LONGITUDINAL BEHAVIOR DYNAMICS AMONG EXTREMIST USERS IN TWITTER

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IEEE BIGDATA — DECEMBER 15–18, 2021

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INTRODUCTION

- Dark side of online interactions: misinformation, trolling, cyberbullying

- **Extremist groups** (Al-Qaeda, white supremacists, and **ISIS or** the Islamic State of Iraq and Syria) have embraced social media as a tool to:

  - Recruit new members

  - Undermine their rivals

  - Spread propaganda

- ISIS has been described by the FBI as the most adept terrorist group at using Internet and social media propaganda to recruit new members.

RELATED WORK

- Alfifi et al.
  - Retweets of ISIS are more than 3 times likely to be from suspended accounts
  - So, ISIS re-tweeters are also involved in malicious activities (and are most likely ISIS supporters)

- Badawi et al.
  - Explored how ISIS makes use of social media to spread its propaganda and to recruit militants
  - Provide evidence of important offline events that are strongly intertwined with the online conversation
  - Certain topics dominating the conversation right before or after ISIS's activity spikes

- Berger and Morgan
  - Studied how suspensions were limiting the social network of English-speaking ISIS supporters
  - Individual users who repeatedly created new accounts after being suspended suffered devastating reductions in their follower counts.

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MOTIVATION

- Research gap in large scale analysis of ISIS reach and impact.

- Can we identify strategy/behavioral pattern that ISIS uses in Twitter?

- How does ISIS use different interaction strategies on Twitter to create a thriving online extremist community?

DATASET BREAKDOWN

- Original dataset collected by Texas A&M contains 17B+ Arabic tweets

- A sample of the original dataset
  - 2,438,794 tweets from 2014 to 2015
  - ISIS and ISIS-related

Type of Tweet	Percentage
Tweets from ISIS	60.8%
Mentions of ISIS accounts	20.5%
Retweets of ISIS tweets	15.3%
Quotes of ISIS tweets	2.8%
Quotes of Mentions of ISIS	0.6%

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USER SUSPENSIONS

- Initially 93,159 users

- 25,000+ ISIS sympathizers (ISIS seed accounts)
  - Identified by crowdsourcing initiated by the Anonymous hacking group
  - Expanded by researchers

- Mostly got suspended by Twitter over time

- The number of users suspensions begins to drastically increase around March–July 2015

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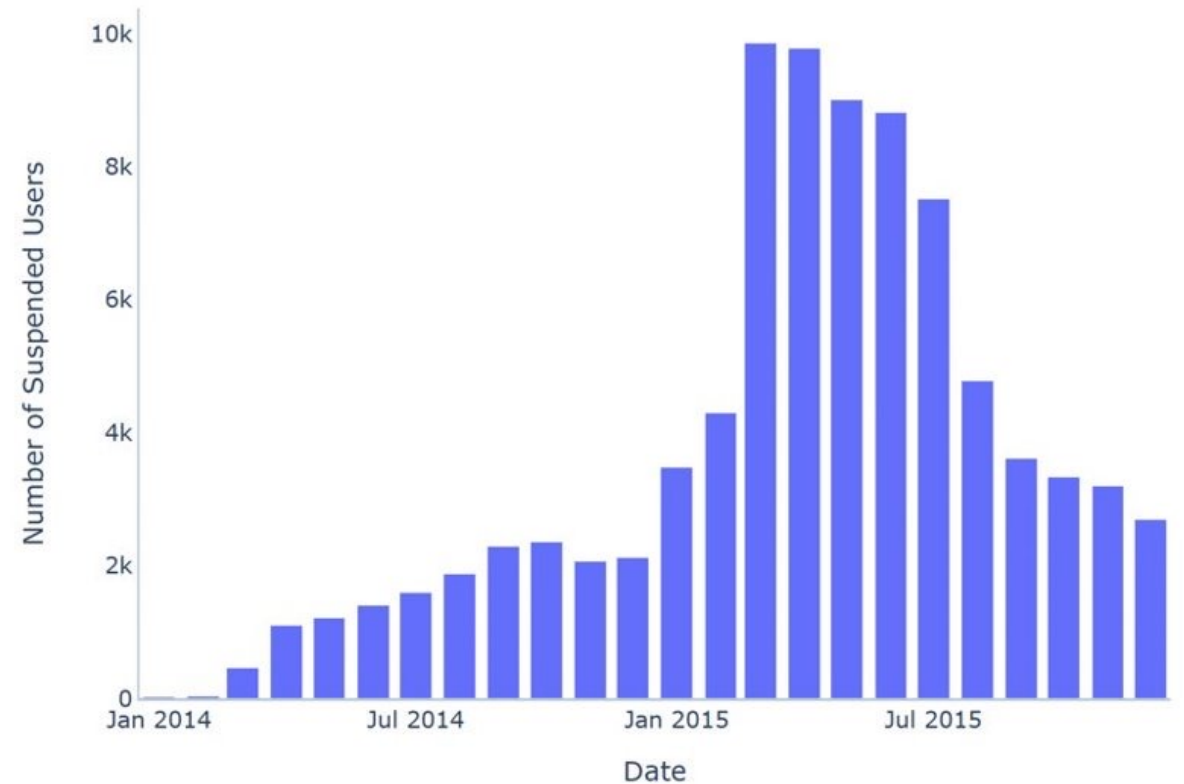
USER BEHAVIOR MODEL

- We model each user as a strategic agent who will choose to:

  - Tweet

  - Retweet

  - Quote or Mention

- 105 epochs (105 weeks during 2014–2015: 2*365 / 7)

- Each user has 315 (= 3 x 105) features

- This can be modeled by a two-dimensional unit simplex embedded in R^3 (Δ^3)

$$\mathbf{n}^i(e) = \left(n_T^i(e), n_R^i(e), n_Q^i(e) \right)$$

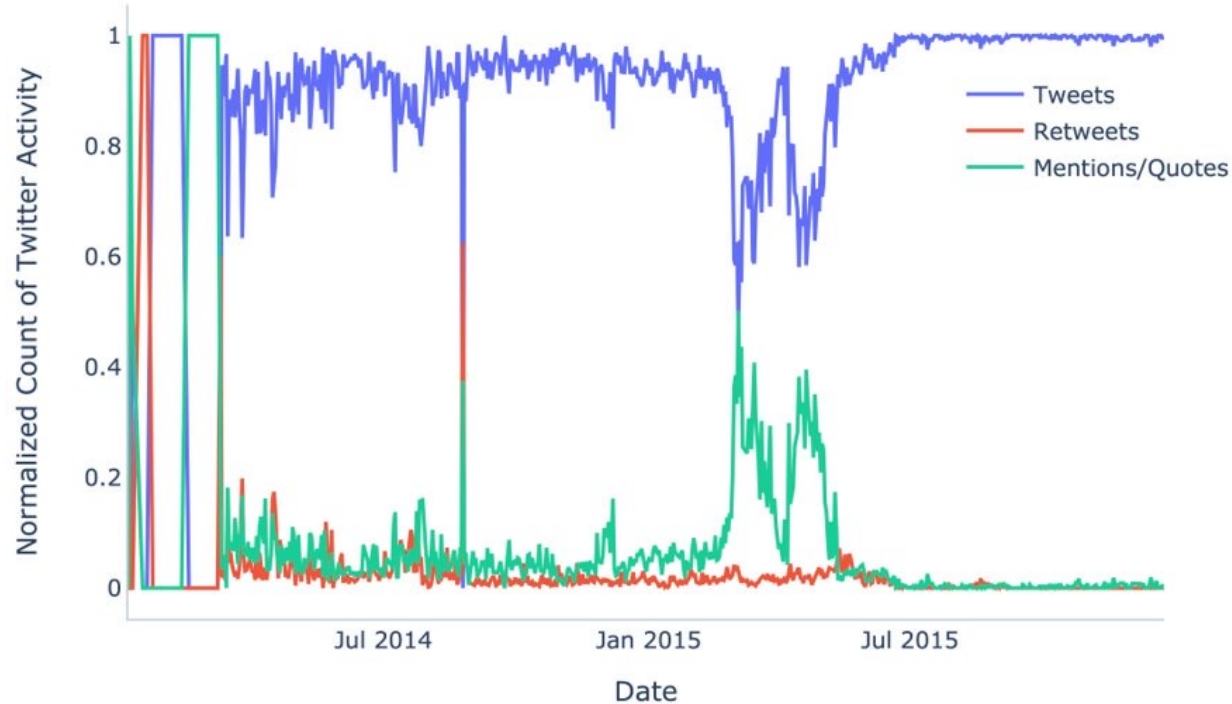$$\Delta^3 = \left\{ \mathbf{x} \in \mathbb{R}^3 : \|\mathbf{x}\|_1 = 1, \mathbf{x_i} \geq 0 \right\}$$

$$\|\mathbf{x}\|_1 = \sum_i |x_i|$$

$$\mathbf{x}^i(e) = \frac{\mathbf{n}^i(e)}{\|\mathbf{n}^i(e)\|_1}$$

$$\mathbf{g}(e) = \sum_i^N \mathbf{n}^i(e)$$

USER BEHAVIOR MODEL (CONT'D)

- The dataset is dominated by tweet activity.
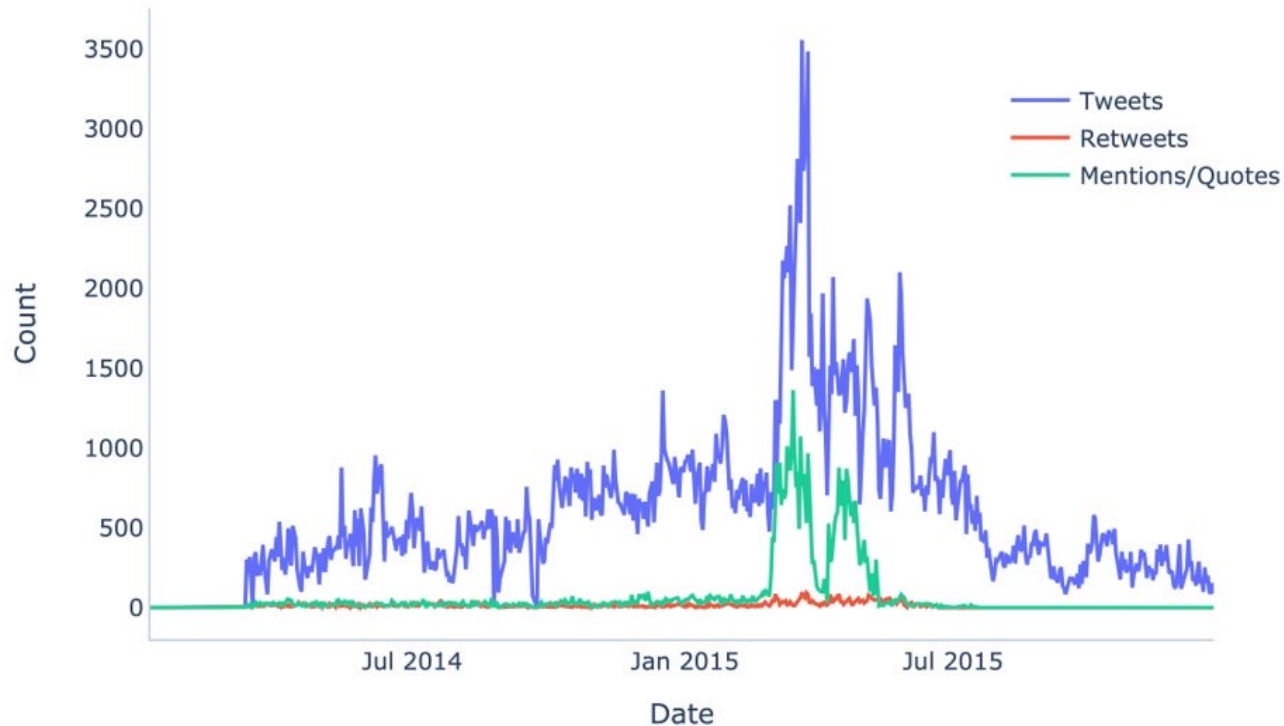
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$$\mathbf{g}(e) = \sum_i^N \mathbf{n}^i(e)$$

USER BEHAVIOR MODEL (CONT'D)

- Strategy changes substantially in the middle of 2015 as a result of account suspensions.
- An increase in number of RTs and QT/MT:
  - Switch in the strategic behavior of key accounts

$$\mathbf{n}^i(e) = \left(n_T^i(e), n_R^i(e), n_Q^i(e)\right)$$

$$\Delta^3 = \left\{\mathbf{x} \in \mathbb{R}^3 : \|\mathbf{x}\|_1 = 1, \mathbf{x_i} \geq 0\right\}$$

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$$\mathbf{g}(e) = \sum_i^N \mathbf{n}^i(e)$$

$$\mathbf{x}^g = \frac{\mathbf{g}(e)}{\|\mathbf{g}(e)\|_1}$$

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BEHAVIOR CLUSTERING

- K-means (unsupervised) clustering
  - Best Silhouette and Davies-Bouldin scores with k=4

- GMM (Gaussian Mixture Models)
  - Best Silhouette and Davies-Bouldin scores with k=4

- K-means yielded better scores, but clusters were to some extent consistent among the two methods.

- PCA to project 3*105-dimensional vectors into 3-dimensional vectors
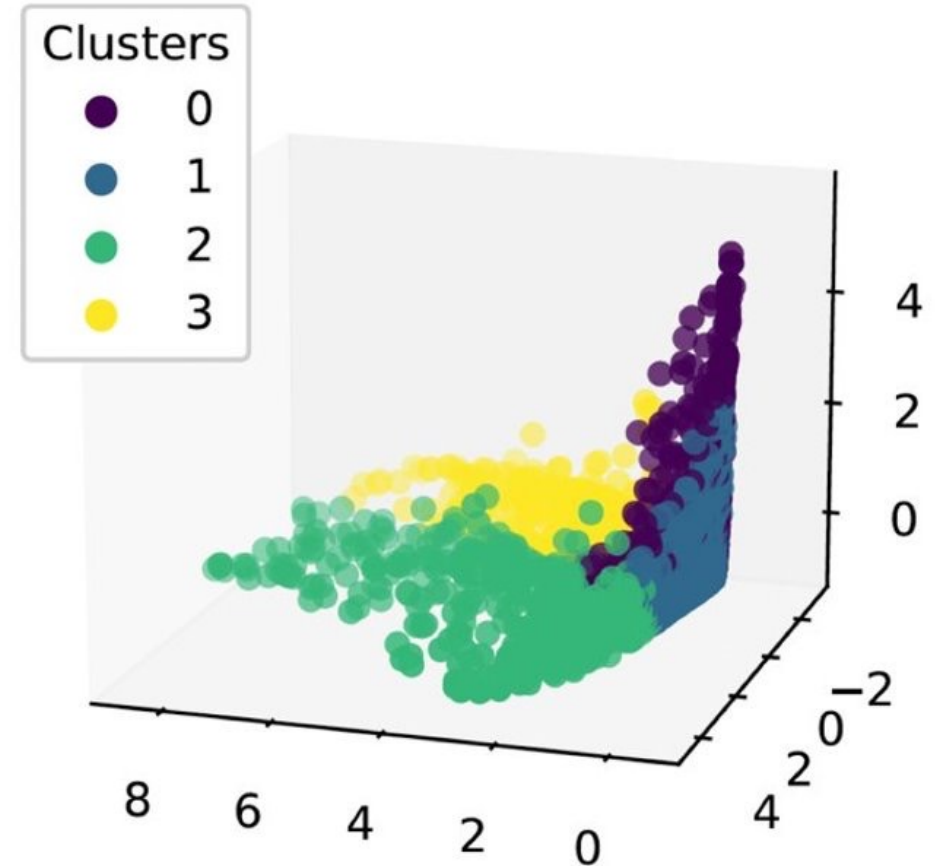
ROLES AND BEHAVIOR PATTERNS

- **Content Producers:** tend to produce original content (tweets)

- **Content Amplifiers:** Use *retweets, quotes,* or *mentions* as a tool to amplify the posted tweets

- **Bimodal Cluster:**

  - Begin by using a mixture of tweets, retweets and quotes,

  - Then, transition to almost exclusive use of tweets

  - And then, transition back

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CLUSTERS OF ACCOUNTS

Cluster 0
Content producers

61% of 500 top
retweeted users
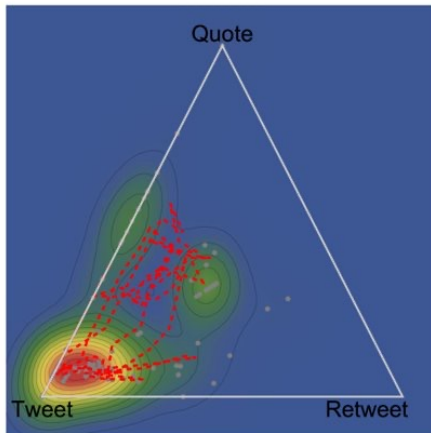
Cluster 1
Content amplifiers
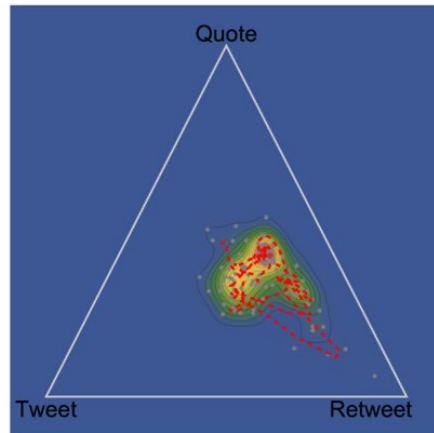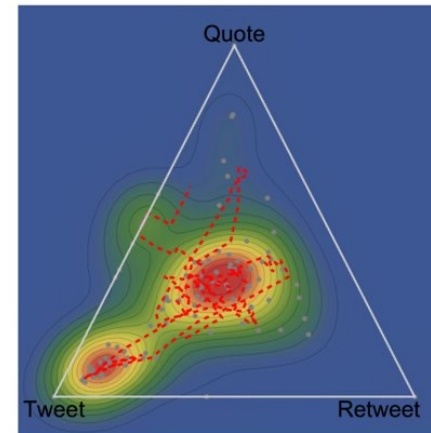
Cluster 2
Bimodal

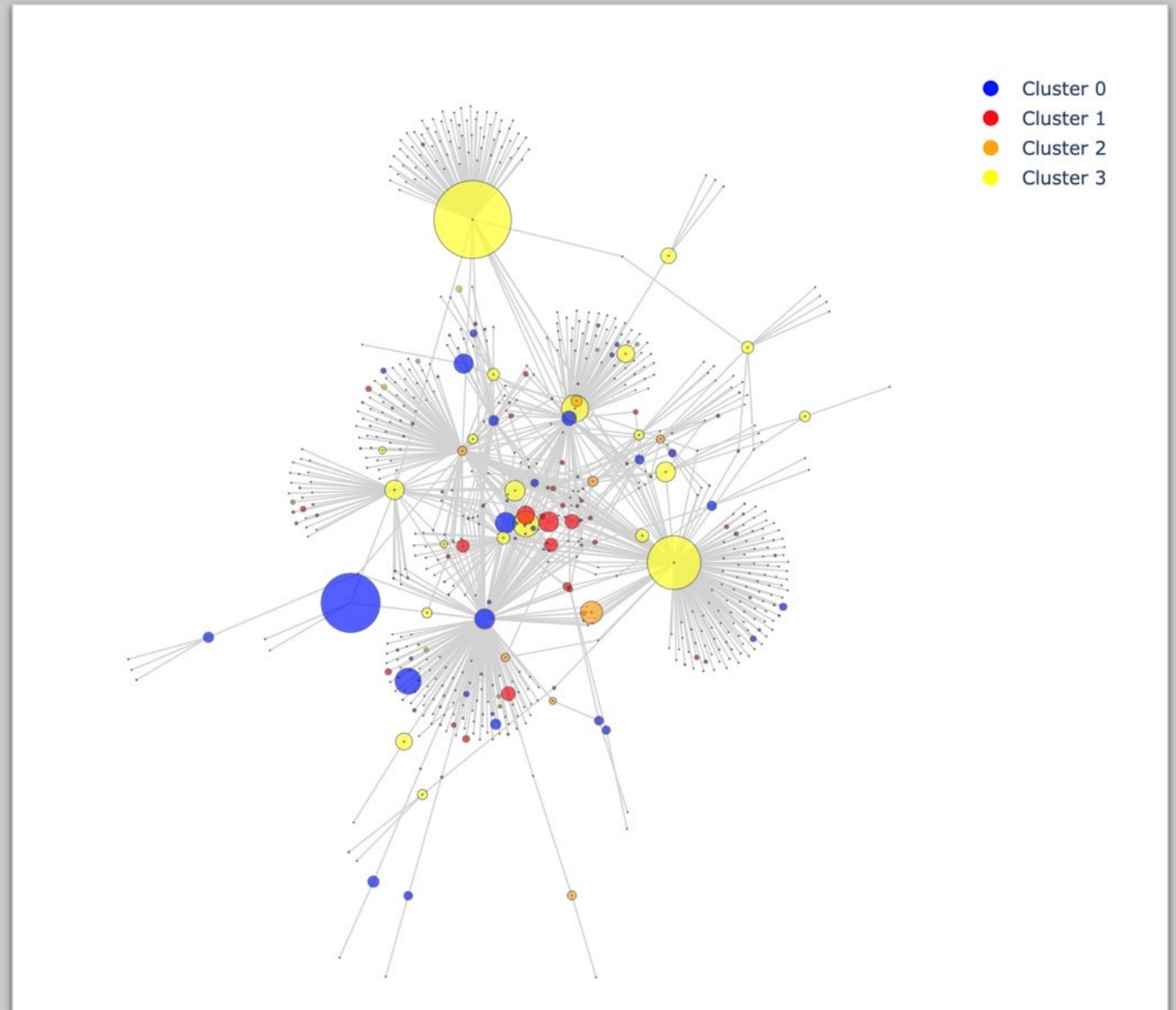
Cluster 3
Content producers
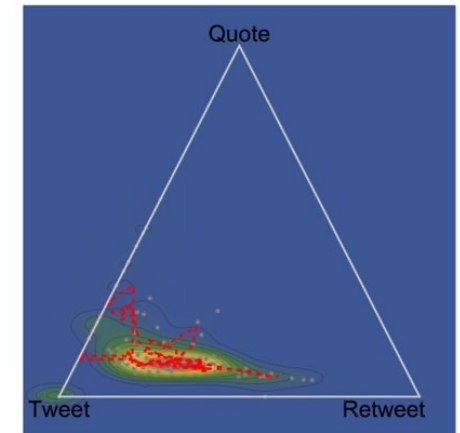
SHIFTED ACCOUNTS

- Number of accounts in the bimodal cluster who shifted from amplifying to tweeting and vice versa

- An increasing number of users shift from amplifying to tweeting until week 64 (2nd week of March)

- Smooth decrease in shifting from tweeting to amplifying (week 66; parts of the 1st and 2nd weeks of April)
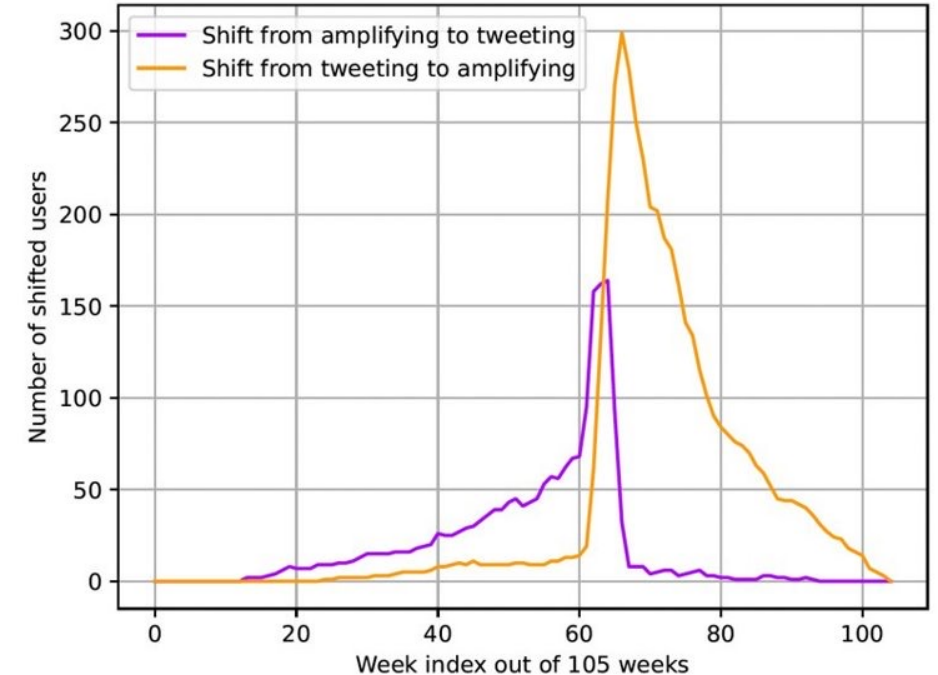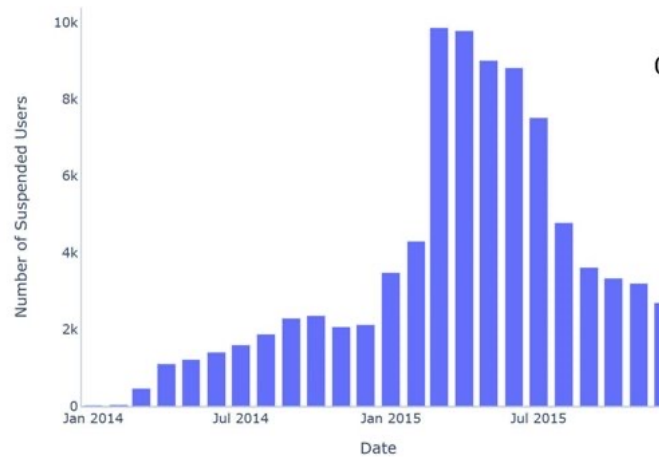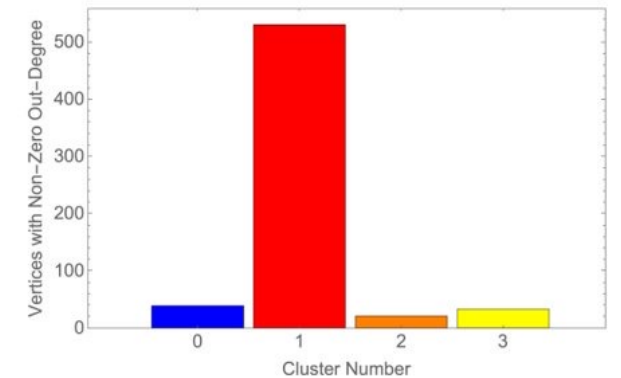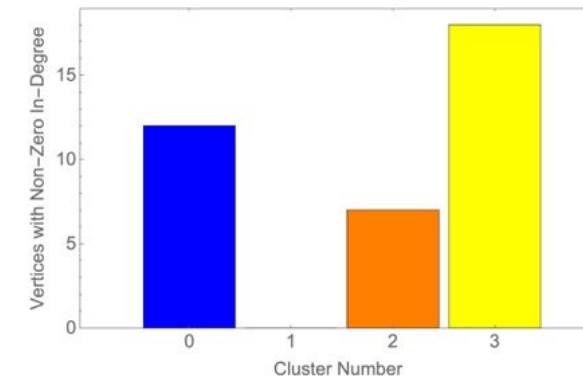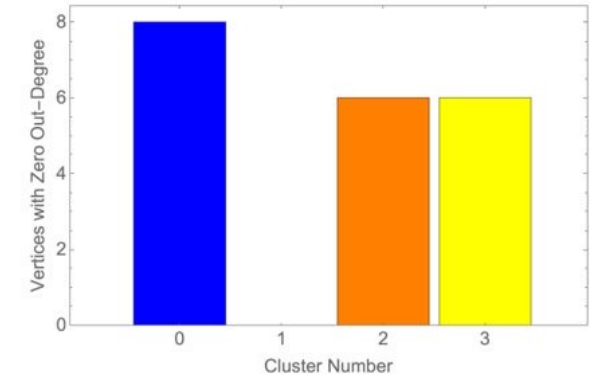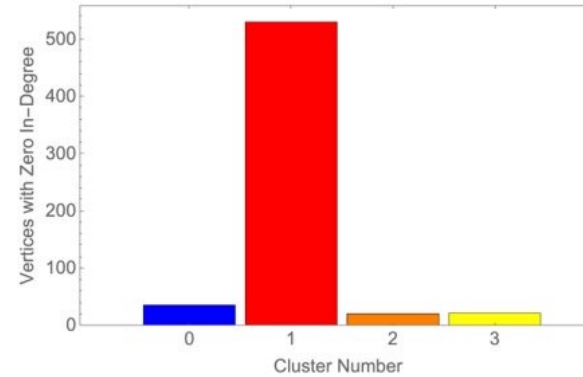
RETWEET NETWORK OF TOP-50 TWEETERS

- Top 50 accounts who posted the highest number of tweets during 2014–2015

- Larger vertex = more posted tweets

- 643 vertices in total (including retweeters of top-50)

- Accounts in C_0 and C_3 (content producers) are heavily retweeted


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CENTRALITY OF CLUSTERS

- A higher number of accounts in the amplifying cluster (C_1) have zero in-degree (are not retweeted)

- A higher number of accounts from content producing (C_0 and C_3) and the bimodal (C_2) clusters have non-zero in-degrees (are retweeted) and zero out-degrees

- Some accounts are used solely for retweeting content while other accounts are used for content production

- Supports our clustering

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RETWEET NETWORK OF TOP-50 ACTIVE ACCOUNTS

- Top 50 accounts based on total Twitter activity

- 1,927 vertices in total (including retweeters)

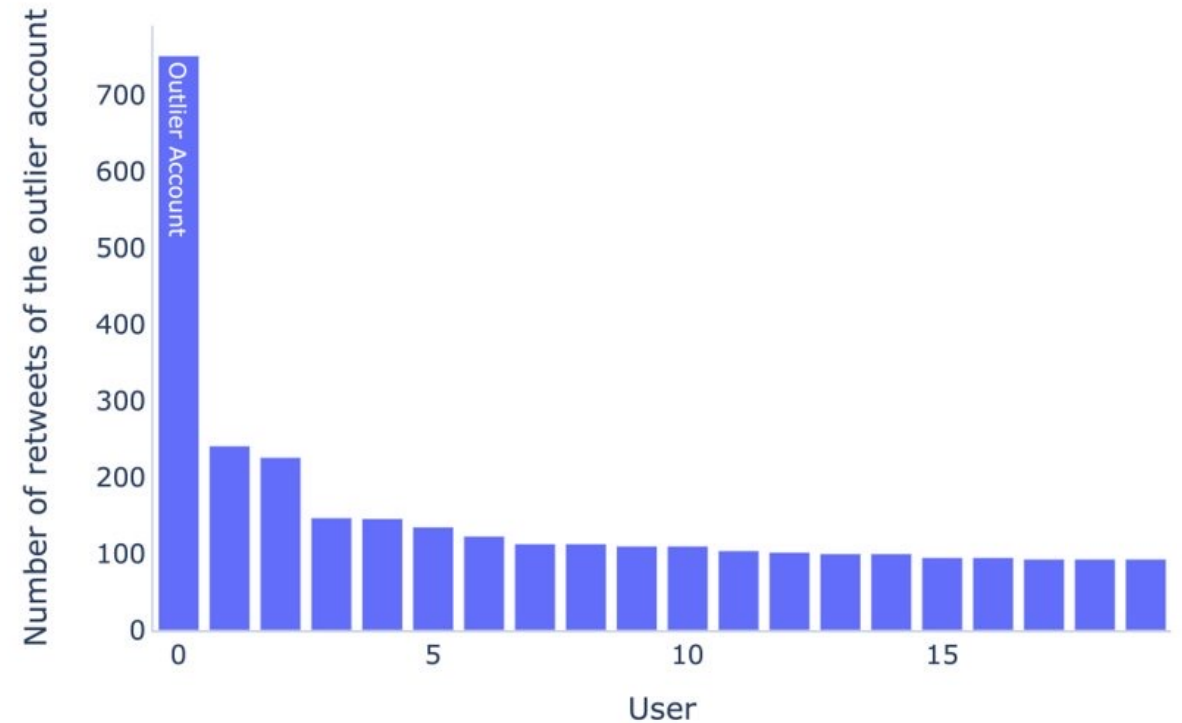PennState
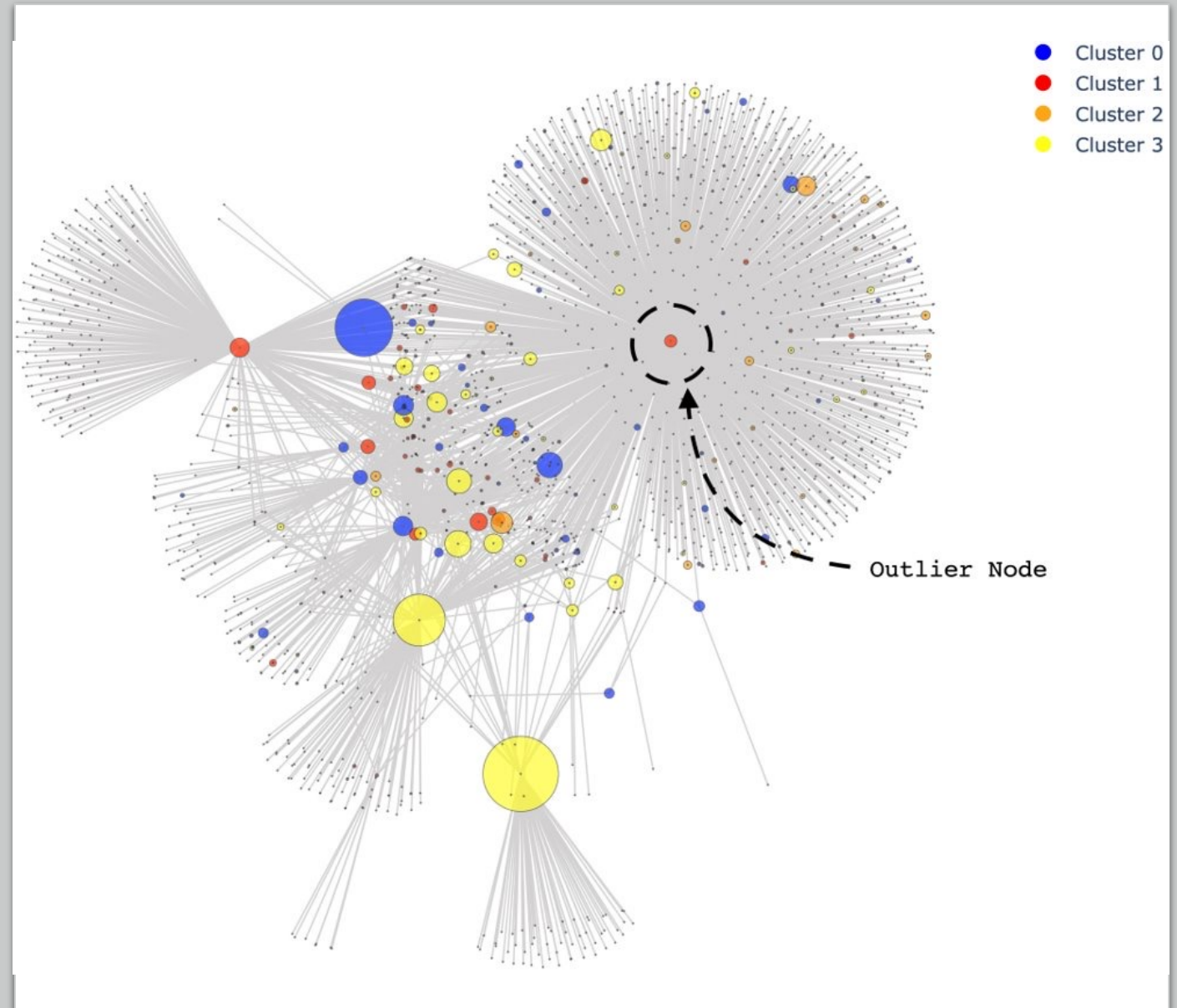
OUTLIER ACCOUNT

- Top 20 users

- 50k+ followers

- Produced 15,000 tweets

- 64% of retweeters are non-ISIS

  - Significant impact in reaching out

    to accounts beyond the ISIS community
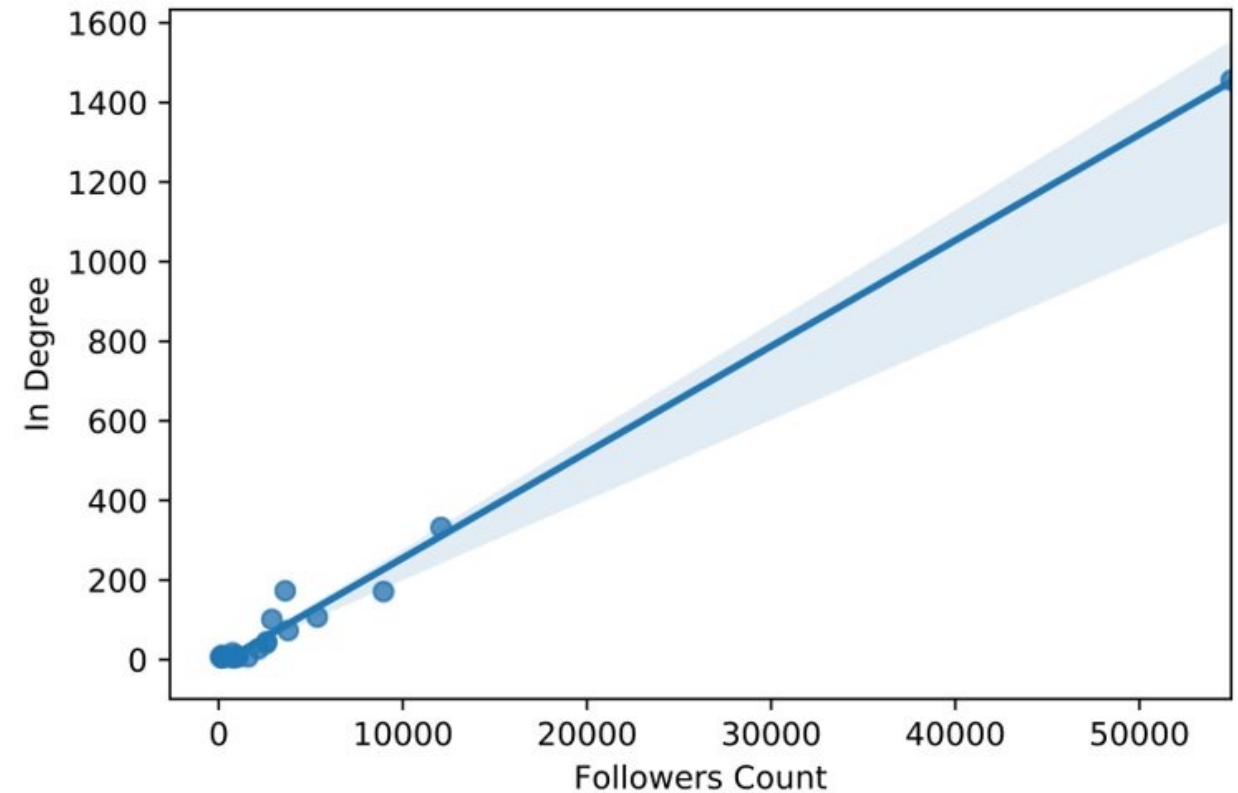
OUTLIER ACCOUNT (CONT'D)

- Top 20 users

- ISIS users who retweeted the outlier account at least 100 times
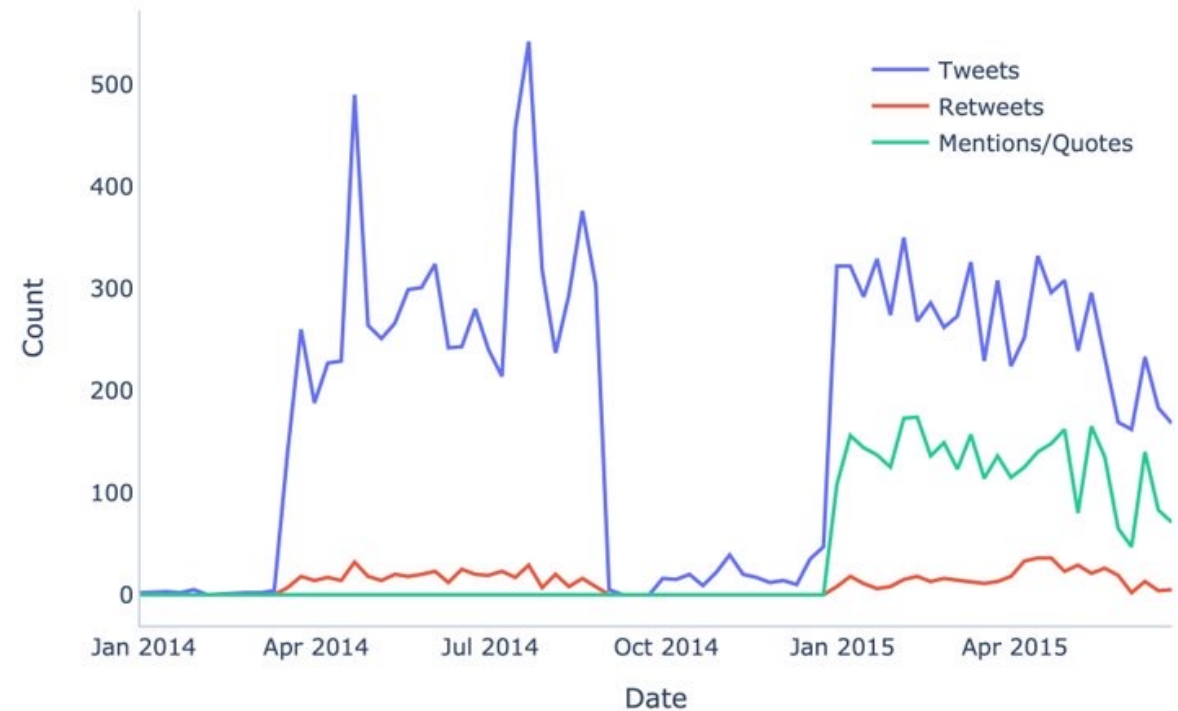

Top 20 users who retweeted Outlier account

OUTLIER ACCOUNT (CONT'D)

- Wilcoxon signed-rank test

  - Measure the statistical significance of difference between the behavior of the outlier and top-50 active users

Column	Result	P-Value	Stat.
Tweets	Diff.	4.4×10^{-9}	869
Quotes/Mentions	Diff.	2.2×10^{-8}	417
Retweets	No diff.	0.71	1622
Combined	Diff.	3.1×10^{-18}	45

Thanks for your attention!

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