

# Mapping Extremist Networks with Visual Imagery

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## Research Objectives

### Substantive problem:

- Identifying networks of collaboration between groups within a clandestine movement

### Methodological objective:

- Place videos into feature space derived from visual imagery [1, 2] and detect clusters

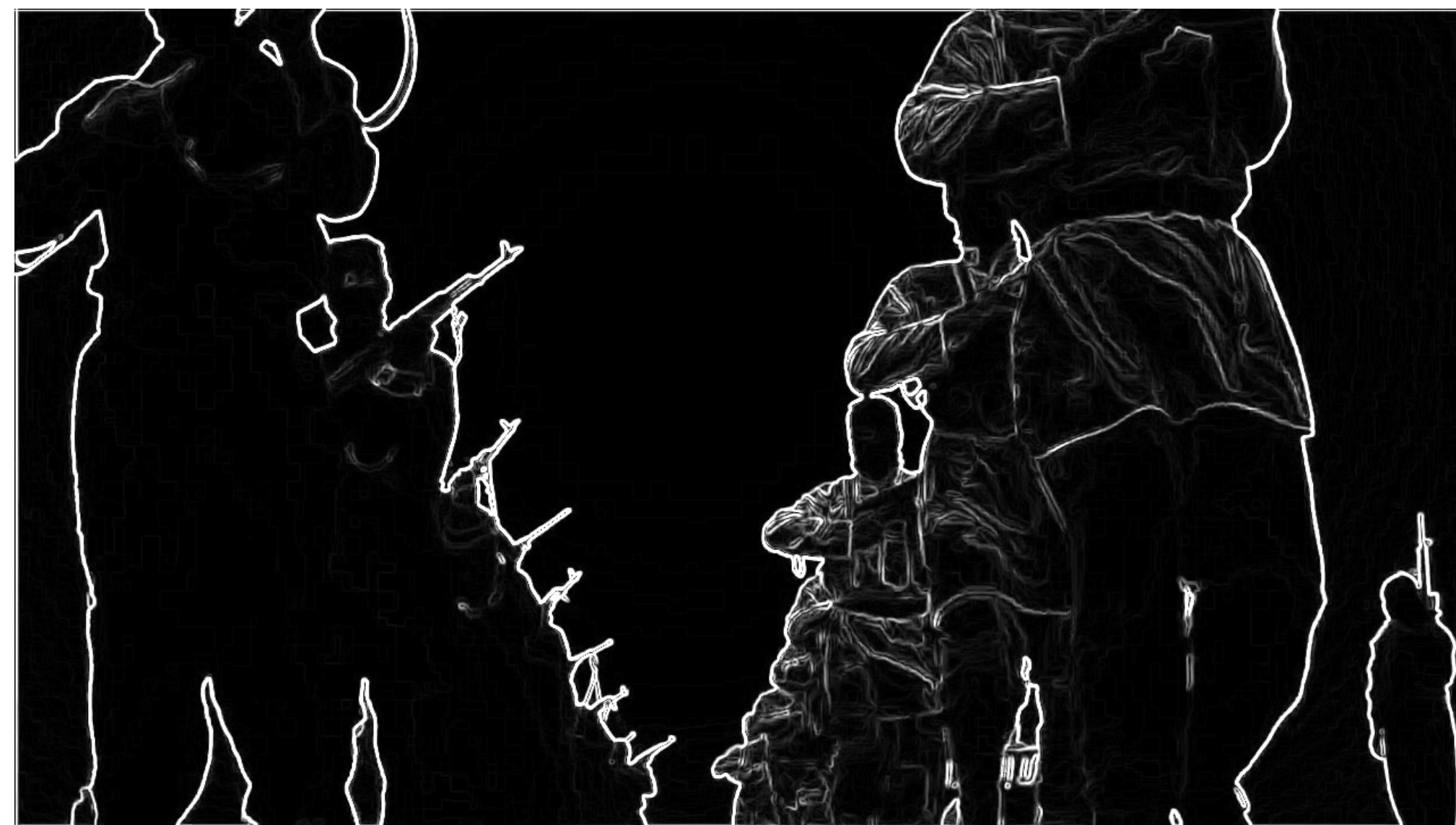
## Video as Data

Each video is split into individual scenes using the PySceneDetect Python library and one frame per scene is extracted for keypoint detection.

- 235 videos produced by Salafi jihadi groups

## Preprocessing & Extraction

Frames are binned by mean complexity after applying an edge detection filter to reduce false positives.



Keypoints are detected using a SURF detector with different thresholds by complexity bin, extracted with a RootSIFT descriptor, and represented by a 128 length vector using the OpenCV Python library.



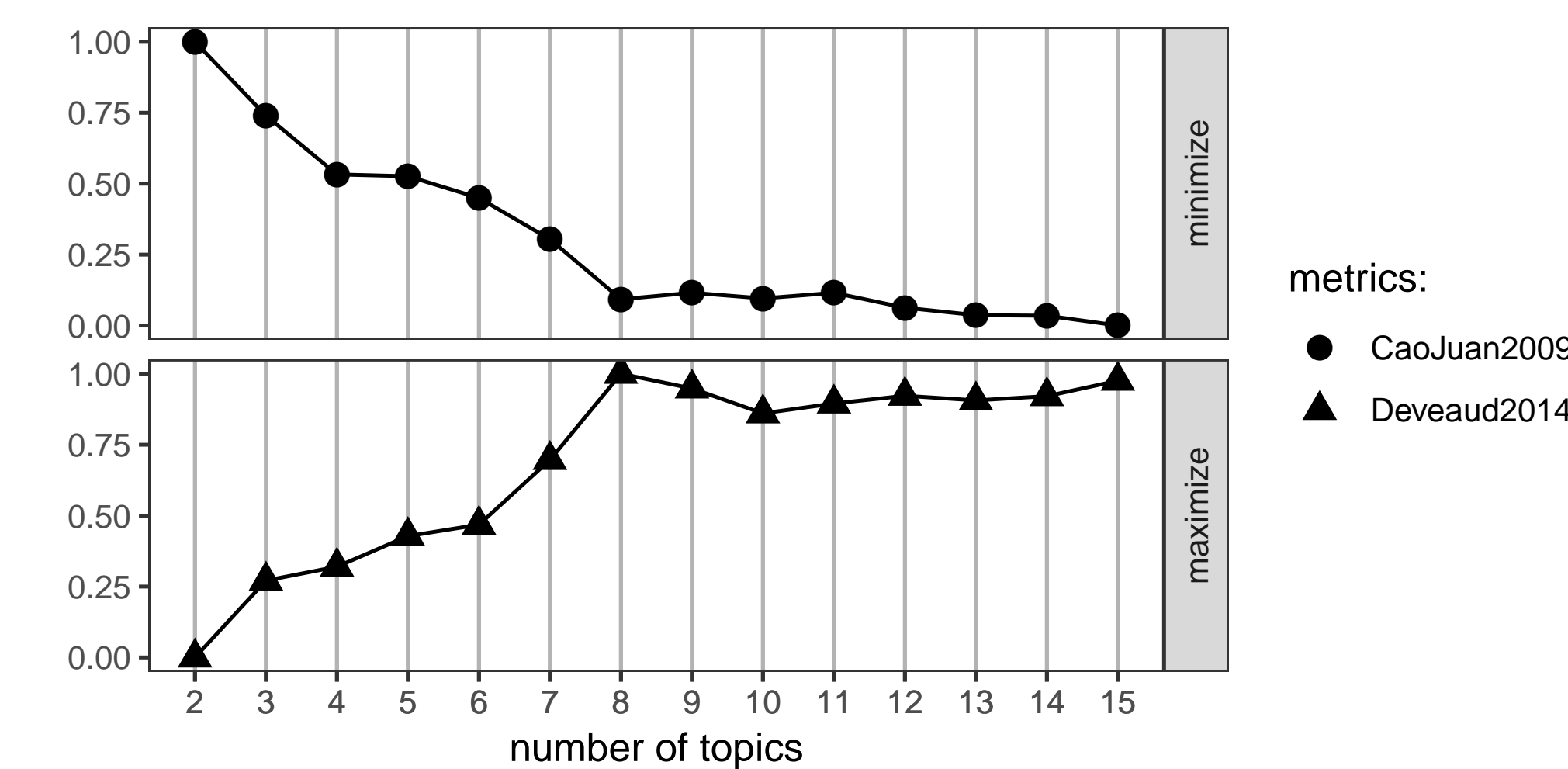
## Feature Engineering

Each frame contains a variable number of keypoints. Keypoints of interest are aggregated to feature classes using  $k$ -means clustering on RootSIFT representations with  $k = 45$ . A video-feature matrix is generated by taking the count of keypoints by feature class for all frames in each video.



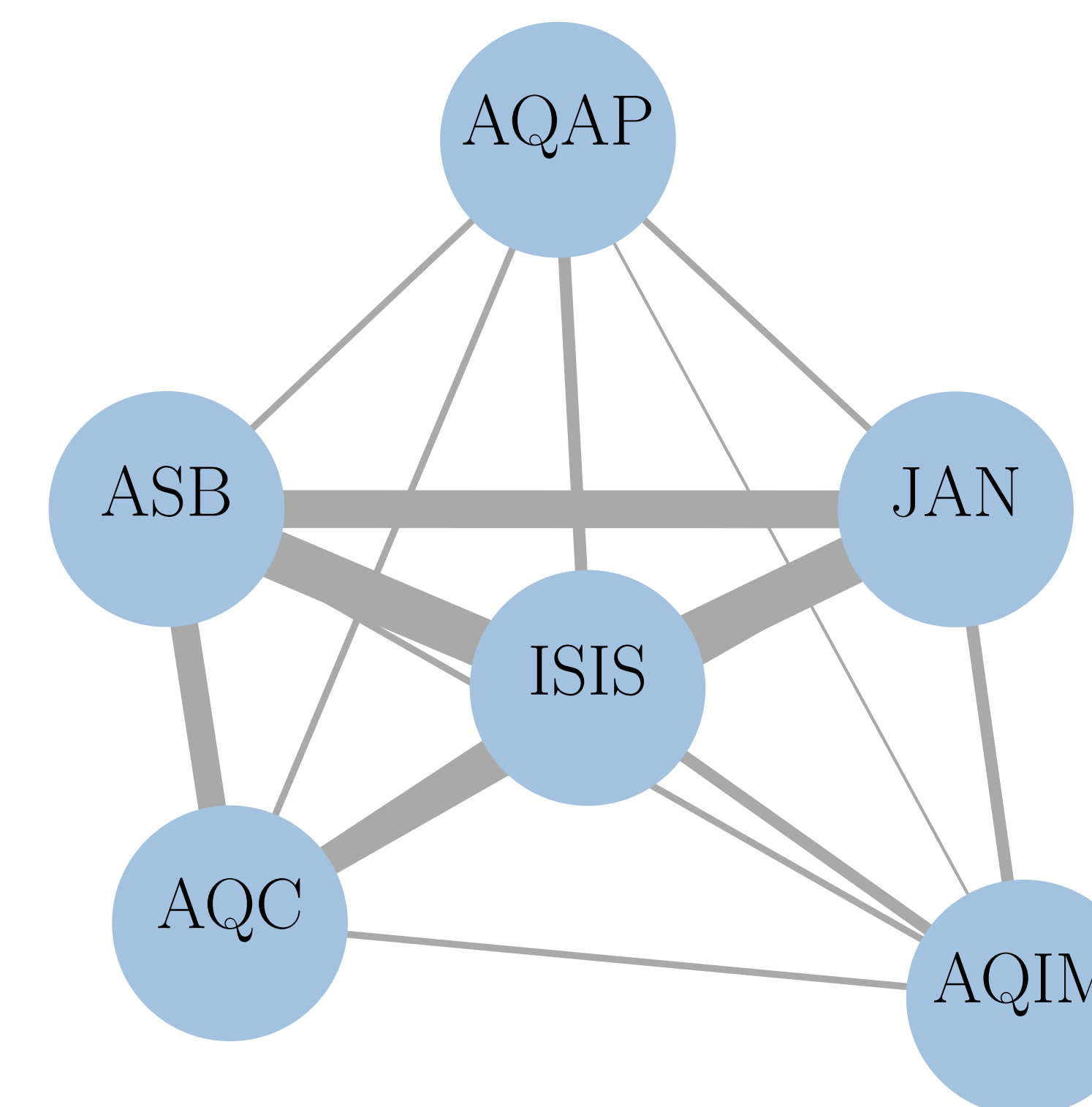
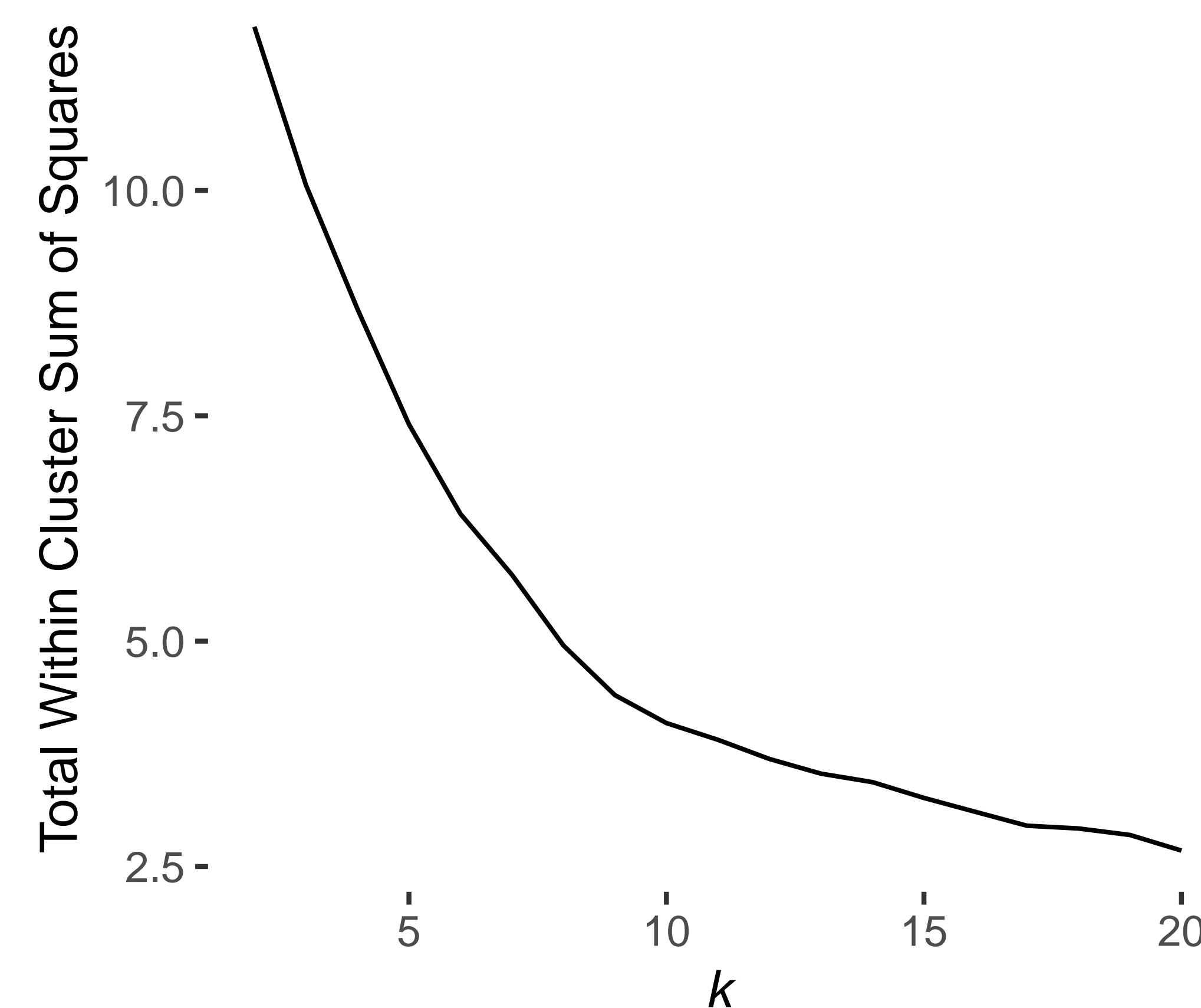
## Dimensionality Reduction

Latent Dirichlet allocation is used to reduce the 45 dimensional feature space, constraining the resultant feature space to a simplex. 8 topics were chosen based on standard model selection criteria. Topics are less directly interpretable than in a text model as the features associated with each topic are a composite of multiple keypoints.

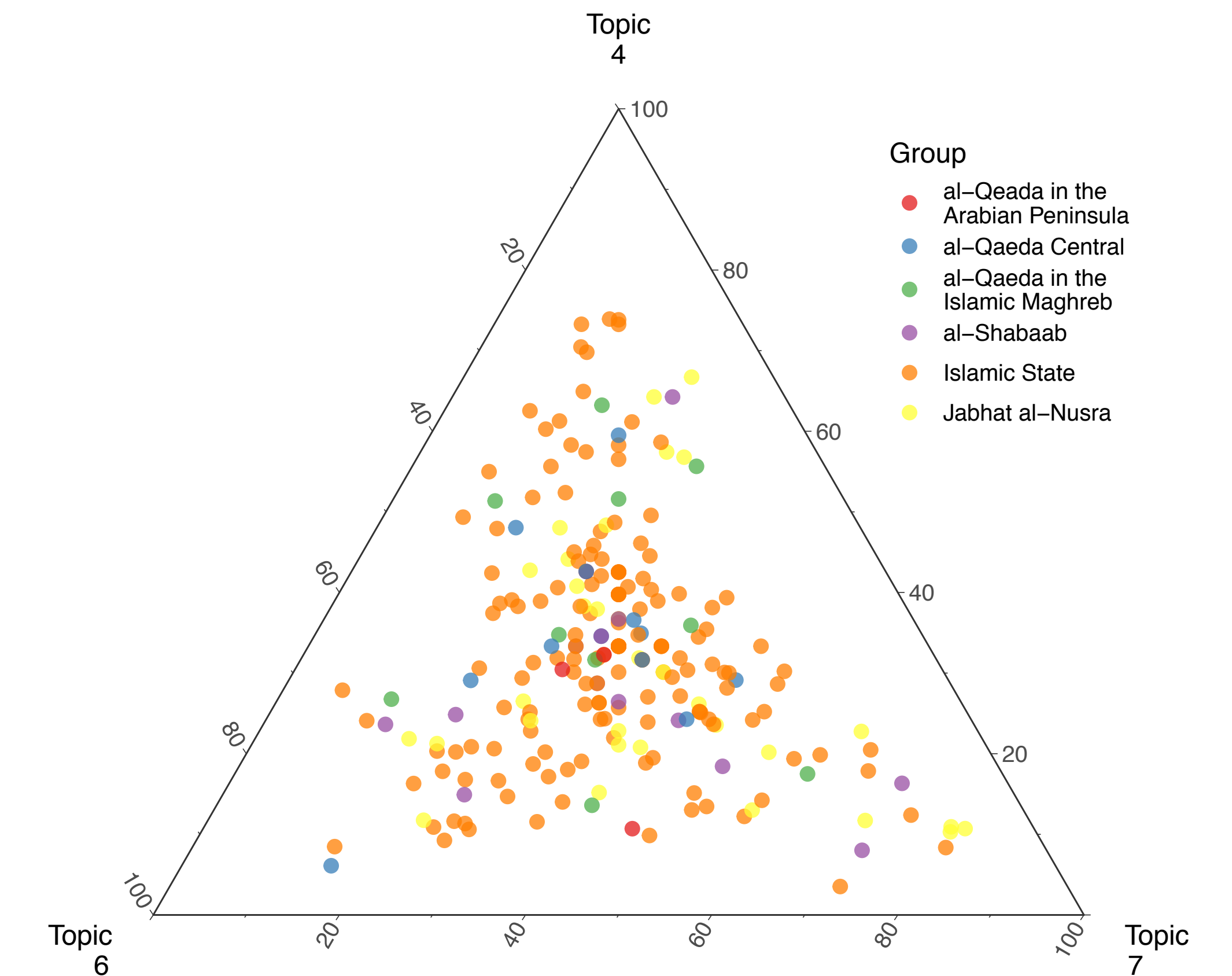


## Visual Topic Model

- Mixed membership vectors of the videos obtained from LDA are clustered using  $k$ -means clustering
- The elbow method is used with total within cluster sum of squares to select  $k = 9$  as the optimal number of clusters
- Each resulting topic-cluster represents a group of videos that use similar visual imagery
- Topic-clusters are used to construct an affiliation network with groups and topic-clusters as nodes
- Projected to a single mode network where edge weights between groups represent the number of group-video-group triples shared between them
- Larger edge weights indicate a higher number of shared visual image patterns between groups



## Most Prevalent Topics



## Conclusion

- High level of shared visual themes between Syrian groups, but also with al-Shabaab
- Suggests that while al-Qaeda in the Arabian Peninsula became more active in the wake of al-Qaeda Central's decline, it may be less transnationally focused
- Groups with large edge weights may be competing for the same pool of recruits or collaboratively sharing production resources
- Al-Qaeda central videos largely occupy center of the simplex, possibly reflecting diverse messaging

## Next Steps

- Employ video summarization to extract frames
- Continue tuning feature extraction parameters
- Incorporate group labels and video dates

## References

[1] Michelle Torres. Give me the full picture: Using computer vision to understand visual frames and political communication. Working Paper, 2018.

[2] June Hwang, Kosuke Imai, and Alex Tarr. Automated Coding of Political Campaign Advertisement Videos: An Empirical Validation Study. Working Paper, 2019.