

The Hebrew University of Jerusalem
Faculty of Social Sciences
The Federmann School of Public Policy and Government

Master's Thesis:
Pessimism: Exploring a New Indicator for Forecasting Terrorism

Submitted by Kenneth Wainwright, #77728439-9

Submitted to Dr. Claude Berrebi

30 December 2014

Abstract

This study analyzes the correlation between pessimistic political statements and terror acts as an indicator to forecast terrorism. Analysts and academics argue the importance of developing and verifying specific indicators of terrorism, but there is little explicit discussion of these factors. It examines pessimistic statements by Palestinians against Israel as indicators of an impending terrorist attack. The research draws on an established dataset covering terror events in Israel between 2000 and 2006 and introduces a unique dataset of pessimistic statements derived from the Global Database of Events, Language, and Tone (GDELT) while controlling for economic, demographic, and security variables. Pessimistic statements made by the PLO and mentioned in the first paragraph of a media report during any given 21-day period are positively correlated with terrorist attacks in general, and suicide attacks in particular, in the following 21-day period.

Table of Contents

Introduction.....	1
Definition of Terrorism.....	4
Root Causes of Terrorism	4
Proximate Indicators of Terrorism.....	8
Theoretical Basis.....	14
Hypotheses	17
Description of the Data	17
A. GDELT - Pessimistic Statement Characteristics.....	20
B. Terror Attacks.....	20
C. Economic and Demographic Characteristics	21
D. Security Characteristics	21
E. Normalizing the Data – Cubic Spline Interpolation.....	22
Empirical Framework	23
Results.....	27
Testing the Full Econometric Model	30
Conclusion	34
Bibliography	39
Appendix.....	43

Introduction

Can pessimistic statements by political leaders serve as indicators of upcoming terror attacks? Anecdotal evidence from the Second Intifada indicates a curious relationship between pessimistic statements and terrorist attacks:

On February 10th, 2001, PLO leader Yasser Arafat remarked in response to the election of Ariel Sharon as Israeli prime minister, that “Europe, America and Russia have to move quickly...time is precious because the situation is very serious.”¹ Four days later, on February 14th, a Palestinian bus driver accelerated into a crowd of Israelis in Tel Aviv, killing eight and injuring twenty.²

On February 12th, 2002, Yasser Arafat told reporters that an Israeli missile strike against Palestinian fighters in the Gaza Strip “mean [Israel] does not want calm. It wants to continue the escalation against our mighty people.”³ Eighteen days later, on March 2nd, 2002, a Palestinian suicide bomber struck an ultra-Orthodox neighborhood of Jerusalem, killing 9.⁴

Mahmoud Abbas on May 4th, 2003 “delivered a strong message to Washington against the Israeli escalation...[warning] that such operations jeopardize his efforts to convince Palestinian groups to halt their attacks on Israel.”⁵ This was followed by five terror attacks: a suicide bombing killed three Israelis on May 17th, 2004⁶, a suicide attack on a Jerusalem bus killing seven passengers on May 18th⁷, and three other suicide attacks by the end of May 19th⁸

On June 28, 2003, in impromptu remarks captured on videotape, Mahmoud Abbas vowed to press the Israelis for the release of Palestinian prisoners, shouting through a loudspeaker, “There will be no peace or security if even one Palestinian prisoner remains behind bars.”⁹ Three days later, on June 30, 2003, an Al Aqsa Brigade

¹ Tim Cornwell, “Arafat: West must act now to avoid war,” in *The Scotsman*, February 10, 2001, Saturday, Pg. 1, 985 words.

² Matthew Kalman, “Eight dead in Israeli bus stop massacre; Barak vows vengeance after Palestinian ploughs into passenger queue,” in *Daily Mail* (London), February 15, 2001, Pg. 23, 679 words.

³ Graham Usher, “Israel blamed as missiles kill five Palestinian guerrillas,” in *Guardian Weekly*, February 13, 2002, International News; Pg. 2, 623 words.

⁴ Larry Kaplow, “Suicide attack kills 9 Israelis,” in *The Atlanta Journal-Constitution*, March 3, 2002 Sunday, Metro Edition, News; Pg. 3A, 502 words.

⁵ Khaled Abu Toameh, “Gazans turn against Abbas at funerals,” in *The Jerusalem Post*, May 4, 2003 Sunday, News; Pg. 3, 657 words.

⁶ Craig Nelson, “Sharon, Abbas' first talk yields 'remarkably little'; Violence mars top-level meeting,” in *The Atlanta Journal-Constitution*, May 18, 2003, Sunday, Home Edition, News; Pg. 3A, 874 words.

⁷ Karin Laub, “Bomb delays peace deal” in *The Advertiser*, May 19, 2003, Monday, Foreign; Pg. 25, 619 words.

⁸ Craig Nelson, “5th Mideast bombing jolts reeling peace effort,” in *The Atlanta Journal-Constitution*, May 20, 2003, Tuesday, Home Edition, News; Pg. 4A, 655 words.

⁹ Carol Rosenberg, “Abbas presses his demands; The Palestinian premier wants political prisoners released, settlements frozen,” in *The Philadelphia Inquirer*, June 29, 2003 Sunday City Edition, National; Pg. A03, 768 words.

fighter shot and killed a Romanian truck driver near the northern West Bank village of Yabed.¹⁰

In each of these cases, a pessimistic statement by a Palestinian leader preceded a fatal terror attack by a Palestinian on Israelis or Israeli interests by less than three weeks.

Exploring proximate indicators of terrorism have rested largely in the hands of intelligence professionals. Khalsa (2004) and Allen (1998) discuss historical and proposed techniques to improve the collection and analysis of intelligence data to better predict future security problems, terrorism included. The United States Defense Advanced Research Projects Agency (DARPA) developed (and then quickly cancelled) the Policy Analysis Market in the early 2000s, estimating economic, military, and terrorism variables as a betting market to measure geopolitical instability in the Middle East.¹¹ This is not to say that academics have been absent from the discussion. Enders and Sandler (2000, 2002) have written extensively about forecasting terrorism, but have not been explicit about antiterrorism application. Hanson (2006) expands the concept of designing speculative predictions about terrorist attacks, arguing that a terrorism futures market could help inform a more comprehensive terrorism policy.¹² Parente, et al. (2005) propose the use of the Delphi method of using expert panel questionnaires to predict the onset of terror attacks.¹³ In each academic case, however, predictions were for terror attacks in the next year and did not focus on the intensity of the attack. As Bakker (2012) notes, the methodology used by academics, policymakers, and think tanks to forecast terrorism is vague.

¹⁰ "Lorry driver shot dead in West Bank; Romanian is first victim since militant pledge to stop attacks," in *Belfast News Letter* (Northern Ireland), July 1, 2003, Tuesday, NEWS; Pg. 12.

¹¹ A full account of this project can be viewed at <http://hanson.gmu.edu/policyanalysismarket.html>.

This study examines the relationship between pessimistic statements made by Palestinians towards Israel reported in the media and Palestinian terrorism against Israel. While there is not enough theoretical backing to confirm a causal relationship between these statements and terror attacks, a correlation between statements and terrorism can still be a useful and valid predictor for forecasting measures of future terrorism. The utility of the correlation may be illustrated by comparing forecasting terrorism to forecasting weather events. Much as a meteorologists observe current atmospheric conditions like temperature, pressure, and wind speed to predict the weather in future days and weeks, observations of statements by national leaders as reported in the media may provide key indicators of future terror events. While a weatherman's forecast may influence you to carry an umbrella tomorrow, an effective terrorism forecast may lead policymakers to establish or strengthen checkpoints to prevent or deter an attack even if these statements simply represent an unknown underlying or external factor of terrorism.

This study, therefore, explores a previously undocumented indicator of a near-term terrorist attack. It is based on a time-series analysis of daily data on terror events in Israel, Palestinian statements reported in the media, and interpolated data for monthly and quarterly economic, demographic, and security measures during the Second Intifada, from the year 2000 through 2006.

The paper is organized as follows: in the second section, the background of terrorism research is described, including studies into the root and proximate causes of terrorism; the third section describes the theoretical background supporting the impact of political statements on violent acts; in the fourth contains the description of the data; in the fifth the results are presented; the final section contains the study's conclusions.

Definition of Terrorism

When discussing a topic as broad as terrorism, it is important to both identify and clarify the definition of the topic in order to establish common understanding. While many definitions of terrorism have been offered in the last 20 years, this study uses that as defined by the United States Department of State, in which:

(d) (1) the term "international terrorism" means terrorism involving citizens or the territory of more than one country;

(2) the term "terrorism" means premeditated, politically motivated violence perpetrated against non-combatant targets by subnational groups or clandestine agents; and

(3) the term "terrorist group" means any group practicing, or which has significant subgroups which practice, international terrorism (United States Code, Title 22, §2656f(b)).

The United States Department of State, which compiles an annual report on terrorism to Congress, further clarifies that the term “non-combatant” referred to in 22 USC. 2656f(d)(2), includes civilians as well as military personnel not deployed in a war zone or a war-like setting, whether or not they are armed or on-duty (Department of State 2013). This definition is important, as it normalizes *who* is a terrorist (subnational groups or clandestine agents) and *what* constitutes a terrorist act (premeditated, politically motivated violence perpetuated against non-combatants) for statistical analysis.

Root Causes of Terrorism

Much has been written about the foundational causes of terrorism. “Common knowledge” proposed by pundits and politicians alike, point to poor education, opportunity, and socio-economic status as root causes of terrorism. Writing in Foreign Affairs, then US Senator Chuck Hagel argued

“Although poverty and despair do not "cause" terrorism, they provide a fertile environment for it to prosper. The strains of demography, frustrated economic

development, and authoritarian governments contribute to radicalized populations and politics (Hagel 2004).”

US Secretary of Defense Robert Gates noted in a speech that

"On the negative side of the ledger, I think we have not made enough progress in trying to address some of the root causes of terrorism in some of these societies, whether it is economic deprivation or despotism that leads to alienation..."¹⁴

Recent academic studies, however, indicate that education and socio-economic status have little impact on terror events and who becomes a terrorist, at least not in the anticipated way.

Early empirical research provided evidence that the decision to participate in a terrorist attack was not related to the lack of education or socio-economic status of the individual. Russell and Miller's (1983) study of urban terrorists determined that 2/3 of terrorists had at least some undergraduate education. Hudson and Majeska (1999), in their study on the sociological characteristics of terrorists in the Cold War period, determined that terrorists had a higher education than the average population. Additionally, Marc Sageman's (2004) interviews with over 400 terrorists affiliated with al Qaeda, determined that most terrorists were solidly middle-class, while terrorist leaders were upper-class. 2/3 of the terrorists he interviewed had attended college, and 60% had professional or semi-professional occupations. While these studies were not statistically rigorous, involving unrepresentative samples of terrorists, they did indicate that the common belief of the poorly-educated terrorist was suspect and deserved more thorough analysis.

As statistical information became more readily available, academic researchers undertook advanced empirical studies to better explore the link between socio-economic status and terrorism. Alan Krueger and Jitka Maleckova (2003) studied the biographies of Hizballah militants ages 15 to 38, comparing their details to those of the general Lebanese

¹⁴ The Associated Press, "Gates focuses on 'root causes of terrorism'," 3 June, 2007, http://www.sptimes.com/2007/06/03/Worldandnation/Gates_focuses_on_roo.shtml. Accessed 10 October 2004.

population in the same age bracket as recorded in the Lebanese Population and Housing Survey. Their analysis suggested that poverty was inversely related to becoming a Hizballah fighter and that education was positively related with the likelihood of becoming a Hizballah fighter. In the Lebanese context, their study demonstrated little statistical support for the theory that poor education and poverty were roots of terrorism and postulated that terrorism is better understood as a response frustration and indignity springing from political repression. Claude Berrebi (2007) studied terrorist biographical data of Hamas and Palestinian Islamic Jihad *shahids* (self proclaimed martyrs) between the late 1980s and May 2002 and compared their demographic profiles to those of the general Palestinian population. Similar to Krueger and Maleckova's analysis in the Lebanese perspective, Palestinian terrorists in Berrebi's study exhibited a similar conclusion: terrorists tend to be well-educated and come from a higher socio-economic category than a control group from a similar population. In both studies, the socio-economic and education background of the individual did not predict terrorist activity.

These statistical analyses demonstrate that individual low economic status does not have an impact on one's decision to be a member of a terrorist organization; they also do not indicate whether an overall depressed macroeconomic condition may be a root cause of terrorism. James Piazza (2006) explored this concept by challenging the "rooted-in-poverty hypothesis" for the prediction of terrorism through analysis of socio-economic and non-socio-economic variables. He analyzed per capita income, literacy, life expectancy, equal wealth distribution, GDP growth, employment, and food security, finding that disadvantages in each category were not related to an increase in terrorist acts.

Alan Krueger and David Laitin (2008) came to a similar conclusion after studying global terror attacks, although doing so from a different point of view. Looking at the country origin of the attackers and their target countries, their analysis indicated that,

controlling for political regime, the economic status of the *country of origin* of the terrorist mattered little. Instead, the economic status of the *target* country is what matters. Krueger and Laitin contend that terrorists tend to originate from countries with relative political oppression and low levels of civil liberties, while target countries tend to be wealthy, regardless of the income of the country of origin of the attackers. Their work contributed to the expanding body of econometric research challenging the commonly held belief that poor economic status is a root of terrorism. While economic conditions may influence terrorism, the effect is indirect and more nuanced than many pundits acknowledge.

With most empirical works demonstrating that economic conditions are not correlated with terror attacks, Benmelech, Berrebi, and Klor (2012) took a novel approach and explored whether economic conditions impact the *quality* of terrorism. Examining Palestinian suicide attacks in Israel between 2000 and 2006, the authors found that while economic factors had no effect on the numbers of attacks, deteriorating economic conditions had positive effects on the age, education, and operational experience of the suicide terrorist. Higher unemployment rates and greater income inequality were associated with more mature, more educated, and better-experienced attackers who attacked more important Israeli targets. They determined that terror organizations were able to capitalize on high unemployment and poor economic conditions to recruit better terrorists who were not only more capable of attacking important targets, but were also able to do so closer to their home district without being caught before the attack. Additionally, they found that recessionary conditions raise the likelihood that a suicide terrorist belongs to a political faction that provides exclusive public goods, which in the Palestinian context is the terrorist group Hamas.

Even more recently, Enders et al. (2014) took a closer look at the ways in which increasing economic standards are associated with an increase in terrorism. By measuring how per capita GDP impacted terrorism from 1970 to 2010, they determined that terrorist

attacks peaked primarily at a middle-income range that varied according to the sample, whether relatively wealthy leftist terrorists prior to 1993 or fundamentalist and nationalist/separatists groups afterwards. They found that an increase in per capita GDP is associated with an increase in terrorism up to a certain GDP per capita threshold, after which the relationship reverses. With the Palestinian Territories having a relatively low per capita GDP, their findings, while important, do not contradict the established observations that Palestinian terrorism against Israel increased alongside Palestinian economic status.

Proximate Indicators of Terrorism

Much of the academic research into the causes of terrorism have focused on deep-seated economic, social, and political foundations, the application of rational choice theory to suicide terrorism and influential factors in target selection by terrorists. The analyses described above help inform long-term policy decisions for reducing successful terror attacks. In essence, they *explain* terrorism rather than *forecast* it. Less has been written about the proximate indicators of terror attacks. Academic research over the past two decades has helped us better understand what does, or more often does not, lead to an individual's decision to be a terrorist or successfully conduct an attack. Good policy, however, should also be able to prevent terrorist attacks in the short term while also addressing the root causes over the long term.

Governmental efforts to oppose terrorism throughout the threat spectrum can be broadly defined as combating terrorism. Within this concept lie offensive measures – counterterrorism - and defensive measures - antiterrorism. Counterterrorism involves operations undertaken by a government to render terrorists and their networks incapable of using violence to advance their goals (US JCS 2014). Examples include raids and strikes on

terrorists and their support cells and more indirect method, such as home demolitions.¹⁵

Antiterrorism, on the other hand, involves governmental measures used to reduce the vulnerability of individuals and property to terrorist acts (US JCS 2010). Antiterrorism spans from terrorism awareness training and drill for government officials, to establishing checkpoints to deter attacks, to the physical fortification of high payoff targets against terrorist infiltration and attacks. This study focuses primarily on antiterrorism.

One strand of antiterrorism studies examines the long-term effectiveness of policies in reducing the number or effectiveness of terror attacks. Walter Enders and Todd Sandler (1993) studied American antiterrorism policies from 1968 to 1988, using vector autoregression and intervention analysis to evaluate the effectiveness of these policies to reduce modes of terror attacks. They found that policies enacted to prevent one form of terrorist act often resulted in increases in other kinds of attacks. For instance, installing metal detectors in airports resulted in fewer skyjackings, but at the same time increased other kinds of hostage attacks. At the same time, “get tough” legislation and retaliatory raids failed to bring forth long-term reduction of terrorist attacks against the United States and its interests. Antiterrorism policies directed at specific threats, therefore, do not appear to be useful to bringing about an overall reduction in terrorist attacks.

Another thread of antiterrorism studies focuses on trend analysis for the forecasting of terrorist events. Bruce Desmarais and Skyler Cranmer (2013) researched transnational terrorist events from 1980 to 2002, applying a probabilistic modeling approach to develop an edge-forecasting method. The edge, in their study, originates from the state producing the transnational terrorist threat and proceeds to the state attacked by that terrorist. They found

¹⁵ For an example of counterterrorism studies, see Efraim Benmelech, Claude Berrebi, and Esteban Klor, *Counter-suicide-terrorism: Evidence from house demolitions*, No. w16493. National Bureau of Economic Research, 2010.

that their method both accurately forecasts both the origin country and target country of terrorism during hostilities, and that new edges can be forecast as well. Ibrahim Toure and Aryya Gangopadhyay (2013) used a latent semantic indexing algorithm to analyze textual descriptions of terror attacks to classify terrorist groups based on similar patterns of terrorist behavior, in order to help identify future attacks. Aaron Clauset and Ryan Woodard (2013) approach the issue from a different perspective, looking at “large” terrorist attacks such as *al Qaeda’s* attack on America on September 11th, 2001 and whether they are statistical outliers. They determine that there is a relatively high probability of a 9/11-sized event, both from a historical perspective and forecasting in the future, based on long-standing global and political social processes. The method employed in these studies, while helpful for academics and for gaining a deeper understanding of terrorism, are less helpful for policymakers. The use of esoteric means of evaluating data may be difficult for policymakers to understand, employ, and replicate; obscure or difficult to obtain data and computer programs may be a deterrent to the employment of a particular forecasting methodology. More simple, and therefore more user-friendly, methods may be more readily used by policymakers.

Focusing more directly on the Israeli-Palestinian conflict, Berrebi and Lakdawalla (2007) studied terrorist attacks in Israel from 1949 to 2004, determining that distance from a terrorist home base, city size and importance, and ethnic demographics each had an impact on terrorism risk in Israel. Importantly for this study, they also determined that most localities experience an increased risk of terror attack in the day following an attack, but that this risk decays to pre-attack levels after 8 weeks. This pattern was represented in all localities except the capital, Jerusalem, which saw a significant increase in terror risk 8 weeks after surviving without an attack. Perry et al. (2013) improved the predictive power of Berrebi and Lakdawalla’s study by examining suicide bombings in four Israeli cities conducted by

Hamas, Al Aqsa Martyr's Brigade, and the Palestinian Islamic Jihad, using spatial pattern analysis to help discover target preference patterns for suicide attacks. They included socio-cultural, economic, and political variables with added qualitative data to increase the ability to predict both the timing and location of suicide attacks in Israel. Their study showed that the above variables had significant relationships with the odds of an attack in specific neighborhoods; Jewish religious holidays, political negotiation, and operation by the IDF were also associated with increased risk of suicide attack.

The application of antiterrorism can be conceived as a specific change in the allocation of resources, whether personnel or material, in response to an increase in the threat of terrorism. Increasing awareness among security services and the public, increasing the amount and location of security, and placing more stringent measures on border crossings from terrorist bases are examples of policies enacted to deter or prevent successful terrorist attacks in the short term. Recognizing that increased vigilance and security measures can only be effectively maintained in the short run, policymakers must rely on readily-available and easy to use indicators that best forecast when a terror attack may occur.

The task of collecting and analyzing the indicators of terror attacks falls to the various domestic and foreign intelligence agencies. Indicators are “those [collectable] things that would have to happen and those that would likely happen as [a] scenario unfolded (McDevitt 2002).” Some key indicators are obvious, albeit often difficult to collect: terrorist training, weapons movement/employment, and target surveillance. Intelligence agencies collect indicators like these through collection methods that fall under four broad disciplines: Human Intelligence (HUMINT), Signals Intelligence (SIGINT), Imagery Intelligence (IMINT), and measurement and Signatures Intelligence (MASINT). Additionally, counterintelligence (CI), law enforcement, and open sources can also provide raw data to aid in analysis.

The specific methods and techniques for intelligence collection are, of course, secret. Former intelligence officials, however, have published theoretical foundations for terror prediction in order to streamline analysis and improve success. In *Forecasting Terrorism: Indicators and Proven Analytic Techniques*, Sundri Khalsa (2004) proposes an indicator-based forecasting system that divides indicators into three primary groups reflecting essential factors of terror risk: adversary capability, adversary intentions, and target vulnerability. She presents 68 separate indicators by priority, data type (quantitative and qualitative), and primary collector (the disciplines enumerated above), of which only seven are quantitative. Among the quantitative indicators, some of which are left blank for security reasons, the information is collected by law enforcement and counterintelligence. As Khalsa notes, the overwhelming reliance on qualitative indicators is problematic for intelligence agencies since they inherently require analyst intuition, which harms accuracy in the assessment.

The standard indicators of terrorism, such as those outlined by Khalsa, may not apply to all types of terrorism. The threat of micro-actors, so-called “lone wolf terrorists,” has received increased attention in policy and academic circles as well as the media starting in the past decade; perhaps the most famous example is the attack on US soldiers at a clinic at Fort Hood, Texas by US Army Major Nidal Hassan on November 8th, 2009 (McKinley 2009). By their very nature, lone wolf terrorists act based on self-radicalization, spurred by external events to attack their target independently of a larger group or orders from a higher commander (Spaij 2010, Phillips 2011). Although it is not tested in this study, pessimistic statements may be a more general indicator of a future terror attack that can be more broadly applied and interpreted with respect to emerging threats such as lone-wolf terrorism.

Open sources, therefore, remain an important component of data collection to help add to the overall analysis of potential terror threats. In describing an ideal model for collecting intelligence, however, Khalsa identifies only four open source indicators. The

advent of “big data” and vast repositories of open source information may provide important indicators of upcoming terrorist attacks and with proper analysis, may allow security services to deter or prevent such attacks.¹⁶ That being said, data collection itself is insufficient; the analysis of the data is what drives decision-making. The expansive amount of open source data, however, presents problems: how to analyze the data both effectively and efficiently? On which open source indicators should governments focus?

This paper proposes a unique analysis of open-source intelligence to add an additional tool to the intelligence analyst’s ability to forecast an upcoming terror event. Drawing on new and existing datasets, the usefulness of *quantitative* indicators of terror attacks is demonstrated. This paper examines pessimistic statements made by Palestinians regarding Israel and their correlation to terrorist attacks in Israel during the second Intifada. In particular, the research shows that pessimistic statements towards Israel made by Palestinian Liberation Organization (PLO) leaders are positively correlated with both incidents of terror attacks and deaths in a 21-day period, even when controlled by economic, political, and security variables. To be clear, this study does not argue that these statements represent a direct causal link between pessimistic statements and terror. While such a relationship may exist, these statements may also be interpreted and retransmitted by terrorist leaders to initiate attacks; the relationship could be the opposite, whereby Palestinian leaders make pessimistic statements based on a perception of the society’s mood, unwittingly serving as a bellwether for upcoming terrorist events. An external event such as a reduction in moral or material support by an ally, unseen or unmeasured, may impact both the pessimistic statement and serve as a catalyst for a terrorist attack. Regardless of the underlying mechanism, the presence of a correlation indicates that it can be a useful quantitative addition to the overall

¹⁶ Caline Malek, “‘Big Data’ system can prevent terrorism, Abu Dhabi forum hears,” May 22, 2014, <http://www.thenational.ae/uae/technology/big-data-system-can-prevent-terrorism-abu-dhabi-forum-hears>. Accessed 7 September 2014.

terror forecasting model, the importance of which cannot be overstated for policymakers searching for ways to reduce terrorist threat.

Theoretical Basis

The concept of using pessimistic statements, presented in the media, as an indicator of upcoming terror attacks has not been approached in academic literature. The theoretical basis for this study, therefore, comes from a variety of academic disciplines and topical paths.

The interplay between the media and terrorism has been the subject of numerous academic studies. At its most basic form, however, it is based on theories of communication. One perspective from which to view mass communication is the “hypodermic needle” or “magic bullet” theory, which postulates that mass media immediately, powerfully, and directly effects its audiences (Katz and Lazarsfeld 1955). From this perspective, the pessimistic statements by Palestinian leaders in this study could be seen as a directed call by a leader for followers to conduct a terrorist attack. The influence of media messages can also be modeled through the two step flow theory of communication. Introduced by Paul Lazarsfeld, Bernard Berelson, and Hazel Gaudet (1948), the two step flow theory postulates that individuals (opinion leaders) who pay close attention to the media receive the information, and then pass on their own interpretations to the mass audience, adding their own interpretations to the actual media content. The application of this theory to the subject of my study hypothesizes that the pessimistic statements of political leaders do not directly influence terror attacks, but instead spur individual opinion leaders to reinterpret the message, take action, and order attacks. From either perspective, leader statements broadcast in the media have an impact on the audience, whether directly or indirectly.

Beyond general communication theory, however, there are two broad theories on the interplay between the media and terrorism. Michel Wieviorka (1993) argues that there are

four separate relationships between terrorists and the media: pure indifference, in which terrorists only seek to terrorize their specific victims; relative indifference, in which terrorists do not seek media outlets because they already have means to discuss and explain their positions; media-oriented strategy, which is a manipulation of the media by terrorists; and total break, in which the media are targeted by terrorists. Wilkinson (1997) argues the existence of a symbiotic relationship between media and terrorism. On the one hand, terrorists do not generally control mass media outlets; on the other, they are continually attempting to manipulate and exploit the media in order to accomplish their own ends. The media, likewise, seek to publicize terror attacks in the attempt to maintain or build their share of a competitive audience market. Wilkinson maintains that terrorist use the media to convey propaganda and fear, mobilize broad support for their cause, frustrate the response of security forces, and boost their specific constituency to raise funds and inspire further attacks. Of the two theories, Wilkinson's is more satisfying; simply put, terrorism needs the media to survive. Without an audience, terror has no lasting effect. Without media coverage, terror organizations can hardly terrorize and cannot recruit new supporters and cell members.

How do pessimistic statements influence an audience, particularly those made by political leaders? Zullo and Seligman (1990) argue that a "pessimistic ruminator" was significantly more likely to lose an American presidential election than an optimistic speaker. Indeed, those who demonstrated helplessness in response to bad events were deemed more passive, more disliked by others, and did not inspire hope. It is the third element that is most relevant to my study; explaining events pessimistically leads to expectations that bad events are uncontrollable (Abramson et al. 1978). Pessimistic statements made by leaders and broadcast through mass media may lead to a drop in the public's confidence in the leader, or despair of the possibility of an improvement in the contemporary political, social, or economic situation.

Factors leading to political violence have also been studied extensively. Anderson and Bushman (2002) theorized person factors, including beliefs, attitudes, and values, as well as situational factors, including aggressive cues, provocation, and frustration, as key inputs into violent action. Psychological studies also indicate that political speech can be a violent cue for those individuals susceptible to aggression (Bushman 1995, 1998; Dill, Anderson and Deuser 1997). Turk (2002) outlines a scheme to analyze the social dynamics of the individual's progression from coercive, to injurious, to destructive violence, with terrorism being the most extreme manifestation of the pattern. Additionally, mild provocative cues tend to cause the greatest effects in trait-aggressive individuals (Marshall and Brown 2006). Kalmoe (2014) argues that individuals with aggressive personality traits also expressed greater support for political violence, and that their support doubled when exposed to political messages with metaphors that are mildly provocative but mundane and seemingly innocuous. This indicates that when triggered, these individuals are capable of participating in more extreme reactions. When applied to the present study, this implies that pessimistic statements may be more strongly correlated with suicide attacks than general terror attacks.

When the above theories of communication, psychology, media, and terrorism are combined, a theoretical base is built wherein pessimistic statements by political leaders may represent cues for terror leaders to order an increase in the frequency or intensity of terrorist attacks. Their statements may send signals to terrorist leader within society about poor or unacceptable progress towards a favorable political outcome; whether intentionally or not, these statements may lead terrorist leaders to take action against their opponent. A reverse action is also possible: the leader may act as a social sensor, whereby the broadcasting of a leader's pessimistic statements somehow reflects an underlying current within the society that helps predict a terror event. In this mechanism, leaders simply reflect society and transmit a warning of a dim future – that is, a terrorist attack - even if they're unaware that they're doing

so. It's also possible that an unknown external factor both leads a leader to make a pessimistic statement while also triggering an individual to participate in a terror attack. An increase in military activity by the enemy or the loss or reduction of support by a key ally or supporter may be events that the media and intelligence agencies are not sensitive enough to measure and impact leaders to express pessimism about the enemy while also serving as a catalyst for terrorists to take action. Regardless of the mechanism or underlying context, pessimistic statements may be a significant indicator of future terrorist attacks.

Hypotheses

This study hypothesizes that pessimistic statements made by Palestinians leaders about Israel are positively correlated with future terror attacks conducted by Palestinians against Israelis. Since suicide attacks are an extreme manifestation of terror attacks, it also postulates that the correlation between these pessimistic statements and suicide attacks will be even stronger than that of the general hypothesis.

Description of the Data

A. Pessimistic Statement Characteristics

The dataset for pessimistic statements is derived from the Global Database of Events, Language, and Tone (GDELT), a database containing over a quarter-billion event records covering the entire world from 1979 to the present. The GDELT Project was established by Kalev Leetaru, a Yahoo! Fellow, to better understand the evolving global trends by using all available open information sources to codify, as much as possible, communicative discourse and global human behavior. GDELT automatically compiles daily updates from tens of thousands of broadcast, print, and online news sources from around the world; its historical back file includes news reports from AfricaNews, Agence France Presse, Associated Press, Associated Press Online, Associated Press Worldstream, BBC Monitoring, Christian Science

Monitor, Facts on File, Foreign Broadcast Information Service, The New York Times, United Press International, and The Washington Post. GDELT machine-codes events by the Textual Analysis By Augmented Replacement Instructions (TABARI) system (Leetrau and Schrodt 2013). Simply put, it is the largest database of events available in open-source. Its ability to automatically capture and categorize a wide spectrum of events throughout the globe in real-time, as well as historically, provides an unprecedented opportunity for researchers to discover previously unknown spatial and temporal trends in global society based on news, social media, and online textual repositories.

GDELT captures events in a modified CAMEO format, recording an action performed by Actor1 upon Actor2 (Gerner et al 2002). Each unique event record contains 57 fields, including actor names, country codes, and known group codes. Event attributes include a binary “root event” code, which indicate whether an event occurred in the lead paragraph of a document, the raw CAMEO action code describing the act that Actor1 performed on Actor2, the number of mentions of the event, the number of sources, and the number of articles. The events, as well as the actors, are also geo-referenced.

Since this information is machine-coded with TABARI, some discussion on the accuracy of the coding results is necessary. Best et al. (2014) compared the TABARI-coded lead sentences of Reuters news stories relevant to the Israeli-Palestinian conflict to hand-coding the full text of those articles. The results were encouraging; hand-coding the full text did not significantly improve the information derived through the machine-coded TABARI data. Racette et al. used GDELT to analyze the occurrence of violence in Sudan, while also validating the GDELT data to confirm the event, actor, and location fields (2014). Their study determined that 81.2 percent of event codes recorded in GDELT, on average, accurately reflect the nature of the collected articles compared to their hand-coded analyses. These studies bring confidence to the accuracy of the GDELT dataset. No coding method is

perfect, even if accomplished by hand, but the ability of machine-coded algorithms to handle millions of datapoints allows it to be consistent.

In addition to the studies cited above, scholars have used GDELT in a variety of other schemes. Yonamine uses the GDELT dataset to geo-spatially analyze levels of violence in Afghanistan each month, outperforming a naïve model which assumed that the level of conflict tomorrow will be the same as today (2013). His model, however interesting, forecasts a very coarse measure of domestic violence and is tested with only one exogenous control variable. Phua et al. test the GDELT dataset against events in Singapore and find that while some of the subjective variables such as tone and intensity are problematic, its event variables provide a promising source to forecast future events (2014). Keneshloo et al. use GDELT to generate forecast models for country-level domestic crises in Brazil, Argentina, Mexico, Venezuela, and Colombia (2014). In a critical analysis, Hammond and Weidmann argue that the local geospatial variables generated through GDELT's algorithm do not correlate well with hand-coded results (2014). They note a "capital bias" in GDELT, indicating that sub-national geographic references may not be accurate, while agreeing that GDELT correlates well with other established machine-coded databases. For the purposes of this study events are studied at the national level, thereby accounting for this identified lack of refinement in GDELT's dataset.

In order to process a manageable amount of data, the dataset is parsed to include all events coded 01 (Make Public Statement) initiated by Palestinians (Actor1 coded PSE) towards Israelis (Actor2 coded ISR) between January 1st, 2000 and December 31st, 2006, reflecting 13,600 separate and unique events. These events were then further parsed to reflect pessimistic statements (CAMEO code 012)¹⁷ made by Palestinians towards Israelis during

¹⁷ Each event in the CAMEO coding methodology is assigned according to a three digit code. The first two digits provide the coarsest measure of the event (with the third digit being a zero), and each additional

this time period, which represents 1,596 unique pessimistic statements.¹⁸ These statements were then further delineated into those made by Palestinian government officials and elites, those made by Hamas or specifically attributed to Isma'il Haniyeh, and those made by the Palestinian Liberation Organization (PLO) or specifically attributed to Yasir Arafat, Mahmoud Abbas, Ahmed Qureia, or Nabil Shaath. Optimistic statements (CAMEO code 013) in these subgroups were also gathered for analysis.

B. Terror Attacks

The dataset contains detailed information on all terror attacks by Palestinians against Israeli targets in Israel, the West Bank, and the Gaza Strip between January 1st, 2009 and December 31st, 2006. The terror events represented in the dataset compiled by Berrebi (2007) and updated by Benmelech, Berrebi, and Klor (2012), representing successful terror attacks as reported by the Israel Security Agency (ISA) and news reports. The database comprises a daily record of the type of terror attack (method) and number of civilians killed in the attack. The 2000-2006 time period comprises 299 terrorist attacks in which at least one Israeli civilian was killed, with a total of 905 Israelis killed by terror attacks during this time period. Of the total, suicide attacks stand out as disproportionately effective: 76 of the terror attacks were perpetuated by suicide terrorists, who caused 537 of the total Israeli civilian deaths. Put more concisely, suicide attackers represent 25% of the total attacks, but account for 59% of Israeli civilians killed.

digit provides a greater level of specificity into the event. Some event categories have a maximum of three digits, while others have four. For example, Code 010 is an unspecified public statement and Code 012 is a pessimistic statement; code 080 is an unspecified act of yielding to something, code 086 is an unspecified act of allowing international involvement, and 0863 is the act of allowing for humanitarian access.

¹⁸ The CAMEO codebook (Gerner et al. 2002) provides the following examples of statements coded as *pessimistic*: "Former West Germany Chancellor Willy Brandt said in a radio interview broadcast today he was skeptical over Moscow's will to agree on limiting European-based nuclear weapons" and "Israeli Prime Minister Ehud Barak said Friday he was very pessimistic about the chances of resuming peace talks with Syria, Israel radio reported." The underlined terms are the explicitly pessimistic component of the verbal act.

C. Economic and Demographic Characteristics

The data for the economic variables of interest (change in real GDP growth per person, change in income inequality, change in unemployment, and change in the percentage of public administration and security spending to GDP) and the demographic variables of interest (change in average years of education, change in percentage of the population working in Israel, and change in the percentage of the population living in refugee camps) were derived from the Palestinian Labor Force Survey (PLFS). The economic variables represent tested measures used in previous studies (Benmelech, et al. 2012, Enders et al. 2014) as well as the addition of the percentage of public administration and security spending to GDP; this variable was included because an increase in spending on security should, at least theoretically, correlate to a reduction in terrorist attacks. The demographic variables are also used in prior studies and have been shown to have statistically significant impacts on various measures of terror and terror risk. The PLFS is compiled quarterly by the Palestinian Central Bureau of statistics. Approximately 30,000 households in East Jerusalem, the West Bank, and Gaza are queried in the survey annually, with approximately 23,000 completing the questionnaire each year between 2000 and 2006. For this study, since statements are distributed by media outlets throughout the entire Palestinian Territories, only the aggregate values of the Palestinian Territories were collected.¹⁹

D. Security Characteristics

This study also considers security measures taken by the Israeli government against the Palestinian population at large. Two measures of security are considered: the number of Palestinians fatally injured by the Israeli Defense Forces (IDF), and the change in the number of Palestinians in Israeli administrative detention. Data on the number of Palestinians fatally

¹⁹ Consequently, the district-level results of the survey were not considered for the purposes of the analysis conducted in this paper.

injured by the IDF between 2000 and 2006 was collected by the Israeli human rights organization B'Tselem, and reflect the date of the incident and the numbers fatally injured. The difference between the date of injury and the date of death is subtle, but is preferred because it reflects the direct action of an IDF soldier's attack rather than the more random date of the Palestinian's death. This event, conducted by the IDF against Palestinian, could also instigate an individual to conduct a terror act, so it is included as a control variable.

The data on the number of Palestinians in Israeli administrative detention was also collected by B'Tselem. The raw data reflects a survey of all Palestinians administratively held by the IDF or the Israel Prison Service (IPS) on a monthly basis.²⁰ Administrative detention reflects imprisonment of an individual based on administrative order only, without trial or indictment. The practice is considered particularly egregious by Israeli human rights organizations and Palestinian leaders,²¹ and may also instigate terror events by Palestinians against Israelis, therefore also making it useful as a control variable.

E. Normalizing the Data – Cubic Spline Interpolation

As is evident from the discussion of the data above, the frequency of the collected information varies from daily to quarterly measurements. Since the main variables of interest represent daily measurements (terror attack and pessimistic statement), the remainder of the data should reflect estimated daily values to normalize the time intervals.

There are a few methods to estimate daily values based on monthly or quarterly data points. The first is piecewise-linear fit, which simply linearly connects each value. The resulting curve allows for estimation at any interval, but because the slope changes abruptly at each data point it may not represent the expected reality of the data.

²⁰ In two nonconsecutive months, neither the IDF nor IPS provided statistics to B'Tselem. In 2005, first the IPS and then the IDF refused to provide statistics to B'Tselem for a period of 4 months pending approval through a freedom of information request. Despite these gaps, the data indicates a generally linear change in the administrative detainee population from month to month.

²¹ See B'Tselem, "Administrative Detention," available online at http://www.btselem.org/administrative_detention/20141007_spike_in_number_of_administrative_detainee.

The other method, and method used to estimate the daily values for the economic, demographic, and security variables, is cubic spline interpolation. For each variable, there are n data points (whether monthly, quarterly, or at some other interval), with $n-1$ spaces between them. Across each space, a unique cubic polynomial is drawn connecting the two points. Then, the first and second derivatives are forced to be continuous, so that at each connecting point they are equal to the derivative on the other side. The resulting third-degree piecewise-polynomial curve, or cubic spline, is smooth and may more plausibly estimate values between known data points than simple linear fit.²² This method is considered highly reliable for this kind of data analysis. For example, the US Department of the Treasury uses it to compute the treasury yield curve based on close of business bid yields for on-the-run securities (US Department of Treasury 2009). Since the cubic splines are automatically related to each other by a cubic polynomial, however, any regressions using them must be robust to autocorrelation. This can be accounted for by using Newey-West standard errors (Newey and West 1987 and Woolridge 1991).²³

Empirical Framework

This study estimates a model to forecast terrorism conducted by Palestinians against Israelis, and assesses whether pessimistic statements by Palestinians against Israelis are correlated with future terror attacks. In equation (1), the model tests the simple correlation of these variables at 7 day, 21 day, and 8 week periods

$$(\text{ Terror Events})_{t+1,i} = \alpha_{0,i} + \beta_2(\text{ Pessimistic Statement})_{t,i} + \varepsilon_{t,i} \quad (1)$$

²² For a thorough discussion of cubic splines, see Chris Rorres and Howard Anton, *Applications of Linear Algebra 3rd ed.*, New York: John Wiley and Sons, 1984 and Christian Habermann and Fabian Kindermann, "Multidimensional Spline Interpolation: Theory and Applications" in *Computational Economics* Vol 30 Issue 2, September 2007, pp 153-169.

²³ It is important to note that the interpolated values are only being used for control variables, while our main variables are left unaltered.

Where (Terror Events) represents a vector of terror outcome measures, including the number of terror attacks in $t + 1$, the number of Israelis killed in terror attacks in $t + 1$, the number of suicide terror attacks in $t + 1$, and the number of Israelis killed in suicide terror attacks in $t + 1$. Terrorism outcome measures also includes dichotomous variables, in which the occurrence of at least 1 terror attack in $t + 1$ assigns the variable a value of 1 and a value of 0 otherwise. An additional dichotomous variable in the vector is assigned the value of 1 if at least 1 suicide terror attack occurs in $t + 1$ and zero otherwise. Daily summary statistics for each of these measures of terror events are depicted in Table 1.1.

<u>Table 1.1 - Daily Terror Events</u>							
<u>Variable</u>	<u>Summary Statistics</u>						<u>Days with Terror Event</u>
	<u>Mean</u>	<u>Standard Deviation</u>	<u>Median</u>	<u>Min</u>	<u>Max</u>	<u>Obs.</u>	
<u>Terror Events (per day)</u>							
Terror attacks	0.116934	0.371119	0	0	3	2557	257
Civilian deaths caused by terror event	0.35393	1.805778	0	0	29	2557	257
Suicide attacks	0.030505	0.18515	0	0	2	2557	72
Civilian deaths caused by suicide attacks	0.210012	1.671849	0	0	29	2557	72
Terror attack, (1 = at least one attack)	0.100508	0.300736	0	0	1	2557	257
Suicide attack (1 = at least one suicide attack)	0.028158	0.165456	0	0	1	2557	72

The (Pessimistic Statement) variable represents the sum of pessimistic statements made by Palestinians towards Israelis in time period t , as represented in print media. The (Pessimistic Statement) variable may be either be standard, meaning it occurred anywhere in a news report, or a “root” statement, meaning that it was reported in the first paragraph of a news report as a measure of the statement’s relative importance. Additionally, the variable can represent the sum of any Palestinian pessimistic statements, the sum of pessimistic statements made by Palestinian governmental or elite individuals, pessimistic statements

made by Hamas (including Isma'il Haniyah), or the sum of pessimistic statements made by the PLO (including those attributed to Yasir Arafat, Mahmoud Abbas, Ahmed Qureia, or Nabil Shaath). As a robustness test, analysis of the predictive power of optimistic statements made by Palestinians shows that any of these categories are not significantly correlated to any of the measures of terror attacks. Summary statistics for these daily Palestinian statements are represented in Table 1.2 for all statements and Table 1.3 for root statements.

<u>Table 1.2 - Daily Palestinian Statements</u>							
<u>Variable</u>	<u>Summary Statistics</u>						<u>Days with Statements</u>
	<u>Mean</u>	<u>Standard Deviation</u>	<u>Median</u>	<u>Min</u>	<u>Max</u>	<u>Observations</u>	
<u>All Statements</u>							
Total Statements	5.318733	4.385709	4	0	42	2557	2349
<u>Pessimistic Statements</u>							
Total Pessimistic Statements	0.624169	1.156026	0	0	10	2557	836
Government and Elite							
Pessimistic Statements	0.039891	0.2547907	0	0	4	2557	75
Hamas Pessimistic							
Statements	0.035589	0.2404364	0	0	5	2557	68
PLO Pessimistic Statements	0.01095	0.1422123	0	0	4	2557	20
<u>Optimistic Statements</u>							
Total Optimistic Statements	0.82323	1.378078	0	0	13	2557	974
Government and Elite							
Optimistic Statements	0.212358	0.6810909	0	0	10	2557	328
Hamas Optimistic							
Statements	0.078608	0.395198	0	0	5	2557	131
PLO Optimistic Statements	0.033242	0.2423916	0	0	4	2557	59

Each specification of the model controls for economic, demographic, and security changes or measures during time period t . Equation (2), therefore, depicts the relationship of the explanatory and the variable of interest on terror events:

$$\begin{aligned}
 (\text{ Terror Events })_{t+1,i} = & \alpha_{0,i} + \beta_2(\text{ Pessimistic Statement })_{t,i} + \gamma_3(\text{ Economic Variables })_{t,i} \\
 & + \delta_4(\text{ Demographic Variables })_{t,i} + \eta_5(\text{ Security Variables })_{t,i} + \varepsilon_{t,i}
 \end{aligned}
 \tag{2}$$

Table 1.3 - Daily Palestinian Statements (Root Events)*

<u>Variable</u>	<u>Summary Statistics</u>						<u>Days with Statements</u>
	<u>Mean</u>	<u>Standard Deviation</u>	<u>Median</u>	<u>Min</u>	<u>Max</u>	<u>Observations</u>	
<u>All Statements</u>							
Total Statements	3.058271	2.949252	2	0	25	2557	2096
<u>Pessimistic Statements</u>							
Total Pessimistic Statements	0.330074	0.8296674	0	0	9	2557	504
<u>Government and Elite</u>							
Pessimistic Statements	0.029331	0.2227304	0	0	4	2557	55
<u>Hamas Pessimistic</u>							
Statements	0.018381	0.1608566	0	0	3	2557	38
<u>PLO Pessimistic Statements</u>							
	0.00704	0.1116691	0	0	4	2557	14
<u>Optimistic Statements</u>							
Total Optimistic Statements	0.421197	0.9517653	0	0	9	2557	587
<u>Government and Elite</u>							
Optimistic Statements	0.058663	0.3352064	0	0	5	2557	99
<u>Hamas Optimistic</u>							
Statements	0.030113	0.2278371	0	0	4	2557	56
<u>PLO Optimistic Statements</u>							
	0.024638	0.2106772	0	0	4	2557	43

* A Root Event in GDELT is an event which is noted in the first paragraph of a media report. A first-paragraph mention of an event may be an indicator of an event's relative importance.

The economic measures include changes from the start to the end of time period t in Palestinian Territory real GDP growth per person, income inequality, unemployment, and the percentage of public administration and security spending as part of GDP. The demographic variables include changes from the start to the end of time period t in Palestinian Territory average years of education, percentage of population working in Israel, and the percentage of the Palestinian population in refugee camps. Lastly, two security control variables are presented: the sum of Palestinians fatally injured by the IDF during time period t , and the change in the number of Palestinians in Israeli Administrative Detention from the start to the end of time period t . An error term, ε_t , represents the non-systemic determinants of terror attacks. Summary statistics for the economic, demographic, and security controls are depicted in Table 1.4.

Negative binomial regression is used as the primary tool to model the terror events because they are non-negative over-dispersed outcome variables; Table 1.1 shows that the variance exceeds the mean for all of the terror event count variables. For the dichotomous terror event variables, probit regression is used. Poisson, OLS, and Logit models are also used as robustness tests.

<u>Table 1.4 - Daily Economic, Demographic, and Control Variables*</u>						
<u>Variable</u>	<u>Summary Statistics</u>					
	<u>Mean</u>	<u>Standard Deviation</u>	<u>Median</u>	<u>Min</u>	<u>Max</u>	<u>Observations</u>
<u>Economic Variables</u>						
Real GDP Growth per person	-0.01	0.07	0.00	0.21	0.12	2376
Income Inequality	1.10	0.08	1.09	0.96	1.29	2512
Unemployment	0.05	0.03	0.04	0.03	0.11	2512
Percentage Public Administration and Security Spending to GDP	0.14	0.02	0.14	0.09	0.18	2422
<u>Demographic Variables</u>						
Average Years of education	9.21	0.28	9.23	8.70	9.43	2512
Percentage of Population working in Israel	0.05	0.03	0.04	0.02	0.11	2512
Percentage of Population in Refugee Camps	0.17	0.01	0.17	0.15	0.23	2512
<u>Security Variables</u>						
Number of Palestinians Fatally Injured by IDF	1.55	3.29	0	0	62	2557
Number of Palestinians in Israeli Administrative Detention	614.41	337.75	713	7	1140	2188
*Daily values computed from Quarterly and monthly values using cubic spline interpolation. Economic variables from Palestinian Labor Force Survey (PLFS) and Palestinian Central Bureau of Statistics. Demographic values from PLFS. Security variables from B'tselem.						

Results

Table 2.1 (located in the appendix) shows the simple regression of equation (1). The selected time period is 21 days; that is, the statement variable represents the sum of statements over a 21 day period t , while the terror variable represents the sum of terror events in the next 21 day period. Terror attacks, deaths from terror attacks, suicide attacks, and

deaths from suicide attacks are modeled using negative binomial regression as explained above. Dichotomous variables for attack and suicide attack are modeled with probit regression.

Total Palestinian statements about Israel are positively correlated to each of the terror outcome variables and are statistically significant. Pessimistic statements by Hamas are also statistically significant, but interestingly the coefficients carry negative values. Statements made by the PLO or its identified leaders, however, are both positive and statistically significant across all six terror outcome variables. The Hamas statements may carry a negative coefficient because it reflects that as an entity and at that time, it is out of capacity to recruit or gain support for more active terrorists from its population. They may therefore be correlated with a decrease in measures of terrorism because Hamas pessimistic statements reflect this overall lack of ability to conduct attacks. The positive PLO coefficient, on the other hand, may reflect a warning by PLO leaders in which they, perhaps unwittingly, indicate that they have lost control over the popular support for a political agreement with Israel, thereby signaling a coming terror event. Table 2.2, below, represents the same tests, but with “root” statements only – those statements which were reported in the first paragraph of the respective media report. The results are similar to those in Table 2.1.

Tables 2.3 and 2.4 (located in the appendix) show the results of testing equation (1) again according to all statements and root statements respectively, but with changes in time period t . The model is tested with a 7 day and 8 week time period; the results can be compared with the 21 day time period in Table 2.1. On a seven-day time period, total statements resulted in statistically significant results for attacks and deaths. Hamas pessimistic statements resulted in negative but statistically significant results for attacks, deaths, and suicide deaths. An eight-week time period results in positive and statistically

significant results for the terror outcome variables with respect to PLO statements, whether root or not, but does not do so for the dichotomous attack and suicide attack variables.

Table 2.2 -Correlation of Important (Root) Statements on Terror Events
Newey-West standard errors in parentheses.
Statements in t (21-day time period), Terror Events in t+1 (21-day time period)

Terror Variables Statement Variables	<u>Negative-Binomial Regression, Newey-West Standard Errors</u>			<u>Probit Regression, Newey-West Standard Errors</u>		
	<u>Attacks</u>	<u>Deaths</u>	<u>Suicide Attacks</u>	<u>Attack Dummy</u>	<u>Suicide Deaths</u>	<u>Attack Dummy</u>
ROOT Total Statements	0.0139835 (.0012965)	*** .0117325 (.0018686)	*** .0077258 (.0018244)	*** .0106034 (.0025832)	*** .0131992 (.002276)	*** .0079322 (.001758)
ROOT Total Pessimistic Statements	-	-0.0037086 (.0105898)	-0.0000291 (.010701)	.0212018 (.0155091)	.0360114 (.0110684)	.0122278 (.0090833)
ROOT Government and Elite Pessimistic Statements	-.1400648 (.0287665)	*** -.0325271 (.0361657)	.0586096 (.0392799)	.0624219 (.0427819)	.0222332 (.038162)	.0683027 (.0378941)
ROOT Hamas Pessimistic Statements	-.1561525 (.0280044)	*** -.0823682 (.0333891)	* -.0303306 (.0397804)	-.0218613 (.0421594)	.1667424 (.0572417)	** .0782098 (.039518)
ROOT PLO Pessimistic Statements	.1010079 (.0498242)	* .2118945 (.0457837)	*** .3160627 (.0594091)	*** .3096604 (.0519913)	*** .2493308 (.0785354)	*** .4981367 (.088483)

* denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.001$

The overall results from tables 2.1 through 2.4 indicate that among the statement variables tested, statements by the PLO towards Israel in general, as well as those noted in the first paragraph of a media report (root statement), are positively correlated to each of the measures of terror events and are statistically significant. Additionally, while both 21-day and 8-week periods showed reliable predictive power, a 21-day period balances statistically significant coefficients with a realistic amount of time during which policymakers can respond and maintain vigilance against terror threats. As noted by Berrebi and Lakdawalla (2007), while the general risk of terror attacks decreases over time in a particular locality, it appears to increase sharply over time in Jerusalem. As such, it isn't surprising that an 8-week model has stronger statistical significance, but 8 weeks is too long for policymakers to make an impact. Additionally, a 7-day period may not give policymakers enough time to make a substantive change to prepare for the upcoming threat.

Testing the Full Econometric Model

Table 3.1 (below) presents the results of testing equation (2), which includes economic, demographic, and security control variables. Based on the results from tables 2.1 through 2.4, the independent variable of interest is PLO statements towards Israel, which appeared in the 1st paragraph of a media report. Similarly, a 21-day time period for both t and $t+1$ is tested. Negative binomial and probit regressions with Newey-West standard errors are presented, as before.

In the full model, pessimistic PLO statements towards Israel remained positive and statistically significant for five of six measures of terror events; as will be shown later, the significance of root pessimistic PLO statements gradually decreases in relation to the number

Table 3.1 - Results from Regression of Terror Events in 21-day time period t+1 on PLO statements (Root) and Palestinian Economic, Demographic, and Political Variables in time period t, 2000-2006

Newey-West standard errors in parentheses.

	Pessimistic Statement					
	<u>Negative Binomial Regression</u>			<u>Probit Regression</u>		
	<u>Number of Terror Attacks</u>	<u>Deaths from Terror Attacks</u>	<u>Number of Suicide Attacks</u>	<u>Deaths from Suicide Attacks</u>	<u>Terror Attack Occurred (1=yes)</u>	<u>Suicide Attack Occurred (1=yes)</u>
(1)	(2)	(3)	(4)	(5)	(6)	
PLO Statement towards Israel, noted in 1st Paragraph of news report	.0840097 (.0742538)	.1491731 * (.0676395)	.1869527 * (.0907915)	.1839815 * (.0809886)	.5811448 ** (.1917139)	.7453501 *** (.156024)
<u>Economic Variables</u>						
Change in Real GDP Growth per person	6.863622 (1.383287)	*** 7.363148 *** (1.958135)	7.639921 *** (2.013488)	*** 9.170126 *** (3.364382)	15.68295 *** (2.532277)	10.88904 *** (1.982658)
Change in Income Inequality	-18.06383 (3.278667)	*** -34.14089 *** (5.519516)	-19.21931 *** (5.732446)	*** -21.56444 *** (8.163973)	-8.474579 (5.595563)	-14.07886 ** (4.674428)
Change in Unemployment	-81.31393 (8.148694)	*** -34.54487 ** (11.45548)	-12.79042 (11.46576)	4.228325 (16.81813)	-240.4957 *** (59.0801)	-108.2699 *** (25.01901)
Change in Percentage Public Administration and Security Spending to GDP	-22.26224 * (9.138097)	-34.54487 ** (11.30207)	-20.89733 (14.14749)	-25.3006 (18.59937)	38.99005 ** (13.63367)	-2.49508 (14.21773)
<u>Demographic Variables</u>						
Change in Average Years of education	19.51298 (15.58209)	67.92831 *** (20.88086)	-17.41074 (20.48847)	64.65797 * (28.22942)	-5.020972 (24.6087)	-7.973014 (21.87625)
Change in Percentage of Population working in Israel	-124.1837 * (60.94913)	-258.5288 *** (75.29972)	-22.03903 (93.00922)	-296.0766 * (119.5455)	-502.4873 *** (108.3487)	-232.3168 * (91.08071)
Change in Percentage of Population in Refugee Camps	-30.18031 ** (11.03078)	-41.63338 ** (13.99223)	-12.67068 (11.70891)	-2.453807 (18.48082)	4.288847 (16.27992)	-6.224351 (15.28718)
<u>Security Variables</u>						
Number of Palestinians Fatally Injured by IDF	.0048902 (.001519)	*** .0065884 *** (.0017588)	.0040238 * (.0018612)	.0041261 * (.0020915)	.0008559 (.002088)	.0010327 (.0018675)
Change in number of Palestinians in Israeli Administrative Detention	.0007848 * (.0003132)	.0003686 (.0004891)	.0006911 (.0005441)	-.0001691 (.0006371)	-.0007526 (.0006657)	-.0014174 (.0008153)
R-squared	.150	.072	.063	.065		
Observations	2103	2103	2103	2103	2103	2103

* denotes $p < 0.1$, ** denotes $p < 0.05$, *** denotes $p < 0.001$

of terror attacks as control variables are added. Of note, root PLO pessimistic statements over a 21 day period are correlated with the occurrence of at least one terror attack in the next 21 day period at a 1% level and correlated with at least one suicide attack at a .1% level.

To test the robustness of the pessimistic variable, Table 3.2 (located in the appendix) also presents the full model (2) regressions, but with the diametrically opposed variable: optimistic PLO statements towards Israel, noted in the first paragraph of a media report. When tested alongside the same economic, demographic, and security variables, optimistic statements are not statistically significant in relation to any measure of terror. Put simply, pessimistic statements by PLO leaders are positively correlated with future terror events; optimistic statements are not.

Table 3.3 (below) shows comparisons of testing equation (1) using other regression techniques: results from negative-binomial regression is compared to Poisson and OLS, and probit regression is compared to logit. Both Poisson and OLS techniques reach results where root PLO pessimistic statements remain statistically significant in relation to all measures of terror events. While the negative binomial model remains the preferred analysis method due to the over-dispersion of no occurrence of terror acts and deaths in this study, this test demonstrates that the basic equation is not sensitive to the choice of regression model. Unsurprisingly, both probit and logit analyses of the model produce similar results; both indicate that root PLO pessimistic statements against Israel are valid predictors of future terror events. Since there is no specific theoretical background to direct using the logistic model in this case, the probit model remains preferred.

Table 3.3 – Comparison of Econometric Models – Negative Binomial, Poisson, OLS, Probit, and Logit Regressions
 Results from Regression of Terror Events in 21-day time period t+1 on PLO statements (Root) and Palestinian
 Economic, Demographic, and Political Variables in time period t, 2000-2006

	<u>Number of Terror Attacks</u>			<u>Deaths from Terror Attacks</u>		
	<u>Negative- Binomial</u> (1)	<u>Poisson</u> (2)	<u>OLS</u> (3)	<u>Negative- Binomial</u> (4)	<u>Poisson</u> (5)	<u>OLS</u> (6)
PLO Pessimistic Statement towards Israel, noted in 1st Paragraph of news report	.1010079 (.0498242)	** .0877449 (.0368964)	** .2605416 (.1275741)	.2118945 (.0457837)	*** .1976229 (.0257758)	*** 2.238329 (.3891288)
R-Squared	.150	.177	.195	.072	.167	.134
Observations	2103	2103	2103	2103	2103	2103
	<u>Number of Suicide Attacks</u>			<u>Deaths from Suicide Attacks</u>		
	<u>Negative- Binomial</u> (7)	<u>Poisson</u> (8)	<u>OLS</u> (9)	<u>Negative- Binomial</u> (10)	<u>Poisson</u> (11)	<u>OLS</u> (12)
PLO Pessimistic Statement towards Israel, noted in 1st Paragraph of news report	0.3160627 (.0594091)	*** .2655643 (.0418667)	*** .3029725 (.0654332)	.3096604 (.0519913)	*** .2782069 (.0285153)	*** 2.25176 (.2855018)
R-Squared	.063	.148	.124	.065	.197	.135
Observations	2103	2103	2103	2103	2103	2103
	<u>Terror Attack Occurred (1=yes)</u>			<u>Suicide Attack Occurred (1=yes)</u>		
	<u>Probit</u> (13)	<u>Logit</u> (14)		<u>Probit</u> (15)	<u>Logit</u> (15)	
PLO Pessimistic Statement towards Israel, noted in 1st Paragraph of news report	.2493309 (.2493309)	*** .4155183 (.1513942)	**	0.4981375 (-0.088483)	*** .8006475 (.1525711)	***
R-Squared						
Observations	2103	2103	2103	2103	2103	2103

* denotes $p < 0.1$, ** denotes $p < 0.05$, *** denotes $p < 0.001$

Tables 4.1 and 4.2 present the full equation (2) of the probit model of root PLO pessimistic statements with the phased addition of the economic, demographic, and security control variables for the dichotomous event of a suicide attack and a terror attack, respectively, in the next 21 day period. Of the two models tested, however, the probit analysis of the relationship between the pessimistic statement and the occurrence of at least one suicide attack is the most consistent at 0.1% significance in all iterations, as shown in Table 4.1.

Finally, Table 5 presents the computation of marginal effects following the probit regression of the full model (2). One additional PLO pessimistic statement towards Israel reported in the first paragraph of a media report during any given 21-day period increases the probability of at least one terror attack in the following 21-day period by 0.158; it increases the probability of at least one suicide terror attack by 0.262.

Conclusion

Through econometric analysis, this study demonstrates that pessimistic statements by opposition groups are correlated with future terror events and may be an indicator overlooked by policymakers and analysts. Whether alone or controlled by various economic, demographic, and security variables, pessimistic statements by the PLO and its leaders over any given 21-day period were correlated to the numbers of Israelis killed in all terror attacks and suicide attacks, as well as the number of suicide attacks conducted over the next 21 day period. When modeled towards dichotomous variables for the occurrence of at least one terror attack or suicide attack during this period, the results are more striking: each additional pessimistic PLO statement is correlated with a 15.8% increase in the probability of a terror attack in the next 21-day period and a 26.2% increase in a suicide attack. The evidence derived from this analysis support both hypotheses outlined at the beginning of this study.

Table 4.1 - Results from Regression of Terror Events in 21-day time period t+1 on PLO statements (Root) and Palestinian Economic, Demographic, and Political Variables in time period t, 2000-2006

Newey-West standard errors in parentheses.

	<u>Pessimistic Statement</u>							
	Suicide Attack Occurred (1=Yes), Probit Regression							
	(1)		(2)		(3)		(4)	
PLO Pessimistic Statement towards Israel, noted in 1st Paragraph of news report	.4981375 (.088483)	***	.6017926 (.116971)	***	.6710499 (.1322202)	***	.7453501 (.156024)	***
<u>Economic Variables</u>								
Change in Real GDP Growth per person			12.56409 (1.819387)	***	11.13351 (1.868094)	***	10.88904 (1.982658)	***
Change in Income Inequality			3.097533 (3.224749)		-3.959723 (3.891269)		-14.07886 (4.674428)	**
Change in Unemployment			-110.1135 (20.18385)	***	-107.1085 (22.62957)	***	-108.2699 (25.01901)	***
Change in Percentage Public Administration and Security Spending to GDP			3.784397 (12.92471)		10.30774 (13.39053)		-2.49508 (14.21773)	
<u>Demographic Variables</u>								
Change in Average Years of education					-61.77138 (19.04969)	***	-7.973014 (21.87625)	
Change in Percentage of Population working in Israel					-180.6852 (92.04373)	*	-232.3168 (91.08071)	*
Change in Percentage of Population in Refugee Camps					20.63841 (14.73314)		-6.224351 (15.28718)	
<u>Security Variables</u>								
Number of Palestinians Fatally Injured by IDF							.0010327 (.0018675)	
Change in number of Palestinians in Israeli Administrative Detention							-.0014174 (.0008153)	
Observations	2496		2301		2301		2103	

* denotes $p < 0.1$, ** denotes $p < 0.05$, *** denotes $p < 0.001$

Table 4.2 - Results from Regression of Terror Events in 21-day time period t+1 on PLO statements (Root) and Palestinian Economic, Demographic, and Political Variables in time period t, 2000-2006

Newey-West standard errors in parentheses.

	<u>Pessimistic Statement</u>			
	Terror Attack Occurred (1=Yes), Probit Regression			
	(1)	(2)	(3)	(4)
PLO Pessimistic Statement towards Israel, noted in 1st Paragraph of news report	.2493309 (.0785354)	*** .2318388 (.1032596)	* .2682155 (.1289969)	* .5811448 (.1917139)
<u>Economic Variables</u>				
Change in Real GDP Growth per person		8.361728 (1.833413)	*** 8.903848 (1.942638)	*** 15.68295 (2.532277)
Change in Income Inequality		-8.05234 (3.43703)	* -7.495749 (4.27274)	-8.474579 (5.595563)
Change in Unemployment		-134.9495 (22.02903)	*** -138.4727 (27.64655)	*** -240.4957 (59.0801)
Change in Percentage Public Administration and Security Spending to GDP		40.88888 (10.87624)	*** 39.485 (11.40096)	*** 38.99005 (13.63367)
<u>Demographic Variables</u>				
Change in Average Years of education			30.61425 (19.49119)	-5.020972 (24.6087)
Change in Percentage of Population working in Israel			-289.5099 (85.72708)	*** -502.4873 (108.3487)
Change in Percentage of Population in Refugee Camps			-8.955751 (13.17388)	4.288847 (16.27992)
<u>Security Variables</u>				
Number of Palestinians Fatally Injured by IDF				.0008559 (.002088)
Change in number of Palestinians in Israeli Administrative Detention				-.0007526 (.0006657)
Pseudo R ²				
Observations	2496	2301	2301	2103

* denotes $p < 0.1$, ** denotes $p < 0.05$, *** denotes $p < 0.001$

Table 5 - Marginal Effect of Pessimistic PLO statements in time period t on terror events in time period t+1, 2000-2006

	<u>Terror Attack Occurred (1=Yes), Probit Regression</u>		<u>Suicide Attack Occurred (1=Yes), Probit Regression</u>	
PLO Pessimistic Statement towards Israel, noted in 1st Paragraph of news report	0.1584271 (0.156024)	***	0.2621832 (0.1917139)	**
* denotes $p < 0.1$, ** denotes $p < 0.05$, *** denotes $p < 0.001$				

There are several explanations for these results. Pessimistic statements may reflect not only the feelings of the politician, but of the general population as well. An expressed lack of confidence in the relationship between Palestinians and Israelis may lead to an increased reliance on terrorist events to upset the status quo. The pessimistic statements may also be an unanticipated cue causing terror cell leaders to initiate an attack due to perceived ineffectiveness of the political process. Suicide attacks, being generally the most spectacular and fear-instilling of terror tactics, may be seen as a way to quickly bring about political change. Another interesting component of the study is that PLO pessimistic statements, rather than those made by Hamas or Islamic Jihad, were those to best predict terror events. This may be because the PLO was the dominant political faction at the time and therefore dictated the rules of the game, or because pessimistic statements by the PLO reflected an ebb in the overall Palestinian disillusionment with the status quo with Israel, leading to more and better-trained terrorists, including suicide attackers. Regardless of the underlying mechanism establishing the correlation, pessimistic statements remain useful barometers of an impending terror attack, giving policymakers tools to mitigate the coming attack.

The goal of this study was to analyze and, if possible, add a useful new indicator to the intelligence analyst's and policymaker's toolkit. The results of this research indicate that analysts and policymakers should include pessimistic statements into their threat algorithms and analyses to sharpen their forecasting capabilities, at least within the Israeli-Palestinian context. With an overwhelming amount of data to be collected daily, analysts must focus limited resources to bring pertinent information to policymakers to best respond in the short term to terrorist threats.

This study also demonstrates the usefulness of "big data" in open-source intelligence analysis. In this case, the GDELT dataset, which continues to be updated daily, provides a unique point of departure for further studies into security and terrorism. Further research is needed to examine the relationship between pessimistic statements and terror attacks outside of the context of the Second Intifada and the Israeli-Palestinian paradigm as a whole. Analysts, however, can immediately apply the indicator to their historical databases to determine its applicability to their unique terrorism problem sets in the past to help forecast, and prepare for, terror attacks in the future.

Bibliography

- Abramson, L. Y., G. I. Mealsky, and L. B. Alloy. "Hopelessness depression: A theory-based subtype of depression." *Journal of Personality and Social Psychology* 42: 619-630.
- Allen, Charles E. "Warning and Iraq's Invasion of Kuwait: A Retrospective Look." *Defense Intelligence Journal* 7, no. 2 (Fall 1998): 33-44.
- Anderson, Craig A., and Brad J. Bushman. "Human aggression." *Psychology* 53, no. 1 (2002): 27.
- Bakker, Edwin. "Forecasting terrorism: The need for a more systematic approach." *Journal of Strategic Security* 5, no. 4 (2012): 10.
- Benmelech, Efraim, Claude Berrebi, and Esteban Klor. *Counter-suicide-terrorism: Evidence from house demolitions*. No. w16493. National Bureau of Economic Research, 2010.
- Benmelech, Efraim, Claude Berrebi, and Esteban F. Klor. "Economic conditions and the quality of suicide terrorism." *The Journal of Politics* 74, no. 01 (2012): 113-128.
- Berrebi, Claude. "Evidence about the link between education, poverty and terrorism among Palestinians." *Peace Economics, Peace Science and Public Policy* 13, no. 1 (2007).
- Berrebi, Claude, and Darius Lakdawalla. "How does terrorism risk vary across space and time? An analysis based on the Israeli experience." *Defence and Peace Economics* 18, no. 2 (2007): 113-131.
- Best, Rebecca H., Christine Carpino, and Mark JC Crescenzi. "An analysis of the TABARI coding system." *Conflict Management and Peace Science* 30, no. 4 (2013): 335-348.
- Bushman, Brad J. "Moderating role of trait aggressiveness in the effects of violent media on aggression." *Journal of personality and social psychology* 69, no. 5 (1995): 950.
- Bushman, Brad J. "Priming effects of media violence on the accessibility of aggressive constructs in memory." *Personality and Social Psychology Bulletin* 24 (1998): 537-545.
- Clauset, Aaron, and Ryan Woodard. "Estimating the historical and future probabilities of large terrorist events." *The Annals of Applied Statistics* 7, no. 4 (2013): 1838-1865.
- Department of State. *Country Reports on Terrorism 2013*.
<http://www.state.gov/j/ct/rls/crt/2013/index.htm>. Accessed 3 September 2014.
- Desmarais, Bruce A., and Skyler J. Cranmer. "Forecasting the locational dynamics of transnational terrorism: A network analytic approach." *Security Informatics* 2, no. 1 (2013): 1-12.

- Dill, Karen E., Craig A. Anderson, Kathryn B. Anderson, and William E. Deuser. "Effects of aggressive personality on social expectations and social perceptions." *Journal of Research in Personality* 31, no. 2 (1997): 272-292.
- Enders, Walter, Gary A. Hoover, and Todd Sandler. "The Changing Nonlinear Relationship between Income and Terrorism." *Journal of Conflict Resolution* (2014): forthcoming.
- Enders, Walter, and Todd Sandler. "The Effectiveness of Antiterrorism Policies: A Vector-| Autoregression-Intervention Analysis." *American Political Science Review* 87, no. 04 (1993): 829-844.
- Enders, Walter, and Todd Sandler. "Is transnational terrorism becoming more threatening? A time-series investigation." *Journal of Conflict Resolution* 44, no. 3 (2000): 307-332.
- Gerner, Deborah J., Philip A. Schrodtt, Omür Yilmaz, and Rajaa Abu-Jabr. "Conflict and Mediation Event Observations (CAMEO): A new event data framework for the analysis of foreign policy interactions." *International Studies Association, New Orleans* (2002).
- Habermann, Christian, and Fabian Kindermann. "Multidimensional spline interpolation: Theory and applications." *Computational Economics* 30, no. 2 (2007): 153-169.
- Hagel, Chuck. "A Republican Foreign Policy." *Foreign Affairs* (July/August 2004). <http://www.state.gov/j/ct/rls/crt/2013/index.htm>. Accessed 10 October 2004.
- Hammond, Jesse and Nils B. Weidmann. "Using machine-coded event data for the micro-level study of political violence." *Research and Politics* (July-September 2014): 1-8.
- Hanson, Robin D. "Designing Real Terrorism Futures." *Public Choice* 128, no. 1/2 (July 2006): 257-274.
- Hudson, Rex A., and Marilyn Majeska. "The sociology and psychology of terrorism: Who becomes a terrorist and why?" Washington, DC: Library of Congress, 1999.
- Kalmoe, Nathan P. "Fueling the fire: Violent metaphors, trait aggression, and support for political violence." *Political Communication* 31, no. 4 (2014): 545-563.
- Katz, Elihu and Paul Felix Lazarsfeld. *Personal Influence*. New York: The Free Press, 1955.
- Keneshloo, Yaser, Jose Cadena, Gizem Korkmaz, and Naren Ramakrishnan. "Detecting and Forecasting Domestic Political Crises: A Graph-based Approach." (2014).
- Khalsa, Sundri. *Forecasting Terrorism: Indicators and Proven Analytic Techniques*. Lanham, MD: Scarecrow Press, 2004.
- Krueger, Alan B., and Jitka Malečková. "Education, poverty and terrorism: Is there a causal connection?." *The Journal of Economic Perspectives* 17, no. 4 (2003): 119-144.

- Krueger, Alan B., and David D. Laitin. "Kto kogo?: A cross-country study of the origins and targets of terrorism." *Terrorism, economic development, and political openness* (2008): 148-173.
- Lazarsfeld, Paul Felix, Bernard Berelson, and Hazel Gaudet. *The People's Choice: How the Voter Makes Up His Mind in a Presidential Campaign*. New York: Columbia University Press, 1948.
- Leetaru, Kalev, and Philip A. Schrodt. "GDELT: Global data on events, location, and tone, 1979–2012." In *of: Paper presented at the ISA Annual Convention*, vol. 2, p. 4. 2013.
- Marshall, Margaret A., and Jonathon D. Brown. "Trait aggressiveness and situational provocation: A test of the traits as situational sensitivities (TASS) model." *Personality and Social Psychology Bulletin* 32, no. 8 (2006): 1100-1113.
- McDevitt, James J. *Summary of Indicator-Based-Methodology*. Unpublished handout, n.p., n.d. Provided January 2002 at the Joint Military Intelligence College. Quoted in Khalsa, 2004.
- McKinley Jr, J.C. (2009). After years of growing tensions, 7 minutes of bloodshed. *New York Times*, November 9, p. 1.
- Newey, Whitney K., and Kenneth D. West. "A Simple, Positive Semi-definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix." *Econometrica* 55, no. 3 (1987): 703-08.
- Parenté, Rick J., Tiffany Noël Hiöb, Rebecca A. Silver, Carrie Jenkins, Margaret P. Poe, and R. Jacob Mullins. "The Delphi method, impeachment and terrorism: Accuracies of short-range forecasts for volatile world events." *Technological Forecasting and Social Change* 72, no. 4 (May 2005): 401-411.
- Perry, Walter L., Claude Berrebi, Ryan Andrew Brown, John Hollywood, and Amber Jaycocks. *Predicting Suicide Attacks: Integrating Spatial, Temporal, and Social Features of Terrorist Attack Targets*. Rand Corporation, 2013.
- Phillips, Peter J. "Lone wolf terrorism." *Peace Economics, Peace Science and Public Policy* 17, no. 1 (2011).
- Phua, Clifton, Yuzhang Feng, Junyao Ji, and Timothy Soh. "Visual and Predictive Analytics on Singapore News: Experiments on GDELT, Wikipedia, and STI." *arXiv preprint arXiv:1404.1996* (2014).
- Piazza, James A. "Rooted in Poverty?: Terrorism, Poor Economic Development, and Social Cleavages 1." *Terrorism and Political Violence* 18, no. 1 (2006): 159-177.
- Racette, Mark P., Christopher T. Smith, Michael P. Cunningham, Thomas A. Heekin, Joseph P. Lemley, and Richard S. Mathieu. "Improving situational awareness for humanitarian logistics through predictive modeling." In *Systems and Information Engineering Design Symposium (SIEDS), 2014*, pp. 334-339. IEEE, 2014.

- Rorres, Chris, and Howard Anton. "Applications of linear algebra." (1979).
- Russell, Charles and Bowman Miller. "Profile of a Terrorist." *Perspectives on Terrorism*. Wilmington, Delaware: Scholarly Resources Inc.: 45-60.
- Sageman, Marc. *Understanding terror networks*. University of Pennsylvania Press, 2004.
- Sandler, Todd, and Walter Enders. "Applying Analytical Methods to Study Terrorism*." *International Studies Perspectives* 8, no. 3 (2007): 287-302.
- Spaaij, Ramón. "The enigma of lone wolf terrorism: an assessment." *Studies in Conflict & Terrorism* 33, no. 9 (2010): 854-870.
- Toure, Ibrahim, and Aryya Gangopadhyay. "Analyzing terror attacks using latent semantic indexing." In *Technologies for Homeland Security (HST), 2013 IEEE International Conference on*, pp. 334-337. IEEE, 2013.
- Turk, Austin T. "Political violence: patterns and trends" in Silverman, Robert A., ed. *Crime and Justice at the Millennium: Essays by and in Honor of Marvin E. Wolfgang*. Springer, 2002: 31-44.
- U.S. Department of Treasury. "Treasury Yield Curve Methodology." February 26, 2009. <http://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/yieldmethod.aspx>. Accessed July 6, 2014.
- U.S. Joint Chiefs of Staff. *Antiterrorism*. Joint Publication 3-07.2. Washington, DC: U.S. Joint Chiefs of Staff, November 24, 2010.
- U.S. Joint Chiefs of Staff. *Counterterrorism*. Joint Publication 3-26. Washington, DC: U.S. Joint Chiefs of Staff, October 24, 2014.
- Wieviorka, Michel. *The Making of Terrorism*. Chicago: University of Chicago Press, 1993.
- Wilkinson, Paul. "The Media and Terrorism: A Reassessment." *Terrorism and Political Violence* 9, no. 2 (Summer 1997): 51-64.
- Wooldridge, Jeffrey M. "On the application of robust, regression-based diagnostics to models of conditional means and conditional variances." *Journal of econometrics* 47, no. 1 (1991): 5-46.
- Yonamine, James E. "Predicting Future Levels of Violence in Afghanistan Districts Using GDELT." *Unpublished Manuscript* (2013).
- Zullo, Harold M. and Martin E. P. Seligman. "Pessimistic Rumination Predicts Defeat of Presidential Candidates, 1900 to 1984." *Psychological Inquiry* 1, no. 1 (1990): 52-61.

Table 2.1 - Correlation of Palestinian Statements on Terror Events

Newey-West standard errors in parentheses.

Statements in t (21-day time period), Terror Events in t+1 (21-day time period)

Statement Variables	Negative-Binomial Regression, Newey-West Standard Errors			Probit Regression, Newey-West Standard Errors		
	Attacks	Deaths	Suicide Attacks	Suicide Deaths	Attack Dummy	Suicide Attack Dummy
Total Statements	.0071441*** (.0006801)	0.0054989*** (.0009552)	.0032862*** (.0010017)	.0045972*** (.0013782)	.0065715*** (.0011446)	.0031922*** (.0009602)
Total Pessimistic Statements	.0033127 (.005173)	0.0029751 (.0069632)	-.0073002 (.0070614)	.0125957 (.0114583)	.0075389 (.0068797)	-.0072099 (.0056088)
Government and Elite Pessimistic Statements	-.0440774 (.0238995)	0.0387413 (.0320694)	.1162726*** (.0331137)	.1386293*** (.0417591)	.0812705* (.0336539)	.1025827** (.0325286)
Hamas Pessimistic Statements	-.1613415*** (.0201924)	-0.1336466*** (.0296344)	-.1101779** (.0363929)	-.08818** (.0408421)	.0246856 (.0304948)	-.0196021 (.0280214)
PLO Pessimistic Statements	.1102861** (.0350107)	0.104837** (.0355637)	.1714004*** (.0487742)	.1389451** (.0471023)	.1953767*** (.0614386)	.2047561*** (.0596561)

* denotes $p < 0.1$

** denotes $p < 0.05$

*** denotes $p < 0.001$

Table 2.3 - Variations of Time Period of Statements on Terror Events

Newey-West standard errors in parentheses.

7 Day Periods

Terror Variables Statement Variables	<u>Negative-Binomial Regression, Newey-West Standard Errors</u>				<u>Probit Regression, Newey- West Standard Errors</u>	
	<u>Attacks</u>	<u>Deaths</u>	<u>Suicide Attacks</u>	<u>Suicide Deaths</u>	<u>Attack Dummy</u>	<u>Suicide Attack Dummy</u>
Total Statements	.0141892 (.002204)	*** .0091701 (.0033771)	** .0006542 (.0035649)	-.0003897 (.0050975)	.0027608 (.0037472)	.0089363 (.0045489)
Total Pessimistic Statements	.0160944 (.0122098)	-.0097187 (.018591)	.0139492 (.0186473)	-.0297837 (.0279791)	.0247223 (.0193314)	.0284977 (.0278142)
Government and Elite Pessimistic Statements	-.0541964 (.0794729)	.0081826 (.1108331)	.070932 (.0904431)	.0789888 (.1439556)	.1268895 (.0928539)	.2041948 (.1285609)
Hamas Pessimistic Statements	-.2426331 (.0697359)	*** -.2977498 (.0915298)	*** -.224345 (.1274131)	-.2705472 (.1335936)	* .0607408 (.0664639)	.2187842 (.1399419)
PLO Pessimistic Statements	-.0250302 (.0930943)	-.1942955 (.1105601)	-.1448695 (.1767581)	-.3457413 (.2271447)	.1587239 (.1458346)	-.3332232 (.2855905)

* denotes $p < 0.1$

** denotes $p < 0.05$

*** denotes $p < 0.001$

Table 2.3 (continued) - Variations of Time Period of Statements on Terror Events
Newey-West standard errors in parentheses.

8-week Periods

<u>Negative-Binomial Regression, Robust Standard Errors</u>				<u>Probit Regression, Newey-West Standard Errors</u>			
<u>Attacks</u>	<u>Deaths</u>	<u>Suicide Attacks</u>	<u>Suicide Deaths</u>	<u>Attack Dummy</u>	<u>Suicide Attack Dummy</u>		
.003937 (.0002644)	*** .0040071 (.0003704)	*** .0032533 .0004223	*** .0041212 (.0004874)	*** .000429 (.0023448)	.0003729 (.0045123)		
.0090685 (.0028519)	*** .006697 (.0034533)	* .0070396 .0035289	.0081487 (.0042849)	.0215974 (.0231862)	.0061596 (.0353054)		
-.0403768 (.0108129)	*** .0378989 (.0127045)	** .0694667 .0137259	*** .0953532 (.014588)	-.00793 (.1131372)	.0540221 (.2358569)		
-.1404812 (.0106345)	*** -.0920564 (.0108405)	*** .0948914 .0171355	*** -.0653894 (.0128378)	.0735594 (.1240879)	-.0065908 (.1668859)		
.1646571 (.0178102)	*** .2065024 (.0245075)	*** .2536043 .0204028	*** .2643406 (.0305245)	-.1184904 (.0998044)	-.062605 (.2053771)		

* denotes $p < 0.1$
 ** denotes $p < 0.05$
 *** denotes $p < 0.001$

Table 2.4 - Variations of Time Period of Root Statements on Terror Events

Newey-West standard errors in parentheses.

7 Day Periods

Negative-Binomial Regression, Newey-West Standard Errors

Probit Regression, Newey-West Standard Errors

Terror Variables Statement Variables	<u>Attacks</u>	<u>Deaths</u>	<u>Suicide Attacks</u>	<u>Suicide Deaths</u>	<u>Attack Dummy</u>	<u>Suicide Attack Dummy</u>
ROOT Total Statements	.0232431 (.0037624)	*** .01729 (.0056894)	** .0046018 (.0060264)	.0024874 (.0083526)	.0055941 (.0061737)	.0121561 (.0076568)
ROOT Total Pessimistic Statements	-.0082948 (.0174892)	-.0451701 (.0263133)	.0334604 (.0277723)	-.0365415 (.0392639)	.0491165 (.0265051)	.0425157 (.0407549)
ROOT Government and Elite Pessimistic Statements	-.2552426 (.0713689)	*** -.0558719 (.1242366)	.0731127 (.0985875)	.1402255 (.1697159)	.1545827 (.1143274)	.1462097 (.1313715)
ROOT Hamas Pessimistic Statements	-.329666 (.1130028)	** -.4306396 (.1462175)	** -.2333694 (.1835968)	-.4246229 * (.1905722)	.1639965 (.1001829)	.3865236 (.2352066)
ROOT PLO Pessimistic Statements	-.1406163 (.1188446)	-.136917 (.1386063)	.0362465 (.1924996)	-.1200386 (.236865)	.1966279 (.1324468)	-.2674446 (.3634988)

* denotes $p < 0.1$

** denotes $p < 0.05$

*** denotes $p < 0.001$

Table 2.4 (continued) - Variations of Time Period of Root Statements on Terror Events
Newey-West standard errors in parentheses.

21-day Periods

Terror Variables Statement Variables	Negative-Binomial Regression, Newey-West Standard Errors				Probit Regression, Newey- West Standard Errors	
	<u>Attacks</u>	<u>Deaths</u>	<u>Suicide Attacks</u>	<u>Suicide Deaths</u>	<u>Attack Dummy</u>	<u>Suicide Attack Dummy</u>
ROOT Total Statements	0.0139835 (.0012965)	*** .0117325 (.0018686)	*** .0077258 (.0018244)	*** .0106034 (.0025832)	*** .0131992 (.002276)	*** .0079322 (.001758)
ROOT Total Pessimistic Statements	-	-0.0037086 (.0105898)	-0.000291 (.010701)	.0212018 (.0155091)	.0360114 (.0110684)	*** .0122278 (.0090833)
ROOT Government and Elite Pessimistic Statements	-0.1400648 (.0287665)	*** -.0325271 (.0361657)	.0586096 (.0392799)	.0624219 (.0427819)	.0222332 (.038162)	.0683027 (.0378941)
ROOT Hamas Pessimistic Statements	-0.1561525 (.0280044)	*** -.0823682 (.0333891)	* -.0303306 (.0397804)	-.0218613 (.0421594)	.1667424 (.0572417)	** .0782098 (.039518)
ROOT PLO Pessimistic Statements	.1010079 (.0498242)	* .2118945 (.0457837)	*** .3160627 (.0594091)	*** .3096604 (.0519913)	*** .2493308 (.0785354)	*** .4981367 (.088483)

* denotes $p < 0.1$
 ** denotes $p < 0.05$
 *** denotes $p < 0.001$

Table 2.4 (continued) - Variations of Time Period of Root Statements on Terror Events

Newey-West standard errors in parentheses.

Terror Variables Statement Variables	<u>8-week Periods</u>				<u>Negative-Binomial Regression, Robust Standard Errors</u>		<u>Probit Regression, Newey-West Standard Errors</u>	
	<u>Deaths</u>	<u>Attacks</u>	<u>Suicide Deaths</u>	<u>Suicide Attacks</u>	<u>Attack Dummy</u>	<u>Suicide Attack Dummy</u>		
ROOT Total Statements	.0075174 (.0005216)	*** .008609 (.0006792)	** .0075594 (.0008219)	*** .0095397 (.0009001)	*** .0013502 (.004416)	*** -.0005484 (.0075562)		
ROOT Total Pessimistic Statements	-.0037046 (.004451)	.0021685 (.0052439)	.003011 (.0055845)	.0090004 (.0062336)	.0221216 (.033169)	-.0029225 (.0513175)		
ROOT Government and Elite Pessimistic Statements	-.0766508 (.0153008)	*** .009605 (.0063401)	.032964 (.0192257)	.0552641 (.0187934)	-.0331199 (.1180742)	.0115826 (.2640135)		
ROOT Hamas Pessimistic Statements	-.1603879 (.0117714)	*** -.0903525 (.0133656)	*** -.0712968 (.0179676)	*** -.0454918 (.0165803)	.071521 (.1213092)	-.0077704 (.1772482)		
ROOT PLO Pessimistic Statements	.1095656 (.013314)	*** .1881531 (.0191935)	*** .2638578 (.0180524)	*** .2581535 (.0254933)	-.1528773 (.1238102)	-.1899714 (.2282697)	**	**

* denotes $p < 0.1$

** denotes $p < 0.05$

*** denotes $p < 0.001$

APPENDIX

Table 3.2 - Results from Regression of Terror Events in 21-day time period t+1 on PLO statements (Root) and Palestinian Economic, Demographic, and Political Variables in time period t, 2000-2006

Newey-West standard errors in parentheses.

	Optimistic Statement					
	<u>Negative Binomial Regression</u>				<u>Probit Regression</u>	
	<u>Number of Terror Attacks</u>	<u>Deaths from Terror Attacks</u>	<u>Number of Suicide Attacks</u>	<u>Deaths from Suicide Attacks</u>	<u>Terror Attack Occurred (1=yes)</u>	<u>Suicide Attack Occurred (1=yes)</u>
(1)	(2)	(3)	(4)	(5)	(6)	
PLO Optimistic Statement towards Israel, noted in 1st Paragraph of news report	-.0520388 (.0398865)	-.0085841 (.0491744)	-.0454163 (.0562159)	.0481995 (.0582566)	-.0036246 (.0492814)	.050191 (.0496738)
<u>Economic Variables</u>						
Change in Real GDP Growth per person	6.982354 *** (1.36694)	7.693256 *** (1.974083)	8.221925 *** (2.087648)	9.88123 ** (3.333285)	16.80738 *** (2.5668)	12.36786 *** (2.115712)
Change in Income Inequality	-19.04124 *** (3.363582)	-21.29796 *** (5.498915)	-20.59744 *** (5.864693)	-22.09808 ** (8.088823)	-8.878777 (5.541348)	-14.1124 ** (4.741718)
Change in Unemployment	-77.41545 *** (8.16112)	-30.86419 ** (11.47876)	-6.891698 (11.63394)	5.557316 (16.90991)	-239.7114 *** (60.40745)	-104.8391 *** (24.74773)
Change in Percentage Public Administration and Security Spending to GDP	-19.70773 * (8.910512)	-31.17121 ** (11.0579)	-13.65284 (15.41806)	-21.21959 (17.90953)	46.6853 *** (12.90563)	10.41082 (15.228)
<u>Demographic Variables</u>						
Change in Average Years of education	15.3642 (15.51403)	67.93849 ** (21.40596)	-21.37251 (20.956)	69.31209 * (28.97777)	.9370834 (24.74999)	2.26712 (21.64652)
Change in Percentage of Population working in Israel	-110.3865 (62.50284)	-239.6573 ** (76.91459)	-1823365 (94.63075)	-279.2598 * (119.3175)	-454.2561 *** (107.0775)	-165.4452 (92.63959)
Change in Percentage of Population in Refugee Camps	-25.53366 * (10.95918)	-37.04989 ** (13.94733)	23.58676 (15.37883)	.78689 (18.48046)	10.43435 (15.7496)	4.107801 (14.8935)
<u>Security Variables</u>						
Number of Palestinians Fatally Injured by IDF	.0048766 *** (.0014534)	.0066319 *** (.0016937)	.0041292 * (.0017319)	.0042245 * (.002036)	.0015099 (.0020408)	.0025733 (.0016168)
Change in number of Palestinians in Israeli Administrative Detention	.0006852 * (.0003126)	.0003458 (.0004843)	.0006068 (.0005237)	-.0001237 (.0006392)	-.000842 (.0006764)	-.0014356 * (.0007178)
R-squared	.150	.072	.063	.065		
Observations	2103	2103	2103	2103	2103	2103

* denotes $p < 0.1$, ** denotes $p < 0.05$, *** denotes $p < 0.001$