The United States' Drone Program:

Analyzing its Effectiveness Through the Lens of Rational Expectations

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Introduction

The United States military, in conjunction with the Central Intelligence Agency (CIA), has drastically expanded its drone program as a key component of its counterterrorism strategy in the Middle East over the past decade.

The program has since been a topic of heated debate in the U.S. and around the world, as concerns have arisen over the program's affects, unintended consequences, and morality. The U.S. government defends its drone program as a relatively cheap alternative to other military operations that does not place American military personnel in harms way, while still being effective at damaging the infrastructure and capabilities of terrorist organizations in the region. Others, however, are not convinced that drone strike operations are as successful at degrading the capabilities of well-established organizations such as al-Qaeda, ISIS and others, arguing that the U.S. government has not been honest regarding the program's effectiveness, leaving them to question whether the program is as successful as the government has led the public to believe (Becker and Shane, 2012). Although scholars and analysts have debated the topic for years now, a consensus over the effectiveness of the U.S.' drone program is far from being reached.

This paper seeks to contribute to previous literature that analyzes the effects of the United States' drone program on terrorist organizations, with the goal of gaining a better understanding of the effectiveness of the U.S.'s counterterrorism strategy as a whole. My review of the existing literature characterizes terrorists as being rational actors, discusses the findings of recent studies that examine the effects of drone strikes, and outlines the theories that these studies have frequently employed to explain these impacts. I adopt Brophy-Baermann and Conybeare's theory of rational expectations and hypothesize that the effects of drone strikes on terrorist organizations' operational output will diminish over time as terrorists become more resilient to such strikes by utilizing their rational expectations. As a measure of 'operational output', my dependent variable is the amount of time between terrorist attacks; my independent variables are (1) the running sum of drone strikes conducted against an organization, and (2) whether or not a strike is the first strike ever conducted against an organization. I utilize a Cox model that measures the relationship between drone strikes and the time until failure (the time between terrorist attacks), but does not include assumptions about the underlying hazard rates of an event. I find no statistically significant relationship between my dependent variable and both of my independent variables; these results did not provide support for either of my hypotheses. Nonetheless, I conclude that future studies that employ the rational expectations theory and consult more thorough, reliable, and consistent data sources have the potential to yield significant and meaningful results.

Literature Review

Terrorists as Rational Actors

It is first necessary to understand as a basis of this analysis that terrorist organizations and their leaders are inherently rational actors (Enders and Sandler, 2011; Sandler, Tschirhart, and Cauley, 1983; Brophy-Baermann and Conybeare, 1994). Sandler, Tschirhart, and Cauley clarify that the goals of a terrorist organization do not determine rationality; instead, the ways in which a group pursues these goals in the face of constraints (most notably characterized by limited resources, such as time and money) indicates rationality. They conclude that terrorists ought to

be considered rational "when they efficiently utilize scarce resources to achieve their respective goals and effectively respond to changes in their constraints."

Previous works that study the ways in which drone strikes effect terrorist organizations have overwhelmingly neglected to *explicitly* take into consideration the idea that terrorists are rational actors and therefore respond to drone strikes in a rational manner. The dominant explanatory theories in the current literature vary greatly in how they attempt to explain how terrorist behavior might account for a positive relationship between drone strikes and an increase in terrorist attacks, but they are all connected in one critical way—no matter how this relationship is explained, each theory suggests (albeit indirectly) that terrorists' actions in the wake of drone strikes are usually taken in a manner that promotes the well-being and strength of the organization, signaling an underlying understanding that terrorists behave in a rational manner and are rational actors.

Additionally, the rational-actor theory can explain the relative secrecy of terrorists, which has made it difficult to study terrorist behavior. As rational actors, terrorists follow logical processes and make choices based upon political and strategic considerations (Crenshaw, 1998). They are therefore inherently private regarding their internal operations; they do not tend to release information, such as their recruitment numbers, to the press or public (White, 2013). Doing so would allow a group's enemies to gain a much deeper understanding of its internal processes and organization, thereby greatly aiding counterterrorism efforts that would directly undermine the terrorist group's success. It is likely for this same reason that much of the United States military's counterterrorism operations are classified and held out of the public view. Due to this level of secrecy it is extraordinarily difficult to obtain reliable information regarding their internal processes, resulting in a relatively narrow field of potential ways to measure the impact of drone strikes on these organizations.

Explanatory Theories

Although the existing literature does not form an absolute consensus, a substantial portion of findings to this point indicate either a weak or nonexistent causal relationship between drone strikes and a decrease in the targeted organization's operational output, regardless of how such output is measured. Boyle concluded that drone strikes "have negative consequences sufficient to offset the administration's strongest arguments in their favor." Others contend that drone strikes exacerbate social volatility and that the 'collateral damage' that they cause almost inevitably fuels instability and escalates violent retaliation against convenient targets (Hudson, Owens, and Flannes, 2011). Plaw and Fricker caution against a rapid expansion of the U.S.' drone program, arguing that strikes targeting low-level Taliban increase resentment and hostility towards the U.S. in Pakistan and are likely to provoke retaliations against the U.S. Smith and Walsh's analysis found that drone strikes are entirely ineffective at degrading al-Qaeda's ability to generate propaganda. Some studies that analyze the impacts of leadership decapitations—which include a sizable portion of U.S.-conducted drone strikes—find that decapitations have "counterproductive consequences" that may actually embolden or strengthen the targeted organization and that decapitations do not increase the likelihood of organizational collapse (Lyall, 2014; Jordan, 2014; Jordan, 2009).

It should be noted that others have found drone strikes to be effective. Johnston and Sarbahi find that drone strikes are associated with short-term decreases in the incidence and lethality of terrorist attacks, although they did not find evidence that this association persisted long-term. Other studies on leadership decapitations have found that they significantly increase

the morality rate of terrorist groups, arguing that terrorist groups are susceptible to decapitations because their unique organizational characteristics amplify the importance of leaders and make leadership succession more difficult (Price, 2012). Zenko notes that although drones have major drawbacks, they have allowed the U.S. to decimate al-Qaeda's leadership and disrupt the activities of many other militant groups.

Those whose findings suggest the U.S.' drone program to be ineffective or counterproductive have presented various theories that attempt to explain why this may be the case. Many believe that drone strikes—especially those that target lower level, localized fighters—lead to a "blowback effect", which ultimately aids the recruitment efforts of terrorist groups (Boyle, 2014; Cronin, 2009; Smith and Walsh, 2013; NYU/Stanford, 2013; Plaw and Fricker, 2012). When groups like al-Qaeda are targeted by drone strikes, they often propagandize them by broadcasting footage of such strikes to local civilian populations, which "portray[s] them as [acts of] indiscriminate violence against Muslims" and attempt to "frame Americans as immoral bullies who care less about ordinary people than al Qaeda does" (Cronin, 2009). Consequently, the theory goes, enraged civilians—especially those who's family members or friends were killed in recent strikes—are much more likely to support, or even join the ranks of, terrorist organizations in their area. As a result, many scholars argue that drone strikes assist terrorist groups in recruiting and provide them with additional financial backing, resources, and public approval that they need to continue operating effectively (Smith and Walsh, 2013; Cronin, 2009; NYU/Stanford, 2013).

These impacts are compounded when strikes result in 'collateral damage,' or the killing of civilians, which quickly causes public distrust and hostility towards the U.S.; there is sufficient evidence suggesting that the resulting public outrage is not confined to the regions in which these strikes take place as they are extensively covered by the news media in countries such as Pakistan, causing populations to believe that drone strikes have caused even more civilian casualties than is actually the case (Kilcullen and Exum, 2009). In an article reporting on the public backlash in Pakistan that occurred after a strike in January 2006, *The New York Times* described "rallies and demonstrations in the tribal areas and Pakistan's cities" by civilians who were "protesting the high number of casualties and the perceived American involvement"; the protestors persisted *despite* the Pakistani government's (probably untrue) announcement that *it* had conducted the strike, *not* the United States—an example that gives credence to accusations that drone strikes fuel animosity, resentment, and overall anti-American sentiments among local populations (Gall and Khan, 2006). Taking into consideration that at least 370 civilians—a highly *conservative* estimate—have been killed by drone strikes in Pakistan, Somalia, and Yemen to date, the geographical extent of these sentiments among the impacted countries' populations is likely widespread (New America Foundation), all of which provides further rationale for the "blowback effect" theory.

In his analysis on whether airstrikes are an effective tool against insurgent organizations, Lyall offers a different explanatory theory after finding that airstrikes actually lead to an increase in insurgent attacks for at least 90 days after a strike occurs. Additionally, among his findings was a positive association between drone strikes and an increased amount of insurgent attacks, albeit a substantially smaller increase in insurgent attacks as compared to non-drone airstrikes. Lyall's theory that insurgent groups' "reputational concerns" drive these spikes in attacks in the wake of an airstrike is also used to explain increased terrorist activity in the wake of drone strikes. Insurgent groups feel the need to demonstrate their resolve to the local populations that they control or wish to control, and are willing to engage in more costly actions to do so when

necessary. When airstrikes are conducted against these insurgent groups, civilian populations may begin to question the power, prestige, or capabilities of the insurgent group that controls their community. In these instances, insurgents are incentivized to reassert their authority and dominance by ramping up violent attacks in order to demonstrate that they still retain the ability to punish anyone who may consider defecting or discontinuing their support for the group. By increasing attacks, then, insurgent organizations can "blunt the counterinsurgent's efforts to drive a wedge between rebels and locals" by preventing whispers among locals that the insurgents' "control is slipping away" (Lyall, 2014).

Another theory—that of "purposeful retaliation"—attributes increased terrorist attacks in the wake of drone strikes to the idea that drone strikes, especially those that target and kill top terrorist leaders, provide motivation for retaliation, which usually come in the form of attacks (Hudson, Owens, and Flannes, 2011). When an organization's top leader is killed, his death becomes a rallying cry for the rest of the group and rejuvenates the resolve of its members to continue to carry out attacks against the United States and its allies. Hundreds of the group's members almost immediately make it their mission to avenge their great leader's death at all costs. For example, consider the Khost bombing in December of 2009 wherein an al-Qaeda sympathizer, Mulal al-Balawi, infiltrated a CIA compound in Camp Chapman, located near Khost, Afghanistan, and proceeded to detonate a bomb that killed, among others, 7 CIA officers. A video that surfaced after the attack featured al-Balawi, who exclaims that the attack was conducted in retaliation for the U.S.' drone strike that had killed Baitullah Mehsud, the leader of the TTP, in August of that year (Warrick, 2011). The theory also applies to lower-profile retaliations conducted in response to strikes that kill low-level militants and civilians, which are much more common (Plaw and Fricker, 2012).

The theory of 'rational expectations,' which Brophy-Baermann and Conybeare utilize in their study of the relationship between Israel retaliations and their impact on terrorist attacks conducted in the region from 1968 to 1989, has been almost entirely ignored in the current literature as a potential explanation for the positive relationship between drone strikes and an increase in terrorist attacks. The theory relies mainly on the premise that terrorists are rational actors that utilize their rational expectations to anticipate drone strikes and circumvent their negative impacts.

Theory and Hypotheses

Theory

The literature includes independent variable variation—most works either analyze the impacts of leadership decapitations or seek to determine the effects of the U.S. drone program as a whole. Inquiries into the impacts of these 'leadership decapitations' have gained popularity in recent years. Estimates that upwards of 50 senior al-Qaeda and Taliban leaders have been eradicated via drone strike contribute to the suggestion of a substantial relationship between drone strikes and leadership decapitations (Boyle, 2014). As a whole, the literature deems leadership decapitations to be relatively effective—many have suggested that leadership decapitations may inhibit the operational capabilities of terrorist organizations by taking out the group's most highly skilled members, forcing the group to diminish its resources in order to take extra precautions to keep its leaders safe, and disrupting the group's hierarchy, operational routine, and organizational continuity (Price, 2012; Zenko, 2013).

Nonetheless, a critical distinction separates leadership decapitations from drone strikes. Important to recognize in this context is that although leadership decapitations are often executed via drone strike, the U.S. military commonly conducts other types of military operations to perform decapitations as well—for example, recall SEAL Team Six's May 2, 2011 *raid* on a compound in Abbottabad, Pakistan, that was successful in killing Osama bin Laden, former al-Qaeda head (Jordan, 2014). To that end, noteworthy is the fact that *not all* U.S.-conducted drone strikes are leadership decapitations. In order to thoroughly and completely examine the effects of the U.S.' drone program on the operational capabilities of terrorist organizations, *all* drone strikes, whether they target leaders or not, must be subject to analysis. As Boyle mentions, the impacts of drone strikes "extend beyond a tally of leaders removed from the battlefield" and ought not solely be scrutinized based upon whether they "eliminate bad guys." To explore the level of success of leadership decapitations is undoubtedly a worthwhile endeavor, but doing so does not fully portray the effects of U.S. drone strikes and would lead to an incomplete analysis in this context. It is therefore necessary to analyze *all* drone strikes so that their effects can be better understood.

Drone strikes may very well be initially effective, but this does not mean that they will continue to be effective as the U.S. continues its drone strike program. The U.S. military tends to presuppose that terrorists' reactions and responses to strikes will remain stagnant over time, failing to take into account the how the organizations' reactions and responses to the strikes might *change* as drone strikes become a more central component to U.S. counterterrorism efforts (Hayden, 2015). The previous literature's indication that drone strikes do not impede the operations of terrorist organizations runs counter to expectations of a stagnant and consistent response and subsequently raises a number of legitimate concerns. How is it that such a critical component of the United States' counterterrorism strategy might be largely unsuccessful in accomplishing its goals? What factors are contributing to the resilience of the terrorist groups that drone strikes target? What are the terrorists doing that has allowed them to undermine the efforts of the world's most powerful military and technologically sophisticated intelligence community?

Brophy-Baermann and Conybeare's theory of "rational expectations" may be useful in answering these lingering questions in a manner that takes into account an important consideration that has entirely been left out in the current literature: that terrorist organizations are rational actors. Their 1994 study analyzed how Israeli 'retaliations' (coming in the form of some sort of attack or strike) against adversarial Lebanese terrorist organizations impacted these organizations' natural rate of terrorist attacks from 1968 to 1989. Their data yield three major findings: first, the data was consistent with the existence of a natural rate of terrorist attacks under rational expectations; second, unexpectedly large retaliations were necessary in order to cause a terrorist organization's natural rate of attacks to deviate; and third, even when disruptions to a terrorist organization's natural rate of attack do occur, they are of temporary nature and do not persist long term. Further, their findings indicated that the natural rate of terrorist attacks on Israel was only disrupted by the first major Israeli retaliation. In other words, only the most severe and unexpected Israeli retaliations actually caused the natural rate of terrorist attacks to decrease—and even when this deviation did occur, it was only temporary.

Brophy-Baermann and Conybeare conclude that Lebanese terrorists—as rational actors—have rational expectations that enabled them to withstand Israeli retaliation attacks against their organizations and assisted them in consistently maintaining, with few exceptions, the natural rate of terrorist attacks that they conduct in the wake of Israeli retaliations. They determine that due

to the terrorists' utilization of such rational expectations, Israeli retaliations were largely ineffective at deterring future terrorist attacks, and the only way to cause substantial deviations in their natural rate of attacks is to surprise them with "an unexpected rate of retaliation."

The applicability of Brophy-Baermann and Conybeare's findings in this discussion is obviously limited. Their analysis describes only the relationship between Israeli retaliations and Lebanese terrorist attacks and their data and is sorely outdated. However, a strong case can be made that applying the theory of rational expectations will substantially contribute to research that seeks to determine the ways in which modern terrorist groups in Pakistan, Somalia, and Yemen are impacted by U.S.-conducted drone strikes. My analysis will take this approach.

I theorize that the effects that drone strikes have on terrorist organizations' operational output will diminish over time as terrorists become more resilient to such strikes by utilizing their rational expectations. I argue that these rational expectations enable terrorist groups to minimize the strikes' adverse effects on the groups' operational output because they become better able to anticipate and prepare for future strikes, as they grow accustomed to the timing, targets, and frequency of the strikes. Furthermore, these rational expectations equip terrorist leaders with the understanding that they will almost undoubtedly be the targets of such strikes at one point or another, which gives them time to pick and train a successor who can easily transition into a leadership role in the event that their leader is killed and can continue normal operations with little to no interruption. More generally, terrorists use their rational expectations to prepare operational strategies that will best allow them to undermine or circumvent the impacts of, and even take advantage of, future drone strikes.

My anticipation that the effects of drone strikes will diminish over time is of vital importance. Among its implications is that the very first strike that is conducted against a terrorist group will have the strongest adverse impact on the group's operational capabilities. Further, I anticipate that each additional strike will have less of an adverse effect on the terrorist group's operational output than the one before it did, and that eventually these effects will diminish altogether as terrorists learn how to minimize the strikes' impacts. Moreover, I believe there to be a strong possibility that once the total number of strikes against an organization reaches a certain threshold, each additional strike may increase the group's operational output.

It is necessary now to define 'operational output' in a measurable manner that can yield a usable dependent variable for my analysis. The current literature has employed a variety of dependent variables to determine the ways in which drone strikes impact the terrorist organizations they target; such variation is undoubtedly justifiable considering that there are a number of potential ways that drone strikes' impact on terrorist organizations can be assessed. Smith and Walsh took a unique approach by analyzing the drone campaign's effects on al-Qaeda's *propaganda output* in Pakistan, noting the strong emphasis that the organization has placed on the regular production and dissemination of propaganda as a key component of its strategy to promote its recruitment efforts, long-term success, and longevity. Johnston and Sarbahi seek to determine whether drone strikes cause changes in the *incidence and lethality of terrorist attacks* and the targeting of tribal elders conducted by organizations in Pakistan. They justify their approach by emphasizing the fact that terrorist attacks are "more widely recorded and reported" as compared to other operational measures such as recruitment efforts (Johnston and Sarbahi, 2015). It was with this key consideration—the relative visibility of terrorist attacks compared to other measures of operational output—in mind that I subscribe to Johnston and Sarbahi's definition of 'operational output' and have resolved to measure operational output in

terms of terrorist attacks. This measure will adequately fit into my theory and will yield more substantive results considering the wealth of information currently available on terrorist attacks.

Hypotheses

My first hypothesis is that as the number of drone strikes that the U.S. military conducts against terrorist organizations increases, the number of days between the groups' terrorist attacks will decrease. Put plainly, as the number of drone strikes increases, their deterrent effect is expected to decrease.

Additionally, I hypothesize that the first drone strike against an organization will have the greatest deterrent effect, which will be observed by the longest amount of time passing between the first strike and the impacted group's next terrorist attack, as compared to each of the following strikes.

Data and Methodology

Data

In order to analyze the effects that drone strikes have on terrorist organizations' operational output, and how these effects change as the number of strikes increases, I compiled a spreadsheet that included every day of every month of every year from 2004 to 2015 for each of the 9 terrorist groups—al-Qaeda in Somalia, al-Shabaab, al-Qaeda in Yemen, Ansar al-Sharia, al-Qaeda in the Arabian Peninsula (AQAP), Islamic Movement of Uzbekistan (IMU), Haqqani Network, Taliban (which includes strikes against the TTP), and al-Qaeda in Pakistan—that were targeted by drone strikes occurring in Pakistan, Yemen, and Somalia during that time period. As a result, 39,448 observations (or days) were included in my analysis.

I utilized New America Foundation's International Security Data Site to gather information regarding the organization targeted, date, location, country, target type, and number of militants/civilians/total killed for each drone strike that the U.S. conducted within this time frame. New America Foundation's drone data is a compilation of information on drone strikes gathered from credible news reports. Individual entries are made for each strike and as much information as is available on each strike is provided. Along with such information, I kept a running total of the sum of drone strikes conducted against each organization and the number of days between each drone strike.

I then exported data for my DV directly from the Global Terrorism Database (GTD), which provides a comprehensive list of terrorist attacks conducted by every terrorist group to ever exist. I limited collection of such data to attacks conducted by the 9 groups listed above. The data were imported into STATA and coded so as to be ready for analysis. Each terrorist group was assigned a number and the various target types—which initially included gatherings, funerals, houses, buildings, businesses, compounds, training camps, madrassas, vehicles, motorcycles, and militant compounds—were clustered so as to be considered either a building or not. The New America Foundation's data provided a minimum and maximum range for their numbers of militants killed, so in an effort to avoid overstating drones' impacts, only the *minimum* number of militants killed was kept and included in the tests. In instances that the group that a strike targeted was deemed to be 'unclear' in the New America Foundation data, those strikes were entirely omitted from the analysis, which drastically decreased the number of strikes observed. Any strikes that targeted Baitullah Mehsud ("BM"), Hakimullah Mehsud, or

Maulvi Nazir were interpreted to be strikes against the TTP and were inputted as strikes against the Taliban in Pakistan.

The data was examined according to a unit of analysis consisting of group, country, and day. Considering that my model compares the amount of time between terrorist attacks (or until failure), a daily analysis will yield more precise results than would an analysis based on months or years.

Dependent Variable

My dependent variable (DV) is the number of days between terrorist attacks conducted by each group from the years of 2004-2015, which is being utilized as a measure of operational output. I have chosen this particular measure for 3 reasons: (1) terrorist attacks represent an external measure of terrorist group operations that is relatively well-recorded as compared to other measures; (2) by measuring the number of *days* between each attack, my model will be much more effective at taking timing into account and will be more precise in determining the direct relationship between drone strikes and the incidence of terrorist attacks; (3) executing terror attacks is one of the top priorities of most terrorist organizations—if strikes are indeed effective at degrading these groups, their adversarial effects should be directly indicated by an increase in the number of days between attacks that the targeted group conducts.

Data on my dependent variable was obtained from the Global Terrorism Database (GTD), which is published and updated by the National Consortium for the Study of Terrorism and Responses to Terrorism (START) in conjunction with the University of Maryland. The GTD is "an open source database including information on terrorist events around the world from 1970 through 2014," which includes more than 140,000 cases that are based on credible reports from a variety of open media sources (START 2014). It is currently the most comprehensive unclassified database on terrorist events in the world. The GTD's defines a terrorist attack as "the threatened or actual use of illegal force and violence by a non-state actor to attain a political, economic, religious, or social goal through fear, coercion, or intimidation," and in order for an incident to be included in the GTD, each of the following characteristics must be present: the incident must be intentional, the incident must entail some level of violence or immediate threat of violence, and the perpetrators of the incidents must be sub-national actors (START 2015). As a result, it is very likely that every attack that has been conducted by each of the 9 religious terrorist organizations under analysis has been included in the GTD database and thus, in my analysis.

Independent Variables

Consequently, I have developed 2 interrelated independent variables for my analysis. My first IV is the total number of drone strikes that have been conducted against an organization, which begins at one and increases over time. The primary reason for my utilization of this measure is the fact that it will allow me to take into account how the effects of drone strikes change as the sum of drone strikes increase, which will serve to directly answer my hypothesis.

My second IV is a dichotomous variable, which asks simply if the strike under consideration is the first strike that was ever conducted against that particular terrorist group. If the answer is yes, the variable is coded as "1", and if the answer is no, the variable is coded as "0". If my second hypothesis is correct, the first strike against a group will have the strongest effect. The presence of this dichotomous variable will enable the impact of the first strike, as compared to all subsequent strikes, to be directly assessed. Data for both of my IVs was collected

from New America Foundation's International Security Data Site. A description of that database and the information it contains was discussed in the *Data* subsection of the "Data and Methodology" component of this paper.

Control Variables

I control for 2 outside, but potentially influential, variables in my analysis. First, I take into account the number of militants killed in each drone strike. A strike that kills a large number of militants is likely to be at least marginally more effective than a strike that kills none. When a large number of a group's militants are killed at once, the group loses that many people who otherwise would have been available to conduct attacks or perform other organizational tasks. Controlling for the number of militants killed in each strike will ensure that this consideration is not ignored in my analysis.

I also control for the type of target of each drone strike. I clustered a variety of target types into being either one of two things: a building or not a building. I did so under the acknowledgement that a strike that targets a small house may have very different effects than a strike that targets a funeral, where dozens of militants and sympathizers might potentially be gathered to mourn the loss of a prominent terrorist leader. These controls take into account the more tangible impacts of drone strikes that may contribute to the strikes' overall level of effectiveness, which are necessary to include due to the fact that my DV measures the psychological impacts of strikes that change group behavior but does not measure any physical impacts that may affect group behavior as well.

Method of Analysis

My analysis was conducted using a Cox proportional hazards model, which is a type of hazard model (also referred to as an event history model or survival analysis). A hazard model is particularly useful in this context due to the fact that it measures the "time until failure", or the amount of time (in days) between terrorist attacks, which will enable me to observe the direct, short-term impacts of drone strikes. Further, using a Cox model allows us to estimate the hazard function without having to specify the distributional form (Box-Steffensmeier and Jones, 2004). In my analysis, I cluster standard errors on terrorist organizations as compared to clustering them on countries. Utilizing a Cox model in this study is critically important because it does not make assumptions about the underlying hazard rate of an event. An example of when these assumptions can properly be made is when we know that someone who has a terminal illness will die from that illness; the hazard rate of a terminal illness, then, can be anticipated because we know for a fact that the person is going to die. However, in this context, there is not the same certainty about terrorist attacks. Considering that my dependent variable is the number of days in between terrorist attacks, and that I do not have any basis of certainty that a group will conduct another attack (nor do I have a basis of certainty that would enable us to predict when attacks might occur in the future), assumptions about this hazard rate must be left out of this analysis, and the Cox proportional hazards model allows me to do so.

Results and Analysis

[Table 1 Here]

Table 1 presents the results of my analysis. Included in Table 1 are the following variables: running sum of drone strikes, whether the strike is the first drone strike, minimum number of militants killed, and the target type. The coefficients are the hazard ratios. The data presented in Table 1 shows no significant relationships between any of the variables and the amount of time between terrorist attacks. Noteworthy is that the Hazard Ratio can be interpreted by using 1.0 as a baseline; any number over the baseline represents a percentage *increase* in the time between terrorist attacks with each additional drone strike, whereas any number under the baseline represents a percentage *decrease* in the time between terrorist attacks with each additional drone strike.

The results of my study indicate that drone strikes have no effect on the time between terrorist attacks. My findings indicate that as the number of strikes against a terrorist group increases over time, there is a minute and negligible reduction in the time between attacks, indicating no causal relationship. In terms of analyzing the variable's hazard ratio, if the relationship were significant it would show a .02% decrease in the time between attacks for each additional strike. However, since no such significance is present, the hazard ratio cannot be interpreted as indicating any sort of result. As such, I fail to find support for my first hypothesis.

The first strike conducted against an organization also had no statistically significant impact as compared to subsequent strikes. However, if the relationship were significant, the Hazard Ratio would indicate that the first strike against an organization increases the time between attacks by 69% as compared to each additional strike. As mentioned previously, the relationship's statistical insignificance discredits such interpretations of the Hazard Ratio. Consequently, I also fail to find support for my second hypothesis. Additionally, the data suggests that the number of militants killed in drone strikes had no effect on the time between terrorist attacks and that the type of target struck by a drone also had no statistically significant impact.

Although the results do not provide support my first hypothesis, the fact that drone strikes do not increase the time between attacks may actually provide support for the notion that they do not have a deterrent effect. Even though the results do not indicate that the effect of drone strikes *diminished* with each additional strike, they show that strikes have no effect on the time between terrorist attacks at all, no matter how many strikes had been conducted against the organizations in question. My first hypothesis did not directly predict these results, but it does assume that drone strikes will *eventually* become entirely ineffective.

It is critical to interpret these results with consideration to the major quality issues that plague the data sources that I utilized. The Security Data on drone strikes in Pakistan, Yemen, and Somalia included a disproportionately large number of strike entries wherein the targeted group was "unclear", which resulted in the omission of a substantial portion of drone data, since these strikes could not be definitively attributed to targeting a specific terrorist organization. Various additional inconsistencies were widely prevalent in the Security Data. News reports that contributed to the information in many drone strike entries often contradicted each other on the organization targeted, the number of militants and civilians killed, and even the location of where the strikes occurred.

Of course, it may very well be the case that my study did not employ the proper dependent variable to yield significant results. As discussed previously, a number of dependent variables could have been utilized in this context to measure drone strikes' effects on a terrorist organization's operational output, including: monthly recruitment numbers, propaganda output, the incidence and lethality of terrorist attacks, and the group's control of territory. Each of these

measures is promising, but the relative difficulty in obtaining the sorts of data necessary to quantify these potential variables makes studying them an uphill battle for even the most zealous political scientists. Studies that utilize data on any of these alternate DVs, but test them through a Cox model and employ the theory of rational expectations, may yield particularly intriguing results.

It is true that the results in Table 1 do not support the rational expectations theory, but this is not to say that the theory is entirely no longer applicable to future works. There remains a possibility that this theory can explain other terrorist behaviors in the wake of drone strikes that were not accounted for in my analysis, specifically the potential measures of operational output listed above. Moreover, it may very well end up being the case that the rational expectations theory ultimately proves to be ineffective at explaining the impact of drone strikes on terrorist organizations. Nonetheless, there is good reason for future work to employ the rational expectations theory considering the current literature's failure to entertain it altogether.

Conclusion

This paper embraces the rational expectations theory as a way to explain terrorist group behavior in the wake of U.S.-conducted drone strikes on organizations in Pakistan, Yemen, and Somalia. My hypotheses that the effects of drone strikes on terrorist organizations' operational output will decrease with each additional strike, and that the first strike against a terrorist group will have the greatest deterrent effect compared to subsequent strikes, were not supported by my findings. The lack of statistically significant relationships present in my results indicates the severe limitations that my data sources, particularly the Security Data, placed on my findings. Further research should seek to utilize stronger datasets that are more comprehensive, consistent, and thorough, which may implicate the adoption of an alternative dependent variable, which may be necessary to produce stronger and more conclusive results in the future.

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Table 1: Drone Strikes' Effect on Time Between Terrorist Attacks

	Time Between Terrorist Attacks (Time Until Failure)
Running Drone Strike Sum	.986 (.011)
First Drone Strike	1.69 (1.29)
Militants Killed (Minimum)	1.03 (.034)
Target Type (Building—y/n)	.625 (.251)
N	19326
Wald χ^2	20.27

Note: Hazard Ratios with robust standard errors clustered on group in parentheses. * Significant at .10, ** Significant at .05, *** Significant at .01