Does Social Media Influence Conflict? Evidence from the 2012 Gaza Conflict*

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Abstract

How does international public support via social media influence conflict dynamics? To answer this question, I construct a unique dataset drawn from social media sources to examine the behavior of Israel and Hamas during the 2012 Gaza Conflict. I code Hamas's and Israel's communication, their conflict intensity, and United States, United Nations, and Egyptian attention to the conflict at an extremely disaggregated (hourly) level for the full 179 hours of the conflict. Notably, I also use social media sources to construct hourly time series data on each side's popular support from international audiences during the conflict. I employ a Bayesian Structural Vector Autoregression (BSVAR) to measure how Israel's and Hamas's actions respond to shifts in international public support. The main finding is that shifts in public support reduce the conflict intensity, particularly for Israel. Conversely, increases in the attention of the international actors—US, Egypt, and UN— slightly increase the conflict intensity of both Hamas and Israel. The results provide an important insight into how information technology is changing the role of international audiences in conflict, and how they in turn, shape participants' strategies.

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1 Introduction

"`The IDF has embarked on Operation Pillar of Defense.`"
-*@IDFSpokesPerson* 15:45 November 14, 2012

"`We recommend that no Hamas operatives, whether low level or senior leaders, show their faces above ground in the days ahead.`"
-*@IDFSpokesPerson* 18:22 November 14, 2012

"`@idfspokesperson Our blessed hands will reach your leaders and soldiers wherever they are (You Opened Hell Gates on Yourselves).`"
-*@AlQassamBrigade* 19:04 November 14, 2012

Historically, information technology advances have altered the path of conflict by changing the way leaders communicate to their armed forces, and interested audiences monitor events (van Creveld, 1989). Technology increases the speed and dissemination of information, allows new audiences to follow the conflict, and express their (the audiences') support or dissatisfaction for different actors. For example, the use of the telegraph and the advent of railroad to quicken communication and transport have led many historians to dub the American Civil War as the first "modern war" (Hagerman, 1992). Especially relevant to the current paper, Marten (2012) argues that the widespread use of the telegraph and mass newspaper coverage allowed ordinary civilians to follow the American Civil War at an unprecedented speed and intimate level, and that this shaped citizens' and politicians' attitudes towards the war. New technology provides new information to leaders, and influences their strategies and constraints that are central to the bargaining models of international conflict (Fearon, 1995, 1997). Previous research on audience costs and foreign policy public opinion argues that democratic leaders may be uniquely sensitive to shifts in domestic support (Fearon, 1994; Mueller, 1973). Yet this research is agnostic on how international public support constrains (or enables) conflict.[1] Other research argues that states may be responsive to international public opinion and threats to their legitimacy due to international norms (Finnemore and Sikkink, 1998), or as a way to lower the costs of favorable policy implementation in foreign

[1]Many states have actually tried to do the reverse—engender support among targeted foreign constituencies for support or involvement in a conflict. For instance, the British during World War II (pre-Pearl Harbor) actively attempted to sway the American public to join the war via a sophisticated public relations campaign. See Cull (1995).

constituencies (Thompson, 2006). The lack of research on the effects of international public support on conflict dynamics, especially since many conflicts have transnational dimensions (Gleditsch, 2007),[2] represents an important gap in the current literature.

Most empirical studies of conflict examine the role of third-party actors only at the state-level, and are focused on outcomes (Bercovitch and Sigmund Gartner, 2006), and not the actual dynamics during fighting.[3] This results in a disconnect from the majority of theoretical work which explicitly describes the dynamic process of fighting and bargaining (Kydd, 2003; Beardsley, 2008; Wagner, 2000). The increasing use of social media[4] by states and the general public affords state (and non-state) actors and leaders the ability to more quickly communicate to a wider audience, and elicit feedback during the conflict. For researchers, it also provides a new source of data and insights on conflict behavior. I use social media sources to construct a disaggregated dataset. I then use the dataset to test for the first time (to my knowledge) how states respond to changes in international public support on social media vis a vis international mediators during conflict. The 2012 Gaza Conflict is an excellent case to explore this research question, as it marks one of the first conflicts where both actors (Hamas and Israel) extensively used social media to attempt to sway international opinion (Borger, 2012).[5]

On November 14, 2012 in the late afternoon, the Israeli Defense Forces (IDF) launched a series of airstrikes against Hamas targets in the Gaza Strip in response to increased rocket fire from the Gaza Strip. The fighting continued until a mediated ceasefire, brokered by Egypt and the United States (US), with United Nations (UN) oversight, took effect on November 21, 2012. The escalation of conflict mirrored past hostilities between Israel and Hamas (notably the 2008-2009 Gaza Conflict), with Israel launching airstrikes and Hamas responding with inaccurate rocket fire (Borger, 2012). Yet, the extensive use of social media—specifically Twitter— by both sides in the 2012 Gaza Conflict was unprecedented. Twitter is a social media platform for rapid, public, and concise messages to

[2] For instance many rebel groups receive political and material support from patron actors, or diaspora communities abroad (Salehyan, 2009).

[3] A notable exception is Schrodt and Gerner (2004).

[4] Following the Oxford Dictionary definition, I define social media as "websites and applications that enable users to create and share content, or to participate in social networking." `http://oxforddictionaries.com/us/definition/american_english/social-media`

[5] The IDF and Israeli sources called the conflict Operation Pillar of Cloud and Hamas called it Shale Stones. To avoid using normative names for the conflict, I refer to it as the 2012 Gaza Conflict.

be shared among networked followers.[6] The IDF used its *@IDFSpokesperson* Twitter account to announced its campaign on Twitter (see previous excerpt),[7] and both the IDF and Hamas, via its *@AlQassamBrigade* also engaged each other over social media (IDF Spokesperson, 2012; Al Qassam Brigades, 2012).[8] Each side used social media to attempt to put their own actions in a better context, and denigrate the opposition. While the use of social media during the conflict is interesting, what is of greater interest to scholars of international relations, is what social media (and the data constructed from it) reveals about how actors' strategies are constrained (or not) by international audiences. I use social media to construct extremely disaggregated (hourly-level) data on public support for each actor during the 2012 Gaza Conflict.

The current study improves upon extant studies of conflict and bargaining in the presence of international audiences in three ways. (1) I measure and incorporate both fighting and communication into the empirical models. (2) The use of social media to both track the conflict, and as a communication tool for the conflict participants, represents a new and important data source. I scraped data on Hamas and Israel conflict intensity towards each other from Haaretz (Haaretz, 2012) and Al Jazeera (Al Jazeera, 2012), news organizations that closely followed the fighting on the ground diplomatic efforts. I also used the Haaretz and Al Jazeera to code the interest of the principal international actors in the conflict: the US, the UN, and Egypt. Both Hamas (*@AlQassamBrigade*), and Israel (*@IDFSpokesPerson*) used social media to communicate information, and advocate for their actions to international audiences. This social media data affords the construction of extremely disaggregated data to better understand how the bargaining and fighting process unfold, and how international actors directly influence it. (3) The most innovative part of this paper is the use of social media to create an hourly measure of public support during the conflict. Israel and Hamas made extensive use of hashtags, specific words or phrases prefaced with the pound (#) symbol to categorize their messages,[9] to garner support for their actions, and let other Twitter users show their support by sharing these hashtags in their Twitter feeds. The most prominent

[6]See `https://twitter.com/about` for more information.

[7]They also announced it on YouTube.

[8]They each tweeted approximately 300 times.The Israel Ministry of Foreign Affairs also had engaged over Twitter during the conflict (*@IsraelMFA*), but it was much less active.

[9]From the Twitter website, "the # symbol, called a hashtag, is used to mark keywords or topics in a Tweet. It was created organically by Twitter users as a way to categorize messages."

were the #GazaUnderAttack hashtag (support for Hamas) and the #IsraelUnderFire (support for Israel) hashtag (Ashkenazi, 2013). I collect data on mentions of these hashtag to construct an hourly measure of support for Hamas and Israel.

I use a Bayesian Structural Vector Autoregression (BSVAR) (Brandt and Freeman, 2006; Brandt, Colaresi and Freeman, 2008) to test how conflict participants respond to shifts in international mediators and public support. Three key findings emerge. (1) Both Hamas (#GazaUnderAttack) and Israel (#IsraelUnderFire) paid close attention to changes in their own public support. Hamas's and Israel's communication on social media responded contemporaneously to changes in support. (2) Increases (shocks)[10] in support for rival actors, constrain each actor's conflict intensity. This is especially true for Israel, as increases in support for Hamas decrease their conflict intensity by approximately 177%. Comparatively, increases in the attention of the international mediators (US, UN, and Egypt), slightly increase both actors' conflict intensity. (3) While increases in public support for Hamas constrain Israel militarily, it actually increases the activity of its communication on social media. The results show how much more sensitive the conflict participants were–particularly Israel–to shifts in public support on social media compared to the international mediators. They results also provide new empirical and theoretical insight into how new technology is changing the information available to conflict participants, and hence the trajectory of conflict. Qualitative information presented in Section 6 confirms the empirical results, and points to the increasing primacy played by social media as a tool for conflict, both in the Israel-Palestinian conflict, and other ongoing conflicts.

The remainder of the paper is structured as follows. Section 2 reviews the extant literature on conflict, communication, and technology in the presence of international audiences. Section 3 provides a brief overview of the 2012 Gaza Conflict, and discusses how Hamas and Israel utilized social media. Section 4 discusses the data sources, coding methods, and the empirical strategy. Section 5 presents the empirical results and interpretation. Section 6 offers some discussion and context for the results, and contains the conclusion. Further information on the methods, additional

[10] As Brandt and Freeman (2006) describe, the (BS)VAR framework explicitly assumes an equilibrium for the data generating process. A key question, is how do different variables respond to "surprise" shocks, via impulse response function (IRF) analysis, in other variables.

results and robustness checks are presented in the Appendix and Supplementary Information.

2 Communication, Technology, and International Audiences

As many scholars have argued, war and bargaining are inherently intertwined (Powell, 2004; Wagner, 2000). This is even more true in limited conflicts in which neither side expects a total victory. For actor A, the goal in a limited conflict between actors A and B, in the presence of third-party mediators, is to use a combination of battlefield success and international pressure to arrive at the most favorable settlement for A (Bercovitch and Sigmund Gartner, 2006). Previous research suggests that third-party actors may be able to constrain the behavior of conflict participants via mediation,[11] particularly when the mediators are allies to one of the actors (i.e. biased) (Calvert, 1985; Kydd, 2003). Crucial to the success of mediation is the ability of third-parties to credibly convey information about the costs and benefits of continued fighting to conflict participants (Beardsley, 2008; Kydd, 2003, 2006).[12] In the event of an asymmetric conflict, where actor A is stronger than B, international actors may place more pressure on actor A to stop the conflict to avoid civilian casualties (Gross, 2009; Arreguín-Toft, 2006). This may particularly be the case when actor A has more connections to the international system (Keohane and Milner, 1996; Zeitzoff, 2011). Dixon (1994) suggests that democratic states are more likely to peacefully negotiate an end to disputes due to shared values and norms. Others argue that democracies are more constrained in the threats they make and the conflicts they enter, due to reelection-seeking incentives (Fearon, 1994; McGillivray and Smith, 2008).

Most of the previous research in international relations on bargaining and fighting in the presence of international audiences has focused on states or leaders communicating to domestic audiences, or other leaders and states (Fearon, 1994). The role of popular support among international audiences, or concerned foreign policy elite, remains under-theorized in international conflict

[11]Like Beardsley (2008), I adopt the definition of Bercovitch and Houston (1996) which states that mediation is, "a reactive process of conflict management whereby parties seek the assistance of, or accept an offer of help from, an individual, group, or organization, to change their behavior, settle their conflict, or resolve their problem without resorting to physical force or invoking the authority of law."

[12]Fey and Ramsay (2010) are notably skeptical of the added benefits of mediation, arguing that any information revealed via mediation would be available in its absence.

(Thompson, 2006). Popular international public support is hypothesized to be a key component in many conflicts, especially since many conflicts contain diaspora, or transnational communities that provide support (materially and politically) to conflict participants (Salehyan, 2009). This is especially true in the Israeli-Palestinian conflict, where international institutions, popular perceptions of legitimacy, and public diaspora communities have all played a crucial role in the conflict since its inception (Tessler, 1994; Morris, 2011). Weaker actors, or non-state actors may use violence, and media coverage it engenders, to gain domestic and international support for their actions (especially if the targeted government cracks down in response) (Bueno de Mesquita and Dickson, 2007; Weimann, 2006).

The ability for states to use social media has transformed the way in which concerned elites (from abroad) and diaspora communities can follow a conflict, and apply pressure to actors. States and leaders have responded. Over 75% of world leaders have an active presence on Twitter (Twiplomacy, 2013). Moreover, a growing body of research suggests that social media is upending the traditional political uses of media by 1) democratizing access to media sources, 2) speeding the dissemination of information, which in turn 3) can facilitate and spread collective action (Lance Bennett, Breunig and Givens, 2008; Gil de Zúñiga et al., 2010; Bond et al., 2012). Leaders, cognizant of this potential for collective action, may respond by restricting access to social media (King, Pan and Roberts, 2013). Furthermore, social media allows users to self-select their information sources.[13] For example, Barberá (2013) uses the fact that Twitter networks exhibit homophily—individuals follow those who they support, and feel an affinity with—to estimate ideal points for U.S. members of Congress and voters, and shows that they reflect the underlying left-right dimension. Zeitzoff, Kelly and Lotan (2013) map Twitter follower networks on the Israel-Iran nuclear issue and show that they reflect the pro-Israel versus pro-Iran/Palestinian cleavage, further demonstrating that online follower networks map onto meaningful policy positions. Yet, none of these studies have empirically examined the strategic interaction between support on social media and conflict actors.

[13] For an excellent overview on the properties of Twitter networks see Kwak, Lee, Park and Moon (2010).

3 Public Communication During the 2012 Gaza Conflict

The 2012 Gaza Conflict began on November 14, 2012 with an Israeli air strike that assassinated Ahmed al-Jabari, the second-in-command of Hamas's military wing. Much like the 2008-2009 Gaza Conflict, the Israeli air strikes and assassination of al-Jabari were reportedly in response to increased rocket fire from the Gaza Strip (Kershner and Akram, 2012). The fighting lasted for seven and a half days, during which Israel called up reservists and threatened a full-scale ground invasion of the Gaza Strip. Hamas and other Palestinian militant groups continued to fire rockets into Israel, reaching Tel Aviv and Jerusalem for the first time.

During the conflict, mediation efforts were undertaken in Cairo, Egypt. US Secretary of State Hillary Clinton visited Cairo and met with Egyptian President Mohamed Morsi. Neither the US nor Egypt were impartial in their public statements. Egypt showed much stronger support for Hamas's actions, and the US did the same for Israel (Kirkpatrick and Rudoren, 2012). Since Hamas and Israel had no formal diplomatic relations with each other, indirect talks took place in Cairo between Hamas and Israeli officials, with Egyptian officials serving as the interlocutors (CNN Wire Staff, 2012). UN General Secretary Ban Ki-moon actively participated with Egyptian and US officials in brokering the deal. As part of any ceasefire, Hamas demanded that border crossings be opened and the naval blockade lifted. Israel demanded an end to the rocket fire, and also stricter measures to prevent further weapons being smuggled into Gaza. Eventually, on November 21, 2012, US Secretary of State Hillary Clinton and Egyptian Foreign Minister Mohamed Kamel Amr held a joint news conference in which they announced that a ceasefire would take place at 21:00 Israel (Gaza) time. The ceasefire did not address the broader issues of the Israel-Hamas conflict, but did result in a cessation of rocket fire into Israel and looser regulations on the land border crossings into Gaza. Egypt served as the guarantor of the ceasefire (BBC, 2012).

One of the most interesting aspects of the 2012 Gaza Conflict was the extensive use of social media, particularly Twitter, by Hamas and Israel. Hamas and Israel's interactions during the conflict via English-language Twitter feeds led some pundits to dub it the first "Twitter War" (Sutter, 2012). During the 2008-2009 Gaza Conflict, the IDF maintained an official blog, disseminated press briefings, and used other, more traditional media sources to justify its offensive (Zeitzoff, 2011).

The perception among critics of Israeli actions in the 2008-2009 Gaza Conflict was that the IDF disproportionately targeted Palestinian civilians—with the lopsided casualty numbers cited as evidence of the IDF disregard for civilians. To attempt to counter this perception, during the 2012 Gaza Conflict the IDF Spokesperson Unit, the military unit responsible for media relations during both peace and war, was extremely active on its Twitter feed *@IDFSpokesPerson*. It attempted to both put Hamas's actions in a negative context, and place a positive spin on the IDF's actions (Shachtman and Beckhusen, 2012). The *@IDFSpokesperson* tweeted messages justifying Israel's military offensive such as:

> "What would you do if rockets were striking your country? RT[14] if you agree that #Israel has the right to self-defense *-12:40 November 16, 2012*."

The *@IDFSpokesPerson* feed also described the process of targeting Hamas militants while also denigrating Hamas for hiding among civilians. For example,

> "Hamas' (sic) strategy is simple: Use civilians as human shields. Fire rockets from residential areas. Store weapons in mosques. Hide in hospitals *-10:09 November 18, 2012*."

The *@IDFSpokesPerson* feed was criticized for directly threatening Hamas with its tweets such as the following: "we recommend that no Hamas operatives, whether low level or senior leaders, show their faces above ground in the days ahead (*18:22 November 14, 2012*)." Avital Leibovich, the head of the IDF's Interactive New Media Branch, explained the role of such threats:

> "When rockets are falling on our (Israelis') heads, and I'm referring to 500 rockets in the last 72 hours, if you can even imagine the extent (of it). Then when you have certain time (sic) that you want to convey a message of deterrence to an audience, then that's a good tool (Twitter/social media) to do it" (Hollister, 2012).

The IDF actively sought to rally supporters via social media. It encouraged the use of the hashtag #IsraelUnderFire so that Twitter users show their support for Israel and its actions (Gustin, 2012).

[14] RT means Retweet, and is akin to forwarding in email.

During the 2012 Gaza Conflict, Hamas and Israel faced very different political and military constraints and objectives. Israel's goal was to conduct air strikes to both weaken Hamas and other militant groups' capabilities,[15] and exact a price for continued rocket attacks. Israel's military superiority actually placed it in a conundrum. As the stronger state, it had the ability to invade and physically control Gaza via a ground invasion. This potential ground invasion, while militarily feasible, was internationally unpopular as a result of the large number of casualties suffered in the 2008-2009 Gaza Conflict, and Israel refrained from doing so.[16] Furthermore, the Israeli elections in February 2013 were three months away, factoring into the Israeli decision to avoid a possible costly—both in terms of casualties and international standing—ground invasion.[17] Israel's extensive use of its *@IDFSpokesperson* Twitter feed served three purposes. (1) It was in English, so the communication was likely directed at an elite, international audience.[18] The subject of the IDF's communication emphasized the Hamas rocket attacks and Israeli victimization, and were further used to justify to an international audience Israel's military campaign. 2) Another strategic goal of the *@IDFSpokesperson* Twitter feed was to combat what it perceived as Hamas misinformation. As one member of the IDF Spokesperson Unit highlighted, "we intercepted 90% of their long-range rockets into Israel (via the "Iron Dome"[19]), but if they (Hamas) can manage to say (via Twitter) that they fire rockets until the very last day of the conflict that's a victory for them. Perceptions matter."[20] Trying to shape the conflict narrative (i.e. who was winning), not only influences the mainstream media,[21] but also the perception of mediators. (3) Finally, the tweets also served to

[15] While Hamas, ostensibly has political control of Gaza, other militant groups do operate out of Gaza with varying degrees of support from Hamas. See `http://www.nytimes.com/2012/10/20/world/middleeast/hamas-works-to-suppress-militant-groups-in-gaza.html`

[16] US President Barack Obama voiced serious misgivings over the ground invasion. For instance see `http://www.reuters.com/article/2012/11/18/us-asia-obama-mideast-idUSBRE8AH07Z20121118`

[17] It is unclear how much electoral considerations affected the Israeli military goals during the conflict, as security has historically been the main axis of competition in Israel elections (Schofield and Sened, 2005).

[18] Some have argued that placating the international audience serves a domestic purpose as well. It shows that Netanyahu/Likud-led government cares about international public opinion, and that this translates into votes `http://politicalviolenceataglance.org/2013/03/01/friday-puzzler-why-support-the-taliban/`. This simply echoes Fearon (1995); McGillivray and Smith (2008)–democratic leaders are held responsible for foreign policy, so they care about foreign relations (more than non-democratic leaders).

[19] The name given for Israel's missile defense system. See `http://www.wired.com/dangerroom/2012/11/iron-dome-next/` for an overview.

[20] Author Interview with Eytan Buchman, former head IDF spokesperson for North America, May 1, 2013.

[21] Many of the news organizations covering the conflict also extensively retweeted news stories from the Hamas and Israeli Twitter feeds.

mobilize Israeli sympathizers in other foreign constituencies to pressure relevant external actors of the 'justness' of Israeli military actions. Given the fact that many of the *@IDFSpokesperson* Twitter followers were supporters of Israel and the IDF actions,[22] they could target messages to these supporters. They also had the ability to monitor feedback on how the conflict was viewed by Hamas supporters via the frequency of the two hashtags. The IDF did in fact monitor the volume of support via the changes in the #GazaUnderAttack and #IsraelUnderFire hashtags and passed this information up the chain of command.[23]

Hamas also used its own Twitter feed *@AlQassamBrigade* throughout the conflict.[24] They tweeted about the victimization of Palestinian civilians by the IDF, and bragged about their ability to hit Israeli targets with their rockets. For instance,

> "@IDFSpokesperson Warning to Israelis: Stay away from Israeli #IDF = #IOF[25] and bases. IDF, a terrorist army, will use you as human shields *-00:28 November 21, 2012*"

Other Hamas tweets emphasized the civilian casualties of Israel strikes,

> "#Palestinian children killed by #Israeli air strikes on #Gaza Strip. #GazaUnderAttack #Palestine #IDF #IsraeliTerrorism *-21:00 November 19, 2012.*"

The *@AlQassamBrigade* tweets directly engaged and threatened the *@IDFSpokesPerson* Twitter feed,

> "@IDFSpokesperson Bunch of liars, you killing Gaza civilians deliberately, so & for our role we Promise:'Your Crimes Will Not Go Unpunished'*-22:14 November 19, 2012.*"

Hamas's goals in the 2012 Gaza Conflict were two-fold. (1) As the militarily weaker actor, they could not defeat Israel conventionally. Rather Hamas sought to make the costs, both militarily and

[22] A qualitative survey of the Twitter followers of both *@IDFSpokesperson* and *@AlQassamBrigade*, reveals key differences between the followers. Supporters of Israel (as measured by location, and information in the profile) tend to follow the former, while supporters of the Palestinian cause tend to follow the latter. See Figure 1 in the Supplementary Information for a comparison the location of the Twitter followers. This is consistent with findings from Barberá (2013); Zeitzoff, Kelly and Lotan (2013), who find that who people follow on Twitter is a good proxy for whom they support, and also extracting policy position.

[23] Author Interview with Eytan Buchman, May 1, 2013.

[24] *@AlQassamBrigade* has been active since December 2011.

[25] IOF stands for the Israeli Occupation Force in reference to those who view Israel as an occupying force both in the West Bank, and inside the 1967 borders in Israel.

in terms of international standing, of further military confrontation too high for Israel, and gain a more favorable settlement. Such a settlement would allow a greater range of goods to enter Gaza and help improve its struggling economy (Manna, 2012). (2) The military confrontation also improved Hamas's domestic political support relative to Fatah, as Hamas was able to maintain its resistance mantra, and accuse Fatah of cooperating with the Israelis in the West Bank (McGreal, 2012). The recent ascendancy of the Muslim Brotherhood in Egypt, an ideological ally, also presented Hamas with a more sympathetic neighbor than Egypt under Hosni Mubarak (Kirkpatrick and El Sheikh, 2012). Hamas's extensive use of the *@AlQassamBrigade* Twitter feed during the conflict served two purposes. (1) It used social media to both threaten Israel and demonstrate its resolve in the conflict. This would pressure mediators to negotiate a quick and more favorable settlement (toward Hamas), in order to avoid a lengthy protracted conflict. (2) Hamas's Twitter feed was also in English. They used the feed to emphasize Palestinian victimization by the Israeli military. This would move international public opinion—particularly among sympathetic constituencies abroad—in favor of Hamas, and also hasten a settlement to the dispute in their favor.

Hamas also promoted its own hashtag so that users could show their support by tweeting #GazaUnderAttack (Gordts, 2012). Based on hashtag mentions of #IsraelUnderAttack (Israel) versus #GazaUnderAttack (Hamas), Hamas had more supporters on Twitter as compared to Israel (Ashkenazi, 2013).

4 Data Sources, Coding, and Methods

4.1 Data Sources and Coding

To understand how international public support and international mediators influenced the 2012 Gaza Conflict, I create 9 variables that track key aspects of the conflict. Each variable is coded at the hourly level across the 179 hours of the conflict. The variables capture the attention of the mediators, actions and communication of the conflict participants, and levels of public support. The 9 variables and their associated names (italicized within the parentheses) are given below.

- Hamas Conflict Intensity (*H2I*)

- Israel Conflict Intensity (*I2H*)
- *@IDFSpokesperson* Aggressiveness (*IDF*)
- *@AlQassamBrigade* Aggressiveness (*AQB*)
- UN Attention (*UN*)
- Egypt Attention (*Egypt*)
- US Attention (*US*)
- #GazaUnderAttack Mentions (*#Gaza*)
- #IsraelUnderFire Mentions (*#Israel*)

The international interest in the Israeli-Palestinian conflict lead to multiple, competing news organizations covering the 2012 Gaza Conflict (Calderone, 2012). Increased media coverage provides better density for creation of a conflict events database (Gerner, Schrodt, Francisco and Weddle, 1994). However, having multiple media sources with their own biases and slant presents researchers with unique difficulties (Almeida and Lichbach, 2003; Reeves, Shellman and Stewart, 2006; Davenport, 2009). Particularly in the case of the Israeli-Palestinian conflict, researchers must be cognizant of the bias and slant of particular sources (Zeitzoff, 2011).

To construct a conflict events database of Israeli and Hamas conflict intensity towards each other, as well as US, Egyptian, and UN attention to the conflict, I drew upon two sources. I used Al Jazeera's *Gaza Crisis: Gaza Live Blog* (Al Jazeera, 2012) and Haaretz's *Live Blog: Israel-Gaza Conflict 2012* (Haaretz, 2012). Both of the live blogs reported on the conflict at frequent intervals (usually every 10 or 15 minutes). They also reported statements and actions by international mediators and leaders. Each post generally contained an actor or actors, an action and was timestamped. To create a conflict intensity score for Israel and Hamas towards each other, I coded each relevant blog post from Al Jazeera (2012) and Haaretz (2012) following the coding scheme in Table 1. The conflict intensity scores were aggregated at the hourly level. The conflict intensity should be interpreted as a general measure of how aggressive Hamas and Israeli actions were towards each other in a given period in line with other events data coding scheme (Azar, 1980; Schrodt, 1994).[26] For instance if in an hour time period Hamas threatened Israel and launched rockets, Hamas's conflict intensity would be coded as a 3 (1+2). Or, if in an hour time period Israel called up reserve troops and completed two separate air strikes that would be coded as a 5 for Israel's conflict intensity (1+2+2).

It is important to highlight the fact that Haaretz and Al Jazeera covered the conflict from different geographic bases and with different audiences in mind. Al Jazeera had more reporters in Gaza than Haaretz, whose focus was on Israel (Al Jazeera, 2012; Haaretz, 2012). Furthermore, each source was playing to a different audiences. Al Jazeera's audience demographics tend to be a mix of Arab, left-leaning, and mostly pro-Palestinian individuals.[27] Conversely, Haaretz is traditionally considered a liberal Israeli newspaper.[28] Their coverage and scope of events differed to match their audience demographics and reporting locations. To create a more accurate database of the conflict I combined Haaretz and Al Jazeera conflict intensity scores for both Hamas and Israel to create a unified conflict score for both Hamas and Israel.[29]

Score	**Description**	**Example**
2	Material Conflict	Use of rockets, artillery shells, airstrikes, bombings; military engagement.
1	Verbal Conflict	Threats; warnings; calling up of reserve troops; denigrating the other side.

Table 1: **Israel and Hamas Conflict Intensity Scores**

I also used the Al Jazeera and Haaretz live blogs to develop a measure of international attention to the conflict for each of the mediators involved.[30] For the US, Egypt and the UN, I coded

[26] Implicit in the hourly-level aggregation and coding scheme from Table 1 is the fact that two incidents of verbal conflict are equivalent to one incident of material conflict. A concern may be that the aggregation choices mask conflict dynamics. However, the scale used is reduced in complexity compared to other event scales (Goldstein and Freeman, 1990), so there is less threat from aggregation. Furthermore, in Section 5.3 I show that the main results do not change if I separate out verbal conflict and material conflict. For a more complete take on aggregation and scale issues in event data see Schrodt, Yonamine and Bagozzi (2013).

[27] See here for an overview of their demographics `http://www.allied-media.com/aljazeera/al_jazeera_viewers_demographics.html`

[28] For instance see `http://ajr.org/Article.asp?id=5077`

[29] There may be a concern that I am simply double counting events by combining Haaretz and Al Jazeera measures. However, the correlation between the two sources for Hamas (≈ 0.21) and Israel (≈ 0.063) conflict intensity scores is very small—suggesting that Haaretz and Al Jazeera are picking up different aspects of the conflict

[30] While other countries such as Turkey, and regional organizations such as the European Union and Arab League did make statements, they were not directly involved in the mediation process and there were not enough instances

every instance in which a given actor was mentioned, one of their leaders or representatives made a statement, or there was a reference to their involvement in the mediation efforts. Counts of mentions were then aggregated to the hourly-level to create a measure of attention. This count measure is broad, and intentionally agnostic to the actual content of statements made by the Egypt, the US, or the UN. Furthermore, I did not want to categorize individual statements as pro-Hamas or pro-Israel, given that it can be difficult to extract such intentions from statements, and many of the statements simply contained factual information about the mediation efforts.[31] The following (hypothetical) statements occurring in an hour:

- US Secretary State Hilary Clinton meets with Egyptian leaders to discuss ceasefire efforts.
- US President Barack Obama encourages a cease fire.
- UN Secretary General Ban ki-Moon expresses concern for civilians on both sides.
- Egyptian President Mohamed Morisi criticizes Israel's actions.

would yield a score of 2 for Egypt, 1 for the UN, and 2 for the US. As in the Hamas and Israel conflict intensity scores, I combined both Haaretz and Al Jazeera measures to create unified attention scores for Egypt, the US, and the UN.[32]

In order to code public communication issued by Hamas and Israel, I scraped data from the full 179 hours of the conflict from the *@IDFSpokesPerson* and *@AlQassamBrigade* Twitter feeds. I used the four-point scale in Table 2 to code each tweet and then aggregate them to the hourly-level. The scale measured how threatening and aggressive the IDF and Hamas Twitter feeds were. The bulk of all tweets could be categorized as offensive actions (actions or threats against the other side) or victimization (actions that the other side carried out). Threats or reports of offensive actions

of them in either Haaretz's or Al Jazeera's live blogs (Haaretz, 2012; Al Jazeera, 2012) to construct a meaningful measure of attention, so I exclude them from the analysis.

[31] If the statements would have been coded as directed towards the individual actors, I would have needed to create 6 variables for international attention–US attention towards Israel, US attention towards Hamas etc. Given the limited $N = 179$, this would have decreased the degrees of freedom while increasing the number of assumptions in coding the data. Schrodt, Yonamine and Bagozzi (2013) have shown that other event studies that have used using counts largely come to similar conclusions, as those using a more ordinal scale

[32] There was also a low correlation between how the two sources covered Egypt (≈ 0.24), the US (≈ 0.095), and UN (≈ 0.024) actions.

were scored higher than reports of offensive actions taken by the other side (4 versus 3, and 2 versus 1). Tweets making emotional, or propagandistic appeals were coded as being more aggressive (4 and 2 versus 3 and 1). For instance the following *@AlQassamBrigade* tweet:

> "Oh, Zionists You have to drag yourselves out of hell, go back home now, go back to Garmany (sic), Poland, Russia, America and anywhere else #Gaza *-11:51 November 21, 2012.*"

would be coded as Offensive Propaganda (4). Whereas this *@AlQassamBrigade* tweet:

> "Al Qassam Brigades shelling Israeli targets with 224 projectiles for today, 1426 since Israel's aggression on #Gaza #GazaUnderAttack #Israel *-22:56 November 20, 2012.*"

would be coded as Neutral Offensive (3).

Score	**Description**	**Example**
4	Offensive Propaganda	Bragging about military strikes or capabilities; threats; justifying actions against other side, including the use of offensive photos.
3	Neutral Offensive	Neutral reports of own military action.
2	Victim Propaganda	Use of emotional appeals with respect to victimization by other side, including picture or videos of victims.
1	Neutral Victim	Neutral report on offensive action taken by other side.

Table 2: **Twitter Aggressiveness Scores**

Finally, perhaps the most unique aspect of the 2012 Gaza Conflict was the use of competing hashtags by Hamas (#GazaUnderAttack) and Israel (#IsraelUnderFire) to let supporters signal their support for one of the sides (Borger, 2012). Previous research has used hashtag data to uncover clusters in Canadian politics (Small, 2011) and polarization during the 2010 U.S. congressional midterm elections (Conover, Ratkiewicz, Francisco, Gonçalves, Menczer and Flammini, 2011). The hashtag data were collected by searching the full Twitter firehose for mentions of #GazaUnderAttack and #IsraelUnderFire during the conflict. Individual tweet identification numbers[33] were

[33] A unique identification number for each tweet sent. See `https://dev.twitter.com/` for more information on the Twitter Application Programming Interface (API).

recorded, and then the Twitter API was queried to put together a frequency count of mentions for each hashtag. The hashtag data contains 623,264 tweets, from 180,669 unique users, where the median number of tweets per user was 1, mean number of Tweets per user was 3.4, and the most active user tweeted 791 times. The distribution of tweets per user containing the different hashtag highlights the fact that (1) the tweet volume was not simply driven by a handful of users tweeting hundreds times, but rather a majority of tweets were from a large number of unique users, (2) with a smaller subset showing a more active engagement. Frequencies counts for each hashtag mention were aggregated at the hourly level to create the hashtag counts time series.[34]

The coded data results in a 9-variable time series.[35] Time series plots for each of the 9 variables are shown in Figure 1.

Several of the time series variables have periods with multiple events occurring, and many periods where nothing is happening (scored a zero), skewing the distribution of events across periods. This can be an issue with BSVAR models, since the time series variables are assumed to be approximately normal (Brandt and Freeman, 2006). I use a log transformation on all time series (adding 0.1 to avoid taking the log of zero) to reduce the skew,[36] and ease interpretation of the impulse response functions.[37]

The time series plots also suggest that there may be daily seasonality in the data, reflecting increases in the values of the variables purely due to the time of day, and not an increase in the underlying dynamics. The daily fluctuations appear to be particularly prominent for the hashtag frequencies *#Gaza* and *#Israel*, and possibly *AQB* and *H2I*. It is not surprising that hashtag volume may exhibit seasonality that reflects fluctuations in how many Twitter users are on during a given

[34] I am indebted to Gilad Lotan for providing the the tweet identification numbers and for helping me collect the individuals tweet data via the API.

[35] It would be advantageous to use a fully automated coding system for the 7 variables other than the hashtag frequency, as in Hopkins and King (2010); Gerner, Schrodt, Francisco and Weddle (1994). However, the comparatively small number of blog posts and tweets (430 *@AlQassamBrigade* tweets, 337 *IDFSpokesperson* tweets, 578 posts on Al-Jazeera (Al Jazeera, 2012), 679 posts on Haaretz (Haaretz, 2012).), and their irregular syntax, makes it difficult to implement in practice. As an alternative, I used a general expression automated text search to pick up key words such as "cease", "rocket","egypt","cairo","washington","obama" "morsi" etc., and I was able to code $\approx 74\%$ of the blog posts and tweets. The remaining 26% I coded by hand.

[36] Some might be worried that this addition of 0.1 to the time series biases the coefficients. I also use an alternative transformation–the 4^{th} root–that avoids having to add 0.1 to the time series. The results are nearly identical.

[37] Log transformations mean that the the impulse response functions are in percentage terms.

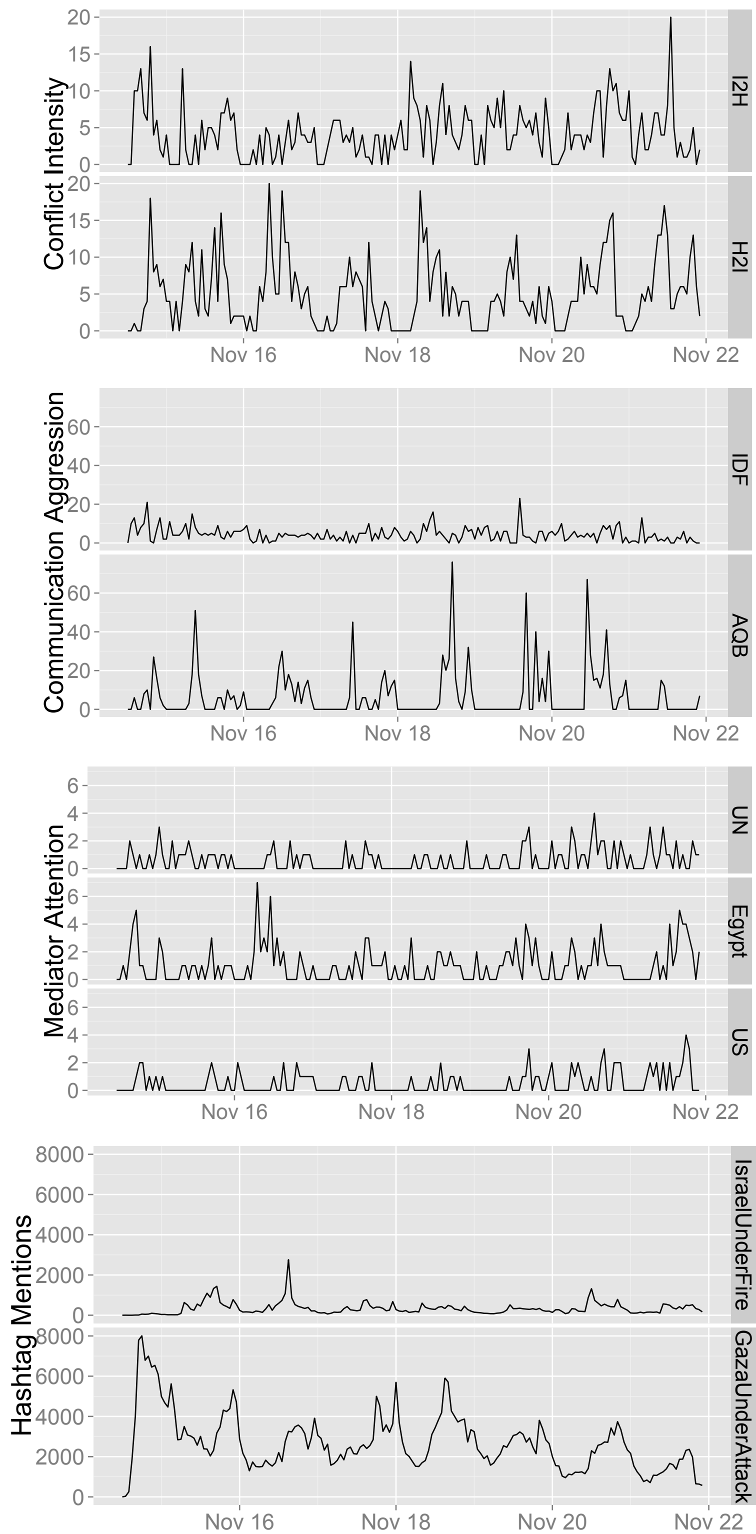


Figure 1: **Hourly Time Series Plots of Variables for the 2012 Gaza Conflict**

time of the day.[38] Yet, it might be an issue if the daily fluctuations in some of the variables masks the actual conflict dynamics. Given the strong theoretical and empirical evidence of regularized patterns in Twitter usage (Cheng, Evans and Singh, 2009), I model the *#Gaza* and *#Israel* hashtag variables as an additive time series with seasonal, trend, and random components (Kendall and Alan, 1983). I then subtract out the daily seasonal components associated with time of day for the two Twitter hashtags time series variables (*#Gaza* and *#Israel*). For the other variables (*I2H, H2I, AQB, IDF, UN, US,* and *Egypt*) I do not remove the seasonality. In the Supplementary Information I show that removing the seasonality for the remaining variables does not change the fundamental results.

4.2 Intuition Behind the BSVAR Method

I use a Bayesian Structural Vector Autoregression (BSVAR) to model the complex dynamics between the Hamas's and Israel's conflict intensity (*I2H* and *H2I*), their communication on Twitter (*AQB, IDF*), international mediator attention (*US, Egypt,* and *UN)*, and international public support on social media (*#Gaza* and *#Israel*). For example, Israel's conflict intensity (I2H) depend on its own past actions, and the past and present actions of the other variables. VAR models allow researchers to explicitly take into account this endogeneity, and have been widely used in political science (Brandt and Williams, 2007) and macroeconomic modeling (Sims, 1980). Previous studies of international conflict have used VAR modeling techniques to model the dynamic, and reciprocal nature of conflicts (Goldstein and Freeman, 1990; Brandt, Colaresi and Freeman, 2008; Kavanagh, 2009).

The advantage of the (BS)VAR approach is that it makes relatively few assumptions[39] about which way causality flows in highly dynamic, multiple time series such as the 2012 Gaza Conflict (Brandt and Freeman, 2006). Rather than assuming, for instance, that shifts in public support only influence the conflict behavior of Israel and Hamas and not the reverse, a BSVAR allows for causality to flow both ways (e.g. from Israel and Hamas to public support and vice versa). The BSVAR model simply assumes that variables in a conflict system are in an equilibrium, or a steady

[38] See Cheng, Evans and Singh (2009) who show that Twitter usage spikes between 11AM EST and 3PM EST.
[39] Other models, such as error correction models are "special cases" of the VAR model.

state, and respond to their own past values, and the past values of other variables in the system (the autoregressive nature). The "structure," or "S" in BSVAR, results from restricting which variables respond contemporaneously to each other. Substantively, which of the 9 variables from the 2012 Gaza Conflict respond within the hour to each other? These restrictions on the structure (known as the A_0 matrix) influence not only the immediate responses (which actors respond with the current time period), but also the long-term strategies available to the actors, and subsequent dynamics of the conflict (Brandt, Colaresi and Freeman, 2008).

The BSVAR assumes that conflict systems (like the 2012 Gaza Conflict) follow an equilibrium pattern of interrelated response and escalation. In order to measure conflict dynamics, the BSVAR uses impulse response functions (IRFs) to see how surprise shocks in one variable move through the system affecting the other variables (Brandt and Williams, 2007). For instance how does a surprise shock in Egyptian attention (*Egypt*) influence Hamas's conflict intensity (*H2I*)? Historically, modeling the uncertainty in error bands around the IRF estimates has been difficult given the non-linearities and high-dimensionality of its derivation (Brandt and Williams, 2007, p. 42). Recent advances in Bayesian methods allow a more precise way to characterize uncertainty in IRF estimates (Sims and Zha, 1999; Brandt and Freeman, 2006). The Bayesian VAR framework provides more coherent, and precise shape bands (Brandt and Freeman, 2006). Especially relevant to the current paper, the Bayesian VAR framework was explicitly created by macroeconomists to account for the difficulty in estimating shorter time series, with multiple endogenous variables (like the current paper). By putting a lower probability on the higher order lags (via a prior), the Bayesian VAR framework provides a more coherent, and accurate way to estimate the system (Sims and Zha, 1998). It also uses a Bayesian framework to compare the fit of different possible contemporaneous relations, or structures, among the variables (Brandt and Freeman, 2009). A more detailed and formal derivation of the BSVAR is presented in the Supplementary Information.

I explore the effect of international audiences—public support and mediators—on Hamas and Israeli actions during the conflict using the BSVAR in two ways. (1) In order to estimate a BSVAR, I must impose structure (on the A_0 matrix) by testing different restrictions on which variables respond contemporaneously to each other.[40] For instance, does allowing Israel's communication on Twitter (*IDF*) to respond contemporaneously to UN attention (*UN)* improve the model fit? Comparing various structure in the BSVAR framework—which contemporaneous relationships between the variables best models the data—allows for the rigorous testing of competing theories of conflict (Brandt, Colaresi and Freeman, 2008). (2) I also use the BSVAR to estimate IRFs and explore how shocks in one variable influence other the variables. In the next section, I first empirically test for the lag length specification. I then use information about the conflict and previous research to derive and test different structural restrictions. Finally, I estimate IRFs, and interpret the results.

5 Results and Interpretation

5.1 Lag Length Specification

Crucial to the BSVAR modeling approach is the selection of the appropriate lag length. Enough lags must be included to avoid issues of serial correlation.[41] However, since each lag increases the number of coefficients per equation by the number of included variables (9 in the present study), more parsimonious models are preferred. In Table 3 I test different lag length specifications. Both the AIC and BIC, point to a 1-lag model (the lowest values). However, this likely is not enough time to incorporate strategic interaction (such as diplomacy and response from Twitter) that likely take longer than an hour to develop (i.e. the time difference between Jerusalem and Washington D.C. is 7 hours). I choose to use a 5-lag model to allow richer dynamics and avoid serial correlation.[42] Furthermore, previous research using a VAR on hourly conflict data on the the 2008-2009 Gaza Conflict, employs a 5-lag model (Zeitzoff, 2011). In the next subsection I test different structural

[40]Non-structural models, or BVAR, use the Cholesky decomposition method to identify the system. In a BVAR the order of the variables imposes the structure.

[41]This is important because Granger causality forms the basis of the BSVAR framework. How does one variable's *past* innovations predict another's *future* innovations. In the Appendix, I present a plot of Granger causality for the 5-lag specification. Each cell corresponds to the *p-value* for the horizontal axis variables and how well they predict innovations in the vertical axis variables. Darker shades represent lower, and more significant p-values. A key result is the that the changes in *#Gaza* and *#Israel* strongly Granger causes *IDF*, but not *AQB*. The results highlight that Israel (via its Twitter feed), was much sensitive to popular sentiment on Twitter compared to Hamas.

[42]The chief concern within the (BS)VAR framework is not enough lags to avoid serial correlation (Brandt and Williams, 2007). The AIC statistics point to possibly a longer lag length. I test a 9-lag model in the Supplementary Information, and the IRF results largely match those of the 5-lag model.

identifications and assess their model fit using BSVAR posterior statistics.

Lags	**AIC**	**BIC**
1	-0.39	1.29
2	-0.04	3.15
3	0.33	5.04
4	0.55	6.77
5	0.62	8.35
6	0.93	10.17
7	1.22	11.98
8	1.24	13.51
9	1.20	14.98
10	1.12	16.41
11	0.80	17.60
12	0.16	18.48

Table 3: **Lag Length Specification Test**

5.2 Structural Identification and Model Fit

The advantage of the BSVAR approach is that unlike a standard VAR, it explicitly models the contemporaneous relationship between the included variables in the system. Different models of contemporaneous relationships assume different speeds of response to certain variables in the system (Brandt, Colaresi and Freeman, 2008).[43] Different models of structural identification provides a means of testing whether or not the *IDF* and, or *AQB* Twitter feeds contemporaneously respond to international mediators (*UN, Egypt*, and *US*) or public support (*#Gaza* and *#Israel*). By seeing which actors Hamas and Israel respond to via their communication and their conflict intensity, and how quickly, I am able to better understand the strategic constraints placed on them by international mediators and international public support.

Previous research in international relations suggests that conflict and diplomatic behavior in the presence of different audiences is dynamic and complex (Putnam, 1988; Guisenger and Smith, 2002; Brandt, Colaresi and Freeman, 2008). Particularly in the 2012 Gaza Conflict, understanding the strategic calculus of Hamas and Israel–as they respond to each other on the battlefield, the international mediators, the other side's communication from their Twitter feeds, and public sup-

[43]For instance Brandt, Colaresi and Freeman (2008) use a BSVAR approach to explore how Jewish Israeli public opinion influences Palestinian and Israeli cooperation.

port via Twitter–requires a model complex enough to match the data generating process. Within a conflict system, certain variables are likely to respond contemporaneously to each other. For instance, previous research has shown that Israel's conflict intensity responds contemporaneously (within the hour) to Hamas's conflict intensity (Zeitzoff, 2011), as it (Israel) has a sophisticated military predicated on quickly responding to Hamas. Conversely Hamas, as a the weaker opponent may be less willing to directly confront Israel (Arreguín-Toft, 2006; Zeitzoff, 2011). Thus a model that allows Israel's conflict intensity to respond within the hour to Hamas, directly influences Israel's subsequent conflict intensity, and also the subsequent values of the other variables as they react to Israel's conflict intensity. Comparing different models of contemporaneous relationships within a conflict system is important for testing hypotheses, because not only do the contemporaneous relationships influence the immediate response dynamics of the conflict, but they change the long-run trajectory of the conflict as they filter through the system.

In Tables 4-6, I explore different potential models of contemporaneous relationships through various configurations of the A_0 matrix. Given the complexity of delineating the structural relationships in a 9-variable BSVAR model (9 equations made up of 9 variables each), I break apart the models, into three separate tables, each exploring a key, strategic aspect of the conflict. In Table 4, I explore internal conflict variables and specifically whether the conflict variables (*I2H* and *H2I*) respond contemporaneously to the other side's communication (*IDF* and *AQB*). Table 5 explores how sensitive each side's strategic communication (via their Twitter feeds *IDF* and *AQB*) is to changes in the mediators' attention (*UN, Egypt*, and *US*). Table 6 looks as how public support (*#Gaza* and *#Israel*) influences strategic communication (*IDF* and *AQB*).

Tables 4-6 presents a series of potential models (A_0 matrices). Each model is composed of 9 rows and 9 columns. Following the notation of Brandt, Colaresi and Freeman (2008, p. 356), the rows are equations and the columns are variables designated (or not designated) to have a contemporaneous relationship with the row variable. In each model, an X represents a "free" parameter to be estimated. The estimated free parameters correspond to the the column variable having a contemporaneous relationship with the row equation. Empty cells are assumed that column variables have no contemporaneous relationships.

Model	Variable	H2I	I2H	IDF	AQB	UN	Egypt	US	#Gaza	#Israel
Baseline	*H2I*	X	X	X	X					
	I2H		X	X	X					
	IDF		X	X	X					
	AQB	X		X	X					
	UN					X				
	Egypt						X			
	US							X		
	#Gaza								X	
	#Israel									X
IDF Conflict	*H2I*	X	X	X	X					
	I2H		X	X	X					
	IDF		X	X	X					
	AQB	X	X	X	X					
	UN					X				
	Egypt						X			
	US							X		
	#Gaza								X	
	#Israel									X
AQB Conflict	*H2I*	X	X	X	X					
	I2H		X	X	X					
	IDF	X	X	X	X					
	AQB	X		X	X					
	UN					X				
	Egypt						X			
	US							X		
	#Gaza								X	
	#Israel									X
Both Conflict	*H2I*	X	X	X	X					
	I2H		X	X	X					
	IDF	X	X	X	X					
	AQB	X	X	X	X					
	UN					X				
	Egypt						X			
	US							X		
	#Gaza								X	
	#Israel									X

Table 4: **Contemporaneous Relationship (Conflict)** Each block specifies the contemporaneous relationships and restrictions in the A_0 matrix. Rows correspond to contemporaneous equations and columns to the variables that do (or do not) have contemporaneous relationships with the row variables. The Xs in each cell represent free parameters, or those estimated to have a contemporaneous impact on a given row variable, while the empty cells are zero restrictions. A zero restriction indicates that the given column variable has no contemporaneous relationship to the row variable (in the row equation).

As Brandt, Colaresi and Freeman (2008) and Brandt and Freeman (2009) argue, it is important when determining different potential A_0 models that theory guide their plausibility. Following Zeitzoff (2011), for all models I restrict *H2I* from responding contemporaneously to *I2H*. I assume that Israel, with its superior military technology (Gross, 2010), would be able to respond

Model	Variable	H2I	I2H	IDF	AQB	UN	Egypt	US	#Gaza	#Israel
Mediator Both	*H2I*	X	X	X	X					
	I2H		X	X	X					
	IDF		X	X	X					
	AQB	X	X	X	X					
	UN			X	X	X				
	Egypt			X	X		X			
	US			X	X			X		
	#Gaza								X	
	#Israel									X
Mediator IDF	*H2I*	X	X	X	X					
	I2H		X	X	X					
	IDF		X	X	X					
	AQB	X	X	X	X					
	UN			X		X				
	Egypt			X			X			
	US			X				X		
	#Gaza								X	
	#Israel									X
Mediator AQB	*H2I*	X	X	X	X					
	I2H		X	X	X					
	IDF		X	X	X					
	AQB	X	X	X	X					
	UN				X	X				
	Egypt				X		X			
	US				X			X		
	#Gaza								X	
	#Israel									X
Mediator Biased	*H2I*	X	X	X	X					
	I2H		X	X	X					
	IDF		X	X	X					
	AQB	X	X	X	X					
	UN					X				
	Egypt				X		X			
	US			X				X		
	#Gaza								X	
	#Israel									X

Table 5: **Contemporaneous Relationship (Mediator)**

contemporaneously to Hamas, but not vice versa.[44] I also allow both both Hamas's and Israel's public communication (*AQB* and *IDF*) to respond to both each other, and also the conflict (*H2I* and *I2H*) contemporaneously. The role of each side's Twitter feeds, to report on the conflict, and cast their side's role in the conflict in a positive light (Rothman, 2012), makes this a fairly benign assumption. Finally, I restrict mediators (*US, Egypt* and *UN*) such that they do not respond contemporaneously (within the hour) to the conflict (*H2I* and *I2H*), or to the communication of

[44] Additionally, when I allow *H2I* to respond contemporaneously to I2H in the best fitting model (*Hashtag Model* from Table 6), the log marginal data density and resulting Bayes Factor is significantly worse (-3852.90) than the *Hashtag Biased* (-3843.72).

Model	**Variable**	**H2I**	**I2H**	**IDF**	**AQB**	**UN**	**Egypt**	**US**	**#Gaza**	**#Israel**
Hashtag Baseline	*H2I*	X	X	X	X					X
	I2H		X	X	X				X	
	IDF		X	X	X					X
	AQB	X	X	X	X				X	
	UN					X				
	Egypt						X			
	US							X		
	#Gaza								X	X
	#Israel								X	X
Hashtag Both	*H2I*	X	X	X	X					X
	I2H		X	X	X				X	
	IDF		X	X	X					X
	AQB	X	X	X	X				X	
	UN					X				
	Egypt						X			
	US							X		
	#Gaza			X	X				X	X
	#Israel			X	X				X	X
Hashtag IDF	*H2I*	X	X	X	X					X
	I2H		X	X	X				X	
	IDF		X	X	X					X
	AQB	X	X	X	X				X	
	UN					X				
	Egypt						X			
	US							X		
	#Gaza			X					X	X
	#Israel			X					X	X
Hashtag AQB	*H2I*	X	X	X	X					X
	I2H		X	X	X				X	
	IDF		X	X	X					X
	AQB	X	X	X	X				X	
	UN					X				
	Egypt						X			
	US							X		
	#Gaza				X				X	X
	#Israel				X				X	X
Hashtag Biased	*H2I*	X	X	X	X					X
	I2H		X	X	X				X	
	IDF		X	X	X					X
	AQB	X	X	X	X				X	
	UN					X				
	Egypt						X			
	US							X		
	#Gaza				X				X	X
	#Israel			X					X	X

Table 6: **Contemporaneous Relationship (Hashtag)**

Hamas and Israel (*AQB* and *IDF*). Given the speed of diplomacy,[45] and time differences between the various mediators, this restriction is fairly reasonable.[46]

[45]See Nickles (2009) for a discussion on diplomatic speed with reference to the advent of the telegraph.

[46]All models in Table 4-6 (and all VAR models) implicitly assume that variables respond contemporaneously to

Table 4 presents the *Baseline* model and then explores the different model specifications for allowing *I2H* and *H2I* to respond to the other side's communication (*AQB* or *IDF*). It explores whether shifts in the other side's Twitter feed led to immediate responses in Israel and Hamas's conflict intensity. For instance the *IDF Conflict* model allows *I2H* to respond contemporaneously to *AQB*. Conversely the *AQB Conflict*, allows *H2I* to respond contemporaneously to *IDF*, and the *Conflict Both*, allows both *I2H* and *H2I* to respond immediately shocks in the other side's communication.

In Table 5, I build upon Table 4, and explore different configurations of how Hamas and Israel respond to international attention from the mediators (*UN, Egypt,* and *US*) via their Twitter feeds (*AQB* and *IDF*). For instance, previous research finds that democratic states are more responsive to international pressures via mediation Dixon (1994). This is captured in Table 5 with the *Mediator IDF* model, which allows *IDF* to respond contemporaneously to shocks in the other international mediators, while *AQB* does not. Other theories, suggest that belligerents may be more likely to respond to allied/biased mediators (Calvert, 1985; Kydd, 2003), which the *Mediator Biased* model captures by allowing *IDF* to respond contemporaneously to *US*, and *AQB* to *Egypt*.

Table 6 builds upon Table 5, and explores the contemporaneous relationship between communication (the Twitter feeds *AQB* and *IDF*), and changes in public support via changes in the frequency of *#Gaza* and *#Israel*. Baseline specification assume that *#Gaza* (*#Israel*) responds to contemporaneous changes in *I2H* (*H2I*), *AQB* (*IDF*) and the other hashtag *#Israel* (*#Gaza*). These models stem from the explicit role of the Hamas and Israeli Twitter feeds— to advance their own hashtag, denigrate the other side's actions, and react to the opposing Twitter feeds.[47] The key question is whether *AQB* or *IDF* both react to shifts in public support to both sides (*Hashtag Both*), only the *IDF* responds to contemporaneous changes in public support (*Hashtag IDF*), only *AQB* responds to contemporaneous changes in public support (*Hashtag AQB*), or whether each side responds contemporaneously to their own constituencies (*IDF* to *#Israel*, and *AQB* to *#Gaza*)

their own innovations. This is captured by the X's on the main diagonal.

[47]Furthermore, alternative specifications that allow *#Gaza* and *#Israel* to react to both conflict actors (*I2H* and *H2I*) and Twitter feeds (*IDF* and *AQB*) contemporaneously fit significantly worse log marginal data density (-3860.19) than the *Hashtag Biased* model in Table 7 (-3843.72). Not having either *#Gaza* and *#Israel* react contemporaneously to either Twitter feeds or conflict feeds also results in a significantly poorer fit (-3859.51).

in the *Hashtag Biased* model.

To test which model best explains the data I fit a 5-lag BSVAR for each of the 13 models proposed in Tables 4-6. Given the large number of parameters to be estimated and complex dynamics, I use a relatively informed prior. This prior shrinks the higher order lags towards zero by putting inexact restrictions on lagged values. The prior is then correlated across equations via the contemporaneous relationships, allowing beliefs about the structure of contemporaneous relationship to be included in the prior (Brandt, Colaresi and Freeman, 2008, p. 357-358).[48]

The BSVAR framework also provides a useful way of testing the in-sample fits of the competing contemporaneous models in Tables 4-6 via the log marginal data density ($log(MDD)$) (Brandt, Colaresi and Freeman, 2008; Brandt and Freeman, 2009). Comparing the log marginal data densities from two models (i and j) $log(MDD_i)$-$log(MDD_i)$ yields a log Bayes Factor. The Bayes Factor provides a relative odds ratio between two models, with larger values indicating a significantly better model fit in favor of $Model_i$ (Geweke, 2005).

Several interesting observations can be gleaned from Table 7. (1) The $log(MDD)$ in the top third of Table 7 compares models which allow *I2H* to react contemporaneously to AQB (*Conflict IDF*), or *H2I* to *IDF* (*Conflict AQB*), or both (*Conflict Both*) to the *Baseline* model, which does not allow either to react contemporaneous to the other's communication on Twitter. The differences in the $log(MDD)$ densities between the three models (excluding the *Baseline*) are small, and compared to the *Baseline* model they are also fairly negligible.[49] However, given the technical superiority of the Israeli military compared to Hamas's, theoretically it makes more sense to allow Israel's conflict intensity to respond contemporaneously to Hamas's communication rather than vice versa (i.e. *Conflict IDF* makes more sense relative to the *Conflict AQB*).[50] Moreover, including the other contemporaneous relationships from the *Hashtag Biased* model and allowing *H2I* to respond contemporaneously to *IDF* leads to a significantly worse (smaller) $log(MDD)$ (-3858.001) than the *Hashtag Biased* model (-3843.72). The same is true when allowing both *H2I* and

[48]IRF plots from a looser prior are presented in the Supplementary Information. The results largely match those from the informed model.

[49]$3.67 \approx e^{1.3}$ for the difference between *Conflict IDF* and the *Baseline* model.

[50]IRF results presented in the Supplementary allow Hamas's conflict (H2I) to respond to Israel's conflict (I2H) and communication (IDF) contemporaneously with both its conflict and communication. The main finding that Israel's conflict intensity is more constrained by an increase in public support for Hamas on social media are confirmed.

Model	**Log Marginal Data Density** *log*(*MDD*)
Baseline	-3860.33
Conflict IDF	-3858.99
Conflict AQB	-3858.97
Conflict Both	-3857.78
Mediator Both	-3876.09
Mediator IDF	-3868.74
Mediator AQB	-3868.07
Mediator Biased	-3867.75
Hashtag Baseline	-3860.30
Hashtag Both	-3848.01
Hashtag IDF	-3855.90
Hashtag AQB	-3859.00
Hashtag Biased	-3843.72

Table 7: **Posterior Model Summaries** Posterior statistics are based on 5-lag model. Estimates are calculated via the `MSBVAR` package in `R` (Brandt and Appleby, 2012) using 10,000 burn-in draws, and 20,000 Markov chain Monte Carlo (MCMC) draws.

I2H to react contemporaneously to the *IDF* and *AQB* in the *Hashtag Biased* model (-3857.52).[51] This suggests, that Israel's conflict intensity was much quicker to react to what Hamas was saying on Twitter than vice versa. 2) The middle third of Table 7 uses the *Conflict IDF* specification, and then tests whether the *IDF* and *AQB* respond to attention from the three international mediators. A comparison of the different $log(MDD)$ and Bayes factors strongly suggest that they do not. The Bayes factor for the *Conflict IDF* model, where neither *IDF* or *AQB* respond contemporaneously,

[51] Both of these models yield very large ($\approx e^{14}$) Bayes factors when compared to the *Hashtag Biased* model, further showing the latter is a better fit.

is much larger compared to any of the *Mediator* models which allow the *IDF* and or *AQB* to react to international mediators ($\approx e^{10}$). It is not surprising that the influence of international mediators takes a longer time to influence the strategic communication of conflict participants. This is not to say that international mediators do not have an effect on Hamas's or Israel's actions or communications, but rather that their effect may take longer to materialize. 3) Finally the bottom third of Table 7 examines whether *IDF* and *AQB* respond contemporaneously to changes in *#Gaza* and *#Israel*. The *Hashtag Biased* model—where *AQB* responds contemporaneously to *#Gaza*, and *IDF* to *#Israel*, presents overall the best fit of all 13 models, with the largest $log(MDD)$. The *Hashtag Biased* has a Bayes Factor of $\approx e^{4.3}$ compared to the closest competing model *Hashtag Both*—a significant improvement.

The *Hashtag Biased* provides the best fit of the data,[52] and also interesting insights on the strategies of Hamas and Israel. Israel's conflict intensity reacts contemporaneously to changes in Hamas's conflict intensity and to its communication on Twitter, echoing previous findings that the stronger actor (Israel) would be more reactive to the weaker actor (Hamas) than vice versa (Zeitzoff, 2011). Another more innovative finding, is the fact that both Israel and Hamas contemporaneously respond to shifts in international public support, via changes in their respected hashtags. This provides a unique insight into how Twitter and other social media allows states to influence international audiences and vice versa. In turn, public support from diaspora communities then influences state behavior. In the next section, I use the *Hashtag Biased* model to explore the IRF and measure how shocks in one variable influence innovations in the other variables.

[52]There may be a concern that the models from Table 4-6 build upon each other. For instance, Table 5 takes the best fit from Table 4 and tests different permutations of relationship with the mediators, and Table 6, takes the best fit from Table 6 and then tests different effects of the hashtag frequency. However, it may be that including the insights and structural relationship from the *Hashtag* model in Table 6, and then retesting the relationship in Table 4 leads to a different results. I reexamine the $log(MDD)$ from the A_0 models in Tables 4 and 5 and find no difference in the substantive interpretations. The best fit models allow Israel's conflict intensity *I2H* to respond contemporaneously to Hamas's communication (AQB), and Hamas's conflict intensity (*H2I*) to not respond contemporaneously to Israel's communication (IDF). Also, the best fit restricts Hamas's and Israel's communication (AQB and IDF) from responding contemporaneously to the international mediators. This confirms that far and away the best fit of any (theoretically sound) permutation is the *Hashtag Biased* model.

5.3 Impulse Response Functions and Interpretation

I use impulse response functions (IRFs) to examine the dynamic effects of the 5-lag *Hashtag Biased* BSVAR model using the vector moving average (VMA) representation. The IRF analysis uses the VMA representation to trace the dynamics of the endogenous variables to "surprise" innovations, or shock increases in the other variables,[53] using the A_0 matrix specified in the *Hashtag Biased* model in Table 6 (Brandt and Williams, 2007, p. 68). Since all the variables are in logarithms, responses to shocks[54] are in percentage change in the variable of interest (Brandt and Williams, 2007, p. 50).

In Figure 2 I report cumulative IRFs over the 12-hour period following a surprise shock to key variables. In other words, how do these shocks accumulate and affect the response variable after 12 hours? Each plot shows the cumulative effect of the shock (*Shock In* variable) variable on the response variable (labeled on the x-axis) after a 12-hour period. 68% (darker colored lines) and 90% (light grey lines) error bands are calculated using 50,000 MCMC draws with 10,000 burn-in draws[55] estimated via the `MSBVAR` package in `R` using the eigendecomposition method described in Brandt and Freeman (2006). Given that there are 9-variables leading to 81 possible IRF estimates, I omit presenting the IRF results for all variables. A list of the main and ancillary IRF results is shown in Table 8 in the Appendix. In the Appendix I also present the full IRF plots for all variables (Figure 5). Additional results and robustness checks are shown in the Supplementary Information. Sims and Zha (1999) and Brandt and Freeman (2006) suggest focusing on the 68% error bands, as they provide a better measure of the central tendency. It should also be noted that the IRF error bands calculated using the eigendecomposition method explicitly account for the asymmetry present in IRF, and are more accurate than Gaussian, or other symmetric approximations (Brandt and Freeman, 2006, p. 19). This method leads the asymmetry in the confidence bands for some of the estimates in Figure 2, and for some estimates having very tight error bands, with little to no variation.[56] The asymmetry in the bands provides substantive information about likely direction

[53] All shocks are "positive" in nature—i.e. an increase in conflict intensity, mediator attention, communication aggressiveness, or public support.

[54] All shocks are one standard deviation of the shock variable by default (Brandt and Appleby, 2012). In this case these are log-transformed variables.

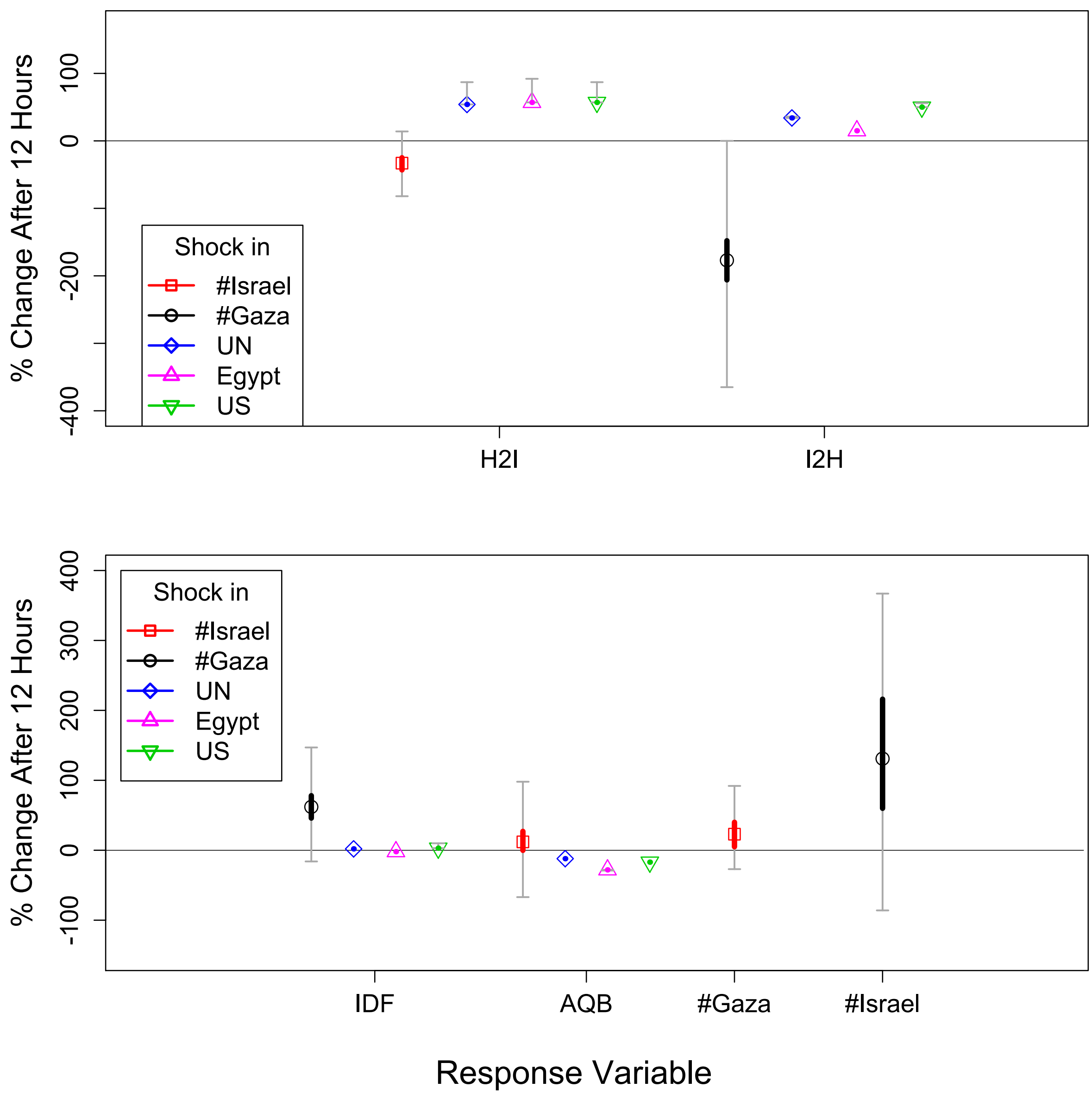
[55] Trace plots show good mixing and convergence.

[56] I also tried using the "Sims-Zha3" (Brandt and Appleby, 2012) which construct error bands using the eigende-

of uncertainty in the respond dynamics. (Brandt and Freeman, 2006).

composition of the full stacked impulse responses (Sims and Zha, 1999). The error bands are even tighter than those presented here with the "Sims-Zha2" method.

Figure 2: **Cumulative IRF plots**



Several key findings emerge from Figure 2. The top plot in Figure 2 compares how shocks in the international mediators (*US*, *UN*, and *Egypt*) and public support (*#Gaza* and *#Israel*) influence Israel's (*I2H*) and Hamas's conflict intensity (*H2I*). Two key results emerge. (1) Shocks in the international mediators slightly increase the conflict intensity of Hamas and Israel. Rather than constraining the actors, traditional mediators have a null to slightly positive effect on increasing the conflict of the actors. (2) Conversely, increases in public support for the other side, constrain the conflict intensity of the actors, especially Israel. A shock to public support for Hamas (*#Gaza*), decreases Israel's response intensity by approximately 177%. This is a large and significant effect. These two results taken together show that international public support constrains conflict participants much more than traditional mediators.

The bottom plot in Figure 2 explores how shocks in international mediators and public support influence Israel's and Hamas's communication (*IDF* and *AQB*). They also examine how public support for Hamas and Israel respond to shocks in each other. As in the results in the top plot, the international mediators have a negligible effect on Israel's and Hamas's communication. However, Israel's aggressiveness and activity on Twitter (*IDF*) increases by approximately 62% following a shock in support for Hamas (*#Gaza*). This represents a novel substitution effect— shocks in support for Hamas decreases what Israel is doing militarily, but increase the activity of its communication. Comparatively, shocks in support for Israel (*#Israel*) have little to no effect on Hamas's communication (*AQB*). Additionally, public support for Israel is much more responsive to shocks in public support for Hamas, than vice versa. The results in the top and bottom plots in Figure 2 suggest that international public support shaped the conflict dynamics of the conflict participants, particularly Israel, much more than the public attention of international mediators.

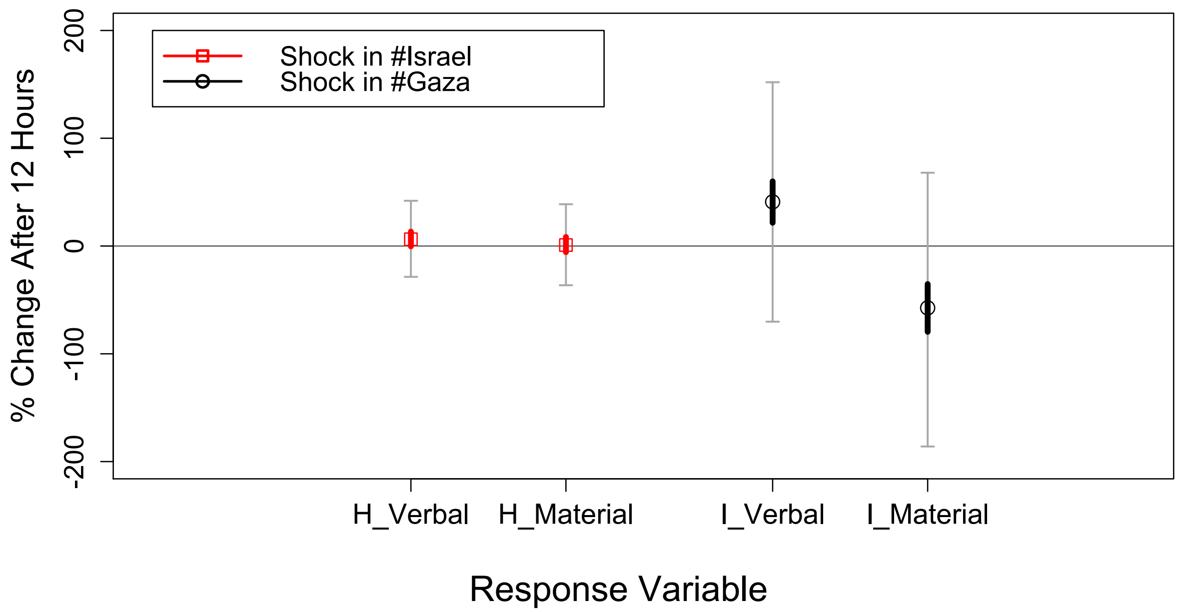
Both Israel's and Hamas's conflict intensity scores are composed of both material and verbal conflict. Yet it might be that material (rockets, air strikes, etc.) and verbal conflict (threats and posturing) respond differentially to shocks in international public support (*#Gaza* and *#Israel*). In order to test this, I rerun the 5-lag *Hashtag Biased* model disaggregating the Hamas's (*H2I*) and Israel's (*I2H*) conflict intensity into separate verbal and material conflict. This new multiple time series contains 11 variables. All the same variables are included as in the previous analysis, but the conflict intensity variables are now separated out into Hamas material conflict (*H_Material*), Hamas verbal conflict (*H_Verbal*), Israel material conflict (*I_Material*), Israel verbal conflict (*I_Verbal*). In Figure 3 I plot the cumulative IRF for shocks in public support and how that influences Hamas's and Israel's material and verbal conflict. T

The results in Figure 3 confirm and provide nuance for the results from Figure 2: Israel's conflict intensity is much more responsive than Hamas's to shifts in public support for the other side.[57] Neither, Hamas's material conflict (*H_Material*), nor Hamas's verbal conflict (*H_Verbal*) respond to shocks in public support for Israel (*#Israel*), with both point estimates are close to zero). Conversely, Israel's material conflict (*I_Material*) and Israel's verbal conflict (*I_Verbal*) do respond to shocks in support for Hamas (*#Gaza*). A shock in support for Hamas decreases Israel's material conflict by $\approx 57\%$, while increasing its verbal conflict by $\approx 41\%$. These findings show that increases in public support for Hamas, actually constrained its military behavior, and not simply its posturing, or threats (verbal conflict). In fact, it conforms to the substitution effect from Figure 2, with increases in support for Hamas constraining Israel militarily, but increasing the activity and aggressiveness of its communication. The finding that increases in public support for Hamas increase the activity of Israel's Twitter feed and it's verbal conflict show that Israel's use of Twitter during the conflict was not divorced from its larger strategy. Rather, it was an integral part of it.

In the Supplementary Information I also address concerns that the main results may be sensitive to the lag length, or that the relationships between variables (other than *#Gaza* and *#Israel*, which are already seasonally adjusted) are confounded by seasonality, or that the results are sensitive to a particular formation of the prior. The three key findings of Israel's greater responsiveness to the shifts in public support (especially compared to international mediators) remains unchanged. (1) Shocks in public support on social media for Hamas (*#Gaza*) decrease Israel's conflict intensity more than the international mediators, and much more than shocks in public support on social media for Israel (*#Israel*) influence Hamas's conflict intensity. (2) Israel's communication on Twitter (*IDF*) increases its aggressiveness and activity following increases in public support for Hamas,

[57]The increasing uncertainty compared to the analysis is likely do the larger number of variables (11 instead of 9), and the fact that there a greater number of time periods where Hamas's and Israel's verbal or material conflict are scored a 0 (compared to the combined conflict scores).

Figure 3: **Cumulative IRF plots (Separating out Material and Verbal Conflict)**



while the mediators have little effect on either actor's communication. (3) Finally, public support on social media for Israel reacts strongly and positively to shocks in public support on social media for Hamas, but not vice versa.

In the next section I discuss the results in terms of their broader significance for understanding how international audiences and communication influence conflict, and how social media is changing this relationship.

6 Discussion and Conclusion

The comparison of different structural models and the findings from the IRFs, all point to actors (particularly Israel) being more responsive to public support on social media compared to the international mediators. The novel data give a unique, micro-level test of how international audiences influence different actors in conflict. It also shows how states engaged in conflict are harnessing social media to sway perceptions and communicate to international audiences. Particularly for Israel, public support via social media affected its strategic communication and its conflict intensity. A further important insight is how shifts in popular support affected Israel to a greater degree than Hamas. Israel's conflict intensity significantly decreases following an increase in support for Hamas. Conversely, there is no such variation in Hamas's conflict intensity following shocks in support for Israel. This finding provides a new international explanation for how democratic states are more constrained in conflict (Fearon, 1994; Guisenger and Smith, 2002). The fact that neither side's conflict intensity is constrained by international mediators, highlights the primacy of international public support—particularly in limited conflict (like the 2012 Gaza Conflict).[58] Additionally, the finding that Israel's communication increases its activity following shocks in support for Hamas, suggests an interesting substitution effect. Shifts in public support may constrain a state's (Israel's) ability to fight, so it increases the activity and aggression of its communication on social media.

A concern may be that the use of Twitter and other social media is simply epiphenomenal with respect to the actual conflict, rather than an integral part of the it. However, qualitative information suggests otherwise. Both Israel and Hamas have continued to keep their Twitter feed extremely active following the conflict (Al Qassam Brigades, 2012; IDF Spokesperson, 2012).[59] Moreover, the creation and increasing role of the IDF's new Interactive Media Unit, dedicated to using social media to sway foreign audiences, further emphasizes the primacy Israel places on social media and its role in future military strategy.[60] What is perhaps most unique and important about social media and its role for future conflicts, is the speed at which it is able to disseminate information to audiences, and for those audiences to provide feedback. Social media allowed Israel and Hamas to tailor their message to their international supporters, and monitor their feedback extremely quickly. Further suggesting the ability of social media's importance in communicating to diaspora supporters, the IDF regularly held, and continues to hold meetings with right-leaning,

[58]It should be noted that this does not mean that mediators have no effect at all on conflict. All three mediators played a documented role in negotiating the ceasefire. Rather, the actors, particularly Israel, are more constrained militarily by international public support relative to *public* mediator attention—a variable used in other studies (Brandt, Colaresi and Freeman, 2008). It may be interesting to compare public versus private mediator statements, but alas the full details of the diplomacy behind closed doors is not publicly available.

[59]Both have Tweeted over 1,000 times as of July 24, 2013 since the end of the conflict. More recently, Hamas's Twitter account was suspended by Twitter for violating its terms of service `http://thelede.blogs.nytimes.com/2014/01/17/twitter-suspends-hamas-accounts/`

[60]See announcement here `http://www.idf.il/1283-18383-en/Dover.aspx`

pro-Israel bloggers.[61] The ability for social media to quickly engage supporters abroad, who in turn can pressure other international actors, changes the strategy of conflict participants, and the dynamics of the conflict itself. The quantitative and qualitative evidence points to social media not simply being a tool for propaganda, but rather as a strategic tool that changes the way conflict participants fight.

The diffusion of social media into other conflicts provides further evidence of its status as a new tool for conflict. For instance, the Taliban and the International Security Assistance Force (ISAF) in Afghanistan have actively engaged each other on Twitter (Farmer, 2011). More recently, social media has played a large role in the Syrian Civil War. Many competing factions in Syria have their own YouTube and Twitter accounts which they use to publicize their battlefield successes and tout their territorial control (Zambelis, 2012). Even more concretely, Syrian rebel groups have used their Facebook pages to "brand themselves" and to facilitate fundraising (Topol, 2012). Thus social media provides conflict participants an avenue to both attract political and material support, and improve their odds of success. As the number of social media users increases,[62] the role of social media in conflict will likely grew. The key innovation of social media, shown through the lens of the 2012 Gaza Conflict, is how it influences audience participation in international conflict, and how this has a direct effect on the strategic decisions of participants.

I used extremely disaggregated (hourly) data from the 2012 Gaza Conflict to explore how international audiences influence different actors during the course of a conflict. Using novel data on public support on social media for Hamas and Israel, I show that Israel was much more constrained by increases in international public support for Hamas than vice versa. Additionally, I show that neither actor was particularly constrained militarily by public attention of the international mediators. The results also provide micro-level support for previous research that suggests that international audiences influence democracies (Israel compared to Hamas) to a greater degree than non-democracies (Maoz and Russett, 1993; Tomz, 2007; Brandt, Colaresi and Freeman, 2008). Furthermore, the increasing use of social media by state and non state actors to influence

[61] `http://www.fastcompany.com/3003305/inside-israeli-militarys-social-media-squad`

[62] See `http://www.mediabistro.com/alltwitter/social-media-middle-east_b44959` and this survey by the International Telecommunications Union `http://www.itu.int/ITU-D/ict/wtim11/documents/cont/029-E.pdf`

perceptions about the conflict, represents a new and fertile data source for researchers to study extant theories of conflict behavior and develop new ones. The present study provides a template for doing so.

A Appendix

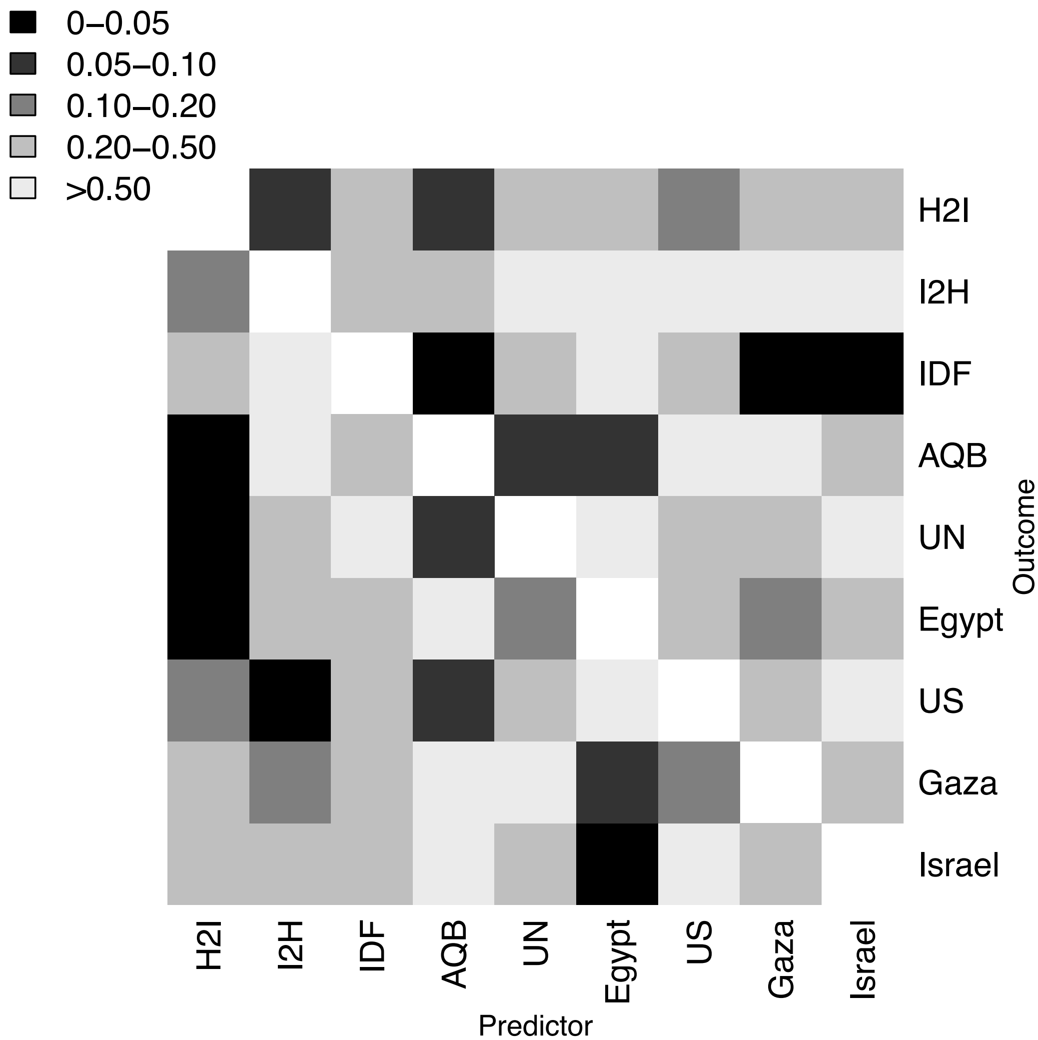


Figure 4: **Granger Heat Map Plot (5 hour lag)**

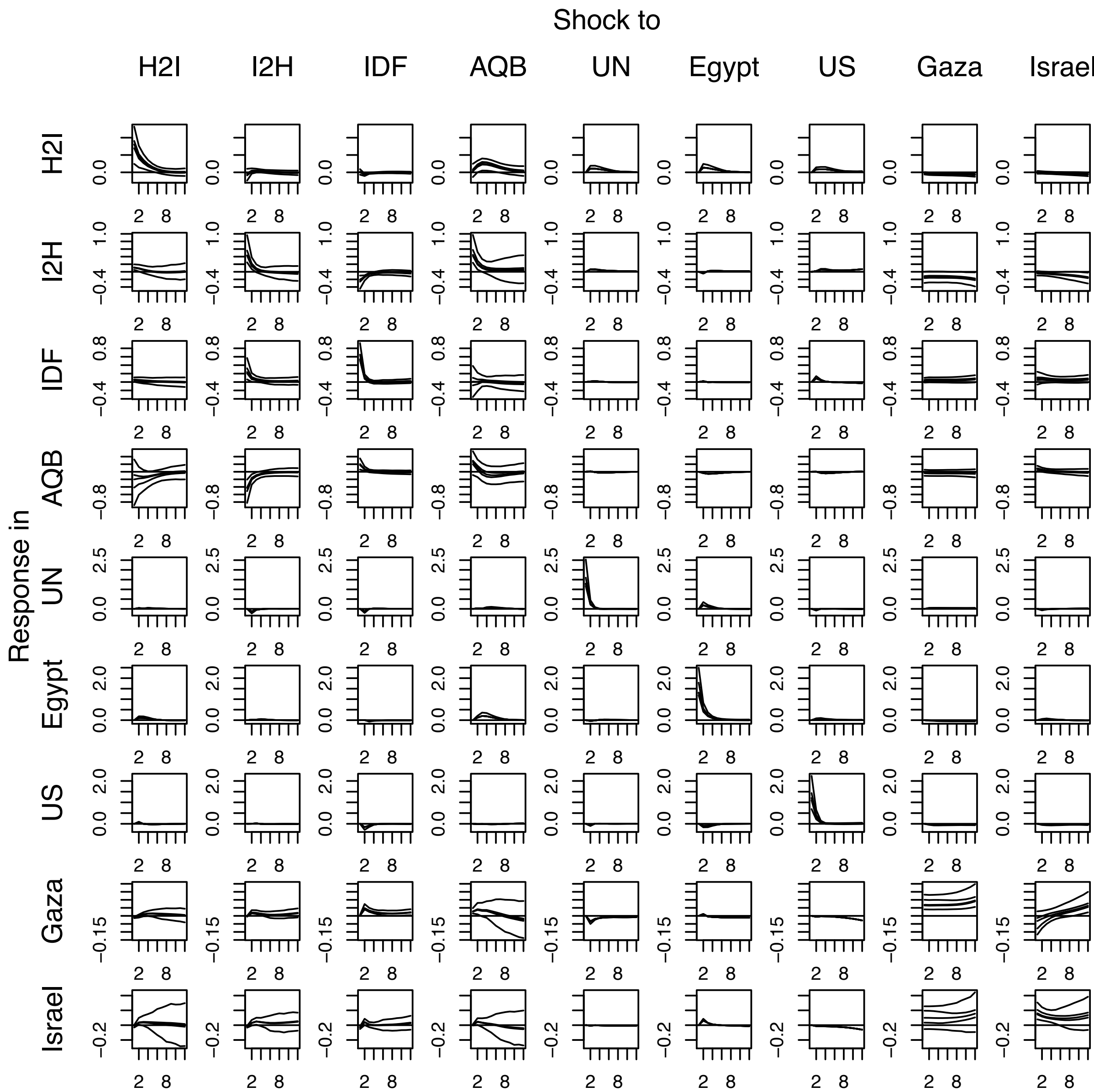


Figure 5: **IRF Plots for all Responses for BSVAR Hashtag Biased (5-lag model)**

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Shock In	*Response By*	*Cumulative Median Response After 12 hrs.*	*68% Regions*	*90% Regions*
H2I	I2H	0.25	(0.14, 0.36)	-(1.42, 2.07)
I2H	H2I	0.04	(-0.08, 0.18)	(-0.71, 0.86)
IDF	H2I	-0.13	(-0.17, -0.09)	(-0.50, 0.20)
IDF	AQB	0.22	(0.16, 0.27)	(-0.38, 0.88)
AQB	I2H	1.27	(0.94, 1.87)	(-1.68, 5.02)
AQB	IDF	-0.04	(-0.46, 0.39)	(-2.18, 2.11)
#Gaza	H2I	-0.56	(-0.66, -0.46)	(-1.12, -0.08)
#Gaza	I2H	-1.77	(-2.06, -1.48)	(-3.65, 0.00)
#Israel	H2I	-0.33	(-0.43, -0.25)	(-0.82, 0.14)
#Israel	I2H	-0.98	(-1.12,-0.84)	(-2.20, -0.03)
#Gaza	IDF	0.62	(0.46, 0.78)	(-0.16, 1.47)
#Gaza	AQB	-0.39	(-0.57, -0.20)	(-1.42, 0.63)
#Israel	IDF	0.69	(0.48, 0.95)	(-0.24, 1.88)
#Israel	AQB	0.12	(-0.00, 0.27)	(-0.67, 0.98)
#Gaza	#Israel	1.31	(0.60, 2.16)	(-0.86, 3.67)
#Israel	#Gaza	0.23	(0.05, 0.40)	(-0.27, 0.92)
UN	H2I	0.54	(0.54, 0.54)	(0.54, 0.87)
UN	I2H	0.34	(0.34, 0.34)	(0.34, 0.36)
UN	IDF	0.02	(0.02, 0.02)	(0.02, 0.02)
UN	AQB	-0.12	(-0.12, -0.12)	(-0.12, -0.12)
Egypt	H2I	0.57	(0.57, 0.57)	(0.57, 0.92)
Egypt	I2H	0.15	(0.15, 0.15)	(0.15, 0.15)
Egypt	IDF	-0.02	(-0.02, -0.02)	(-0.02, -0.02)
Egypt	AQB	-0.28	(-0.28, -0.28)	(-0.29, -0.28)
US	H2I	0.57	(0.57, 0.57)	(0.57, 0.87)
US	I2H	0.50	(0.50, 0.50)	(0.50, 0.56)
US	IDF	0.03	(0.03, 0.03)	(0.03, 0.10)
US	AQB	-0.17	(-0.17, -0.17)	(-0.17, -0.17)

Table 8: **Cumulative Impulse Response Functions from BSVAR Hashtag Biased (5-lag model)**

Shock In	*Response By*	*Cumulative Median Response After 12 hrs.*	*68% Regions*	*90% Regions*
#Gaza	H_Material	-0.03	(-0.10, 0.03)	(-0.41, 0.32)
#Gaza	H_Verbal	0.01	(-0.06, 0.07)	(-0.34, 0.33)
#Gaza	I_Material	-0.57	(-0.80, -0.35)	(-1.86, 0.68)
#Gaza	I_Verbal	0.41	(0.22, 0.60)	(-0.70, 1.52)
#Israel	H_Material	0.01	(-0.06, -0.08)	(-0.36, 0.39)
#Israel	H_Verbal	0.06	(-0.00, 0.13)	(-0.29, 0.42)
#Israel	I_Material	-0.11	(-0.23, 0.02)	(-0.91, 0.72)
#Israel	I_Verbal	0.18	(0.08, 0.28)	(-0.51, 0.90)
UN	H_Material	0.17	(0.17, 0.17)	(0.17, 0.18)
UN	H_Verbal	0.08	(0.08, 0.08)	(0.08, 0.08)
UN	I_Material	0.21	(0.21, 0.21)	(0.21, 0.24)
UN	I_Verbal	0.03	(0.03, 0.03)	(0.03, 0.03)
Egypt	H_Material	0.28	(0.28, 0.28)	(0.28, 0.36)
Egypt	H_Verbal	0.11	(0.11, 0.11)	(0.11, 0.11)
Egypt	I_Material	0.23	(0.23, 0.23)	(0.23, 0.25)
Egypt	I_Verbal	0.04	(0.04, 0.04)	(0.04, 0.04)
US	H_Material	0.17	(0.17, 0.17)	(0.17, 0.17)
US	H_Verbal	0.08	(0.08, 0.08)	(0.08, 0.08)
US	I_Material	0.25	(0.25, 0.25)	(0.25, 0.30)
US	I_Verbal	0.10	(0.10, 0.10)	(0.10, 0.12)

Table 9: **Cumulative Impulse Response Functions from BSVAR Hashtag Biased (5-lag, 11-variable model Separating out Material and Verbal Conflict)**

Supplementary Information: Does Social Media Influence Conflict? Evidence from the 2012 Gaza Conflict

Thomas Zeitzoff*

March 11, 2014

A Online Appendix

A.1 BSVAR Model

Following the notation in Brandt and Freeman (2009), the 9-variable 2012 Gaza Conflict VAR can be written as a dynamic simultaneous equation model

$$\underset{1\times m}{y_t}\underset{m\times m}{A_0} + \sum_{l=1}^{p} \underset{1\times m}{y_{t-\ell}} \underset{m\times m}{A_l} = \underset{1\times m}{d} + \underset{1\times m}{\epsilon_t}, \quad t = 1, 2, ...T. \tag{1}$$

Equation (1) shows "each vectors and matrix's dimensions noted below the given matrix. This is an m-dimensional VAR for a sample size of T (179 hours), with y_t a vector of observations for m (9) variables at time t, A_ℓ the coefficient matrix for the ℓ'th lag, $\ell = 1$ 1, . . ., p, p the maximum number of lags (assumed known), d a vector of constants, and ϵ_t a vector of i.i.d. normal structural shocks" (Brandt and Freeman, 2009, p. 8-9). The key structural aspect of Equation (1) is the contemporaneous relationships in A_0, or how the 9 variables of the 2012 Gaza Conflict respond within the hour to each other. The structural model can be transformed from Equation (1) into the reduced form model by post-multiplying Equation (1) by $A0^{-1}$ and expressing the contemporaneous (exogenous) variables in terms of their lagged valuables (Brandt and Freeman, 2009, p. 12)

$$y_t = c + y_{t-1}B_1 + \;\; + y_{t-p}B_p + u_t, \quad t = 1, 2..., T \tag{2}$$

where

$$c = dA_0^{-1}, \quad B_\ell = A_\ell A_0^{-1}, \quad \ell = 1, 2, ..., p, \quad u_t = \epsilon_t A_0^{-1}. \tag{3}$$

As Equations (2) and (3) show, the structural identification of A_0 in the BSVAR influences both the contemporaneous relationship, and also the longer-term dynamics as they move through the system (Brandt and Freeman, 2009, p. 12).

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Given the large number of parameters for each equation ($\approx m \times p = 9 \times 5 = 45$) to be estimated and complex dynamics, a BSVAR uses hyperparameters to specify beliefs about the dynamics within the BSVAR system (Brandt and Freeman, 2006, 2009).[1] I use a relatively informed prior:

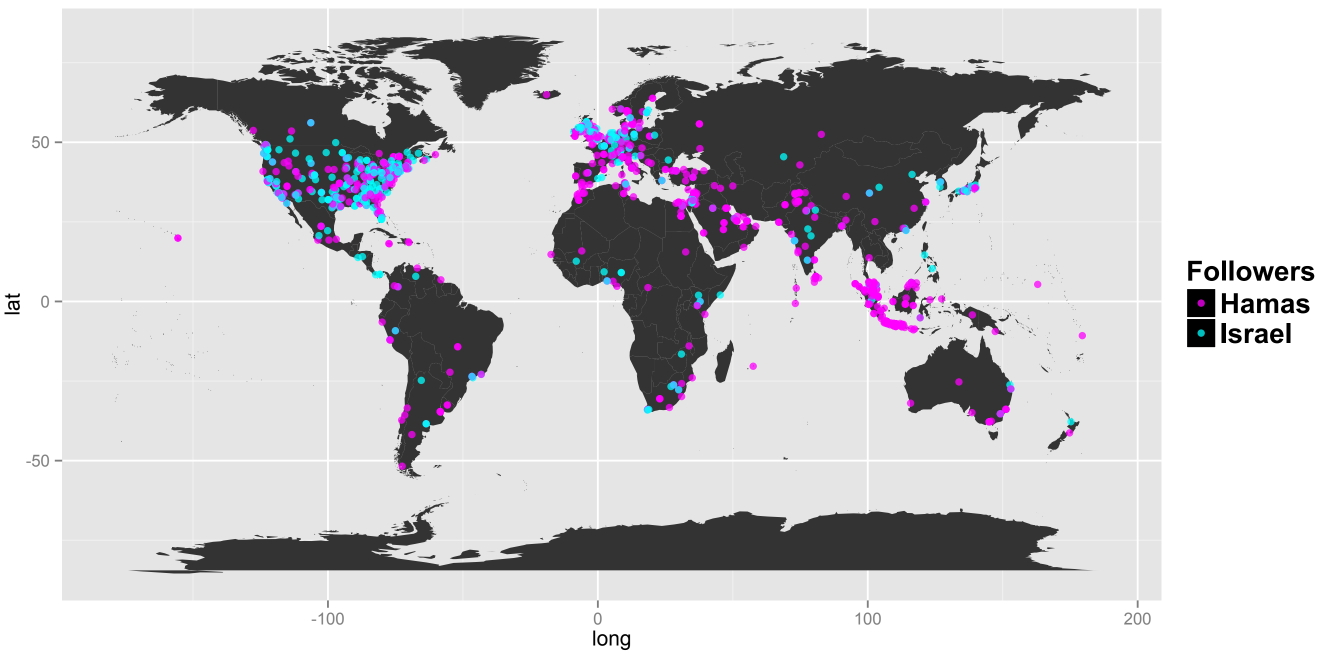
$\lambda_0 = 0.8$, λ_1=0.25, $\lambda_3 = 2$, $\lambda_4 = 0.5$, $\lambda_5 = 0.25$, $\mu_5 = 0$, $\mu_6 = 0$

which shrinks the higher order lags towards zero, and allows beliefs about the structure of the contemporaneous relationships to be explicitly modeled (Brandt, Colaresi and Freeman, 2008, p. 357-358).

[1]Following (Brandt and Freeman, 2009, p. 120): "the hyperparameters influence or control the estimation of the BSVAR in the following way: error covariance matrix scale (λ_0), standard deviation of AR(1) (persistence) (λ_1), decay of lag variances (λ_3), standard deviation of intercept (λ_4), standard deviation of exogenous variables (λ_5), sum of autoregressive coefficients component(μ_5), and correlation of coefficients/initial condition component (μ_6)."

A.2 Geographic Distribution of Followers

Figure 1: **Twitter Followers Map**



Each dot represents a follower of *@AlQassamBrigade* (magenta) or *@IDFSpokesperson* (cyan). I randomly sampled the location data of 1,000 followers of each of the two Twitter feeds using the `twitteR` package in `R`. I then used Google's Location API to extract a latitude and longitude for each location that was able to be matched ($\approx 25\%$). The resulting map shows the distribution of followers.

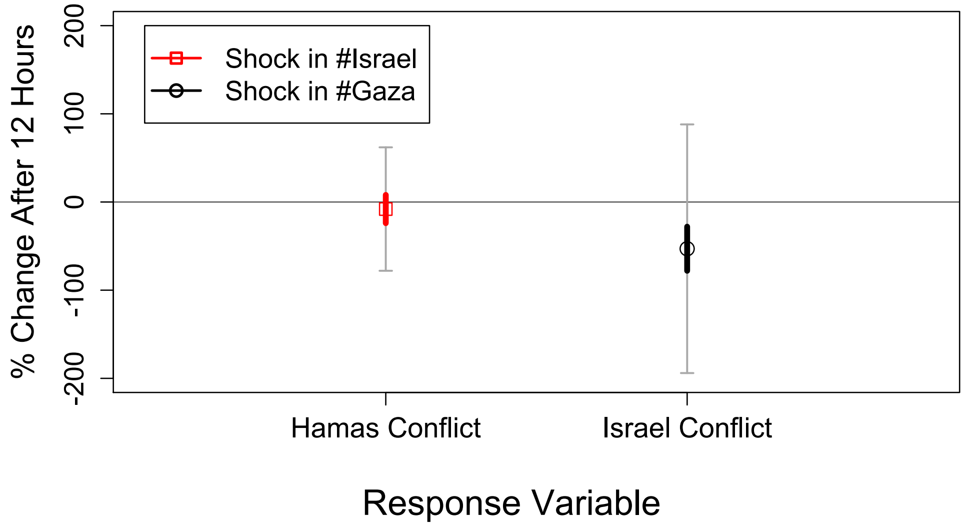


Figure 2: **Cumulative Impulse Response Functions from BSVAR 5-lag model (allowing H2I to react contemporaneously to IDF and I2H)**

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Shock In	*Response By*	*Cumulative Median Response After 12 hrs.*	*68% Regions*	*90% Regions*
H2I	I2H	0.18	(0.05,0.38)	(-1.53, 2.23)
I2H	H2I	-0.07	(-0.19, 0.07)	(-0.90, 0.78)
IDF	H2I	-0.08	(-0.12, -0.05)	(-0.40, 0.21)
IDF	AQB	0.11	(0.07, 0.15)	(-0.40, 0.74)
AQB	I2H	0.85	(0.46, 1.43)	(-2.34, 4.68)
AQB	IDF	0.16	(-0.25, 0.62)	(-1.87, 2.31)
#Gaza	H2I	-0.61	(-0.68, -0.51)	(-1.21, -0.08)
#Gaza	I2H	-2.46	(-2.80, -2.13)	(-4.70, -0.41)
#Israel	H2I	-0.32	(-0.47, -0.24)	(-0.96, 0.10)
#Israel	I2H	-1.22	(-1.39,-1.06)	(-2.58, -0.27)
#Gaza	IDF	0.63	(0.48, 0.73)	(-0.19, 1.48)
#Gaza	AQB	-0.89	(-1.07, -0.72)	(-1.93, 0.17)
#Israel	IDF	0.36	(0.09, 0.61)	(-0.82, 1.47)
#Israel	AQB	-0.05	(-0.17, 0.10)	(-0.82, 0.81)
#Gaza	#Israel	1.24	(0.57, 2.03)	(-0.79, 3.49)
#Israel	#Gaza	0.26	(0.11, 0.44)	(-0.20, 0.91)
UN	H2I	0.53	(0.53, 0.53)	(0.53, 0.85)
UN	I2H	0.41	(0.41, 0.41)	(0.41, 0.42)
UN	IDF	0.04	(0.04, 0.04)	(0.04, 0.04)
UN	AQB	-0.02	(-0.02, -0.02)	(-0.02, -0.02)
Egypt	H2I	0.53	(0.53, 0.53)	(0.53, 0.83)
Egypt	I2H	0.25	(0.25, 0.25)	(0.25, 0.26)
Egypt	IDF	-0.002	(-0.002,-0.002)	(-0.002 -0.002)
Egypt	AQB	-0.19	(-0.19, -0.19)	(-0.19, -0.19)
US	H2I	0.54	(0.54, 0.54)	(0.54, 0.81)
US	I2H	0.50	(0.50, 0.50)	(0.50, 0.53)
US	IDF	0.14	(0.14, 0.14)	(0.14, 0.21)
US	AQB	-0.05	(-0.05, -0.05)	(-0.05, -0.05)

Table 1: **Cumulative Impulse Response Functions from BSVAR Hashtag Biased (5-lag model with Looser Prior)**

$\lambda_0 = 0.8$, λ_1=0.3, $\lambda_3 = 1.8$, $\lambda_4 = 0.5$, $\lambda_5 = .25$, $\mu_5 = 0$, $\mu_6 = 0$

Shock In	*Response By*	*Cumulative Median Response After 18 hrs.*	*68% Regions*	*90% Regions*
H2I	I2H	0.99	(0.94, 1.05)	(-0.78, 2.96)
I2H	H2I	-0.08	(-0.11, -0.03)	(-0.99, 0.85)
IDF	H2I	-0.17	(-0.18, -0.16)	(-0.48, 0.11)
IDF	AQB	0.30	(0.28, 0.32)	(-0.27, 0.94)
AQB	I2H	-0.25	(-0.45, -0.06)	(-4.93, 4.43)
AQB	IDF	-0.85	(-1.07, -0.65)	(-3.63, 1.76)
#Gaza	H2I	-0.84	(-0.88, -0.77)	(-1.50, -0.17)
#Gaza	I2H	-1.08	(-1.26, -0.88)	(-3.29, 1.18)
#Israel	H2I	-0.66	(-0.73, -0.58)	(-1.35, 0.08)
#Israel	I2H	-0.52	(-0.61, -0.44)	(-1.99, 1.00)
#Gaza	IDF	1.39	(1.30, 1.45)	(0.41, 2.37)
#Gaza	AQB	0.73	(0.62, 0.84)	(-0.46, 1.88)
#Israel	IDF	1.72	(1.59, 1.88)	(0.62, 3.09)
#Israel	AQB	0.95	(0.88, 1.02)	(-0.05, 2.01)
#Gaza	#Israel	2.56	(2.25, 3.25)	(0.16, 6.46)
#Israel	#Gaza	0.81	(0.67, 0.91)	(0.06, 1.69)
UN	H2I	0.61	(0.61, 0.61)	(0.61, 0.61)
UN	I2H	0.24	(0.24, 0.24)	(0.24, 0.24)
UN	IDF	-0.03	(-0.03, -0.03)	(-0.03, -0.03)
UN	AQB	0.20	(0.20, 0.20)	(0.20, 0.20)
Egypt	H2I	0.65	(0.65, 0.65)	(0.65, 0.65)
Egypt	I2H	0.56	(0.56, 0.56)	(0.56, 0.56)
Egypt	IDF	0.02	(0.02, 0.02)	(0.02, 0.02)
Egypt	AQB	0.07	(0.07, 0.07)	(0.07, 0.07)
US	H2I	0.67	(0.67, 0.67)	(0.67,0.67)
US	I2H	0.44	(0.44, 0.44)	(0.44, 0.44)
US	IDF	-0.25	(-0.25, -0.25)	(-0.25, -0.25)
US	AQB	0.09	(0.09, 0.09)	(0.09, 0.09)

Table 2: **Cumulative Impulse Response Functions from BSVAR Hashtag Biased (9-lag model)**

Shock In	*Response By*	*Cumulative Median Response After 12 hrs.*	*68% Regions*	*90% Regions*
H2I	I2H	-0.19	(-0.24, -0.15)	(-1.22, 0.73)
I2H	H2I	-0.48	(-0.55, -0.44)	(-0.99, -0.14)
IDF	H2I	-0.13	(-0.17, -0.10)	(-0.51, 0.18)
IDF	AQB	-0.08	(-0.18, -0.01)	(-0.90, 0.68)
AQB	I2H	0.83	(0.54, 1.22)	(-1.81, 3.90)
AQB	IDF	0.71	(0.44, 1.05)	(-0.85, 2.39)
#Gaza	H2I	-0.37	(-0.45, -0.28)	(-0.84, 0.04)
#Gaza	I2H	-2.06	(-2.41, -1.71)	(-4.33, 0.05)
#Israel	H2I	-0.31	(-0.41, -0.20)	(-0.79, 0.20)
#Israel	I2H	-0.89	(-1.05, -0.71)	(-2.26, 0.24)
#Gaza	IDF	0.63	(0.47, 0.77)	(-0.11, 1.42)
#Gaza	AQB	0.01	(-0.18, 0.19)	(-1.05, 1.00)
#Israel	IDF	0.53	(0.27, 0.77)	(-0.61, 1.60)
#Israel	AQB	0.24	(0.11, 0.37)	(-0.60, 1.09)
#Gaza	#Israel	2.55	(2.18, 3.77)	(1.06, 5.24)
#Israel	#Gaza	-0.16	(-0.37, -0.03)	(-0.73, 0.43)
UN	H2I	0.14	(0.14, 0.14)	(0.14, 0.16)
UN	I2H	0.38	(0.38, 0.38)	(0.38, 0.38)
UN	IDF	-0.03	(-0.03, -0.03)	(-0.03, -0.03)
UN	AQB	0.29	(0.29, 0.29)	(0.29, 0.43)
Egypt	H2I	0.08	(0.08, 0.08)	(0.08, 0.09)
Egypt	I2H	0.14	(0.14, 0.14)	(0.13, 0.14)
Egypt	IDF	-0.03	(-0.03, -0.03)	(-0.03, -0.02)
Egypt	AQB	0.003	(0.003, 0.003)	(0.003, 0.01)
US	H2I	0.14	(0.14, 0.14)	(0.14, 0.14)
US	I2H	0.30	(0.30, 0.30)	(0.29, 0.30)
US	IDF	-0.07	(-0.07, -0.07)	(-0.07, -0.06)
US	AQB	0.29	(0.29, 0.29)	(0.29, 0.46)

Table 3: **Cumulative Impulse Response Functions from BSVAR Hashtag Biased (5-lag model with ALL variables seasonally adjusted)**