Methods in the Madness:
Modeling Tactics of Violence in Insurgencies and Rebellions

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Researchers interested in replicating findings should contact the authors for access to the necessary platform, templates, and protocols. Published documentation and theoretical footnoting for the models appearing in this paper are available at www.lustickconsulting.com.
Abstract

What role do different forms of violence play in shaping insurgencies and counterinsurgencies? Traditional political science research has recognized the potential political consequences of violence, particularly when it comes to strategic bombing and nuclear weapons. It has also been recognized that among insurgencies there are “repertoires of violence,” which structure the tactics that can be deployed. Unlike the city-destroying capabilities of major powers, however, there has been little investigation into what political effects, if any, accrue from these small-scale choices of how insurgencies and counterinsurgencies choose to implement acts of violence. This paper will draw on our own previous work studying Improvised Explosive Devices (IEDs) for the Office of Naval Research “Sciences Addressing Asymmetric Explosive Threats” program in order to use agent-based modeling (ABM) to explore tactics as options within a repertoire of violence with possible political consequences. By drawing on a rich vein of government reports and media accounts surrounding the development and use of IEDs by insurgent groups around the world, we identify and describe a set of theoretical parameters that inform both a group’s decision and ability to deploy IEDs or any other specific tactic, including infantry engagement, mechanized forces, bombings, or airstrikes. Our findings suggest that although tactics can sometimes play an interesting role in the political dynamics of insurgency, it is more likely that these effects are outweighed by larger political circumstances.

Introduction

Use of specific tactics has been largely ignored by political science, in part because they are often assumed to be chosen primarily based on military effectiveness. However, there may be important political or psychological components to the use of particular tactics—a possibility that has not been well-studied. To start, there are many examples of strategies that go well beyond guiding tactical decisions to maximum military effectiveness in order to allow an additional psychological or political impact. A well-known example is Rapid Dominance, used in the 2003 invasion of Iraq and popularized in the public mind as “Shock and Awe”. To quote the originating document, "Rapid Dominance is aimed at influencing the will, perception, and understanding of an adversary rather than simply destroying military capability, this focus must cause us to consider the broadest spectrum of behavior, ours and theirs, and across all aspects of war including intelligence, training, education, doctrine, industrial capacity, and how we organize and manage defense" (Ullman, 1996). In addition, the advantage of nuclear weapons over conventional tactics has also been described as going beyond military effectiveness into the psychological effects, in that the most fearsome examples are impractical for winning any particular battle, but can easily threaten cities, populations, and governments directly. With the Cold War over, perhaps the most useful modern example is terrorism against civilians, where the goal is to produce psychological and policy reactions and overreactions from a more
powerful adversary that play into the terrorists' goals and narrative. This last example also brings the question of political goals to the level of tactical, rather than strategic, violence.¹

Beyond the direct psychological effects of a particular tactic, however, there may be less obvious political effects that are caused by the distribution of available tactics in a battlespace leading to the uneven adoption or use of particular tactics. In asymmetric conflicts tactical operations, rationally intended to demonstrate will at the strategic level, may appear irrational at the tactical level. Combatants might not even be aware of the political rationales behind their use of a particular tactic. For example, Michael Horowitz describes the diffusion of suicide tactics between groups over time as being shaped by non-rational structural factors such as identities and networks. Horowitz tells the story of overall adoption patterns being influenced by linkage patterns between groups as well as their own organizational capacity. In other words, “sometimes desire is not enough to adopt an innovation” (Horowitz, 2010). Elisabeth Wood also considers the mechanisms that lead to variation in tactic use, specifically the use of sexual violence during wartime. “[A]ddressing the puzzle of variation in sexual violence requires three levels of analysis, that of the armed group (an insurgent group or a national military), the small unit in which combatants have face-to-face relations, and the individual” (Wood, 2006). To put this another way, the interaction between levels of analysis can create incentives that lead to apparently non-rational tactic choices. So existing literature tells us that patterns of tactic use need to be understood at multiple levels of analysis, and in relation to both internal and external group characteristics.

There are likely many other understudied examples of this kind of phenomenon, but one in particular struck us as important given our research into Syria and Iraq. After continuous coalition airstrikes against ISIS for the past two years, some observers are wondering about their efficacy to actually “degrade and ultimately destroy” the group (Hudson, 2014). But perhaps this tactic is not used because of its expected military effectiveness, but rather due to militarily extraneous factors. Robert Pape provides his own theory of the use of US air power for decapitating the adversary’s network: “Decapitating the enemy has a seductive logic. It exploits the United States' advantage in precision air power; it promises to win wars in just days, with few casualties among friendly forces and enemy civilians; and it delays committing large numbers of ground troops until they can be welcomed as liberators rather than as conquerors. But decapitation strategies have never been effective, and the advent of precision air weaponry has not made them any more so” (Pape, 2004). From this perspective, US interest in adversary use of IED or other tactics might be best served by considering the organizational and political functions they serve.

The original motivation for understanding the role of tactics in insurgencies came from work investigating improvised explosive devices (IEDs) for the Department of Defense. During military operations in Iraq and Afghanistan, IEDs became the single most deadly weapon used by insurgents against the U.S. military and allies. IEDs have accounted for at least half of the

¹ Pape (2003) argues that suicide bombing has a ‘strategic logic’ and consequent successes that have driven greater adoption of the tactic.
American casualties in the conflicts (Krepinevich & Wood, 2007) – roughly 3,800 dead and 33,000 wounded between 2003 and the end of 2013 (Zoroya, 2013). In response, the U.S. Department of Defense has poured billions of dollars into countering the threat. According to one estimate, the Pentagon has spent roughly $75 billion on vehicles and equipment designed to counter IEDs during the length of the Iraq and Afghanistan conflicts (Zoroya, 2013). The focus of the vast majority of this spending to counter IEDs has been on narrow technical approaches to counter the problem. For example, new armored vehicles to protect soldiers from blasts or high-tech devices to hunt IEDs made up the lion’s share of funding – 22,000 Mine-Resistant Ambush-Protected vehicles (MRAPs) alone cost $36 billion (Carey & Yossef, 2011).

Some of that funding for our previous work came to us via the Office of Naval Research “Sciences Addressing Asymmetric Explosive Threats” program and helped to fund Lustick Consulting’s Virtual Strategic Forecasting and Analysis Tool (V-SAFT) project. We felt that the emphasis on detecting IEDs in place or directly protecting soldiers, while understandable, ignores the political implications of the use of IEDs within the context of complex insurgencies. We concur with the critique introduced by McFate and others that more attention needs to be directed to the “bomber” not “the bomb” and to the left of “boom,” rather than to its right (McFate, 2005). Indeed our focus became, not the bomber, per se, but the character of the network of people, resources, and expertise that produced both bombers and bombs. For it is ultimately the evolutionary imagination this network naturally displays in the face of serial countermeasures that results in the particular difficulty posed by IEDs as an insurgent tactic. If the problem is not merely a technical one solved by supplying troops in armored personnel vehicles with devices to automatically find and neutralize deployed IEDs, then combating the threat requires synthesizing and integrating knowledge about people, groups, mobilization frameworks, and emergent processes characteristic of insurgencies.

We operationalized these elements and then deployed them as a module within three agent-based models—a virtualization model of Syria and Iraq (“Syraq”) and two generic models—simulating the kind of state-insurgency relationships that feature the conflictual encounters and tactical choices of interest. Using results from a variety of treatment conditions involving thousands of individual model runs, we explore when and how tactics play a role in shaping insurgencies.

Why agent-based modeling?

In order to predict the circumstances under which adversaries will act in particular ways, we have to move beyond the two prominent approaches to the problem—game theoretic and statistical models. While each can provide insight into the this challenge, neither can capture violent tactics as an element of a complex and adaptive process.

Standard game-theoretic models give valuable insight into abstract situations with which are associated specific responses as rational from the point of view of an individual player (e.g. the prisoner’s dilemma). These situations are created by stipulating categorical, simplified, and
static assumptions. For example, games can only have two real players\(^2\); the utility functions of
the players are fixed a priori and cannot change; player choice is not only be limited, but
completely known by each player; and the payoff schedule must be established a priori and
must also be completely known by each player. While evolutionary game theory adds a
promising level of dynamism through iteration in a game with players following sequential
strategies, the payoff structure and set of available strategies remain static.

As is well known, game theoretic and statistical models make radically different assumptions in
order to accomplish their objectives. Game theoretic models start with theoretical hunches and
then use assumptions about rationality to forecast strategic choices under different conditions of
choice. Statistical models instead start with large data sets containing information on many
dimensions about the phenomenon of interest. These datasets can then serve as test-beds for
predicting particular metrics, for example the number, intensity, effectiveness, and collateral
damage of violent attacks. Essentially, statistical models (including statistical mechanics
models) are based on snapshots of proxies (often averages) for variables expected to be
relevant. The correlations that may be established between a particular set of variables and
outcomes of interest are representations of a static set of relationships. Typically, the variables
are state or structural variables describing “global” attributes of a situation or setting. This wide
focus and this approach’s inability to capture local interactions behind outcomes such as IED
attacks severely limit its potential for discovering signatures for the likely appearance or
prevalence of particular kinds of tactics deployed in complex and dynamic settings.

Similar to game theoretic models, agent-based models are formal representations. Once the
rules constraining agent behavior are stipulated, the model yields outputs that do not vary
depending on decisions or judgments by a human analyst. Similar to statistical models,
agent-based models can incorporate very large numbers of distinct attributes of a complex
situation. Unlike game theoretic models, however, agent-based models can feature very large
numbers of distinctive and simultaneously or serially interacting players. Patterns that arise are
observed and evaluated in relationship to known rules of behavior and initial conditions. In this
respect the logic of discovery supplied by ABM’s is inductive, i.e. similar to that associated with
statistical models. As long as reasonable expectations about individual agent behavior can be
algorithmically described, computer-assisted ABM’s are well-suited to handle complex systems
with evolutionary dynamics. ABM therefore naturally suggests itself as useful for addressing
tactic use within in a complex political terrain. These features of ABM are crucial both for
studying the development of an insurgency to the point where using a particular tactic becomes
a possibly attractive option; and with respect to patterns of adaptation, as insurgent forces come
up against the “selection rule” of effective countermeasures. ABM models offer unique
opportunities for examining both expected and unexpected interactions among actors and
circumstances leading to successful or unsuccessful attacks.

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\(^2\) “N-player” games is a misnomer, since the ego player faces a set of players each one of which is figured
as having identical characteristics.
By subjecting large numbers of runs from identical initial conditions to small stochastic shocks, analysts can study the range of expected variation associated with identical assumptions about agent behavior rules and initial conditions. In essence, each run of an agent-based modeling program produces one “history” (or future, depending on whether the model is tuned to the past or the present) of that model’s virtual world— one specific counterfactual story drawn from the vast array of stories associated with automatically enforced cotenability assumptions (Lustick, 2010). In other words, each of these trajectories has features consistent with the laws governing the model (the virtual world) and with the specific initial conditions (which can be produced randomly). If the virtual world is constructed to mimic key elements of the real world, and if the theories used to do so are good, then patterns discoverable in multiple histories of this virtual world are the basis for testing hypotheses about relationships and phenomena that exist in the real world. Of course, since ABMs rely on what we do know to illuminate processes of emergence and nth order consequences of complex interactions, they are always limited by the quality of available theory and data.

**General Model Description**

The model we have built to study IED use in a counterinsurgency context is based on Lustick Consulting’s well-established PS-I agent-based modeling framework. Over the past decade, we have used PS-I successfully to model conditions in several countries including Egypt, Libya, and Yemen.³ Here, we offer a brief summary of the model’s mechanisms, but for detailed descriptions of the framework and examples of countries we have modeled, see Reichert et al. (2014, pp. 18-20) and Lustick et al. (2012). For the original description of our tactic model, see (Lustick, et al., 2015). We will describe three versions of that model in our results section, all of which use the same underlying model rules, but are initialized with different input data. Briefly, two key model concepts, identity and authority, are explained below.

An identity is an affiliation that animates the political behavior of agents. Identities can be ethnicities, religions, political parties, military organizations, tribes, economic classes, or any other affiliation that can drive political behavior. The Syraq model, for example, has about 50 identity-groups, including common cleavages like Sunni/Shia, Kurd/Arab, and ISIS/Iraq/Syria. It’s also important to note that identities are constructed, relatively fluid, and multiple can be held by an agent at once in their repertoire. Each timestep, an agent chooses to activate on one over another depending on the identity’s local and global salience.⁴ In a typical Syraq model run, for example, the ISIS identity may weaken (due to external attacks or internal fragmentation) which allows agents to activate on other identities like Sunni or tribal affiliations.

Authority is measured by tracking which agents have joined (or been captured by) a particular state or statelet. This political authority is locally defined, fluid, and in constant competition with

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³ The models presented here use the original PS-I framework, but are run in the open-source agent-based modeling software Netlogo (http://ccl.northwestern.edu/netlogo/).

⁴ For more information on how particular algorithms and triggers work in our models, see Lustick 2000 and Lustick 2004.
other zones. This operationalization reflects Paul Staniland’s insight that “states and insurgents are not simple-minded maximizers of monopoly but instead are optimizers of authority in complex, often counterintuitive, interaction with other armed actors” (Staniland 2012). In addition, networks of elite agents are featured amidst thousands of “basic” agents. Elite networks are operationalized to capture communication, organizational ties, and support mechanisms among these more influential leaders of different groups.

Tactic Model Framework

We have operationalized our theoretical framework of tactics in an ABM module using four key factors–cost, range, risk, and expertise. This module is incorporated within the model so that repertoires of tactics are available to different kinds of agents in different circumstances. In this section we will first discuss the tactics implemented in the model, second we will outline the features used to operationalize their real-world distinctions, and third we will describe how tactics are technically integrated into the ABM.

<table>
<thead>
<tr>
<th>Attacker Tactic</th>
<th>Defender Tactic</th>
<th>Light Engagement</th>
<th>Light Mechanized</th>
<th>IED/Bombing</th>
<th>Heavy Engagement</th>
<th>Heavy Mechanized</th>
<th>Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Engagement</td>
<td>0.5</td>
<td>0.4</td>
<td>0.7</td>
<td>0.4</td>
<td>0.3</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Light Mechanized</td>
<td>0.7</td>
<td>0.5</td>
<td>0.3</td>
<td>0.6</td>
<td>0.3</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>IED/Bombing</td>
<td>0.4</td>
<td>0.6</td>
<td>0.1</td>
<td>0.5</td>
<td>0.6</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Heavy Engagement</td>
<td>0.6</td>
<td>0.4</td>
<td>0.7</td>
<td>0.5</td>
<td>0.3</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Heavy Mechanized</td>
<td>0.7</td>
<td>0.6</td>
<td>0.3</td>
<td>0.6</td>
<td>0.5</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td>0.6</td>
<td>0.8</td>
<td>0.2</td>
<td>0.6</td>
<td>0.8</td>
<td>0.6</td>
<td></td>
</tr>
</tbody>
</table>

We model four distinct categories of violent tactics, two of which have “light” and "heavy” versions. When an agent chooses to attack during a timestep, the likelihood of attack success
depends on the tactic attribute of the defending agent (see Table 1). In addition, each tactic has a different cost, range, and backfire risk associated with it (see Table 2).

1. **Engagement**: A high-risk, low-range tactic that has the benefit of being the cheapest (see below for resource requirements of each tactic) available. Even the most cash-strapped organization can field a squad of men with AK-47s, capable of inflicting newsworthy harm upon the enemy. Heavy infantry of the sort maintained by established governments is a step up in training and equipment, but is used in much the same way on the battlefield.

2. **IED/Bombing**: A cheap (often being built from whatever is readily available), low-risk (the bombmaker may be nowhere near the battlefield), and reasonably effective tactic, particularly against vehicles.

3. **Mechanized**: This tactic has higher costs than engagement, though with greater range, and includes all sorts of armed and armored vehicles, tanks, and artillery. This tactic is generally effective against infantry, but is vulnerable to air power. This tactic can be either light or heavy, reflecting the spread between jury-rigged vehicles such as “technicals” and the purpose-built fleets found in established armies.

4. **Air**: In return for a very high cost, air power provides an unparalleled range at minimal risk.

<table>
<thead>
<tr>
<th>Tactic</th>
<th>Cost</th>
<th>Range</th>
<th>Backfire Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Infantry</td>
<td>0</td>
<td>1</td>
<td>100%</td>
</tr>
<tr>
<td>Light Mechanized</td>
<td>2.4</td>
<td>2</td>
<td>100%</td>
</tr>
<tr>
<td>IED/Bombing</td>
<td>1.1</td>
<td>2</td>
<td>5%</td>
</tr>
<tr>
<td>Heavy Infantry</td>
<td>0.5</td>
<td>1</td>
<td>100%</td>
</tr>
<tr>
<td>Heavy Mechanized</td>
<td>3.2</td>
<td>2</td>
<td>70%</td>
</tr>
<tr>
<td>Air</td>
<td>5</td>
<td>4</td>
<td>5%</td>
</tr>
</tbody>
</table>

**Cost**

The problem for most revolutionary or insurgent organizations is their weakness relative to the state power arrayed against them; in which weakness is measured politically, financially, and militarily. Accordingly, insurgents often cannot directly fight the state with conventional weapons in a conventional battle and hope to survive, let alone win. In most cases rebels do not have

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Our model also has another factor, flexibility, which governs how easily an agent learns new tactics. However, in the models presented here it is held constant across all agents. For more information on this framework, see Lustick 2015.
access to advanced armored vehicles and weapons, especially in the early stages of an insurgency. As an alternative, most IEDs can be fashioned from components available in everyday items, and simple infantry engagement can be even less costly since nothing needs to be built. Moulton (2009) points out that consumer demands for lighter, smaller, and more reliable electronic devices have made IED elements convenient for use as power sources and triggers widely and cheaply available. As easily available and increasingly sophisticated technology spreads, insurgents find different ways of using their components, thereby multiplying variation in IED operation and potency. Accordingly, IEDs provide considerable “bang for the buck” – they can kill soldiers or destroy armored vehicles for relatively little cost and risk, for insurgents, who are removed from the immediate scene.

The ubiquity of low-cost options available to IED manufacturers is illustrated by the wide variety of high explosives and triggers used. In Iraq, early IEDs often incorporated rewired artillery shells from unsecured munitions depots (Zorprette, 2008) (Naval Research Lab Washington DC, Materials Science and Technology Division, 2006) (Barry, 2006) (Eisler, 2007) (Wilkinson, et al., 2008) (McFate, 2005). During later stages of the conflicts in Iraq and Afghanistan, widely available fertilizer became a major component for explosives (Zorprette, 2008) (Webb, 2012) (Faroq, 2013) (Haber, 2014). After the Afghan government banned sales of ammonium nitrate-based fertilizer, Taliban insurgents switched to potassium chlorate, a cheap and common industrial chemical (Vanden Brook, 2013) (Haber, 2014). Many IEDs found in Afghanistan often used simple and inexpensive pressure plates triggered by a vehicle or soldier (Castner, 2012) (Webb, 2012). By 2015, ISIS was using even cheaper chemicals, perhaps reflecting the toll the war has taken on their resources without affecting their ability to build bombs as needed (Conflict Armament Research, 2016).

Low-cost tactics like IEDs can thus help establish the bona fides of an insurgent group by giving them initial successes that can then establish themselves as serious and worthy of support of potential sympathizers (Martin, 2009). IEDs are thus one particular cheap technique used in asymmetric warfare to minimize the stronger side’s advantage in conventional forces.

Range
The range of a tactic is how far from the attacker’s base an operation can be mounted. Airstrikes have a much greater range than mechanized tactics, which in turn have more range than infantry. Although in themselves they are static weapons, IEDs and bombings functionally have considerable range – they can be quickly (and inconspicuously) transported by vehicles to sites far from their assembly points in ways that conventional infantry or armored forces cannot.

Risk
Risk recognizes that every attack, and especially failed attacks, entail costs to the attacker that vary by tactic. For example, the defeat of a conventional infantry unit leads to heavy casualties, and possibly many prisoners and abandoned equipment. In turn, these may lead to intelligence windfalls for an opponent and possible dangers to both attackers and their network of contacts.
A failed missile strike or rocket attack on the other hand, simply means the waste of ordnance. One major aspect of risk, then, is the proximity of the individual combatants to the combat. Infantry are quite close and exposed to the action, while aircraft tend to be farther away. IEDs provide considerable tactical depth to their operators on a number of levels. Many IEDs are automatically triggered, by a component as simple as a pressure plate or as sophisticated as a laser beam, which ensures that the person who planted it and any observers can be far away from the site of the attack (Vanden Brook, 2013) (Webb, 2012) (Zorprette, 2008). Other IEDs are remotely triggered by control devices (such as cell phones) that enable operators to be fairly far away from the attack (Moulton, 2009) (Zorprette, 2008).

Note that independent of considerations of standoff, even successful attacks retain an element of risk. Casualties occur, equipment gets destroyed, left behind or captured, and tactics and techniques are exposed to enemy inspection and analysis. Successful IED attacks are no different – exploded bombs leave valuable intelligence clues about their construction and possible DNA evidence of their handlers. Sophisticated forensics investigators work to turn these clues into operational intelligence that can facilitate undermining IED users and networks (Castner, 2012) (Webb, 2012) (Moulton, 2009).

Expertise

Tactics can be more or less effective depending on the expertise of the individual or group using the tactic, including their level of training. In addition, new knowledge relevant to deploying a tactic can be acquired through trial and error. As insurgents observe the results of their handiwork, they tweak explosives and devices to control yield, increase the lethality and reliability of their weapons, and evade tactical countermeasures. In the case of IEDs, there is also considerable evidence of professional expertise supporting insurgents to varying degrees across conflicts. In the case of Iraq, skilled operatives from the Iraqi intelligence agencies went underground after the 2003 U.S. invasion and anchored numerous bomb-making networks (McFate, 2005). Networking across terrorist groups also spreads expertise. For example, Osama Bin-Laden sent Al Qaeda members to Hezbollah to learn about suicide bombs, a particularly lethal tactic (Horowitz, 2010). The United States has accused Iran of providing both supplies and techniques that allowed insurgents to more effectively target vehicles (Zorprette, 2008). In Afghanistan, bombs tended not to be as sophisticated, but still evolved to effectively target allied forces.

However, expertise can also be a burden on some groups. Horowitz notes that “while experienced groups are often better at adopting incremental or sustaining innovations, disruptive innovations that require changing organizational forms or transforming operational methods can challenge more established groups” (Horowitz, 2010). On the other hand, groups that do not have an operational past allow them more easily to branch into new tactics. In this way, expertise can be both a positive and negative trait that increases short-term effectiveness while potentially reducing long-term flexibility.
Intersection of Tactical and Political Modules

Our model architecture permitted the insertion of the tactics model as a complement to, and interdependent with, other modules governing agent behavior and the political consequences of that behavior with respect to group alienation or alignment with other groups. At its base, the tactics model allows each agent a single tactic. Depending on the political situation, an agent with a tactic may attempt to attack a single other agent that meets the political requirements. The tactics and expertise of the two agents involved are used to probabilistically determine the level of success, ranging from a heavy penalty on the victim to a slightly more minor penalty upon the attacker and the attacker’s network. Within this relatively simple framework, there are five main model mechanisms where tactics and politics meet.

1. **Resources**: An agent’s ability to gain, maintain, or use particular tactics depends in part on the size of its activated identity, which we use to operationalize resources. For example, this might mean that in some situations, an agent cannot learn a new tactic because its group is too small.

2. **Attack Distance**: Similarly to resources, the distance of an attack depends on the size of the agent’s identity. Larger identities have a greater reach, and so are more likely to find a valid target, but also more likely to attack agents far away from any immediately relevant problem. This base range is then adjusted by the range factor inherent in the tactic being used.

3. **Target choice**: There are two steps in the process of a potential attacker choosing a target agent: military and political selection. Military selection partly determined by range, as discussed above, and partly by the expertise of the potential targets (expert agents are likely more militarily active and thus are prioritized). However, these potential targets are further restricted by political situation of the attacker and potential victim. Dominant agents in a position of power can only attack those they perceive as being alienated from the political system, and vice versa.

4. **Learning network**: After a successful attack or defense, the victorious agent attempts to teach its tactic to other agents in its network who are subscribed to its activated identity. It does so by either increasing the expertise of an agent that already has its tactic, or providing the opportunity to switch off of an old tactic onto the recently successful one.

5. **Network Backfire**: Although having a strong network allows an agent to increase its expertise and learn new tactics, it also creates a vulnerability in the form of network backfire. When an agent attacks (successfully or not), there is a risk of backfire. Because backfires are conceptually the result of exposure of a portion of a militant network, the attacker’s agent’s network is also slightly penalized.
Model Description

We employed three different models for this project—two generic models and one virtualization model (Syria and Iraq, called “Syraq”). Each uses the same underlying model rules, but are initialized with different input data. Our simplest of the three models, “Ethniland” has been used in a number of papers studying regional autonomy and political decentralization (Miodownik, 2006) (Miodownik and Cartrite, 2010). The version of Ethniland employed here is a 64x64 grid, has 20 identities of semi-random distribution, and includes autonomous region in the bottom-right quadrant that has its own authority structure. The state zone is randomly seeded with the three heavy tactics (heavy engagement, heavy mechanized, and air) and the autonomous region is seeded with the three light tactics (light engagement, light mechanized, and bombings/IEDs.)

The second model is called “Importstan” and is a more advanced version of Ethniland. Although there is still an autonomous region that is significantly different from the rest of the country, the specific identities are distributed within each region according to data imported (hence the name) from the World Values Survey. To accomplish this, we selected a number of countries that are both in the World Values Survey dataset and have experienced a long-running insurgency to use as an empirical foundation for identities and other attributes of the model. For each randomized model run, two of these countries are selected. Three quadrants of the map are seeded according to three districts from the first country, while the insurgent zone is seeded according to a random district from the second. Certain generic identities (state and military) are artificially weakened in the insurgent zone, but still guarantee some overlap of identities between the two zones, along with international identities such as religions, languages, and political parties. The tactics are seeded using the same rules as Ethniland.

The third model is a full virtualization of Syria and Iraq which we built to examine the region’s possible futures from 2015 onward. The Syraq model has over 50 identities, including ethnic, religious, political, and military groups, and five zones of authority (Assad Regime, Rebel-held territory, ISIS-land, Shia Iraq, and Kurdistan). Unlike in the previous two models, all tactics are available to all agents, although emergent restrictions develop due to differing available resources and learning networks.

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6 For differences between virtualization and generic or “ensemble” models see (Lustick and Miodownik, 2009).
7 For more information on Syraq, see (Garces, et. al., 2016).
Model Results

In order to test the effect of tactics on politics in our models, we punctuated batches of runs generated with each model at particular timesteps in order to measure the pairwise difference between runs that were identical except for the external punctuation.\footnote{In particular, the punctuation was a set of 40 attacks at timestep 100 (out of 189 timesteps) by exogenous attackers using different tactic types. External attacks then continued every ten timesteps for the remainder of the run.} Specifically, our punctuations featured a violent exogenous shock carried out by an invisible, external attacker using each of the six tactics. After the punctuation, all differences from the baseline run can be wholly attributed to the punctuation of a particular tactic. We started this process by experimenting with the Syraq model, which is the most complex since it virtualizes a real case.

Consistent with previous IED-focused studies, the various tactic punctuations did change the distribution and usage of tactics in the model.\footnote{For reference, this paper reports on results from Ethniland experiments 695, 696, 697, 698, 699, 700, and 701; Ethniland locked bias experiments 711, 712, 713, 714, 715, and 716; Importstan experiments 664, 665, 666, 667, 668, 669, 670, and 672; and Syraq experiments 674, 675, 676, 646, and 720.} While we also found statistically significant differences in political effects like identity activation, we found it difficult to explain why those particular differences occurred. Certain tactics helped or hindered particular identities, which suggests that attacks can be politically important. Unfortunately without having identified the mechanism in the virtual worlds created by our models that delivers these effects, they appear as indistinguishable from the randomness emergent from a highly complex system. The results from our Syraq model, thus remained opaque. Our push to isolate and control the experiment eventually led us to test the same punctuations in a simpler generic model.

Many of the same patterns observed in Syraq held true in our work with Importstan, namely that the external attacks generally (but not always) produced a decrease in anger and the Herfindahl Index of identity activation in the short term.\footnote{The Herfindahl Index is a common measurement of the amount of competition in a market. It equals the probability that two entities taken at random from the dataset of interest represent the same type (https://en.wikipedia.org/wiki/Herfindahl_index).} In Syraq we found that in the short term, agents saw a drop in anger while the landscape exhibited an increase in identity fragmentation, though there were no long-term differences. In Importstan, on the other hand, we saw both short- and long-term changes in those two variables. To clarify, “bias” is a set of global signals for each identity of which all agents in the landscape are simultaneously aware and use to update their activated identity over time. In addition, an angry agent is defined as an agent whose activated identity bias is at least two points lower than the bias of another identity in its repertoire. So the proportion of agents who feel anger changes over time depending on how responsive identity activation is to global bias changes. Therefore, the correlation of fractionalization and anger in our results makes sense, since large identity blocs tend to have the effect of ‘oppressing’ agents into being activated on a non-optimal identity, thereby increasing the likelihood of anger.\footnote{For a more in-depth discussion of anger, see (Alcorn, Garces, and Lustick, 2013).}
At this point we became confident in these results, but because of the variation in identities inherent in the model seeding process of Importstan, it was just as difficult as it had been with Syraq to determine the mechanisms behind the political effects of tactics. The third and final model we ran was Ethniland, a relatively abstract “generic” model. Unlike Importstan, which seeds the map using a different combination of country data each time, Ethniland trajectories all begin from a fundamentally identical landscape of identities and other relevant features. Again, tactic punctuations increased fragmentation and decreased anger. While no changes were observed as between tactic types, there were some differences in magnitude—the heavy infantry tactic was significantly better than others at increasing fractionalization overall and decreasing anger in the insurgent zone, IEDs had similarly strong effects in the state zone. Notably, while IEDs are theoretically and experimentally an effective option against the established state, heavy infantry is the best counter to IEDs. In general, more violence in our models generally leads to less anger, at least in the short-term. However, we found that in the medium-term there was no difference between fragmentation in the baseline and treatment cases for Syraq, and a significant difference from the baseline that was indistinguishable by tactics in Ethniland and Importstan (see Figure 1).

Figure 1: The three graphs above show the baseline to treatment effect on the Herfindahl Index (HI) of identity activation at timestep 120. It’s clear that there is a strong effect of violence on HI of activation in Ethniland and Importstan from the baseline, but no statistically significant differences between treatments. In Syraq, there is no distinguishable differences between the baseline and any treatment.
Figure 2: The figures above show two sample timesteps from one Ethniland model run (ID 86884). Each agent is colored with its currently activated identity at timestep 99 (left) and timestep 101 (right). In between these two timesteps the external punctuation has occurred. Each agent also has a dot in the middle and is more lightly colored if it is angry. Between these two timesteps the Herfindahl Index of activation and the number of angry agents both drop (0.264 to 0.250 and 2878 to 2662, respectively.) The red circles indicate the sites of two individual attacks. The top-left attack shows how the victim and the neighboring agents are released to pick identities that do not leave them angry. The bottom right circle shows a more complicated outcome that occurred after an attack on the border between two identities–some agents have switched identities, but the change in anger is mostly due to a shift that affected the identity as a whole.

Our search for operative model mechanisms to explain the results of tactic-specific violence was aided by combining observations across our experimentation with the three different models. Violence is operationalized as penalizing the victim’s activated identity, and that penalty is strong enough that most victims and the victim’s neighbors will change identities briefly. Since angry agents are those activated on a less favorable identity than one of those to which they are subscribed, violence can often be a way to release the underlying tension in a model, providing agents opportunities to switch to a more favored identity (see Figure 2). We confirmed this hunch by comparing the likelihood of individual agents being angry depending on whether they were just attacked at the agent level of analysis. Consistently in each model, we found that likelihood of being angry was always lower for agents who were just attacked or near an agent that was just attacked. However, not all of our experimental conditions showed a decrease in violence from the baseline. In some cases the post-treatment average likelihood of violence remained the same as the baseline. This is because as favorability of identities shift, the more heterogenous landscape can produce more anger, more regularly, than a uniform territory.

Having found a reasonable mechanism, we repeated our experiments on all three models with an additional punctuation that locked global identity bias at the same time as the external attack punctuations begin. If our theory were accurate, we would expect the static identity favorability
to eliminate the rare situations in our model in which violence increases anger, which was precisely what we found. In a world where all identities were locked in static favorability, every attack punctuation decreased model anger, and the decreases showed no signs of recovering (see Figures 3 and 4).

**Figure 3**: The above six graphs show the effect of the external punctuation in Ethniland on the number of angry agents in the landscape. The light blue lines show the highly variable time-series for each of 120 runs per treatment. The thicker lines represent the average baseline runs (red) and the average treatment runs (blue) in each case. (The baseline is consistent across treatments.) We can see that while anger does decrease on average in most cases, some see no effect in the short or long-term. These graphs also show the negative result of only minimal effects of different tactics.
Figure 4: The six graphs above show the same information as Figure 3, but for the second experiment where we lock bias values at timestep 100. We can now see the slow decline of anger once the bias values are locked, which shows that the effect of violence on the landscape does consistently reduce the number of angry agents, and that number only increases due to the secondary and tertiary effects of violence, not its primary effects.

In the Ethniland results, the punctuations continued to have effects on individual identities, but we still have not found any meaningful patterns or notable correlations that would allow us to make predictions as to which, when, or how identities will be affected. Our examination of three different models leads us to conclude that the political consequences of tactics are dependent upon deeply emergent properties that resist analysis.

Conclusion

Shifting our point of view from an investigation of how effects are produced by the models to the question of what the models’ output, assuming valid operationalizations, suggests about the real world, we observe that our findings here speak directly to a prominent policy question: When is counterinsurgency violence counterproductive by producing more anger (new recruits) than fear (quiescence) from those who otherwise might join the insurgency or from those who desert the insurgency as a result of their fear? (Bennett, 2008) Our findings can be read to suggest that in the short run, at least, the result of counterinsurgency violence, including violence entailing substantial collateral damage, produces more fear than anger, thereby reducing the rate of insurgent attacks.

At a more granular level, we did not find clear evidence of a systematic relationship between the type of tactics employed and their political consequences. To be sure, in each of our models, tactics did matter, tactically speaking. As originally conceived, the tactics module was designed to reflect the evolving needs and contexts of a battlefield, and our results continue to show the
evolution and interplay of the repertoire of violence as agents and groups seek to attack their enemies and defend themselves. However, the primary purpose of this project was to examine whether there are political consequences to military choices. So far our work cannot be used as a basis for suggesting that political scientists would find such relationships if they looked harder for them than they have.

There are, however, possible changes to the implementation of violence in our model that could change these results. Most potential sources of variation in tactics were included, or at least tested in our original design process. Each tactic was treated as a distinctive vector for the delivery of a certain quantity of “violence,” which is to say a sudden and large-scale negative disequilibrating shock. Built into that implementation is the assumption that the effects of violence are independent of the vector of its delivery, or at least that if its effects do differ according to vector of delivery, those differences are due to emergent properties of the situations into which the violence is delivered. Future work may benefit from distinctive operationalizations to capture how the negative shocks that are “violence” can be delivered and experienced by different kinds of targets in analytically distinguishable ways that may be associated with different tactics. While civilians may be killed by artillery shells or by IEDs, it is possible that the nature of the “violence” associated with each tactic is distinctive in its effects. The assumption that the nature of violence is the same between the different tactics has not itself led to unsettling or obviously invalid results, but remains a potential area of future research.

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