2,132 times. The *Pull* practice has shown its effectiveness in terms of being spread out quickly and obtaining information from the public, even though the same message wasn't tweeted on Twitter.

4.2. Received user interactions

Before we examined whether *Pull* and *Networking* social media messages received more user inter-

Table 3
Topic distribution of each agency

Police departments	Facebook				Twitter			
	Posts count	Push (%)	Pull (%)	Networking (%)	Tweets count	Push (%)	Pull (%)	Networking (%)
Albany Police Department	635	51	0	49	404	24	1	74
Augusta Maine Police Department	672	45	0	54	693	33	2	65
Austin Police Department	2,684	62	1	37	2,969	43	2	55
Baltimore Police Department	3,091	63	10	27	2,908	52	9	39
Baton Rouge Police Department	499	76	1	23	42	21	7	71
Bismarck Police Department	372	46	5	48	134	22	7	71
Boise Police Department	324	56	0	44	1,245	26	3	72
Cheyenne Police Department	156	68	1	31	136	34	2	64
Chicago Police Department	390	79	0	20	2,336	3	0	97
City of Atlanta Police Department	1,499	62	2	36	2,720	16	2	82
City of Charleston Police Department	391	79	3	19	1,476	59	5	36
City of Phoenix Police Department	286	61	4	35	719	28	6	66
City of Spokane Police Department	205	42	7	51	639	47	3	51
Cleveland Police	228	52	16	32	538	32	8	59
Columbia Police Department, Tennessee	315	70	4	26	311	17	6	77
Concord Police Department	22	50	0	50	110	37	9	54
Denver Police Department	797	82	1	17	2,868	57	5	38
Des Moines Police	200	69	1	31	241	33	2	65
Detroit Police Department	1,120	26	17	57	396	9	5	86
Dover Police Department	395	57	5	38	529	12	1	87
Frankfort Police Department	111	52	1	47	133	29	2	70
Honolulu Police Department (Official Site)	1,390	72	3	26	1,473	46	4	50
IMPD News	840	22	1	78	2,457	23	3	74
Juneau Police Department	349	60	0	40	115	18	0	82
Lincoln Police Department	203	45	0	54	168	16	2	82
Little Rock Police Department	777	43	4	53	1,275	29	6	65
Madison Police Department	303	59	0	41	1,445	53	0	47
Metropolitan Nashville Police Department	766	3	0	97	453	45	2	52
NYPD	328	74	1	25	2,790	20	17	63
Oakland Police Department	110	80	2	18	503	41	2	57
Oklahoma City Police Department	945	46	18	35	428	42	8	50
Portland Police Bureau	1,874	66	2	32	3,000	48	12	40
San Francisco Police Department	276	83	1	16	533	44	5	52
Santa Fe Police Public Information Officer (PIO)	571	47	8	45	744	20	9	71
Scottsdale Police Department	212	47	6	47	289	46	8	46
St. Louis Metropolitan Police Department (OFFICIAL)	224	55	13	32	970	17	7	76
St. Paul Police Department	256	54	3	43	962	32	3	65
Stockton Police Department	1,941	40	0	60	1,406	26	37	37
Topeka Police Department	427	40	1	60	367	25	1	74
Virginia Beach Police Department	306	26	1	73	352	39	11	51
Grand total	26,490	55	4	41	41,277	34	6	59

actions than *Push* messages and the message on Facebook received more interactions than Twitter, we performed Grubbs' tests to find out whether there were any outliers. The Facebook posts contained 1,938 like outliers, 1,720 comment outliers and 2,334 share outliers, each of which accounts for about 8% of the whole dataset. Similarly, for the Twitter tweets, we also performed Grubbs' tests, and found 2,948 favorite outliers and 2,806 retweet outliers, each of which accounts for about 7% of the whole dataset. We removed the outliers when conducting the following comparisons.

Table 4
Received interactions of posts and tweets sent by the 40 agencies

Category	Topic	Facebook received interactions						Twitter received interactions			
		Likes		Comments		Shares		Favorites		Retweets	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Pull	Request	55	61	9	11	26	26	4	5	10	13
Push	Announcement	65	90	7	11	14	21	3	5	5	8
	Crime	89	94	13	14	20	22	4	5	7	9
	Traffic	20	40	3	8	4	10	2	4	6	8
Networking	Appreciation	104	107	7	9	12	20	3	5	4	7
	Information	62	85	5	9	11	18	3	5	6	9
	Personnel	115	112	10	12	15	23	5	7	9	12
	Tip	42	68	4	7	8	17	4	6	8	9

4.2.1. Interactions within each platform

Finding 3. In general, *Pull* posts and tweets received significantly more interactions in terms of comments/shares on Facebook and favorites/retweets on Twitter. Posts and tweets that contained officers' names (*Personnel*) received significantly more likes on Facebook and favorites on Twitter (*H3 Supported*).

Within each platform, we first studied which social media strategy received significantly more interactions by performing Analysis of Variance (ANOVA) tests. Due to unequal sample sizes and unequal variance for each category, we then conducted Games-Howell tests [53] for post-hoc pair-wise comparisons.

In terms of Facebook likes, there was no significant difference between *Push* ($Mean = 67, SD = 89.65$) and *Networking* posts ($Mean = 66, SD = 89.29$), but both of them received significantly more likes than *Pull* posts ($Mean = 55, SD = 60.51, p < 0.001$). In terms of comments, *Pull* posts ($Mean = 9, SD = 11.49$) received significantly more comments than *Push* ($Mean = 8, SD = 11.53, p < 0.001$) and *Networking* posts ($Mean = 6, SD = 9.27, p < 0.001$), and *Push* posts ($Mean = 8, SD = 11.53$) received significantly more comments than *Networking* ($Mean = 6, SD = 9.27, p < 0.001$). In terms of shares, *Pull* posts ($Mean = 26, SD = 26.50$) received significantly more shares than *Push* ($Mean = 14, SD = 20.98, p < 0.001$) and *Networking* ($Mean = 11, SD = 18.57, p < 0.001$), and *Push* posts ($Mean = 14, SD = 20.98$) received significantly more shares than *Networking* posts ($Mean = 11, SD = 18.57, p < 0.001$).

In terms of Twitter favorites, *Pull* tweets ($Mean = 3.59, SD = 4.90$) received significantly more favorites than *Networking* ($Mean = 3.28, SD = 5.29, p < 0.001$) and *Push* tweets ($Mean = 3.07, SD = 4.69, p < 0.001$), and *Networking* tweets ($Mean = 3.27, SD = 5.29$) received significantly more favorites than *Push* tweets ($Mean = 3.07, SD = 4.69, p < 0.001$). In terms of retweets, *Pull* tweets ($Mean = 10.26, SD = 12.88$) received significantly more retweets than *Push* ($Mean = 6.14, SD = 8.54, p < 0.001$) and *Networking* tweets ($Mean = 5.61, SD = 8.60, p < 0.001$); and *Push* tweets ($Mean = 6.14, SD = 8.54$) received significantly more retweets than *Networking* tweets ($Mean = 5.61, SD = 8.60, p < 0.001$).

We further conducted the same tests to examine which topics received significantly more interactions on Facebook and Twitter separately. Given space limitations, we do not provide all the details of the test results, however Table 4 shows the mean and SD values of each topic on the two platforms. In brief, on Facebook, *Personnel* posts ($Mean = 115, SD = 112.23$) received significantly more likes than *Crime* ($Mean = 89, SD = 93.54$), *Announcement* ($Mean = 65, SD = 89.87$), *Information* ($Mean = 62, SD = 85.43$), *Request* ($Mean = 55, SD = 60.51$), *Tip* ($Mean = 42, SD = 68.36$), and *Traffic* posts ($Mean = 20,$

$SD = 39.94, p < 0.001$). *Crime* posts ($Mean = 13.3, SD = 13.60$) received significantly more comments than all other topics ($p < 0.001$), and *Request* posts ($Mean = 25.66, SD = 26.49$) received significantly more shares than all other topics ($p < 0.001$).

On Twitter, *Personnel* ($Mean = 5.22, SD = 7.32$) tweets received significantly more favorites than *Crime* ($Mean = 3.80, SD = 5.34$), *Request* ($Mean = 3.59, SD = 4.94$), *Information* ($Mean = 3.26, SD = 5.29$), *Appreciation* ($Mean = 2.98, SD = 5.15$), *Announcement* ($Mean = 2.81, SD = 4.58$), and *Traffic* tweets ($Mean = 2.44, SD = 3.66, p < 0.001$). *Request* tweets ($Mean = 10.27, SD = 12.88$) received significantly more retweets than *Tip* ($Mean = 7.64, SD = 9.34$), *Crime* ($Mean = 6.89, SD = 9.36$), *Traffic* ($Mean = 6.30, SD = 7.62$), *Information* ($Mean = 5.65, SD = 8.60$), *Announcement* ($Mean = 5.38, SD = 8.21$), and *Appreciation* tweets ($Mean = 4.14, SD = 7.14, p < 0.001$).

Oftentimes, police agencies sent *Personnel* posts and tweets which contained officers' names on Facebook and Twitter. For instance, NYPD posted "Please continue to keep Officer Moore in your prayers. He was shot on Saturday in Queens while protecting the people of New York City." on Facebook, receiving 20,053 likes. At the same time, NYPD tweeted the similar content on Twitter, "Please continue to keep Officer Moore in your prayers. He was shot on Saturday in Queens while protecting NYC. <http://t.co/7qHcJB8KJF>", receiving 691 tweets. The number of likes and other types of interactions received suggested that *Personnel* messages successfully delivered the "human" side of agencies.

4.2.2. Comparing interactions across facebook and twitter

Finding 4. When the same message was posted and tweeted on both platforms, significantly more interactions were received on Facebook than on Twitter (*H4 Supported*).

Additionally, on Facebook, *Networking* posts received significantly more interactions than *Push* posts; and on Twitter, *Push* tweets received significantly more interactions than *Networking* tweets.

The average likes the 40 agencies received ($Mean = 426.93, SD = 1,484.23$) on Facebook were significantly larger than average favorites ($Mean = 12.30, SD = 13.76$) on Twitter ($t = 5.34, df = 364, p < 0.001, 95\% CI: [261.85, 567.42]$). For the average shares/retweets received per post/tweet each day, the average shares ($Mean = 105.95, SD = 286.71$) on Facebook were significantly larger than the average retweets ($Mean = 36.82, SD = 391.21$) on Twitter ($t = 2.72, df = 667, p = 0.007, 95\% CI: [19.28, 118.98]$). However, a large portion of the Facebook posts was different from the Twitter tweets, i.e., the text was not identical.

In order to understand which platform received more interactions for the same message, we paired up Facebook posts with Twitter tweets. A Facebook post could be paired with a tweet if all of the following three conditions were met: (1) the post and the tweet were sent by the same police agency; (2) they were sent on the same date; and (3) their text was the same in terms of character count and letter sequence.

Out of a total of 26,490 Facebook posts, there were 8,765 posts paired with tweets on Twitter, i.e., they had identical text in the posts and tweets. The remaining 17,725 non-paired Facebook posts and 32,512 non-paired tweets were unique to each platform. We summarized the counts of paired and non-paired posts and tweets according to each topic, as shown in Tables 5 and 6. On both platforms, *Traffic* and *Tip* posts and tweets were shared on both platforms, i.e., agencies used the same text on both platforms for those topics. The paired posts and tweets received significantly more Facebook likes ($Mean = 141.35, SD = 1,099.00$) than Twitter favorites ($Mean = 10.73, SD = 71.53, t = 11.10, df = 8,838, p < 0.001, 95\% CI: [107.56, 153.68]$), and received significantly more shares on Facebook ($Mean = 33.75, SD = 679.23$) than retweets on Twitter ($Mean = 16.99, SD = 112.99, t = 2.28, df = 9,249, p < 0.05, 95\% CI: [2.34, 31.18]$).

Table 5
Comparing paired and non-paired messages on Facebook

Category	Topic	Type	Percentage	Likes			Shares			Text length		
				Mean	SD	P value	Mean	SD	P value	Mean	SD	P value
Pull	Request	Non-paired	70%	53	64	0.241	26	28	0.172	389	291	***
		Paired	30%	58	52		24	22		136	40	
Push	Announcement	Non-paired	67%	75	95	***	17	23	***	463	393	***
		Paired	33%	46	76		7	15		127	46	
	Crime	Non-paired	70%	95	98	***	22	24	***	625	405	***
		Paired	30%	77	82		16	19		119	30	
	Traffic	Non-paired	30%	29	55	***	6	13	**	192	155	***
		Paired	70%	16	31		3	8		135	40	
Networking	Appreciation	Non-paired	60%	118	110	***	15	22	***	260	182	***
		Paired	40%	84	99		8	16		127	51	
	Information	Non-paired	73%	62	84	0.429	12	19	***	131	118	***
		Paired	27%	61	89		9	16		105	43	
	Personnel	Non-paired	67%	129	120	***	17	25	***	329	294	***
		Paired	33%	91	91		12	19		125	49	
	Tip	Non-paired	52%	55	79	***	10	19	***	273	239	***
		Paired	48%	29	52		5	13		141	38	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 6
Comparing paired and non-paired messages on Twitter

Category	Topic	Type	Percentage	Favorites			Retweets			Text length		
				Mean	SD	P value	Mean	SD	P value	Mean	SD	P value
Pull	Request	Non-paired	70%	4	5	***	12	13	***	123	23	***
		Paired	30%	3	4		6	11		120	16	
Push	Announcement	Non-paired	71%	2	4	***	5	7	***	110	32	0.417
		Paired	29%	4	6		7	10		110	29	
	Crime	Non-paired	80%	3	5	***	6	8	***	114	27	***
		Paired	20%	5	6		10	12		122	19	
	Traffic	Non-paired	68%	2	3	***	6	7	0.208	105	34	***
		Paired	32%	3	4		7	9		110	29	
Networking	Appreciation	Non-paired	83%	3	5	***	4	7	0.318	111	36	***
		Paired	17%	5	6		4	6		118	26	
	Information	Non-paired	83%	3	5	***	6	9	***	109	35	***
		Paired	17%	4	5		5	7		114	27	
	Personnel	Non-paired	74%	3	6	***	9	13	0.85	120	26	0.108
		Paired	26%	11	8		10	8		115	25	
	Tip	Non-paired	60%	4	6	0.469	8	10	0.808	118	26	*
		Paired	40%	5	5		8	9		125	21	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Comparing the paired posts on Facebook, *Networking* posts ($Mean = 197$, $SD = 1,568.71$) received significantly more likes than *Push* ($Mean = 105$, $SD = 611.30$, $p < 0.001$) and *Pull* posts ($Mean = 104$, $SD = 727.58$, $p < 0.001$), but there was no significant difference between *Push* ($Mean = 105$, $SD = 611.30$) and *Pull* posts ($Mean = 104$, $SD = 727.58$, $p = 1.000$). *Pull* posts ($Mean = 62$, $SD = 146.49$) received significantly more shares than *Networking* ($Mean = 48$, $SD = 1,054.45$, $p < 0.001$) and *Push* posts ($Mean = 22$, $SD = 188.49$, $p < 0.001$), and *Networking* posts ($Mean = 48$, $SD = 1,054.45$) received significantly more shares than *Push* posts ($Mean = 22$, $SD = 188.49$, $p < 0.001$).

Comparing the paired tweets on Twitter, *Push* tweets ($Mean = 12.30$, $SD = 95.98$) received significantly more favorites than *Networking* tweets ($Mean = 10.70$, $SD = 48.80$, $p < 0.001$) and *Pull* tweets

(Mean = 3.30, SD = 8.37, $p < 0.001$), and *Networking* tweets (Mean = 10.70, SD = 48.80) received significantly more favorites than *Push* tweets (Mean = 3.30, SD = 8.37, $p < 0.001$). *Push* tweets (Mean = 26.00, SD = 160.81) also received significantly more retweets than *Pull* (Mean = 15.80, SD = 54.72, $p < 0.001$) and *Networking* tweets (Mean = 9.20, SD = 52.35, $p < 0.001$), and *Pull* tweets (Mean = 15.80, SD = 54.72) received significantly more retweets than *Networking* tweets (Mean = 9.20, SD = 52.35, $p < 0.001$).

For example, a successful *Networking* Facebook post sent by *Baltimore Police Department*, “Thank you to the students from Gilmor Elementary school for delivering cookies to our Western District police station. Let’s see how many *LIKES* we can get on Facebook to say *THANK YOU* to the students. *OneBaltimore*”, received 30,805 likes and 781 shares. A *Push* tweet sent by *Portland Police Bureau*, “We may have to open a robbery investigation into how @Dame_Lillard of our @trailblazers was left off the #NBAAllStarNYC roster. #VoteLillard”, received 5,394 favorites and 8,360 retweets.

5. Discussion

In this section, we reflect upon our findings and discuss practical implications. We also acknowledge limitations of our work and present future research.

5.1. Reflections on the findings

Agencies were significantly more active on Twitter than on Facebook (*Finding 1*), but the average interactions received on Twitter were significantly less than on Facebook (*Finding 4*). It is possible that the negative impact of high frequency posting contributed to the lower user interaction rates [54] that Twitter received compared to Facebook.

Our findings also indicated that agencies turned to Facebook for much longer posts with richer information than they would tweet on Twitter, and those posts and tweets that they shared on both platforms were confined by the character count constraint imposed by Twitter. We took a good sample of non-paired (i.e., unique on one platform) and paired (i.e., shared on both platforms) posts and tweets sent by each agency. There was more rich information in the non-paired posts and tweets than the paired ones.

The fact that these unique and longer posts on Facebook received more interactions suggests that agencies should not restrict their posts to follow the norm of social media, where posts are typically short. They should provide more details if necessary. For example, a paired *Pull* post from the Cleveland police agency wrote “WANTED for Bank Robbery: Demar Bradford, black male age 32. Know this guy? Call Fifth District investigators at 216-623-5518,” whereas the agency’s non-paired *Pull* post provided more detailed information about the victim, e.g., “MISSING FEMALE ENDANGERED the Cleveland Division of Police Domestic Violence Unit is currently seeking the public’s help in locating a 20 year old female. This female is a victim of Domestic Violence and was last seen on October 25, 2015. She was reported missing on November 9, 2015. Angela Lochan is described as a 20-year-old female of West Indian decent. She is 5’9” tall with brown hair and brown eyes. Anyone with information regarding her whereabouts is asked to contact detectives at 216-623-5864.”

Similarly, a non-paired *Traffic* post from the Columbia Police Department not only informed the traffic condition but also gave suggestions: “***TRAFFIC ALERT*** The Columbia Police Department is on the scene of a broken gas line on Nashville Hwy between Bear Creek Pike/Hwy 43 intersection and Burt Dr. Motorists are encouraged to seek alternate routes and avoid this area if possible. Expect heavy traffic and detours in this area. PLEASE USE CAUTION WHEN DRIVING THROUGH RESIDENTIAL

AREAS as DETOURS!!! Drive the posted speed limit, CHILDREN at PLAY. UNKNOWN when traffic flow will return to normal but we will update this post at that time.” On the other hand, a paired traffic post stated: *“TRAFFIC ALERT UPDATE – Nashville Hwy is back open to normal traffic flow. Thank you for your patience. 7:25 pm.”*

We examined the law enforcement agencies’ social strategies through the lens of public relations theory. Our early work of case studying four municipal police agencies [10] showed that *Pull* strategies were effectively in receiving interactions from the public. This study of 40 agencies’ social media messages re-confirmed the finding across two platforms (*Finding 3*). However, most of the agencies sent very few *Pull* messages on either of the platforms, and some agencies did not apply *Pull* strategy at all (*Finding 2*). This empirical evidence suggests that agencies’ under-use of social media for one-way asymmetric communication [30].

Agencies made more *Push* posts on Facebook and more *Networking* tweets on Twitter (*Finding 2*). This was a surprising finding since previous studies found that Facebook was regarded as a social network platform for image promotion and Twitter was more news-oriented and valuable for informing the public and for urgent warnings [17,18,55,56]. A practical implication of our finding for police agencies could be to balance their use of social media strategies by sending more *Networking* messages on Facebook and *Push* tweets on Twitter.

Our findings also have theoretical contributions. According to Milgram’s famous obedience experiment, people tend to be persuaded by others with status and authority [57]. A legitimate source of authority could make this persuasion even stronger [58]. Our findings show that posts and tweets containing officers’ names received significantly more likes on Facebook and favorites on Twitter, and were shared and retweeted more than many other topics, could be explained in part by these theories. For instance, NYPD posted *“Winter Storm Information and Safety Tips Follow @NYPDNews, @NYCMayorsOffice, @NotifyNYC and @NYCoem on Twitter for the latest updates on the expected winter storm. – Drivers are urged to stay off New York City roads – Call 911 for emergencies, 311 for non-emergencies and loss of heat – Use only portable heating equipment that is approved for indoor use More Safety Tips: <http://www.nypdnews.com/2015/01/winter-storm-information-and-safety-tips.html>”* and received 4,288 likes, 170 comments. The post was shared 516 times. Posting and tweeting about officials, detectives or staff members, even simply including their names, might help promote positive sentiment and legitimacy on social media.

5.2. Limitations and future work

The data used in this study is a snap shot of agencies located in large cities at a certain time. It is likely that police agencies altered their social media posting practices over time for different purposes. Our data can be used to examine if certain strategies received more interactions, however the data cannot be used to claim causal relationships. To fully examine the causality, we would need to apply a triangulation approach, e.g., by interviewing the agencies, collecting their policies, organizational factors as well as other environmental factors such as cultural differences.

In this study, we focused on the top level posting and did not analyze replies to the posts. Public users’ responsiveness, especially the conversational responsiveness, indicates the potential for further collaboration between police and citizens on social media [25]. In the future, we will expand our comment analysis to further understand conversations between the agencies and the public on social media platforms. Studies on how social media is used differently during daily operation versus crisis situations could be developed by integrating our codes with the code themes for crisis management [59,60].

6. Conclusion

In this study, we conducted a multiplatform investigation on how police agencies use Facebook and Twitter in their daily practice. More specifically, we classified 26,490 Facebook posts and 41,277 Twitter tweets sent by 40 U.S. municipal police agencies in 2015 to different topics that correspond to different social media strategies. We applied quantitative methods to examine the patterns of posting/tweeting behavior and user interaction both within and across the two social media platforms. We found that the agencies tweeted more frequently on Twitter but posted much longer messages with richer content on Facebook. The public also interacted with the agencies on Facebook more actively. Interestingly, even though Twitter is found more effective in promoting news-oriented messages and *Networking* type of messages received more interactions on Facebook, the agencies sent more *Push* messages on Facebook. Our findings provide empirical evidence that suggests agencies' under-use or even misuse of social media platforms. We discussed practical implications for law enforcement agencies on Facebook and Twitter by applying platform-specific strategies for more effective community policing. For example, in order to receive more interactions, the agencies may consider to address officials or individual personnel when sending requests to the public.

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