Popping the hood on Chinese balloons: Examining the discourse between U.S. and China-geotagged accounts
by Lynnette Hui Xian Ng and Kathleen M. Carley

Abstract
In this study, we examined online conversations on Twitter about a Chinese balloon spotted over U.S. airspace in January 2023. We investigated the conversations between U.S.-based, China-based and accounts from the rest of the world. We also studied the difference between bots and human accounts within these conversations. We found that U.S.-based accounts referred to the balloon as a surveillance balloon, China-based accounts focused on the shooting and removal of the balloon, while the rest of the world engaged in general discourse. There were also some differences in the focus of topics between bots and human accounts within each region.

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Introduction
On 28 January 2023, a Chinese-operated high altitude balloon was spotted in American airspace. The United States (U.S.) announced that it was a surveillance balloon that could monitor U.S. communications, while China maintained that it was a weather balloon and that it had been blown off-course by wind. The balloon was eventually downed by a missile fired by a F-22 Raptor plane flown by the U.S. Air Force.

Sightings of the balloon floated around social media, with images and videos of the balloon’s destruction captured by U.S. civilians. Speculation and theories on the balloon’s usage travelled through social media, where netizens coined new hashtags, such as #ChineseSpyBalloon and #UFOBalloon, referring to the balloon as a spy balloon and an unidentified flying object.

This balloon incident increased U.S.-China tensions, prompting both countries to hold media briefings to present their narratives. While there were official narratives presented by spokespersons for both countries, we set out to investigate the citizen voice: the perspectives and thoughts of an everyday person. We examined the commonly used social media platform Twitter, a hotbed for discussion on a variety of topics, and segmented the discussion space by the two key geographical locations, U.S. and China.

There have been a long string of studies examining Twitter on U.S. political issues. It has been studied to
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understand public concerns during specific electoral campaign seasons: in the 2016 elections, concerns were raised about Democrats being a threat to security, in the 2020 elections, concerns shifted to domestic entities such as big technology companies (Luther, et al., 2021). It has also been used to identify and access online journalists playing influential but positive roles in political communication (Zheng and Shahin, 2020), as well as political entities like Donald Trump and Hillary Clinton who harness Twitter to spread their campaigns (Akman and Yenimol, 2023). Within these discourses, automated bot agents have been extensively observed, and even noted to distort online political discussion (Bessi and Ferrara, 2016).

Studies on Chinese Twitter discourse have shown active discussion regarding Chinese political issues that involve neighboring countries like Hong Kong (Bolsover and Howard, 2019). There has been evidence that some online messaging has been targeted at Western audiences, such as during the 2021 Summit of Democracy where accounts promoted Chinese-style democracy and discussed U.S. domestic issues such as wealth disparity and gun violence (Jacobs and Carley, 2022). Observations also indicated the involvement and extensive use of bots to amplify messaging, such as during the 2022 Winter Olympics (Myers, et al., 2022), or the large amounts of anti-Chinese-state hashtags spread by automated accounts (Bolsover and Howard, 2019).

This study extends past studies with regards to U.S. and China by examining social media discourse of accounts geotagged to both countries within the same scope.

In this study, we examine the difference in topics presented on social media between accounts that were geotagged in the United States versus those geotagged in China and the rest of the world. While Twitter is banned in China making Chinese Twitter use sparse, we relied on self-expression of geolocation. In doing so, we assumed that accounts deliberately associated themselves and their posts from a geolocation that they tagged, representing a corresponding region with their perspectives. In analyzing narratives, we did so in terms of word and emoji analysis. We provided additional analysis by segregating accounts into bot-like and human-like accounts, in order to consider the presence of automatic, or inauthentic, actors.

In particular, we examined the following research questions:

- **RQ1**: What proportion of the discourse for the balloon incident was organic, and what proportion was inauthentic?
- **RQ2**: Were there different narratives that were posted by accounts that were geotagged from the U.S. versus those from China versus those from the rest of the world?
- **RQ3**: Were there different narratives for bot-like and human-like accounts?

In our findings, we observed a proportion of inauthentic bot accounts (35 percent), which was higher than a global bot population estimate (6–15 percent). While we observed differences in discourse between geographical locations, we did not observe huge differences between bot and human accounts.

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**Methodology**

**Data collection**

This study collected data from the social media platform Twitter. Twitter is a platform where users around the world express their opinions in real time to news and political events. Thus it is an ideal space for understanding discussions within each region. We used the Twitter V1 search API to obtain tweets that
contained the hashtags “#chinesespyballoon”, “#chineseballoon”, and “#weatherballoon”. The search was carried out from 28 January until 1 March 2023. In total, the dataset included around 120,000 unique users and 1.1 million tweets.

**Bot account identification**

Social media bot accounts are automatic accounts. Bot accounts on Twitter have been studied extensively for these accounts have been observed to disrupt social media space: narrative manipulation during elections (Luther, et al., 2021; Borra and Weber, 2012); disinformation spread during key events like deaths and political changes (Nansen, et al., 2019; Recuero, et al., 2021); and, revolutionary calls for freedom in Asia (Ng and Carley, 2021). Analyzing conversations by bot and human accounts provides an idea on how organic discourse differs from inorganic discourse. This separation of narratives can provide indications on a natural point-of-view versus constructed perspectives of an incident.

To identify whether an account was a bot or human, we ran the BotHunter algorithm, a tiered random forest algorithm that evaluates features of an account — such as user name, number of followers, and number of tweets — to return the likelihood that an account is a social media bot. The generated likelihood is a probability between 0 and 1. In this study, we adopted the score of 0.7 as the threshold for marking social media bots: an account with a score above or equal to 0.7 was deemed as a bot; an account with a score below 0.7 was deemed as human (Ng, et al., 2022).

**Geolocation identification**

To assign a geolocation to each account, we used self-disclosed geolocation. This was extracted from an account’s metadata, under the “country” field. Upon retrieving this information from user data, we performed a reverse geolocation search using Nominatim API 4.2.1 [1], which provides detailed information such as state and city of a location string. With these details, we retrieved the country term. For example, if an account declared its location as “Washington, D.C.”, the Nominatim search identified the account as in the “United States”. There were some accounts where geolocation was not disclosed, or the search returned a null result. As such, we indicated these accounts as from the rest of the world.

This procedure can return geolocations from all over the world, but for this study, we primarily focused on accounts geolocated in the United States and China, the two key countries that were involved in this incident. Using this geotagging method, we were able to identify whether there were different conversational narratives that were circulated by accounts of different expressed origins.

Assigning geotags to each account did not mean that an account necessarily originated in the tagged country; rather, it indicated that an account claimed to be from that country. Without further verification, it was not possible to determine the true country of origin of an account: some accounts could be created in one country but identified with the geotag of another. Additionally, the Twitter platform is banned in China, which means that accounts were likely posted through a VPN or from outside of China. Nonetheless, in this work, we analyzed the differences between discourse accounts based on expressed geotagged locations, investigating whether different geotagging assignments differentiated conversations.

**Narrative analysis**

We used a combination of textual, emoji, and image analyses to understand narratives put forth within this event. A tweet typically contains text and sometimes emojis. It can also contain an image as a media attached to a tweet. We extracted and analyzed these three components within geographical areas, and also per type of account, providing a portrayal of the event from different perspectives.

**Textual analysis**

We used topic modeling as a textual analysis method. Topic modeling summarizes themes that are being posted within text of tweets, providing a top-down view of discussion within text. Studying the
characteristics of the content in the text has been useful for news detection, sentiment analysis, topic classification and other tasks (Hong and Davison, 2010).

For each text, we first pre-processed text to remove hashtags, @mentions and URLs, retaining only raw text. We also removed stop words, that is words unimportant to the general meaning of a sentence. Then, we used the Python SkLearn CountVectorizer module [2] to convert words in text into token counts. Finally, we used the Python wordcloud library [3] to plot wordclouds that represented frequency of words, in which a larger size of words in the cloud indicated a higher frequency of a given word within a group of texts. We performed this analysis per geographic region and account type.

With this textual analysis technique, we broke down text chunks into bags of words, characterized by their frequency of use. This ordering assumed that the more frequent words were those of higher focus for the group of accounts, therefore they were repeated more often within text. Therefore, by inspecting word clouds, we were able to visualize key terms that were at the heart of conversations for each group.

**Emoji analysis**

In social media, emojis are frequently used. Emojis are pictograms are used to convey ideas. Emojis have been shown to have communicative functions, expressing rhetorical relations, personal feelings and opinions in a graphical manner (Ge and Herring, 2018). Within our work, we analyzed the frequency of emojis and differences in usage and word representation across geographies. The analysis of emojis provided insights into a pictorial expression of thoughts from accounts across geography, enhancing our understanding into perspectives towards the event. We extract emojis from each text using Python’s regex and emoji packages [4]. Then, we calculated the frequencies of each emoji per geographic group and account type (bot/human).

**Image analysis**

Humorous political images and memes have gained prominence during key events, such as the Brazilian elections or the U.S. presidential elections. Memes can be deliberately created by political fronts with intentions to regulate the frame of an event, or can be cultural constructions created and articulated by the masses (Chagas, et al., 2019). Many humorous memes were circulated during this event, which provided us a source in understanding the humorous appeal of the event.

Images from tweets were downloaded and inspected for their humor. Images identified as humorous memes were manually extracted by two annotators, and agreed upon both ways. Both annotators were within the ages of 30–35 and were well-versed in social media. The images were then matched with their corresponding accounts. Humorous memes were defined as images that provided laughter, poked fun at the situation, and also engaged in satire. Although this methodology can be prone to individual subjectivity, the humor factor of the images was agreed upon by both parties, increasing reliability. In total, there were 18,483 images extracted as humorous memes. We then analyzed the proportion of humorous memes per geographical location, identifying which regions generated more humorous memes. By further analyzing account types that generated memes, we also analyzed whether memes were generated by authentic or inauthentic accounts.

Lastly, we provided a preliminary classification of the humorous memes. Five categories were determined by the two annotators independently, before coming to an overall agreement. After which, memes were manually classified into categories, with annotator disagreement resolved via discussion.
High proportion of bot accounts

In light of the first research question about the proportion of organic vs. inorganic accounts within online discussion, we analyzed the number of bot accounts within our collected data. We segregated the identification of bot accounts by their indicated geographical location, allowing us to perceive the nature of discourse within the event.

The online discussion surrounding the Chinese balloon revealed that bots were extensively involved in the discourse (Figure 1). An average of 35 percent of the accounts were classified as bots, a higher proportion compared to a global study of bot population on social media. It is estimated that there 6–15 percent of social media accounts around the world are bots, and in particular 14 percent of accounts geotagged in the U.S. are bots (Tan, et al., 2023). Our observations of a higher proportion of bot scores demonstrated that automated accounts were extremely interested in this topic. Of note was the higher proportion of bot accounts originating from China: 46.05 percent of accounts that have expressed their geolocation to be in China were classified as bot accounts. Unfortunately, from only social media data, we were unable to identify the operators of these accounts and whether the bot accounts across both the U.S. and China were intended to spread specific messages.

![Figure 1: Proportion of bots within each geographic group.](image)

Differing textual narratives within each region

We observed several differences between narratives put forth by accounts geotagged for each region, as illustrated in the word cloud in Figure 2. Accounts tagged in the U.S. were focused on the location of the balloon and its identification. This can be visualized by larger sized words of “Myrtle Beach”, “airships”, and “spotted over”. Accounts from the U.S. consistently referred to the balloon as “spy balloon” or “surveillance balloon”, leading to a high frequency of those words appearing in the word cloud. These terms demonstrated that accounts from the U.S. perceived the balloon as a threat.
Examples of such tweets included: “The balloon went straight to Myrtle Beach?”; “[...] China’s unmanned airships can easily penetrate US airspace. The US air defense system is not as solid as imagined. The wandering balloon not only can attack remotely, but also can attack anywhere”.

Accounts geotagged in China presented narratives on “MAGA” (Make America Great Again) and “SleepyJoe”. “MAGA” is a phrase associated with previous U.S. president Donald Trump in his political campaign, and “SleepyJoe” refers to a nickname that Trump invented for his political opponent Joe Biden in 2020. The presence of these phrases demonstrated that accounts geotagged to be from China could be attempts to steer attention away from the event and the country.

Examples of the corresponding tweets were: “[...] Come on, we have cameras, drones, and stealth bomber assessoris purchased by the US government, also TikTok, masks, refrigerators, Christmas trees, #MAGA hats and countless spies in the USA. China needs not monitor the evil center with a runaway balloon #ChineseBalloon”, “It’s hard to say the balloon is from China. I.Election:As the 2024 president election is coming, republicanant probably just using this ‘true’ news to make an advantages for @realDonaldTrump, as the government of the US goes.”
For accounts that were tagged within the rest of the world, such as Europe or Asia Pacific, they presented information about the surveillance properties of balloons and also about alternative theories such as the balloon being an UFO (unidentified flying object) with extraterrestrials arriving on Earth. Examples of corresponding tweets were: “Come back soon #alien #UFO #ChineseSpyBalloon [...]”, “This is what we meant by #UFO when the US was shouting loud about #Chinese #SpyBalloon [...] But it was shot down by US and China was unhappy about it”.

We can further interpret these responses with a social cybersecurity lens (Carley, 2020a), framing the activity of accounts geotagged in the two countries in terms of the BEND framework, which characterizes narratives in terms of information maneuvers (Carley, 2020b). The BEND framework provides a taxonomy of maneuvers that users on social media present themselves towards when penning their thoughts about an issue. Using terms from the taxonomy, response towards the balloon from U.S.-tagged accounts were “Dismay” messages, indicating worry about the balloon’s possible spying and surveillance activities. Chinese accounts were performing more of a “Distort” of the narrative, to present a different narrative about the balloon to discuss war and MAGA. This was coupled with “Dismay” narratives, possibly to indicate that the U.S. was over-reacting. At the same time, accounts from the rest of the world presented “Excite” narratives, finding amusement with the issue, talking about UFOs and aliens.

**Similar textual narratives per account type**

In terms of textual narratives perpetuated by bots and human accounts, we did not observe a huge difference in discourse. From an inspection of the word cloud, the two account types generally used the same phrases, hence expressing the same ideas, across all three categories of regions. This could be because that at a regional level, account operators generally had the same point of view of the event, regardless of bot or human, reflected in the similarity of word structures in the word cloud.

![Figure 3: Emojis present by account type and region.](image-url)
Differing key emojis per region and account type

All three region-based groups used different emojis to represent their thoughts. Figure 3 illustrates the emojis through a frequency cloud that were present within each of the group types. Consistent with our previous findings, we observed that accounts from different geographic groups had a different focus within this event. Accounts from the U.S. had a high frequency use of alarm bell and the blaring alarm emojis, sounding an alarm over the presence of a balloon. Examples of the tweets are: “ #ChineseSpyBalloon Similar high-altitude surveillance balloons airships previously spotted over Japan, Philippines [...]”, “Major explosion in the air over Billings, Montana, reportedly where the Chinese balloon was.”

Accounts from China had a high usage of an explosion emoji, possibly related to the destruction of the balloon, and the clown emoji, possibly mocking the U.S. over their overreaction to the balloon. Examples of the tweets are: “Darts and drones to counter balloons.”, “To show you what a the US President @POTUS is, the Chinese sent him a #Ballon”.

For accounts originating from the rest of the world, there was an increased focus on UFOs, aliens, and lighting emoji, consistent with some speculation that the balloon was actually an unidentified flying object. Example of the tweets are: “At least CN [Cartoon Network] City didn’t have sus flying objects ”, #SpyBalloon #ChineseSpyBalloon #TheWheel #ufo #Messiah warns “…They saw going away CLOUD RETURNED LIKE MANNER. clouds Heaven GREAT POWER.’ means went PLANE(#TheWheel, #ufo) that...”,118611326,” [...]

We also observed that bots used emojis differently as compared to humans. For example, in the United States, humans had a higher use of the crown and sad face emojis, while bots had a higher use of explosion and UFO emojis. Bots geotagged in China and the rest of the world had a high usage of the explosion emoji, while humans used a large number of the laughing-with-tears emoji.

Analysis of humorous images

During our study, we discovered a handful of humorous images regarding the event and manually extracted them. These images made reference to the theme of ‘balloon’. Some of them had cultural references to Chinese themes such as using Chinese festive lanterns and food (tangyuan), while others referenced pop culture such as the balloon house in the movie Up (2009) and Winnie the Pooh in flight. The commonality of all these images was that they made use of the original image of the balloon floating above the U.S. Figure 4 provides examples of humorous images retrieved.

Figure 4: Examples of humorous memes posted.
Of the 11,792 identified accounts that posted humorous images, 56.74 percent were identified as bot accounts. These bots were geographically indicated to be from all three regions (United States: 62.52 percent, China: 5.25 percent, Rest of the world: 32.24 percent). However, bots were not the only ones responsible for humorous images, for about half of the identified images were posted by human accounts. These human accounts were geographically distributed where accounts from the U.S. were most predominant (60.62 percent), followed by accounts tagged to be from the Rest of the world (30.79 percent), followed by China-tagged accounts (8.59 percent). In fact, Chinese diplomat Zhang Meifang also posted an image to her Twitter account on 5 February 2023, which provided a sketch of a white balloon in blue sky.

The images were then classified into five categories by two annotators. Table 1 provides the proportion of meme type annotated per category. Most of the images that were circulated on social media were images that overlaid a text or another image on a photo of a white balloon in blue sky. This was likely the most popular way of constructing humorous images related to the event because it was the easiest, requiring only an overlay of an image. The next most popular category of image type was that containing pop cultural references, such as television shows or cartoons. This category was likely to be popular because it used references that could be understood by a broad audience. Lastly, there was a roughly equal proportion of images that contained Chinese cultural references, reference explosions which came about from the destruction of the balloon, and finally a nod to various political figures.

<table>
<thead>
<tr>
<th>Category</th>
<th>Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>With Chinese cultural references</td>
<td>14.89</td>
</tr>
<tr>
<td>With pop cultural references</td>
<td>23.40</td>
</tr>
<tr>
<td>With references to explosions</td>
<td>13.83</td>
</tr>
<tr>
<td>With references to political figures</td>
<td>13.83</td>
</tr>
<tr>
<td>With humorous images/text on an image of a white balloon in blue sky</td>
<td>34.04</td>
</tr>
</tbody>
</table>

**Limitations and future work**

There are a few limitations to this study that should be acknowledged. The data was collected using the Twitter sampling API, which returns a sample of one percent of the tweets generated in social media space. We assume that this returned sample is representative of the data related to this event. While we tried to keep the choice of hashtags to be as generic as possible, there were still biases within the data. Twitter is used more in the West than the East, resulting in a dataset with more tweets originating in the Western world (Statista, 2022). In our dataset that there were 4.3 times more accounts from the U.S. (N=51,283) than China (N=11,897). The number of accounts geotagged from the rest of the world rivaled that of the U.S. (N=56,399). Nonetheless, this collection provided a glimpse of the response and hashtag usage of accounts geotagged from different countries.

Additionally, in determining the locations of geotagged tweets, we relied on the users’ expressions of geolocation. Many accounts did not have a geotagged location. There were also accounts that were deliberately geotagged to other locations rather than the positions that they were posted from.
Future work involves digging deeper into the accounts geotagged to each country and examining their composition — whether they were state-sponsored accounts, news accounts and their political affiliation. It also involves a more in-depth study of the use of humorous images to circulate messages and how that can contribute to an account’s overall social media agenda.

Conclusion

Our examination of a brief spurt of social media discourse surrounding a transnational event shows that accounts geotagged to be from different countries can circulate different narratives. Social media can be used to disseminate ideologies and steer a storyline, which we have observed where accounts from the United States and China have differing discourse. However, from only social media data, we were unable to pinpoint the origin and intent of the narratives, *i.e.*, whether they were state-sponsored narratives, or attempts to soothe diplomatic tensions. We performed multi-dimensional narrative analysis by analyzing textual and emoji content, extracting both word and pictorial representations within tweet text. We found that accounts from different geographic groups had different focus about the event: accounts from the U.S. generally were alarmist about surveillance activities; accounts from China focused largely on U.S. overreaction to the balloon, and accounts from the rest of the world engaged in general discourse and humor.

Our study also investigated the engagement of social media bots on the Chinese balloon, identifying a high percentage of bots present in the discourse. Bots and humans posted similar textual narratives; however they differed in key emojis that they used within tweets.

Lastly, we discussed the presence of humorous memes that emerged during this event. Most of the humorous images that were geotagged were from the United States. There were almost an equal number of bots and humans posting humorous images. We then provided a categorization of the types of memes observed.

About the authors

**Lynnette Hui Xian Ng** is a Ph.D. student in the Department of Computer Science at Carnegie Mellon University. She received her B.S. in computer science from the National University of Singapore. Her current research interests span societal computing and social cybersecurity.
E-mail: lynnetteng [at] cmu [dot] edu

**Kathleen M. Carley** is a professor in the School of Computer Science at Carnegie Mellon University.
E-mail: carley [at] andrew [dot] cmu [dot] edu

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Notes


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