The Eye-of-the-Storm Effect on the Psychological State of Disaster-Affected Populations under Typhoon Mangkhut

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Abstract

We selected behavioral data from Weibo users in typical affected areas (Guangdong) and non-affected areas (Anhui) during Typhoon Mangkhut, and employed big data analysis methods to examine the psychological typhoon eye effect from both temporal and spatial dimensions. The results revealed that, on the temporal dimension, attention to the typhoon in affected areas exhibited differences, but did not display the "high-low-high" psychological typhoon eye pattern. Specifically, attention levels in affected areas were significantly higher after the typhoon' s passage than before its passage, while no significant differences were found between the pre-arrival and during-passage periods, nor between the post-arrival and during-passage periods. On the spatial dimension, no significant differences in attention to the typhoon were identified between affected and non-affected areas. This paper analyzes the limitations of the study, aiming to provide relevant considerations and references for future research.

Full Text

The Psychological Typhoon Eye Effect on Victims Under Typhoon Mangkhut: An Analysis of Microblog Behavioral Data Based on Temporal and Spatial Dimensions

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Abstract

This study examined the psychological typhoon eye effect across temporal and spatial dimensions by analyzing microblog behavioral data from typical disaster-affected areas (Guangdong) and non-affected areas (Anhui) during Typhoon Mangkhut using big data analytics. The results revealed temporal differences in attention to the typhoon in affected areas, but no "high-low-high" psychological typhoon eye pattern. Specifically, attention levels in affected areas were significantly higher after the typhoon's passage than before landfall, while no significant differences were observed between the pre-landfall and during-landfall periods, nor between the during-landfall and post-landfall periods. In the spatial dimension, no significant difference in typhoon attention was found between affected and non-affected areas. This paper analyzes the study' s limitations to provide insights and references for future research.

Keywords: Typhoon Mangkhut; Temporal; Spatial; Microblog Big Data; Psychological Typhoon Eye Effect
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Introduction

Typhoon Mangkhut, designated as international number 1822, was the most powerful typhoon to hit the Pearl River Delta region in 37 years. It made landfall in Taishan Haiyan Town, Guangdong on September 16, 2018, affecting nearly 3 million people across five provinces (Guangdong, Guangxi, Hainan, Hunan, and Guizhou) within just two days. The disaster resulted in 1.601 million people being urgently evacuated and resettled, over 1,200 collapsed houses, and direct economic losses of 5.2 billion yuan, causing severe casualties and property damage to the nation and its people (He, 2018).

Beyond physical destruction, natural disasters inflict profound psychological trauma on affected populations. Accurately understanding and describing the psychological impact of such typhoons is fundamental to addressing post-disaster psychological assistance needs and adjusting public mental health preparedness for future disasters (Shen, Zhang, & Wang, 2014). This study addresses this critical need by employing big data analytics to investigate the dynamic trajectories of psychological states among people in affected versus non-affected areas before, during, and after the typhoon disaster.

Given that typhoons are predictable natural disasters, understanding the psychological evolution of affected populations across three distinct phases—pre-landfall (after receiving warnings but before the typhoon hits), during landfall, and post-landfall (after the typhoon passes)—can help mental health professionals select appropriate intervention strategies for each period. Previous psychological research has identified a "psychological typhoon eye effect," where psychological states paradoxically become calmer as temporal proximity to the high-risk period increases and as spatial proximity to the high-risk location decreases (Li et al., 2009). This phenomenon has been demonstrated across spatial dimensions (Li et al., 2009) and post-disaster temporal dimensions (Shi et al., 2003). However, due to the unpredictable nature of many disasters, prior research has struggled to capture psychological states during the pre-disaster and mid-disaster phases. Typhoons' predictability enables a complete investigation of psychological changes across all three phases. Furthermore, this predictability provides affected populations with a preparation and waiting period, creating psychological expectations during the disaster itself—a key difference from sudden-onset disasters like earthquakes or flash floods that may produce distinct temporal psychological patterns.

Weibo (microblog) data offers two significant advantages for this research: temporal and geographic recording capabilities, and large data volumes. Leveraging typhoon radar maps, this study examines the psychological impact of Typhoon Mangkhut from both temporal and geographic perspectives. Specifically, we analyze Weibo behavioral data from typical affected (Guangdong) and non-affected (Anhui) regions across three time periods—pre-landfall, during landfall, and post-landfall—to investigate changes in attention levels toward the typhoon and apply the psychological typhoon eye effect framework to interpret psychological responses to this natural disaster. This research aims to enhance understanding of psychological state changes surrounding predictable stressful events among mental health researchers while providing practical insights for disaster warning systems, public opinion management, and post-disaster psychological rescue operations.

2.1.1 Temporal Dimension: Typhoon Eye Effect on Attention Levels

This analysis investigates how attention toward Typhoon Mangkhut varied across three time periods among affected populations in Guangdong. The independent variable was time period with three levels (pre-landfall, during landfall, post-landfall), while the dependent variable was attention level toward the typhoon, measured by the frequency of typhoon-related keywords. We hypothesized that affected areas would exhibit a "high-low-high" pattern of attention across the three periods, demonstrating the temporal psychological typhoon eye effect.

2.1.2 Spatial Dimension: Typhoon Eye Effect on Attention Levels

This analysis examines differences in attention toward Typhoon Mangkhut between affected (Guangdong) and non-affected (Anhui) areas during the typhoon event, using the same dependent variable as Section 2.1.1. We hypothesized that significant differences would exist between affected and non-affected regions, with affected populations showing lower attention levels than their non-affected counterparts, consistent with the spatial psychological typhoon eye effect.

2.2 Data Sources

We collected Weibo user data from a typical disaster-affected region and a control region based on the following criteria: (1) users' profile location information indicated Guangdong or Anhui provinces; and (2) posts were published between September 1, 2018, 0:00 and September 30, 2018, 24:00, covering three days before, during, and after the typhoon' s passage. The collected data included all text content from both original posts and reposts (including original reposted content and users' own comments). This process yielded approximately 300,000 eligible Weibo posts, with sample formatting shown in Figure 1 [Figure 1: see original paper].

2.3 Data Processing

The approximately 300,000 collected posts were organized to facilitate subsequent analysis. First, data for each province were divided into three time periods: pre-landfall, during landfall, and post-landfall. Using the typhoon passage period (September 16-18) as the center, timestamp values were converted into three categories: values less than 1537088400 were coded as 1, values between 1537088400 and 1537174800 (inclusive) were coded as 2, and values greater than 1537174800 were coded as 3. These were stored as three separate Excel files (e.g., "Guangdong-Pre," "Guangdong-During," "Guangdong-Post").

Second, separate folders were created for each province. For Guangdong, each folder contained four Excel files: "Guangdong," "Guangdong-Pre," "Guangdong-During," and "Guangdong-Post." Each file' s header row included: User ID, Username, Location, Timestamp, and Weibo Content, with content structure illustrated in Figure 2 [Figure 2: see original paper].

2.4 Data Analysis

Based on a typhoon vocabulary library, we selected 29 typhoon-related terms and calculated their frequency in each "Weibo Content" entry. First, for posts with identical User ID and Timestamp from Guangdong, we summed the frequencies of typhoon-related terms to obtain multiple frequency counts (cnti), with each cnti corresponding to one User ID and one Location. Each User ID could correspond to multiple cnti values. We then calculated the total Chinese character count (ni) for posts with identical User ID and Timestamp. The

frequency pi of typhoon-related terms for each user in each time period was computed as cnti divided by ni. Values of pi with Timestamp 1 were placed in list1, Timestamp 2 in list2, and Timestamp 3 in list3.

Second, for posts with identical User ID, we summed typhoon-related term frequencies to obtain frequency counts (cnti), with each cnti corresponding to one unique User ID. We calculated the total character count (ni) for posts with identical User ID. The frequency pi of typhoon-related terms for each user across the entire typhoon period was computed as cnti divided by ni. Values of pi for Guangdong users were placed in list1, and for Anhui users in list2.

Third, pairwise difference tests were conducted on the lists from both steps, with results schematically shown in Figure 3 [Figure 3: see original paper].

Results

Using big data analytics, this study investigated the dynamic trajectories of psychological states among affected and non-affected populations before, during, and after the typhoon disaster across temporal and spatial dimensions.

In the temporal dimension, Weibo data from Guangdong users revealed a significant difference in typhoon-related keyword frequency between pre-landfall and post-landfall periods ($t = -1.99$; $p = 0.05$), with pre-landfall frequency significantly lower than post-landfall frequency. However, this pattern did not exhibit the hypothesized "high-low-high" psychological typhoon eye effect. We propose two possible explanations: First, Guangdong' s geographic characteristics result in frequent typhoon experiences and risks, so typhoon warnings may not significantly increase public attention. Second, as understanding of typhoons and emergency response measures have improved, post-landfall experiences and continuous news coverage may have heightened public attention.

In the spatial dimension, Weibo data from Guangdong and Anhui showed no significant difference in typhoon attention levels across the entire pre-landfall, during-landfall, and post-landfall periods. This may be because typhoon-related news and updates on Weibo had extensive coverage, prompting non-affected region users to follow the events closely, thereby eliminating significant attention differences.

Figure 3. Schematic diagram of ANOVA results

Discussion

Through Weibo behavioral data analysis, this study investigated whether attention toward Typhoon Mangkhut exhibited the typhoon eye effect across temporal and spatial dimensions among affected and neighboring regions. The results did not support the existence of either temporal or spatial typhoon eye effects. Beyond the aforementioned explanations, methodological limitations may also account for these findings. Specifically, using keyword frequency as an

attention metric may inadequately capture true attention levels, as users might discuss typhoon-related content without using the designated keywords. Future research should employ more comprehensive indicators to measure attention.

This study holds important theoretical and practical significance. Theoretically, it helps mental health researchers better understand psychological state changes surrounding predictable stressful events such as typhoons, earthquakes, and mudslides. Practically, it offers insights for disaster warning systems, public opinion management, and post-disaster psychological rescue operations.

Several limitations should be noted. First, as mentioned, typhoon-related keyword frequency may not adequately reflect attention levels. Future studies should incorporate richer indicators, such as negative emotion-related word frequencies. Second, this study did not control for disaster experience. The regions affected by Typhoon Mangkhut exhibited interesting variations—some provinces like Hunan had no prior typhoon experience, while others like Guangdong had experienced multiple typhoons. Disaster experience may significantly influence psychological characteristics when facing disasters (Jian, 2008; Lei, 2011). Future research should isolate the potential impact of disaster experience to better reveal psychological states among affected populations. Third, this study did not include the Philippines, a severely affected region. After forming east of the International Date Line, Typhoon Mangkhut moved westward, impacting both China and the Philippines, with casualties in the Philippines far exceeding those in China. Limited to Weibo data rather than more internationally recognized sources such as meteorological data or news reports, our sample was confined to China. Comparing the typhoon' s differential impacts on the Philippines and China could provide important insights for disaster warning and public opinion management. For instance, since the typhoon first hit Guangdong, it might have served as an early warning for the neighboring Philippines, potentially producing an "advance" effect in public attention and anxiety levels rather than the typical typhoon eye effect. Future research should expand sample sizes and conduct deeper analyses of psychological states following typhoon disasters.

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Appendix 1: Typhoon Vocabulary Library (29 terms)

Strong typhoon, typhoon, Mangkhut, emergency plan, torrential rain, super typhoon, meteorological expert, strong wind, disaster, protection, hazard, rainfall, monitoring, forecast, weather, typhoon eye, wind scale, average wind speed, cyclone, disastrous weather, atmospheric pressure, path, brightness temperature, wind force, wind speed, pressure gradient, weather map, weather report, high pressure

Note: Figure translations are in progress. See original paper for figures.