

- To limit online polarization, **diversification** appears as an intuitive solution [1]
  - Balance** is delicate in terms of diversity of opinions, sources, and content [2] →
  - Diversification does not always bring a **positive effect** [3][4]
- Need to adapt the level of diversity and recommendation strategies according to behavioral classes**

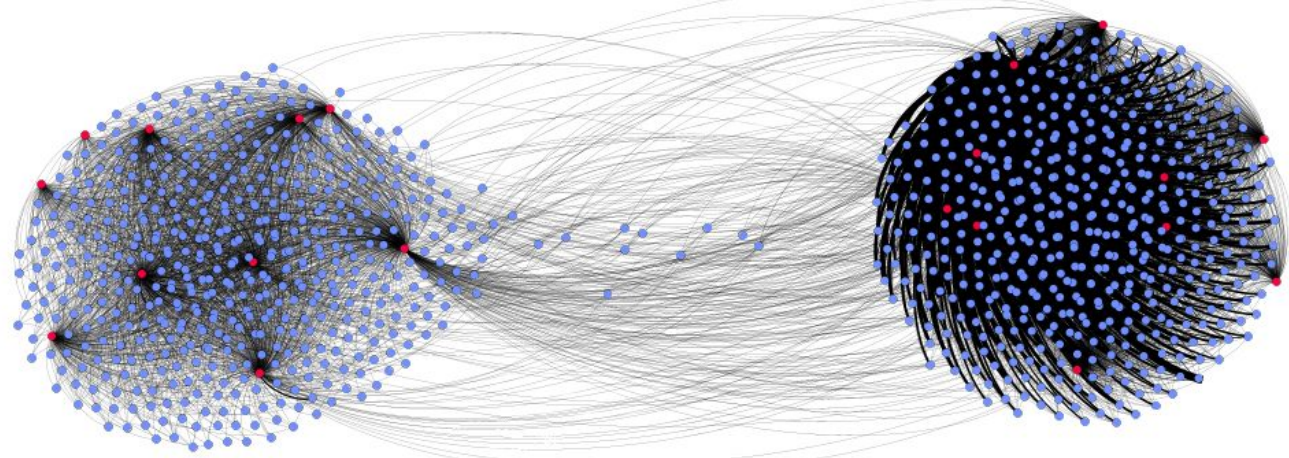
- Can a multi-factorial analysis help to better identify classes of polarization behavior?
- How can recommendations be adapted to identified classes of polarization behavior?

## Twitter Dataset

**Thematic:** COVID-19 vaccine debate  
**Period:** from 01/01/22 to 31/07/22



20 elite users [5]: pro-vaccine / anti-vaccine  
1,000 standard users (retweets)



Graph of standard users' interactions on elite users' tweets

## Polarization Factors

Entropy-based factors to evaluate users' behavior based on all their interactions

$$H_N(Z) = \frac{-\sum_z^n P(z) \log(P(z))}{\log(n)}$$

### Opinions

$H'_{op}$  Distribution of a user's interactions within confronting communities

### Sources

$H'_{so}$  Distribution of a user's interactions on information sources

## Results

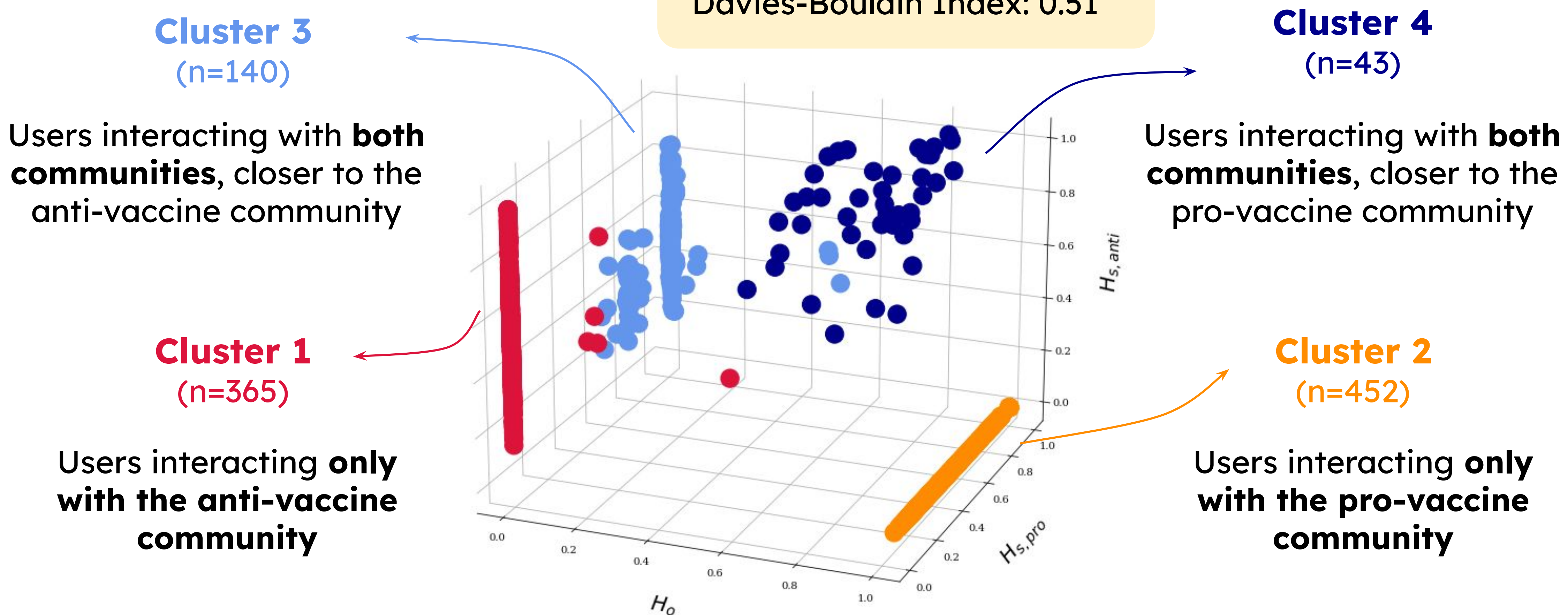
k-means clustering on three polarization factors:

→ Identification of 4 well differentiated clusters

Opinions →  $H_{op}^{\pm} = \frac{\pm H'_{op} + 1}{2}$

Sources  $\begin{cases} H'_{so,pro} \\ H'_{so,anti} \end{cases}$

Silhouette Index: 0.74  
Davies-Bouldin Index: 0.51



**Intermediate users:** 2 interesting clusters made of users that are not completely polarized, but close to anti-vaccine (C3) and pro-vaccine (C4) communities

## Innovative Recommendation Strategies

→ Depolarization strategies tailored to identified polarization classes

Adapt the level of diversity according to the degree of polarization of users

Bring diversity for polarized users based on intermediate users' consumption

**Other avenues to explore:**

- Temporal evolution of polarization
- Context-aware recommender systems

**Objective:** make sure that diversification has a positive impact on users' consumption, and can help to reduce polarization

[1] Helberger, N., Karppinen, K., & D'acunto, L. (2018). Exposure diversity as a design principle for recommender systems. Information, Communication & Society. [2] Raza, S., & Ding, C. (2022). News recommender system: a review of recent progress, challenges, and opportunities. Artificial Intelligence Review. [3] Bail, C. A., Argyle, L. P., Brown, T. W., Bumpus, J. P., Chen, H., Hunzaker, M. F., ... & Volfovsky, A. (2018). Exposure to opposing views on social media can increase political polarization. Proceedings of the National Academy of Science. [4] Treuillier, C., Castagnos, S., Dufraisse, E., & Brun, A. (2022). Being diverse is not enough: Rethinking diversity evaluation to meet challenges of news recommender systems. In Adjunct Proceedings of the 30th ACM Conference on User Modeling, Adaptation and Personalization. [5] Primario, S., Borrelli, D., Iandoli, L., Zollo, G., & Lipizzi, C. (2017). Measuring polarization in Twitter enabled in online political conversation: The case of 2016 US presidential election. In 2017 IEEE international conference on information reuse and integration (IRI).