The Dynamics of Electronic Media Coverage

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Abstract

Electronic media coverage of the events of September 11 was pervasive. This chapter presents an analysis of related Reuters’ articles from September 11 to November 15, 2001, using Centering Resonance Analysis (CRA). CRA identifies influential words within texts, and the connections between them, in the form of a network. We find at least six major themes running through the 66 days of news: the World Trade Center attack itself, economic impact, airport security, political response, military response, and anthrax. Further, these six themes change dynamically over time, suggesting different micro-historical epochs. This suggests a process model of how a terrorist event impacts society as enacted through media content: a trigger event is followed by internal and external institutional responses, and societal impact.
Introduction

The attacks of September 11 on the World Trade Centers and the Pentagon represent an ideal situation to study a terrorist act’s impact on media communication events, because of its horrific magnitude and historical precedence. Media organizations allocated significant resources to sensemaking, tracking, and investigation of the event (Finkel, 2001). Electronic media in particular played a key role, as a significant number of readers turned to the Internet as their source of news and information (Pavlik, 2001). The purpose of this paper is to examine the content of news articles generated by a particular electronic media organization, Reuters. We employ a novel form of text analysis, Centering Resonance Analysis (CRA), which quantifies the influence of words within texts, and creates a network showing their interrelationship. We shall examine influential words in Reuters’ texts across a 66-day period (September 11 to November 15), and also analyze temporal patterns of word influence within this period. This enables us to identify themes and their dynamical patterns, and subsequently a process model linking two different terrorist trigger events to internal and external institutional responses, and to societal impact.

Methods

We chose to examine the content of Reuters’ articles because Reuters is the largest international news organization in the world, and has a very significant on-line readership. Reuters employs over 2000 staff, producing over 30,000 headlines per day in over 200 bureaus. Concerning its electronic news on the Internet, Reuters claims that over 80 million unique users access its articles on the Internet per month (Reuters, 2001). Reuters has the operational traits of both a newspaper and television media organization. Like a newspaper organization, it provides its news in written form, which means it has to pay particular attention to word choice (because
texts are explicit) and content accuracy (because explicit texts are hard to recall for correction).

Like a television organization, it releases stories on a quasi-continuous basis, enabling it to put
down place-holder articles than outline a bare minimum of the story in as rapid a manner as
possible, and then build upon the text in the place-holder as new information is uncovered and
emerging news events unfold. This creates a certain amount of path dependency in their content,
over shorter periods of time.

Data was collected in the following manner. The time horizon of the sample is from
September 11 to November 15, encompassing 66 days. To put this in historical perspective, the
Taliban had just lost control of Kabul, Afghanistan several days before the end of our sample.
Two different data collection approaches were used. From September 11 through the end of the
month, we collected all articles available on Yahoo.com’s news web sites. A sample check
verified that Yahoo.com carried more Reuters articles than any other on-line portal (except for
Excite.com, which carries an almost identical list of articles). Various paths of links found at the
bottom of these stories were followed to ensure that all possible articles were identified. We
then identified those sets of articles that essentially multiple releases of the same story on the
same day, and we kept only the latest and most lengthy version. From October 1 onwards,
following the onset of a change in the way Yahoo.com organized the relevant articles, we
collected all relevant articles from Yahoo’s listing of “Reuters Top Stories”. In this case the list
is already culled from by Yahoo as a sample of all of Reuters releases. In doing so we erred on
the side of inclusion—for example, even though it was not known whether the New York City
plane crash in October, or the anthrax story where “connected” to the September 11 attacks, we
included them in the sample. We tested one particular day (November 12, 2001) to see how the
list from Yahoo’s “Reuters Top Stories” compared to the stream of Reuters articles more
generally available on Yahoo.com and found that their sampling method was comparable to what we had done manually with September’s article sets.

The sequence in which articles occurred is critical to our analysis. Patterns in sequences imply underlying dynamics, and dynamics are important to understand because different ways of organizing and behaving lead to different dynamical patterns. The examination of these patterns can indicate the nature of the underlying, fundamental generative mechanisms that recreate the system on an on-going basis (Dooley and Van de Ven, 1999).

Manifest content analysis is performed on articles using Centering Resonance Analysis (CRA; Corman et al., 2002), a representational method that is a form of network text analysis. CRA assumes that competent authors/speakers generate utterances that are locally coherent by focusing their statements on conversational centers (Lecoeuche et al., 2000). Centers are noun phrases constituting the subjects and objects of utterances. First, concepts are selected using grammatical parsing to unitize the centers by identifying and extracting noun phrases. Second, noun phrase nouns and adjectives are linked sequentially within sentences, and all possible co-occurrences of words within the larger noun phrases are linked. Third, CRA performs concept indexing by analyzing the network of linked nodes generated in the previous step, and calculating the influence of each node. The final step in CRA is concept mapping, whereby the concepts in the network are spatially co-located and visualized.

The influence index calculated in step 3 is of particular importance because it provides the means to identify crucial concepts in the network based on their place in the entire structure of concepts in a text. We operationalize a word's influence as its betweenness centrality in the CRA network (Freeman, 1979). The betweenness measure, as compared to some other measures of centrality, takes into account the position of a node in the entire network rather than just its
local connections. Node with high betweenness, and thus influence, add coherence to the text by connecting words and concepts that otherwise would not be connected.

An example of a CRA network is shown in Figure 1, which shows the map for a text composed of the aggregation of all relevant articles released between 900 and 1200 AM EST on September 11. Shaded nodes are more influential—they are more significant in adding coherence to the text. All of the nodes shown are influential though, as they represent perhaps the top 3-5 percent influential words (30-40 words out of 1000-1500). Arcs connecting the nodes indicate that the author has connected those words in meaningful ways within their discourse, and the strength of connectivity is indicated by the darkness of the line. In the map, we see that the event is being immediately framed as an attack on the U.S. Nodes towards the bottom show that the articles emphasized the locale, *New York, World Trade Center, Washington, Pentagon*. In the upper middle part of the map, there is emphasis on the scene itself: *eyewitness, smoke, scene, Manhattan, explosion*. Note directly to the right of that cluster is *Saudi-born bin Laden* (we will examine this framing in more depth later). *Bin Laden* is connected to *attack*, and the *attack* is primarily being described as *unprecedented*.

**Results**

In order to examine how the content of Reuters’ articles changed over the next two months, we aggregated articles within a given day into a single text, and performed CRA analysis on those texts. The following list shows the most influential terms, in order of magnitude:

- United States, attack, Taliban, people, Afghanistan, Pres. Bush, anthrax, bin Laden, official, Washington, country, New York, American, city, government, security, military, force, war, day, week, leader, group, time, terrorism, world, plane, Afghan, Pakistan, Kabul, office, bomb, new, Saturday, worker, mail, letter, terrorist, air, man, airport

Here is a summary of our analytical, inductive modeling approach:
1. We first identify themes by performing factor analysis on the influence value time series data for each word. Each theme is composed of multiple words, whose influence values are highly correlated with one another over time.

2. We determine an influence score for each theme by taking the average influence across words within the theme; a time series is then constructed.

3. We perform statistical analysis on the thematic time series, including identification of change points, and thus dynamical epochs.

4. A generic model is proposed to account for the dynamical behaviors observed, and is applied to the data.

Themes

We used factor analysis of the daily influence values to determine themes within the texts. The factor analysis is over specified, as there are almost 5000 words, and only 66 different values for each word-variable. We performed analysis with 20, 66, 100, and 200 words, and then also investigated the pairwise correlation between the most influential (240) words (those that had an average influence of over 0.002). We also used non-rotated, rotated (varimax), and oblique methods to see what differences existed. In all of the variations of factor analysis, two strong themes emerged: one associated with the main terrorist attack issues (World Trade Center, anthrax), and one associated with the war in Afghanistan. This served as a starting point for a number of analysis iterations. By coupling our analysis of the pair-wise correlations with the factor analysis results, we were able to identify six themes. No doubt there are more, but these six appeared to largely capture, from a face validity standpoint, the major events over the two months. They also involved about $1/6^{th}$ of the words within the top 240 of influence.
For each theme hypothesized, Cronbach’s alpha was calculated as a measure of the theme’s (factor’s) inter-variable reliability in measuring a common, underlying construct, and further factor analysis was performed to ensure that each factor was cohesive (i.e. it had convergent validity). This resulted in the dropping of some variables until a final set of word-variables for each theme emerged. The results are shown in Table 1:

- **WTC Attack**: the weapon (*plane, hijack, passenger, hijacker*) and its target (*world_trade_center, tower*).
- **Military Response**: the war in Afghanistan, including locales (*afghan, kabul, south*), players (*taliban, northern, opposition, u_n, fighter*), and the context (*force, political*). It is interesting to note that the term *war* itself is not within the factor, perhaps indicating the government’s semantic positioning of the events.
- **Air Security**: security within aviation (*airport, passenger*).
- **Political Response**: the international context of the war on *terrorism*, including the countries outside of Afghanistan (*palestinian, islamic, israel, israeli*) and their conduit (*foreign, minister*).
- **Economic Impact**: the market and its components (*financial, business, bank, trade, market*).
- **Anthrax**: the material (*anthrax, bacterium, spore*), its mode of transport (*mail, letter*), the locale of its discovery (*office, postal, capitol, tom_daschel*), and its effects (*health, test, antibiotic*).

**Time Series Analysis of Themes**

Next, we determine an influence score for each theme by taking the average influence across words within the theme, and then construct a time series. In order to discern specific dynamical epochs, we use statistical change point methods (Poole, et al., 2000). A temporally
local measure of variation, the moving range, estimates the amount of random variation within any given epoch. We then calculate an overall mean, which when coupled with the estimate of short-term variation, yields prediction limits for both the influence value and its moving range. Applying these prediction limits to the data, we can find “outliers”, the presence of which indicates that the data does not likely stem from a singular distribution, or system. These estimated change points yield potential dynamical epochs, where the dynamical behavior of a word’s influence within an epic is constant and across epochs differs. New means and moving ranges are then recalculated for each potential epoch, and outliers identified. A tentative conclusion concerning the demarcations is reached when there are few or no outliers found within each epoch.

A plot of each factor’s time series is shown in Figure 2. Next, we employed the change point analysis discussed above to each factor, and those results are shown in the figure also:

- **Military Response**: Remains small until Day 16, corresponding to the U.S. decision to wage a “war on terrorism”. This undergoes another major spike at Day 60 when the U.S. begins the first major town in Afghanistan falls to the Northern Opposition. During the second epoch, **Military Response** is best modeled as a first-order autoregressive model with a first-order lag autocorrelation of 0.79. This means that the concept has a strong “memory” from day-to-day, and its impact decays exponentially over time.

- **Air Security**: Is immediately large, and decays in a linear fashion until Day 18, when major new initiatives involving airport and passenger security are unveiled, and partially implemented. It moves into the background after day 30, as the news turns to the anthrax attacks. It increases again around Day 47, as new initiatives become more fully implemented and the impact on traveling passengers becomes more pronounced.
- **Political Response**: Is small until Day 6, as world leaders begin to respond to the longer-term issues implied by the attacks. It has a significant increase over a four day period, peaking at Day 23, corresponding to the reaction in the Middle East and Islamic countries concerning the potential of Afghan air strikes and U.S. retaliation. This ends at Day 27, and these contextual issues remain more in the background throughout the rest of the time period.

- **WTC Attack**: Starts of quite large as one would suspect and slowly (linearly) decays over time, except for a blip around Day 18, corresponding to new discoveries about the identities and actions of the hijackers. It remains in the background after that; only more local news agencies such as the New York Times continued to carry extensive news concerning the WTC clean up.

- **Economic Impact**: Shows an immediate spike on Day 3 as international markets respond. Remains small until Day 32, where over the next 9 days there are 3 spikes. It remains small again until a spike on Day 58. Each of the four spikes relate to discussions about the side effects of anthrax attacks. It is interesting to note that economic impact, like *fear*, is associated with bioterrorism, rather than the September 11 attacks.

- **Anthrax**: Dynamically acts as a basic ramp-up and ramp-down phenomenon. It remains small until Day 28, when the first Florida anthrax case was discovered, and increased linearly until Day 42, and then linearly decreases after that. The peak on Day 42 corresponded to the death of two U.S. postal workers, the last deaths associated with anthrax.

Looking at all six together, we observe roughly three times when 3 or 4 of the factor time series change within close time proximity of one another:

Around Day 45: Air Security, Economic Impact, Anthrax

That yields four different micro-historical epochs, each lasting about two weeks. One might also consider the change point in Military Response around Day 60 as indicative of a fifth epoch.

A Model of Terror and Communication

Next we wish to create a model that “explains” the dynamical behavior we observe in the previous analysis. A basic stimulus-response model is chosen (Figure 3). A trigger event (terrorist act) causes an institutional response that has both internal and external components, and both in turn lead to societal impact. The institutional response revolves around a certain set of key actors. In the case of this data set, there are actually two realizations of this process:

1. The WTC Attack is followed by an institutional response. The response has internal (Air Security) and external (Political Response, Military Response) components. The attack is also followed by an Economic Impact, and a general discursive turn of attention to threat.

2. The Anthrax attack generates an institutional response, by the response is not separable from the triggering event itself (see discussion below). It causes an Economic Impact, and a general discursive turn of attention to threat and fear.

Figure 4 shows the thematic data, and data on two other singular terms (threat, fear) in the framework of the model. The actual data is shown in very light lines, while the thick straight lines represent the “mean” value of the theme across that epoch.

For the WTC Attack, we signify two basic phases. The first encompasses the trigger event and its immediate consequences. We observe WTC Attack start at a high level of influence at the beginning of the phase, and linearly decrease in influence over the next 18 days. There is a Political Response during this phase, of moderate magnitude, that took about one week to materialize. There is an immediate spike in the Economic Impact theme, which decays
to background noise after one week. The WTC Attack also generates on-going waves of discursive attention to threat.

A second phase is identified as starting at the point where there are simultaneous, significant changes in the themes representing the institutional response. Specifically, Military Response, Political Response, and Air Security all undergo a significant increase in their mean level, around Day 18. All three responses differ from one another dynamically. The Military Response theme remains moderate in strength until around Day 60, when coordinated attacks against the Taliban begin and the theme increases greatly in influence. The Political Response theme spikes at the very beginning of the second phase and then falls to background. The Air Security theme undergoes changes in influence at three different times. The time lags (about two weeks) between the two changes in Military Response, and the three changes in Air Security, give some indication as to the “speed” of these institutional elements. There is discursive attention to threats throughout the period. Some peaks correspond to official warnings of possible new attacks: Day 7, 32, 53 (the bridge threat in California), and 57 (smallpox, Florida ports). The peak on Day 18 corresponded to the confluence of several international protests of threatened U.S. action, from the Muslim world, or from Muslims (Indonesia, Britain, Pakistan).

For the Anthrax attack, there are two waves of Economic Impact, and an increase in discursive attention to fear. The institutional response cannot be separated from the event itself. The terrorist event was not singular, but rather involved multiple sites across several weeks of time. Likewise, the institutional response was very much entangled with the threat itself, i.e. mail delivery. Within the factor, we denote that terms denote both nature of the event and the response. Discursive attention to fear is almost solely associated with Anthrax, as it reaches its
maximum values at the onset of the anthrax attacks (correlation with anthrax equals 0.21); threat is associated also with anthrax (0.21), but threat and fear tend not to be associated (0.05).

Finally, the words associated with the actors involved in these events are examined, in Figure 5. The top plot shows U.S. officials, and bin Laden. We note that (New York City Mayor) guiliani and (Secretary of State) powell remain relatively low in influence (despite Giuliani later being named “Times Man of the Year”). tom_daschle is directly associated (only) with the anthrax attack, as his office was one of the targets of the attacks. Change point analysis indicates that rumsfeld remains small in magnitude until Day 25, and then peaks on Day 29 as U.S. Claims Control of Afghan Skies (headline of relevant Reuters’ article). Moving forward, rumsfeld has a great deal of volatility, corresponding to specific times when Rumsfeld made public appearances. The dynamical behavior of vp=cheney is more interested. It is common knowledge that Cheney was located in a separate, secure position and kept a low profile, for U.S. national security reasons. The plot shows the specific times when he surfaced. On Day 6, he came forward for the first time to discuss the details of Bush’s odyssey across the country on Air Force One on September 11. On Day 38, he made his “first major appearance” since September 11, to announce, “the war will enter a covert phase”.

Both pres=bush and bin=laden are highly influential throughout the entire period. Pres=bush peaks on Day 13 when Bush announces the “war on terrorism”. On Day 18, both spike, as Reuters headlines U.S. in Hot Pursuit of Prime Suspect. Bin=Laden spikes again on Day 24, as Reuters headlines West Unveils Evidence on bin Laden. Pres=bush reaches its second and third largest values on Day 61-62, corresponding to Afghanistan’s Northern Alliance taking control of the key city of Mazar-I-Sharif, and bin=laden follows on Day 65 as Cheney
Sees End of Taliban Rule, bin Laden on Run, and Bin Laden Denies Knowledge of Anthrax Mail
(incidentally, *bin=laden* and *anthrax* have a statistically significant correlation of $-0.45$.)

In the case of both *pres=bush* and *bin=laden*, no distinct epochs can be discerned—their dynamical behavior is constant throughout the 66 days. ARMA analysis (Poole, et al., 2000) indicates that *bin=laden* is best described by a periodic model, with a period length of 4 days; lag one autocorrelation is 0.46. *Pres=bush* is best described by a simple moving average (MA) model; lag one autocorrelation is 0.22, and autocorrelation decays to zero at lag 4. Examining the cross-correlation, we find that the two are moderately correlated on the same day (0.17), and lagged by one day (0.32, *bin=laden* leading *pres=bush*). These two findings suggest that *bin=laden* is being is best described as a “leading” concept, and *pres=bush* as a following concept (Dooley and Van de Ven, 1999). More specifically, discursive attention to *bin=laden* increases at some point in time, triggered by his own actions and/or communication events, and those from U.S. government officials, and this discursive wave has periodic elements to it, perhaps indicating intention. Discursive attention to *pres=bush* often appears after such attention is paid to *bin=laden*, indicating that some of *pres=bush* was related to a reaction to *bin=laden*.

The second graph in Figure 5 shows attention paid to the groups generally thought of as responsible for the WTC attacks. We see that discussion about the *taliban* and *afghanistan* increased during Phase II of the process, and that *taliban* increased significantly at the same time that the Military Response theme did. We note that while *al qaeda* was denoted as the target of the military response, its discursive influence is small.

In summary, the WTC attack is an example where the trigger event is immediate and short-lived, and the responses are both discursively and temporally distinct from the event itself.
On the other hand, the anthrax attack is an example where the trigger event is temporally extended, and responses are not discursively or temporally distinct from the event itself.

**Conclusions**

In this chapter we examined the content of Reuters’ articles related to the attacks of September 11 over a two-month period. We can make several concluding remarks. First, we demonstrated the methodological efficacy of CRA, and its ability to identify key words and themes within vast amounts of text, and the ability to use that data to determine change points and micro-historical epochs. In terms of media content, we showed that words could have interesting and insightful dynamical histories, that certain words lead and others follow, and that “news events” enacted as words can have “memory” in terms of their impact on media content. Second, we identified that six major themes embedded in Reuters’ content: the World Trade Center attack itself, air security issues, international and political issues relating to the “war on terrorism”, a military response, an economic impact, and anthrax. Further, we found that these themes also had change points, indicating different dynamical epochs, and that these suggested 4 or 5 different epochs, each lasting about two weeks. This led us to propose a model where a terrorist event (WTC attack, anthrax) leads to an institutional response (military, political, air security), and an impact on society (economic impact, discursive attention to “threat” and “fear”). It would be interesting to compare these responses in the U.S., where terrorism is rare, to responses to terrorist attacks in other countries where terrorism is more commonplace.
References


Table 1  Factors representing themes within Reuters’ content

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<thead>
<tr>
<th>Factor</th>
<th>Cronbach Alpha</th>
<th>Words</th>
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<tr>
<td>Military Response</td>
<td>0.83</td>
<td>Afghan, Kabul, south, Taliban, northern, opposition, u.n., fighter, force, political</td>
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<tr>
<td>Air Security</td>
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<td>security, airport, passenger</td>
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<tr>
<td>Political Response</td>
<td>0.88</td>
<td>Palestinian, Islamic, Israel, Israeli, foreign, minister</td>
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<td>WTC_Attack</td>
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<tr>
<td>Economic_Impact</td>
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</tr>
<tr>
<td>Anthrax</td>
<td>0.79</td>
<td>anthrax, bacterium, spore, mail, letter, office, postal, capitol, tom_daschel, health, test, antibiotic</td>
</tr>
</tbody>
</table>
Figure 1  
Reuter's 900-1200 September 11: CRA Map
Figure 2  Themes and Change Points
Figure 3  Model of Terrorist Act and Effect on Media Content

Trigger Event

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Institutional Response

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Societal Impact

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WTC Anthrax

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Internal
Air Security
External
Political
Military

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Economic Impact,
“fear”
“threat”

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Actors
people
groups
Figure 4  Model Applied to Reuters’ Themes

Phase I  Phase II

MILITARY

AIR SECURITY

POLITICAL

WTC_ATTACK

"threat"

ECON_IMPACT

Influence

Pre-trigger  Post-trigger  "fear"

ANTHRAX

Day

Pre-trigger  Post-trigger

"fear"
Figure 5  Actors

Phase I  Phase II

bin Laden  al Qaeda

Point at which WAR theme increases

Taliban

Afghanistan

Phase I  Phase II

bin Laden

Bush

Rumsfeld

Cheney

Powell

Guiliani  Daschle