Project 3 Report: Interactive Propaganda and Toxicity Analysis Dashboard

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Abstract

This report details the implementation and findings of the "Propaganda Tracker" dashboard (Project 3). We analyzed over 160,000 posts from Reddit, Bluesky, and 4chan to investigate the relationship between propaganda techniques and toxicity, specifically for the Israel Palestince conflict. By utilizing our custom data collection and analysis pipeline, and external services like the Google perspective API, we found that (1) geopolitical events trigger significant toxicity spikes ($p < 0.001$), (2) Bluesky exhibits the strongest propaganda-toxicity correlation ($r = 0.252$), and (3) dehumanization is the strongest predictor of toxicity (+14.9% per occurrence). The final system includes an interactive Streamlit dashboard for real-time analysis.

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1 Introduction

This project implements a end-to-end analysis pipeline to detect propaganda and toxicity in social media discourse surrounding the Israel-Palestine conflict. Building on the data ingestion framework from Project 2, we developed an interactive dashboard that allows users to explore temporal trends, platform-specific dynamics, and the linguistic features of propaganda. The system answers three key research questions regarding event-driven escalation, platform norms, and rhetorical techniques.

2 System Architecture

The solution is built on a four-stage pipeline:

(1) **Collection:** Scrapers for Reddit (PRAW), Bluesky (atproto), and 4chan (live catalog scraping) filter posts by conflict-related keywords.
(2) **Processing:** A sequential processing engine performs lexicon matching for propaganda markers (Absolutist, Dehumanization, Emotional, Loaded Language) and queries the Perspective API for toxicity scores.
(3) **Storage:** DuckDB provides a high-performance, columnar store for OLAP-style queries.
(4) **Analysis:** A Streamlit dashboard visualizes results and performs on-the-fly statistical testing.

3 Methodology

We employed rigorous statistical methods to answer our research questions:

- **RQ1 (Events):** Chi-square tests of independence on contingency tables (High Toxicity vs. Event Active Status).
- **RQ2 (Platforms):** Pearson correlation coefficients between daily Propaganda Message Intensity (PMI) and mean Toxicity Scores.
- **RQ3 (Techniques):** Ordinary Least Squares (OLS) regression to quantify the marginal effect of specific propaganda markers on toxicity.

4 Results

4.1 RQ1: Event-Driven Toxicity

We found a statistically significant relationship between major geopolitical events and toxicity spikes (χ^2 p-value < 0.001). During event windows (2 days post-event), the probability of high-toxicity posts (Z-score > 1.5) increases from a baseline of 8.6% to 9.8%. This confirms that offline violence drives online toxicity, albeit with a smaller effect size than anticipated.

4.2 RQ2: Platform Dynamics

Platform-specific correlations reveal distinct community norms. Bluesky shows the strongest positive correlation ($r = 0.252, p < 0.001$) between propaganda and toxicity. Reddit shows a weaker but significant correlation ($r = 0.175, p < 0.001$), while 4chan shows no significant correlation ($r = 0.079, p = 0.101$), likely due to its consistently high baseline toxicity.

4.3 RQ3: Technique Effectiveness

Regression analysis identified "Dehumanization" as the most potent predictor of toxicity, increasing the toxicity score by 14.9 percentage points per occurrence ($p < 0.001$). "Loaded Language" (+6.8 pp) and "Absolutist" terms (+2.7 pp) were also significant predictors.

5 Implementation Highlights

The final dashboard includes:

- **Custom Text Analysis:** An interactive tool allowing users to input text and receive real-time toxicity and propaganda scoring.
- **Statistical Engine:** Automated calculation of p-values and effect sizes displayed alongside visualizations.
- **Timeline View:** Dual-axis charts correlating PMI and Toxicity with interactive event markers.

6 Discussion and Conclusion

The project successfully demonstrates that propaganda techniques are measurable drivers of toxicity, though their impact varies by platform. The strong link between dehumanization and toxicity is

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particularly concerning for early-warning systems. The interactive dashboard provides a transparent mechanism for peers to audit these relationships and validate findings against new data.

References

[1] Google. Perspective API. perspectiveapi.com
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