Once More, With Feeling: Using Sentiment Analysis to Improve Models of Relationships Between Non-State Actors*

Kevin T. Greene† Caleb Lucas

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Abstract

We collect an original corpus of official documents released by Hezbollah and use text analysis to create a measure of their relationships with other non-state groups. Despite recent research that demonstrates these types of relationships affect the length and severity of conflict, data limitations hinder efforts by researchers to capture important variation in them over time. Our approach uses fine-grained text data to capture dynamic trends in these relationships. We demonstrate its effectiveness by showing our model is able to reproduce qualitative accounts of Hezbollah's known alliances and rivalries with other non-state actors with greater accuracy and precision than existing measures. We also compare the approach with event data and demonstrate its ability to provide more granular and complementary information. With further exploration, this technique could assist researchers in improving and developing measures of intrastate cooperation and competition for use in empirical analyses.

*Kevin T. Greene is a Graduate Student in the Department of Political Science, University of Pittsburgh (ktg19@pitt.edu). Caleb Lucas is a Graduate Student in the Department of Political Science, Michigan State University (clucas@msu.edu). Authors are listed alphabetically. Equal authorship is implied. We are grateful to Michael Colaresi, Justin Conrad, Christopher Lucas, Brian Phillips, Jakana Thomas, and James Walsh for helpful comments. Any errors or omissions are solely our responsibility.
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†Corresponding author

1 Motivation

A burgeoning literature within political science is interested in the relationships between armed actors involved in conflict (Bapat and Bond 2012; Bloom 2007; Christia 2012; Fjelde and Nilsson 2012). Researchers argue that these relationships, which are difficult to observe, are fundamental to their strategic choices and can drive violent behavior (Chenoweth 2010). For example, competition and outbidding can result in more lethal groups (Horowitz and Potter 2014; Wood and Kathman 2015), longer lifespans (Phillips 2014; Phillips 2015), and conflict recurrence (Zeigler 2015). Since dynamic, high resolution data regarding these relationships has generally been unavailable, existing work often measures competition and cooperation at the state level (Conrad and Greene 2015) or assumes away variation over time (Asal and Rethemeyer 2008). However, the former aggregates over important heterogeneity within conflicts and the latter is unable to model the erosion/development of relationships.

To address these measurement issues and enable further exploration of these dynamics, we propose applying sentiment analysis to official documents released by non-state actors. This article demonstrates researchers can use this method to generate time-varying information regarding the level of amity or enmity between groups. The measure we develop using sentiment analysis could easily be integrated into a typical regression framework to test theories regarding how non-state relationships affect conflict dynamics. Our recommendation to employ publications produced by armed groups builds on recent research that finds these texts provide meaningful and curated information regarding their platform and the conflict at large (Seib 2017). For example, Jones and Mattiacci (2019) demonstrate that non-state actors engage in public diplomacy through social media channels and Welch (2018) shows that they strategically change their messaging over time.

Specifically, we use natural language processing tools and an original corpus of official documents released by Hezbollah, an armed non-state actor in Lebanon, to demonstrate a method that can assist researchers in developing measures of non-state relationships. In

order to do this, we first select only text written by Hezbollah that is related to one of three other non-state actors (Hamas, al-Qaeda, and Amal).[1] We then hand code the sentiment towards these actors in a random set of the sentences. Finally, we train a model using machine learning with the hand coded sentences and classify the remaining sentences within the corpus. Our model is able to quantitatively capture substantively important and dynamic variation in Hezbollah's speech that mimics their real-world relationships with al-Qaeda, an international rival; Hamas, an international ally; and Amal, a domestic political partner. We validate our results with prior qualitative descriptions of these relationships.

Our paper's central innovation is that it provides researchers a method to generate accurate and dynamic quantitative measures of non-state relations for use in empirical analyses. Indeed, the text-based approach we demonstrate is able to correctly model Hezbollah's relationships with multiple other non-state groups. More so, we are able to capture the degradation of Hezbollah's relationship with al-Qaeda over time, an important improvement over extant measures that do not vary or are categorical. We encourage future researchers to apply similar approaches to other cases and substantive areas to better understand the applicability of this method and to test their theories.

We compare our approach to event data extracted from news articles. This represents the data source that researchers typically use to generate measures of relationships between non-state groups. However, it may have specific blind-spots and biases that may make them less useful for measuring changes in the verbal descriptions of one group by another (Eck 2012; Weidmann 2015). For example, since the major event datasets do not source articles from the websites of violent non-state actors, they do not code observations for the bulk of what non-state groups say about each other, despite these statements representing important signals regarding their relationships and occurring quite often. Rather, verbal events are created only if a statement is important enough to be reported in the news, which typically means they are either counter intuitive or extraordinary. This

[1]We identify both direct and indirect mentions of these groups using coreference resolution (Manning et al. 2014). Details regarding this process are available in the Appendix.

produces bias and limits the sensitivity of the measure to changes in the underlying relationships. We show that using groups' official media outlets produces an accurate measure with less variance than a similar one derived from event data. We encourage researchers to consider ways these different sources of data can be directly integrated in a way that maximizes their respective benefits.

This short article demonstrates that, in terms of measuring positions stated verbally, directly analyzing the content of official texts released by non-state groups provides a complementary data source that can be used with observations generated from media reports. It consequently opens new avenues into research connecting the expressed sentiment of groups to event data and news reports. This is important, as a great deal of non-state groups maintain a consistent internet presence and talk about each other, along with other actors, extensively.

2 Research Design

We contribute to the study of measuring intrastate relations by applying a research design drawn from natural language processing to documents published by Hezbollah in al-Ahed, one of their official media outlets. We analyze media published by Hezbollah for several reasons. First, they manage a variety of relationships with other groups. This allows us to model multiple different *types* of connections and assess the performance of our approach across them. For example, our primary analysis generates an accurate measure of Hezbollah's relationship with a domestic ally (Amal), an international ally (Hamas), and an international rival (al-Qaeda).[2] We purposefully chose al-Qaeda since their relationship with Hezbollah rapidly deteriorated after the Syrian civil war began. Our model is able to capture this important variation within their relationship. Second, Hezbollah represents a common case in civil conflict research and is an important regional actor.

[2]We demonstrate in the Appendix that the process we detail can be used for other political actors as well.

Demonstrating our method with this group is therefore a helpful step in establishing its utility. Finally, they manage multiple websites that host official statements and documents in a format similar to many other comparable groups. We expect our findings generalize to these cases.

Using the English-language version of al-Ahed's website, one of their official media outlets,[3] we construct a corpus using all of Hezbollah's available (2006-2016) official press releases and transcriptions of speeches made by Hassan Nasrallah, its leader. We use what Hezbollah says in these documents regarding other non-state groups to proxy for their relationships with them. This is an intuitive approach to creating such a measure. We expect that the nature of Hezbollah's connections to other groups affects how they talk about them in their official publications. When Hezbollah speaks about a rival group, they are likely to identify contentious issues and criticize the other group and its position directly. However, they might also simply make negative statements regarding their rivals without specifically identifying their disagreements. More so, as their relationship with another group worsens, it is reasonable to expect they will concurrently speak about them more negatively. This suggests that it is possible to reconstruct these relationships using text-based methods, which we successfully do using computational sentiment analysis.

There are a number of examples in our corpus that illustrate how the sentiment of statements tracks real-world relationships. For example, shortly before important municipal elections in Lebanon, Hassan Nasrallah delivered a speech and encouraged people to vote for Hezbollah and Amal. He said their political alliance is "blessed by all intellectual, moral, jihadi, political, and religious norms" and should not be taken for granted. In another speech around the same time, he said Amal is their partner in "in politics, in negotiations, in fighting, in the battlefield, in pain..." Both of these statements from our corpus are obviously positive. Conversely, after an al-Qaeda affiliate attacked civilians in Syria, Hezbollah released a statement that "strongly condemned the brutal crime." Similarly, in

[3]We provide additional information regarding the data and al-Ahed in the Appendix.

a separate speech he discussed how al-Qaeda "killed a great number of Sunnite and Shiite [Islamic] scholars." These are clearly negative and accurately reflect Hezbollah's relationship with al-Qaeda at the time they were published.

Again, this is intuitive, particularly because the documents in our corpus likely represent highly curated versions of the group's official positions since we only use official documents such as press releases and speech transcriptions. Since they are published in English, our corpus only includes text that the group likely employs to project an official image to an international audience.[4] This suggests it represents political and social positions that they consider important to broadcast to state sponsors and potential supporters. It is likely that their relationships with other important non-state actors is salient in this space.

It is possible, however, that certain groups might deceive their audiences and hide or obfuscate certain relationships. This issue generally affects research regarding the activity of armed non-state groups. Our method will not measure when deception is occurring directly. However, the approach we outline offers an important benefit over measures that rely on observable events. It is possible that after entering a secret alliance a group's rhetoric towards their new ally observably softens or shifts. Conversely, when their relationship begins to sour with a group their constituency supports, it is likely that what they say about them is also affected. This is an important dynamic that researchers have yet to explore, but potentially offers the ability to better estimate unobserved connections between groups.

[4]The method we detail is language agnostic. However, we focus on English-language documents since they are likely to contain curated, official positions (Jones and Mattiacci 2019). Researchers interested in including multiple languages in future studies could easily employ machine translation (Lucas et al. 2015) or use multilingual research methods (Haselmayer and Jenny 2017).

2.1 Group-Specific Expectations

In order to substantiate our measure of intrastate relations, we use coreference resolution (Manning et al. 2014) to select sentences in our corpus with direct and indirect references to three non-state groups (al-Qaeda, Hamas, and Amal) that Hezbollah has a known affinity or hostility towards and gauge whether our text-as-data approach can correctly capture this qualitative knowledge. We choose non-state actors with varying characteristics and different types of relationships with Hezbollah. Al-Qaeda is a Sunni terrorist group and international rival while Hamas is an international ally fighting for Palestinian statehood. Finally, Amal is a domestic political partner. In the following paragraphs, we outline the expected relationships based on interactions between the groups, scholarly literature, and information from Stanford's Mapping Militant Organizations (Crenshaw 2016). We then compare the results of our analyses to these known relationships in order to test the validity of our method. We further validate the approach in the Appendix by showing it can accurately capture Hezbollah's relationships with other political actors.

Our expectation is that Hezbollah's speech towards al-Qaeda will largely be negative during our time frame, as the two groups were fighting each other in the Syrian Civil War for much of it. Tension between the groups is not restricted to Syria though, as several years before the conflict Hezbollah accused al-Qaeda affiliates in Lebanon of attempting to assassinate their leader, Hassan Nasrallah (Crenshaw 2016). Further, Al-Qaeda subscribes to a fundamentalist Sunni ideology, while Hezbollah propagates a violent interpretation of Shi'ism. This division represents a deep chasm between the groups; al-Qaeda actively destroys Shiite holy sites and targets Shiite civilians (Bassem 2017). This issue divide is central to the rivalry between al-Qaeda and Hezbollah, with the latter actively attempting to rebuff the regional rise of al-Qaeda's ideology (Gleis and Berti 2012).

Amal has a checkered relationship with Hezbollah. Indeed, disgruntled members of Amal left the group during the Lebanese Civil War to create Hezbollah and the two organizations subsequently clashed over resources, land, and supporters (Levitt 2008). Both

emerged from the war as strong political organizations, but Hezbollah was able to retain its extensive weaponry. They have been in an alliance with Amal since 2006 despite their differences during the war.[5] Indeed, a high-level Hezbollah leader has described their interactions with Amal to be as "one family" (Qasim and Khalil 2005). We therefore anticipate the relationship between Hezbollah and Amal to be generally positive with variation during major domestic political crises.

Hamas, a United States-designated terror group that controls the Gaza Strip, has a longstanding cooperative relationship with Hezbollah (Levitt 2008). The two groups are known to share intelligence, assist each other in weapons smuggling, collude on financial matters, and conduct joint operations. Both benefit from Iranian funding and organizational support. However, during times of infighting with other Palestinian groups, Hezbollah has been less supportive of Hamas, even occasionally criticizing their leadership. We also expect that their differences over the Syrian Civil War to contribute to a downward trend in their relationship during recent years. For these reasons, we expect Hezbollah's speech toward Hamas to be largely positive with some variation during divisive time periods.

2.2 Modeling Relationships with Text

Our model to quantify the relationships between non-state actors uses sentiment analysis, which measures the negative, neutral, or positive valence of a statement, usually about a given subject (Liu 2012). We argue that applying this method to the text released by non-state actors can assist in identifying the type of relationship they have with other groups, as the dynamics of their relationships will measurably affect what they say about other groups. While the sentiment of a statement such as "the alliance between Amal and Hizbullah is relevant to everything" is obvious to humans reading the text, our goal is to build an automated classifier to detect the presence and valence of sentiment. Our aim is

[5]Our data covers 2006-2016, all the years available when they were collected.

to build a quantitative model that is able to capture inter-group dynamics we detailed in the previous section.

We use supervised learning and a dynamic measurement model to accurately identify when Hezbollah is expressing negative or positive sentiment about a given actor. To train our sentiment classification model, we first randomly select 500 sentences with direct or indirect references to Amal, al-Qaeda, or Hamas from our corpus and code them for negative (-1), positive (1), or neutral (0) sentiment towards each of our non-state actors of interest.[6] These labeled sentences are then used as training data for our model, which utilizes multiclass logistic regression. We use 10-fold cross-validation to tune the parameters of the model and ensure sufficient generalization.[7] Next, we classify the remaining uncoded sentences and calculate the average yearly sentiment for each actor for the years 2006-2016. We also compare these results to those found using two different "off the shelf" sentiment dictionaries in the Appendix.

However, observed sentiment is likely a noisy representation of Hezbollah's latent position. We therefore utilize the Kalman Filter to estimate the values of this underlying state (Kalman 1960). In this approach, the observed sentiment values represent an estimate of Hezbollah's unknown latent position plus some observation error $y_t = \theta_t + v_t$, where $v_t \sim N(0, V)$.[8] By using information from the observed sentiment measures, as well as the noise and measurement error of the process, we can produce smoother values of the underlying latent state of Hezbollah's relationship with various actors. We model the transition of this state over time as a simple random walk plus noise $\theta_t = \theta_{t-1} + w_t$, where $w_t \sim N(0, W)$. Future measures of Hezbollah's latent position are therefore determined by the previous estimates of this position plus some error. This is an appropriate way to model relationships between groups since they are not generated each year, but are on-going latent processes.

[6] See the Appendix for a discussion concerning the coding rules and results across other training sizes.

[7] We achieve an average cross-validated accuracy of 80%, far better than the accuracy of guessing the majority class (46%). Details concerning the classifier and evaluation metrics can be found in the Appendix.

[8] The evolution W and observation V variances are estimated using MLE.

3 Empirical Results

3.1 Main Analysis

The results of our main analysis demonstrate our model produces accurate estimates that conform to our expectations and accurately track the relationship between Hezbollah and the varied groups in our analysis. The results are displayed in Figure 1. The plots display the smoothed Kalman estimates as well as the observed average yearly sentiment in Hezbollah's speech towards al-Qaeda, Hamas, and Amal. Observations near 0, 1, and -1 suggest on average neutral, positive and negative sentiment respectively. The estimate regarding al-Qaeda is consistently negative, but steadily decreases after they become involved in Syria. Amal and Hamas both score very high on the sentiment measure. This is also expected. However, the model correctly differentiates between the two groups by estimating a higher score for Amal on average.

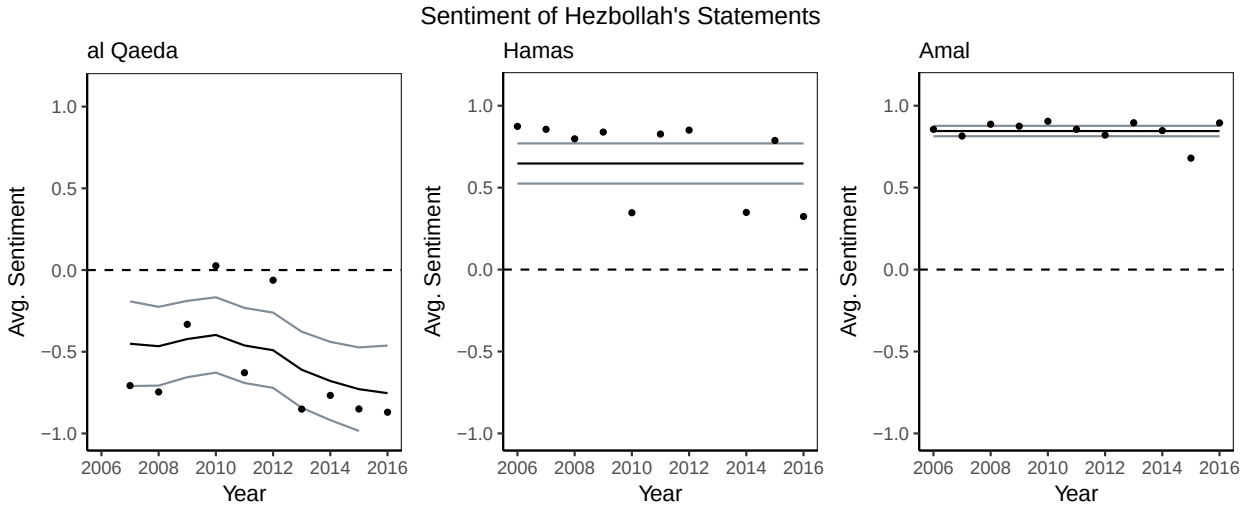

Figure 1: The points represent observed sentiment, while the black lines represent smoothed Kalman estimates. Gray lines denote the 90% prediction interval.

Indeed, the estimates are consistent with expert opinions regarding these groups. For example, Stanford's Mapping Militant Organizations project (Crenshaw 2016) lists Hezbollah and Hamas as having "close ties" and Hezbollah and al-Qaeda as having a "troubled

relationship." The fact that our sentiment classifier successively measures the negative relationship between al-Qaeda and Hezbollah, as well as the expected positive relationship between Amal and Hezbollah, corresponds with prior expectations. Further, the continued drop in sentiment towards al-Qaeda coincides with the group encouraging Muslims to fight against the Syrian regime and the start of direct fighting between al-Qaeda and Hezbollah in Syria (Lister 2015). This trend demonstrates the measure can track substantive events involving non-state groups. We rely on these metrics as a method to assess the model's accuracy since there is no outside metric beyond event data with which to directly compare our measurements. However, such qualitative descriptions are unable to produce comparable dynamic measures for use in quantitative analyses. Our approach enables researchers to explore important dynamics like the correlates of the erosion of relations over time, a task ill-suited for broad categorical codings.

4 Comparison to Event Data

We compare our approach to data coded from events in newspaper reports in this section. We do this for two reasons. First, most researchers use LexisNexis or newspaper reports as their primary sources when generating measures of non-state relations. Second, we use a simple method that produces a continuous measure from this data that is roughly on the same scale as ours and comparable to the measure our approach generates. The results of this comparison demonstrate the unique benefits of our research design and suggests combining these approaches could be fruitful for future researchers. We use the Integrated Crisis Early Warning System (ICEWS) event dataset (O'Brien 2010; Boschee et al. 2017)[9] to model relationships between non-state actors and compare the results to our main analysis' findings. ICEWS is a DARPA-funded initiative that uses hundreds of newspaper sources to automatically collect and code event data. To compare our main

[9]The ICEWS data and codebook can be found here: https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/28075.

analysis to one using this dataset, we select events that occur between 2006 and 2016 (our main analysis' time frame) where Hezbollah is the the actor carrying out the event, while either al-Qaeda, Amal, or Hamas are the target of the event.[10] The names of the groups are standardized to ensure all mentions are captured across time. We match the CAMEO code of each event to its QuadClass to create negative, positive, and neutral events.[11] As with our main analysis, we take the yearly average of these scores and apply the Kalman filter to generate smoothed estimates of Hezbollah's sentiment towards each actor.[12]

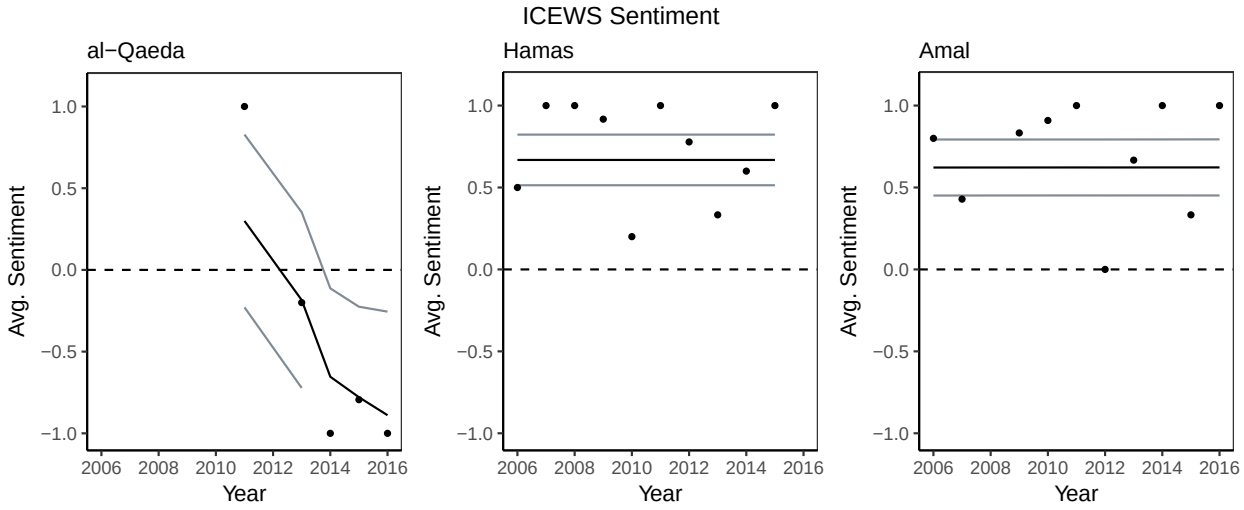

Figure 2: Verbal and non-verbal ICEWS events. The points represent observed sentiment, while the black lines represent smoothed Kalman estimates. Gray lines denote the 90% prediction interval.

We provide the results of this process in Figure 2. The measures derived using our approach and the ICEWS event data result in relatively similar estimates overall, as sentiment towards Hamas and Amal across both approaches are consistently positive. This general convergence provides additional validity to our approach. Differences we do observe are not entirely surprising since ICEWS does not code events from al-Ahed, the source of our data and one of Hezbollah's official media outlets. More significant differences exist between the estimates for sentiment towards al-Qaeda. For example, the

[10] See the Appendix for a comparison of observations between our corpus and ICEWS.
[11] We use the example provided by the Open Event Data Alliance.
[12] We detail additional processing steps in the Appendix.

temporal range of events directed at al-Qaeda from Hezbollah is smaller in the ICEWS data. There are no such events in the ICEWS data before 2011. However, our corpus of official Hezbollah statements captures mentions of al-Qaeda going back to 2007.

Beyond that, the events for the year 2011 in the ICEWS data are also potentially problematic. The estimate for 2011 (the peak of the plot) contains only two events, both of which involve Hezbollah speaking favorably about al-Qaeda. However, these observations appear to be coded from the same event in which a United States federal court in Manhattan included in a 2011 ruling that Hezbollah supported al-Qaeda in relation to the September 11, 2001 attacks.[13] This has the effect of shifting the ICEWS-based estimate from almost perfectly positive in 2011 to almost perfectly negative in 2016, while our approach produces estimates that trend downward as hostilities increase in the Syrian Civil War.

While event data is likely a superior data source for transnational and large-N studies, subnational and group-specific studies could benefit from using the text of non-state groups as a source of data directly to provide insight into non-state relationships. This can help account for missing values in event data, give fuller coverage of interactions between groups, and provide higher resolution for measures such as sentiment. More so, it can enable difficult between-group comparisons and offer rich data for research questions that require measuring unique attributes across groups. Since ICEWS' coding does not provide the actual text used as the source of the events, our approach has the added benefit of being used to conduct additional textual analyses. Future research could consider how the text produced by non-state actors and tools from natural language processing could be used more directly alongside event data to increase the validity and coverage of measures concerning these groups.

[13]There is no certainty that we have identified the correct source for these two observations since ICEWS does not provide a URL or the body of the article used to code individual events. However, the sources, dates, topics, etc. of the articles we found match the two observations in ICEWS (Amiri 2011; "Une Cour de District des États-Unis Soutient que l'Iran est Derrière les Attentats Terroristes du 9/11" 2011).

5 Discussion

In this short article we demonstrate that researchers can apply computational sentiment analysis to official publications released by non-state groups to better measure and understand intrastate relations. We encourage future work to explore the applicability of this approach in other cases and substantive areas. For example, this approach could be used to analyze relationships with other types of political actors as well, such as politicians and international organizations. We provide such an analysis in the Appendix. High volume text sources, such as the Twitter feeds of rebel groups, could be used to generate data that can be updated in real-time similar to the approach taken by Minhas, Ulfelder, and Ward (2015). Alternatively, researchers could use official websites, newspapers, etc. to generate these measures backward in time. Other text-as-data methods, particularly those that go beyond simple bag of words representations of the text such as aspect-based sentiment analysis, could provide even more detailed information regarding the relationships between non-state actors and produce additional benefits over events data (Park, Colaresi, and Greene 2018). Future research could also consider the benefits of differentiating between relatively spontaneous and non-spontaneous documents, such as the transcription of a media interview and formal press release respectively.

A benefit of the approach we demonstrate is that it provides a technique to compare the behavior of groups on their official media platforms, similar spaces that many groups use to communicate. Few tools and data sources exists for such between-group comparisons of non-state actors (Beber and Blattman 2013). This could be particularly useful for comparative analyses modeling something highly dynamic, such as the relationships between rebel groups fighting in Syria. Such studies currently focus on attributes such as ideology, organizational structure, sources of support, etc. Our approach could provide better context and assist in modeling these dynamic, latent relationships.

Furthermore, the ability to better trace and measure the escalation of non-state rivalries is also an important task to policy-makers, as the transition from negative language to

bloodshed is not uncommon. For example, Hezbollah condemned al-Qaeda before conflict started between the groups. Similarly, during the Algerian civil war in the 1990s, the Armed Islamic Group and Islamic Salvation Army often exchanged verbal threats before engaging in armed conflict or massacring civilian supporters of their rivals. As such, future developments analyzing non-state actors' text may provide new insights into measuring and predicting similar escalations in non-state relationships.

Several issues might limit the generalizability of our findings. First, we analyze a single actor. While Hezbollah is certainly an important case in civil conflict research, it is possible that our findings do not apply to other organizations. Second, our corpus only includes official documents published in English. We expect them to represent the group's official position and have no reason to believe analyzing their Arabic versions would produce different results. It is possible that Hezbollah communicates differently in English and Arabic though, perhaps in order to target different parts of their constituency strategically. We encourage researchers to explore substantively important differences between texts published in different languages. Regardless, our approach suggests a fruitful research agenda exists in examining the text that non-state actors produce in order to better measure and understand their relationships with other organizations.

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