Title:
Measuring Cascade Networks on X: The Hyogo Gubernatorial Election

Online political communication during election periods intensifies within condensed time windows, leading to rapid cascades of posts and reactions. These include controversial or misleading posts. Identifying which posts exert strong influence—in terms of diffusion scope and speed—is crucial for understanding how public discourse is reshaped under electoral contexts. We have constructed a large-scale longitudinal cascade database (Cascade DB) of Japanese X (former Twitter) Space, leveraging the Nazuki no Oto service provided by NTT Data. Using this system, we analyze the Hyogo gubernatorial election (November 2024), which is known for the strong influence of SNS on political discourse, the spread of untrustworthy content..

A central question is which kinds of posts gain influence during elections. Identifying the relationship between cascade networks and topic structures can help us understand how democratic discourse is reshaped in electoral contexts. While prior research has investigated cascade size and growth rate separately (Kwak et al., 2010; González-Bailón et al., 2013), fewer studies have sought to integrate these dimensions into a unified measure of influence. To this end, we propose a novel influence index as the geometric mean of the total number of reactions and the number of reactions per hour. This metric captures both the volume (total number of reactions) and the velocity of cascades.

We ranked all cascades on X during the 18-day election period (October 31-November 17, 2024) and the 18 days before and after it based on this influence index. For the original posts of top 3,000 cascades, each text was classified into 12 categories or topics using zero-shot classification with the ChatGPT API (gpt-4o-mini). Cross-period differences in topic and sentiment distributions were evaluated using χ^2 tests, and standardized residuals were visualized in heatmaps.

Figure 1 shows that political topics dominated influential cascades before the election; however, it decreased during and after the election, while news categories shifted significantly (Cramér's V=0.182, p<0.001).
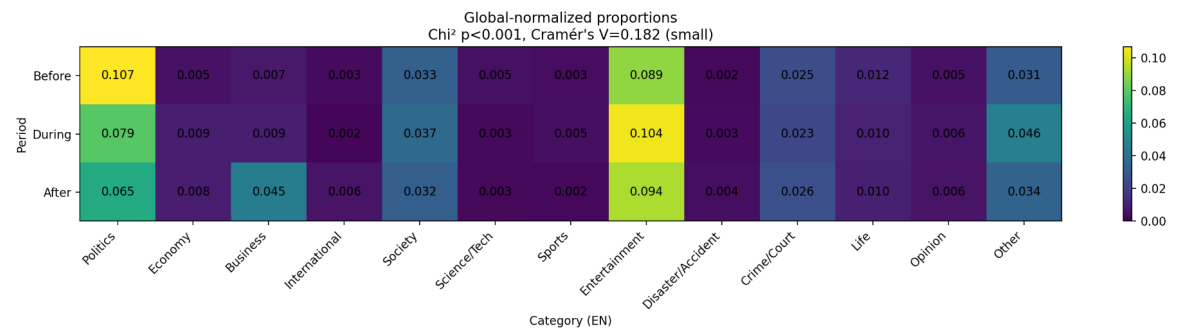

Figure 1. Residual heatmap of topic distributions across before, during and after the election

Figure 2 illustrates cascade networks of influential political posts before, durin
g, and after the election. Nodes represent reactions; edges denote interaction typ
es (blue = reposts, aggregated and terminal; green = quotes; orange = replies). Ar
c angles are determined by the number of quotes and replies for each node. These e
xamples highlight how the structure of influential cascades may shift across elect
oral phases, while systematic differences require statistical analysis across many
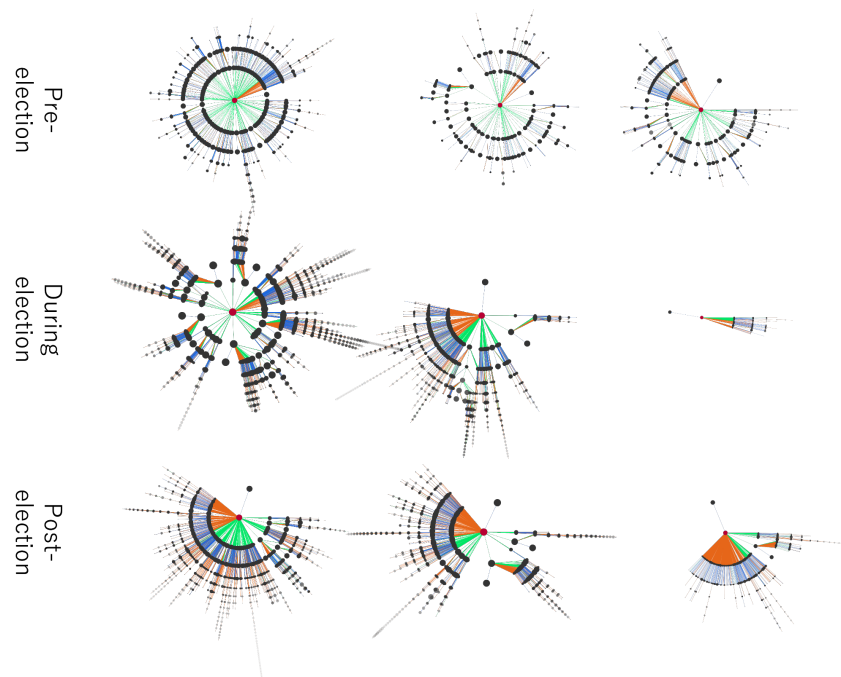cascades.

Figure 2. Cascade networks of highly influential political posts before, during, a
nd after the election

To conclude, we introduced a new influence index to measure the posts on X. Using
this metric, we analyzed how influential cascade networks and referenced topics sh
ifted during and around a gubernatorial election in Japan. The results suggest tha
t the electoral context may systematically affect the content characteristics of d
iffusion. Uncovering these co-evolutionary mechanisms is crucial for understanding
how social media is used in political discourse and for building safer online plat
forms. We will compare the findings with those from other elections, leveraging th
e advantages of our Cascade DB.

References

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