Terrorism Trends in Urban Environments

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Introduction

In the past five years, violent extremist groups have attracted significant attention using urban centers as stages. In 2008, Pakistan-based Lashkar-e-Taiba launched a coordinated assault on Mumbai, India which lasted three days and resulted in 164 civilian deaths. In 2013, Somalia-based Al-Shabaab infiltrated the Westgate mall in Nairobi, Kenya, killing 67 and injuring 175 civilians. Terrorist groups are a tremendous threat to vulnerable cities. In both cases, the groups exploited with relative ease the complex flow of systems in the city to achieve desired outcomes. This sparked a debate about terrorist groups' targeting practices and on how to locate, understand, protect against, and mitigate attacks in the face of megatrends like urbanization, population growth, migration, and connectedness. The urban environment emerges as a unit of analysis for acts of political violence.

Future conflicts are expected to take place in crowded, urban, coastal and connected environments instead of landlocked, remote and rural ones. Especially megacities present fertile grounds for inequality and conflict, as well as the most connected, large, yet vulnerable human and physical sub-system for terrorist attacks. Since 9/11, the fields of geography, urban studies, political science, and many others have contributed to the understanding of terrorist attacks, strategic decision-making, and geospatial aspects of terrorists' targeting behavior. We conduct a large-N pattern analysis using the Global Terrorism Database (START 2013) to illuminate trends in targeting behavior. Our study aims to fill a gap: On a global scale, is there a trend for terrorists to target urban over rural environments?

We use a large-n pattern analysis to investigate predicted trends in terrorism as stated by Davil Kilcullen (2013). Do we find evidence that terrorists in fact have shifted or will shift towards urban environments?

This paper proceeds as follows. First, we conduct a literature review on terrorism trends. We then introduce the operationalization of our variables and then describe our data collection and cleaning process. After that, we visualize some our approach through a number of example attacks. Then, we describe our analysis setup, before finally presenting our findings.

Note: The state of this project right now is a final exam for the class "Collaborative Social Science Data Analysis", taught by Christopher Gandrud at the Hertie School of Governance in the Fall 2014 Semester. Cleaning, Manipulation, and Analysis for the project remain preliminary. We hope to clean more observations and derive more hypotheses in the future with the goal of making the final project part ouf our master thesis.

Literature Review

General

Urban terrorism is by no means a new concept, as it arises in guerilla, riot, and insurgency literature (Crenshaw 1981; Grabosky 1979; Grabosky 1988; Karber 1971; Laqueur 1977; Lupsha 1967). Indeed, the urban context was a feature of Walter Laquer's early study on guerilla warfare. Groups like the Mau Mau of Kenya, the Irish Republican Army, and the Front de Liberacion Nationale employed tactics against colonial powers that exhibited characteristics of urban life and space (Laqueur 1977). Martha Crenshaw's seminal piece on the causes of terrorism highlighted the enduring importance of modernization and urbanization, which she saw as an ever growing opportunity for terrorist groups to execute attacks (Crenshaw 1981). Others highlight the urban space as a ground for recruitment, hiding and communication, as well as the variety of possible targets (Grabosky 1979). Most of the literature leading up to 9/11 recognized the urban element, but did not fully address linkages between urbanization and state security.

The literature explains various reasons for targeting practices, such as instrumental means, i.e., resources and capabilities driving strategy, organizational survival, management, human resources, and funding constraining strategic decisions, or ideological and religious motivation. More specifically, targeting behavior has been growing in importance in terrorism literature due to its policy relevance and potential for prediction. Martha Crenshaw has shed light on how groups shape motivations behind targeting, such as religiosity, communal ties, or other less tangible, intrinsic motivations (Crenshaw 1981). Todd Sandler built strategic game theory models that parse potential decisions with constraints of resources and capabilities taken into consideration (Enders and Sandler 2000). Other theorists believe that organizational survival drives decisions, such as Jacob Shapiro's economic insights into how covert organizations are limited by their ability to fund operations, also known as rational choice (Shapiro and Siegel 2007). Finally, scholars have thoroughly explored characteristics of organizations that elongate or decline lifespans, including analysis of favorable conditions for organizational survival (Blomberg, Gaibulloev, and Sandler 2011). Of course, these theories are not mutually exclusive and they collectively strengthen the understanding of strategic considerations in terrorist decision-making.

However, few theories of strategy take into consideration geospatial aspects or variation in targeting behavior. Consider the following questions. Does the organization want to control territory? Or do they rather want to make a point, provoke a government in the realm of national symbolism, or attract attention? Apart from explaining internal factors of the organization, we can attempt to explain geography-bound terrorism, such as considerations of spatial and hierarchical diffusion, currently nascent in the literature on terrorist group dynamics (Bahgat and Medina 2013). Spatial diffusion refers to one base of operations close to a series of attacks, whereas hierarchical diffusion is the existence of several hot spots from which attacks emanate. These phenomena are supported by findings on geolocated IRA attacks in Northern Ireland and Great Britain. The difference here in spatial and hierarchical diffusion refers to a growing sense-making literature on the spatial logic of terrorism, but also growing importance of, as Bahgat and Medina put it, how cities of high population and administrative worth to the government appear to have become the main targets of modern-day terrorism for a variety of strategic and cost-effective reasons. (2013).

Prominent theorists of conflict re-problematize the issue, taking into consideration megatrends of urbanization, population growth and connectedness. Megacities are their unit of analysis for studying conflict (Kilcullen 2013). Geographers have offered a research agenda for their field in the face of the rising importance of the ancient social phenomena of terrorism (Cutter, Richardson, and Wilbanks 2003). It is often assumed that growing and developing urban environments become increasingly attractive as targets for violent extremists, resulting in more attacks on urban systems, but mostly single case studies like in the Mumbai 2008 case are referenced in support of that claim-larger empirical studies are rare (Beall 2006; Glaeser and Shapiro 2002; Graham 2008; Sassen 2010; Savitch and Ardashev 2001). It said to be a traditional characteristic of terrorism studies that much is written on the basis on little empirical analysis (Jongman 1988). To our knowledge, a comparable study exists only on the geolocation of terror attacks on the U.S. level (Webb and Cutter 2009).

Our main source of data, The Global Terrorism Database (GTD) has been employed in different fields and various ways to study terrorism. Also, it has been used to study specific categorical phenomena or regions, e.g, hostage-taking or weapon types, as well as sweeping trends, such as casualty rates due to terrorist attacks. The research methods followed include geographical mapping, descriptive statistics, and qualitative inquiry (LaFree, Yang, and Crenshaw 2009). There are essentially three camps of researchers in the applied fields using the GTD:

1. Geography
2. Political Science/International Relations
3. Terrorism Studies

In most of the cases, there is a convergence of the three, albeit to different extents. For example, geographers use the data to make sense of geospatial path dependencies of terrorist groups and social network analysis (physical and human geography), whereas political scientists undertake more rigorous qualitative analysis and counter conventional beliefs about security and war. Often, terrorism scholars will focus on one category, region, group, or trajectory. LaFree is producing the most comprehensive review of uses of the GTD, which comes out in 2015. He also has written extensively on how to use the GTD to counter widely held beliefs regarding terrorism (LaFree and Dugan 2009). Correlation work between terrorism and economic, legal, or group characteristic data also exists (LaFree, Morris, and Dugan 2010). This body of work might be viewed as functional. Geospatial analysis of these trends gained traction after 9/11 and have since been growing in importance and policy relevance. Operating under the assumption that large-scale attacks are planned, geospatial analysis, or mapping other types of analysis onto geographical illustrations, provide insights into strategies of targeting and decision-making. In fact, applied geographers have discovered trends in the environment that signal a trend toward targeting areas with high populations (Bahgat and Medina 2013).

In 2013, David Kilcullen contributed a highly influential book on new trends in terrorism (Kilcullen 2013). Using a spatial approach, Kilcullen offers a three-pronged theoretic setup to predict the new trends in terrorism. For him, the change in targeting trends is related to a shift of the targeting environment. Terrorism, he argues, will move from landlocked, distant, and rural places to littoral, connected, and urban ones.

By stating that terrorism will move into new environments, Kilcullen aims to account for a change significantly faster than existing global trends. Since there is a general trend for people to move to connected, urban, and/or littoral environments we would naturally expect terrorism to move with the people. Kilcullen's meaning of a change of environment however does more than just accounting for the global trend towards urbanity. He predicts an increase in terrorism in urban environments that is faster than the overall trend for urbanity.

Variable Operationalization

Our analysis is inherently time based. Nevertheless, time is not our single independent variable. Instead, we also internalize the global trend towards urbanity in our independent variable and estimate their effect on attacks in urban/connected/littoral environments.

Essential for our whole approach is that we use country-based relative community-level data. We analyze attacks taking place in communities ranging from small cities to Megalopolis and relate them to their peers in the same country (We use "city", "location", and "community" interchangeably in this paper). All our variables, being it city size, population density, distance to coast etc. etc. are normalized and calculated as a relative to their country maximum.

Additionally, since our analysis is time-based, we have tried to gather as much of our data for all years of observations. A lot of data was not available. Where possible, we interpolated missing information from single data points we were able to collect over time. Unfortunately, that was not always possible. By now, we were not able to make data time-dependent for all our sources. We marked time-variance after the explanation of each variable. Since we conduct our final analysis on a dataset ranging from 1998 - 2013, we estimate the resulting bias to be negligible.

Dependent Variables

DV.Target.Urban: Attacks in Urban Environments. We measure Urbanity by including: * City Rank: The cities relative rank-size (population) as a log size according to the rank-size rule(time variant) * City Population: The city's relative population (time variant) * Communities' Urban Landcover: The percentage of relative sealed surfaces (not time variant) * Location's Nightlights: Communities nightly emanation of light (not time variant)

DV.Target.Crowded: Attacks in Crowded Environments. We measure Crowdedness by including:

- Location's Population Density: relative (time variant)
- Location's Population Density Growth: relative over past years (time variant)
- Night Light Development Index: relative night lights by economic activity (not time variant)

DV.Target.Connected: Attacks in Connected Environments. We measure Connectedness by including: * Proximity: relative travel time to closest large city (not time variant) * Location's Nightlights: Communities nightly emanation of light as measure of electrification (not time variant * Location's GDP: relative share of GDP (not time variant)

DV.Target.Coastal: Attacks in Coastal Environments. We measure Coastalness by including: * Proximity to Coast: In km, whereas landlocked countries are NA (not time variant)

DV.Kilcullen: a simple aggregation of Urban, Crowded, Connected, Coastal environments

Independent Variables

IV.Time: A date variable ranging from 1998 to 2013 including day, month, and year (whole GTD from 1970 to 2013)

IV.Urban.Share: Total share of population living in urban environments (time variant)

IV.Urban.Share_Year: The yearly change of population living in urban environments (time variant)

IV.Pop.Coastal.Dist: Total share of population living in proximity to the coast (time variant)

IV.Pop.Coastal.Dist_Year: The yearly change of population living in proximity to the coast (time variant)

Data

Data Sets

Global Terrorism Database (GTD)

We will use the START Global Terrorism Database (START 2013) (GTD), as it is the most comprehensive open source database on terrorist attacks (LaFree et al. 2006). The data ranges from 1970-2013, logs 125,000 terrorist attacks, and uses 45 - 120 variables per attack. Among other information, the GTD holds records on the location, the target, and the damage caused by attacks (START 2014). It is a simple .xls file, available after creating an account on the GTD Projects website and it is already tuned towards being turned into a .csv, as close to no excel functions are layered over the data entry. It contains both numeric and factor variables for describing the attacks characteristics. All categorical variables have both categorical numbers and a respective text variable for each number. This creates a lot of redundant information and needs a long tidying process.

The current GTD is the product of several phases of data collection efforts, each relying on publicly available, unclassified source materials. These include media articles and electronic news archives, and to a lesser extent, existing data sets, secondary source materials such as books and journals, and legal documents (START 2014). We are aware of the entangled problems of reliability and comparability.

The original set of incidents that comprise the GTD occurred between 1970 and 1997 and were collected by the Pinkerton Global Intelligence Service (PGIS) a private security agency. PGIS data collection efforts are remarkable in that they were able to develop and apply a similar data collection strategy for a 28-year period (LaFree et al. 2006). After START completed digitizing these handwritten records in 2005, they collaborated with the Center for Terrorism and Intelligence Studies (CETIS) to continue data collection beyond 1997 and expand the scope of the information recorded for each attack (START 2014). CETIS collected GTD data for terrorist attacks that occurred from January 1998 through March 2008, after which ongoing data collection transitioned to the Institute for the Study of Violent Groups (ISVG). ISVG continued as the primary collector of data on attacks that occurred from April 2008 through October 2011.

GTD staff based at START headquarters at the University of Maryland integrated and synthesized data collected across the entire 1970-2013 time span with the goal of ensuring that the definitions and methodology are as consistent as possible across all phases of data collection. In addition, GTD staff at START retroactively coded several key variables not originally available for the PGIS cases, conducted numerous quality control projects, and supplemental data collection efforts. These supplemental data collection efforts involve systematically comparing a variety of additional sources of terrorism incident data to the GTD to identify any missing events that satisfy GTD inclusion criteria. GTD staff research these missing events to identify primary sources of information and code the attack details for addition to the GTD. Beginning with cases that occurred in November 2011, all ongoing GTD data collection is conducted by START staff at the University of Maryland. Additional information on the history and data collection methodology of the database can be found on the GTD website (START 2014).

Given the varied context of GTD data collection, the database is another source of general inconsistency-legacy problems. The GTD now includes incidents of terrorism from 1970 to 2013, however a number of new variables were added to the database beginning with the post-1997 data collection effort. Wherever possible, values for these new variables were retroactively coded for the original incidents, however some of the new variables pertain to details that were not recorded in the first phase of data collection. For any newly added variables that were not retroactively coded, they only exist for post-1997 cases.

GTD is based on PGIS and PGIS is the most granular and comprehensive. To illustrate how consequential these coding differences are we compare terrorism event counts for 1997 between the PGIS database and the U.S. State Department terrorism database. In that year, the Department of State records 304 acts of international terrorism, which caused 221 deaths and 683 injuries. For the same year, the PGIS data reports on 3,523 acts of terrorism and political violence that claimed 3,508 lives and inflicted 7,753 injuries (LaFree et al. 2006).

Country Level Data

Our source for country-level data is the set of World Development Indicators (WDI) provided by the World Bank. We download them using the WDI package for R, a shortcut to the World Bank's API that provides data already formatted in long country-year format (Arel-Bundock 2013).

City Level Data

a. "world.cities" from the R package 'maps'. The database "is primarily of world cities of population greater than about 40,000. Also included are capital cities of any population size, and many smaller towns." (Richard A. Becker and Ray Brownrigg. Enhancements by Thomas P Minka <tpminka@media.mit.edu> 2014) The variables include the city name, country name, approximate population (as of January 2006), latitude, longitude, and capital status indication.

b. "worldcities2013" from MaxMind Inc.(Inc. 2008). This data set provides similar information, but is updated more regularly.

c. "Urban Centers" from wikipedia. In the absence of a free data set on urban centers, we scraped a list with around 500 urban centers (>1 million inhabitants) of the [respective Wikipedia page] (http://en.wikipedia.org/wiki/List_of_urban_areas_by_population)(Wikipedia 2014). It draws from seven different types of sources and is put together in terms of defining urban space and urban centers. We added a hand-coded "coastal city" variable to indicate if a city is close to the coastline and has a port.

Additional Control Variables

Necessary controls are the:

- Relative growth of urban life (populations and space on the country scale (Bank 2013))
- Civil war (1-0 dummy from the Correlates of War (Sarkees and Wayman 2010a) Project, Intra-State War Database 4.0 which is the most updated one)
- Capital Cities (coded by hand)
- Changes of collecting entities: PIGS until 1997, CETIS until 2008, ISVG until 2011 and START since 2011 (all in the GTD)

To elaborate on the last point, we created three preliminary charts to shop how transition in data collecting entities influences variables of our interest.

a. Civil War We include civil war dummy variables because civil wars are likely to exponentially increase the amount of terror attacks in a given year and city. It comes from the Correlates of War project and is called the Intra-State War Database 4.0 (Sarkees and Wayman 2010b).

Data Cleaning

Challenges in All the Data Sets

Missing Information: None of the datasets used can be considered complete with regard to the individual observations. In fact, they contain a huge number of NAs. The subset of the GTD the we use for our analysis (containing only 18 of the original 123 variabels, and only successful terror attacks) has 107143 NA values, summing up to a total of 5.2% of all values. We aim not to have a drastically increased share of NA values in the dataset used for the final analysis. All datasets are very comprehensive and stem from sources with high reputation. An extensive cleaning process was necessary nonetheless.

Spelling Inconsistencies: The main challenge across and within all datasets is the huge variation in spelling of countries and cities, which triggered an extensive hand recoding process. We developed a standardized style for country and city names and applied that to all data sets.

- GTD ~ 120k rows
- cities.a. ~ 50k rows
- cities.b. ~ 50k rows
- WDI ~ 10k rows
- Urban Centers ~ 500 rows
- War ~ 500 rows

Coding Gaps, Information Inconsistencies, and Lack of Detail: All datasets containing georeferenceable data contained this information on varying scales and for different time periods. For example, while some attacks in the GTD were probably geolocated using GPS guidance, others lack their own geoposition and are only presented using the central point of the city or district. When possible, we tried to define position data.

A huge gap existed between the WDI data and the GTD. The GTD assigns attacks to the countries they took place in at the time they happened. However, these countries (Soviet Union, Yugoslavia, GDR,etc.), in some cases, do not exist anymore. The WDI, on the other hand, contains country-level data back to 1960 in the form of countries as they are today.

Data Cleaning Process

We brought all country names to the standard of the World Bank data as a point of reference and because we will draw most of our country level data from there.

Although we combine the two world city datasets, we decided not to bring the city names to the same standard before merging them into the GTD. This has to do with the sort and amount of inconsistencies mentioned above: The more (even inconsistent, wrong, or outdated) city names we have in the world city datasets, the higher our chances to match them with cities mentioned in the GTD (even if by the coincidence of matching typos that we may have overlooked).

Because of the abysmal quality of the city_txt variable in the GTD, at least 750 lines of code were necessary to bring the ~2,5k unique city names to a level in which we could work. Codings like "somewhere at the border" or up to 10 typos (from "Buen%%s Eir$" to "Buenos Aires") for a heavily targeted city are not unusual.

Merging Process

First, we merged the WDI country level data into the GTD by country and year. These indicators contain information on population sized in different settings (living in largest city, living in urban environment, etc.) per country and year.

Second, we merged the two city data sets. We eliminated duplicates, keeping either the city entry that was truthfully coded as capital or the one with the higher population (we ended with ~50k rows + ~50k rows = ~80k rows). As we use them to merge with the cleaned GTD city_txt variable, the more cities in our dataset, the better.

The third step is the most computing intensive one so far: We merged the urban center dataset with the now combined city dataset, assigning each city to its nearest urban center. The reasoning behind this step is that, while we have around 50k different cities in our GTD, only a share of them fulfills the requirement of being "urban" the way we understand it. A small or big distance between the city the attack took place and its closest urban center may serve as a rudimentary indicator for an intent to attack urbanity.

Therefore, we include lat/long data for each urban center using the google maps API. Then, the distance from each urban center to each city was calculated. The merged dataset assigns the closest urban center to each city (and the respective distance). The necessity comes from the way cities are coded in the GTD. While an attack on Tokyo, which is rarely attacked, is usually coded using "Tokyo", attacks in often targeted cities are usually localized more precisely - assigned to districts. Good examples for this phenomenon are Lima, or the urban area around Tel Aviv. Both are attacked often and the GTD delivers predominantly the sub-municipality as the place of attack.

With the new dataset, we can set a parameter of distance around each urban center (as a place holder we currently use $2 * sqrt(urban - centers - area/pi)$, and later decide to count any attack that falls into that parameter as an attack on the urban center itself. If the GTD codes "New York City", it finds both the urban center and the city - but as the GTD sometimes codes "Manhattan", we now have a match on the urban center "New York City" as the distance between the two falls within our parameter.

Finally, we merge the GTD and the combined city-urbancenter dataset. We use a merging varaiable which is a clean character string of the form of $countrynamecityname$, in order to avoid false positives of similar city names across countries. Thanks to our previously unified country and city coding in all datasets, we find a city (thus, population size and also closest urban center) for around 60% of all 120k terror attacks in the GTD. As the GTD often lacks any city name and has "unknown" or area codings (e.g. "District xyz"), 60% is a satisfying result given complexity and resource constraints.

Currently, We are working on increasing the robustness of our observations by cleaning further. The google maps API might provide for further analysis over lat/long calculated distances to cities within, e.g., Arabic-speaking countries with rivaling city names in the latin alphabet.

Visualization

To illustrate our approach, we have selected a subset of example attacks, which are included in our analysis. We also show several maps of the country in which the attacks tooks place (Turkey) to illustrate the distribution of attacks in different degress of urban, connected, and coastal environments.

Example attacks

These are 10 selected attacks in Turkey from 1998 to 2013 in different environments. Apart from human damage (number of killed and wounded), we also display the relative share of nightline, access to roads, proximity to coasts compared to the rest of the cities in Turkey on a level from 0 - 100.

Table.1 Example Attacks in Turkey

X	Date.Place	On.UC	Kill.Wound	Light	Access	Prox.Coast	Dens
113575	2003-11-14, Istanbul	yes	162	96.83	97.62	98.26	81.97
113739	2008-07-27, Istanbul	yes	171	96.83	97.62	98.26	81.86
113414	1999-07-30, Gurpinar	no	4	77.78	0.00	100.00	72.20
113490	1999-03-05, Cankiri	no	14	52.38	99.60	74.08	2.50
113582	2003-08-01, Ankara	yes	11	100.00	98.81	65.96	7.58
113393	1998-11-27, Kirikkale	no	24	77.78	99.40	61.12	6.03
113492	1999-10-18, Bademli	no	1	11.11	57.54	84.91	9.39
113403	1998-09-09, Kuyucak	no	4	19.05	97.02	80.08	6.58
113671	2006-08-28, Antalya	no	69	95.24	99.80	99.23	4.04
113675	2006-08-28, Antalya	no	23	95.24	99.80	99.23	4.04

Attack Summaries (START 2013)

- 2003-11-14, Istanbul: Two car bombings by the militant Islamic group, Great East Islamic Raiders Front (IBDA-C - Islami Buyuk Dogu Akincilar Cephesi), on synagogues in Istanbul, Turkey, killed at least twenty people and injured 302 others. One of the two almost simultaneous blasts occurred at the Beth Israel Synagogue, damaging the building and several cars. Numerous people were reportedly killed and injured in the bombing. The group identified itself in a telephone call to the Anadolu News Agency.
- 2008-07-27, Istanbul: On Sunday, two bombs exploded minutes apart in one of Istanbul's busy shopping districts on the European side. Though the Kurdistan Workers Party denied responsibility for the attack, officials continually accuse them of direct involvement.
- 1999-07-30, Gurpinar: A total of four village guards were killed in Gurpinar, Turkey, when a group of perpetrators attacked the guards who were protecting the Telekom employees. Officials reported that the employees where the target of this attack.
- 1999-03-05, Cankiri: A car bomb attack targeted the Cankiri Provincial Governor, Ayhan Cevik, while he was driving in Cankiri, Turkey. Four people were killed and the Governor and nine others were wounded. The Turkish Workers and Peasants Liberation Army (TKP/ML-TIKKO) claimed responsibility for the attack.
- 2003-08-01, Ankara: An unnamed leftist organization detonated an explosive device in the garden of the Justice Ministry's Center of Education for Judge and Prosecutor Candidates in Ankara, Turkey. Eleven people, including policemen and judges, were injured in the explosion. Although a group claimed responsibility for the attack, Turkey's Interior Minister, Abdulkadir Aksu, did not publicly reveal the perpetrator group's name.
- 1998-11-27, Kirikkale: A bomb exploded on a bus near Kirikkale, Turkey. The explosion killed four passengers and injured 20 others. The bomb was placed in the luggage department of the bus. There was no claim of responsibility for this attack.
- 1999-10-18, Bademli: Unknown perpetrators set a Greek citizen's house on fire in the village of Bademli on Gokceada island, Turkey. A small child died in the fire.
- 1998-09-09, Kuyucak: In one of two related attacks, rebels from the Kurdistan Workers Party (PKK) attacked the Imamli settlement unit in the village of Kuyucak, Turkey, killing one person and injuring three (Mustafa, Hilmi and Nuriye Atici). The perpetrators fled after this incident.
- 2006-08-28, Antalya: Four people were killed and approximately 65 were injured when a bomb attached to a motorcycle detonated in Antalya, Turkey. No one claimed responsibility for the attack.
- 2006-08-28, Antalya: A car filled with explosives exploded 80 meters from the Russian Consulate General in Antalya, Turkey, killing three people and wounding at least 20 more. No one claimed responsibility for the attack, but authorities believed the Kurdish separatists were to blame.

Map Visualisation

Figure 1: Illumination levels in Turkey and example attacks

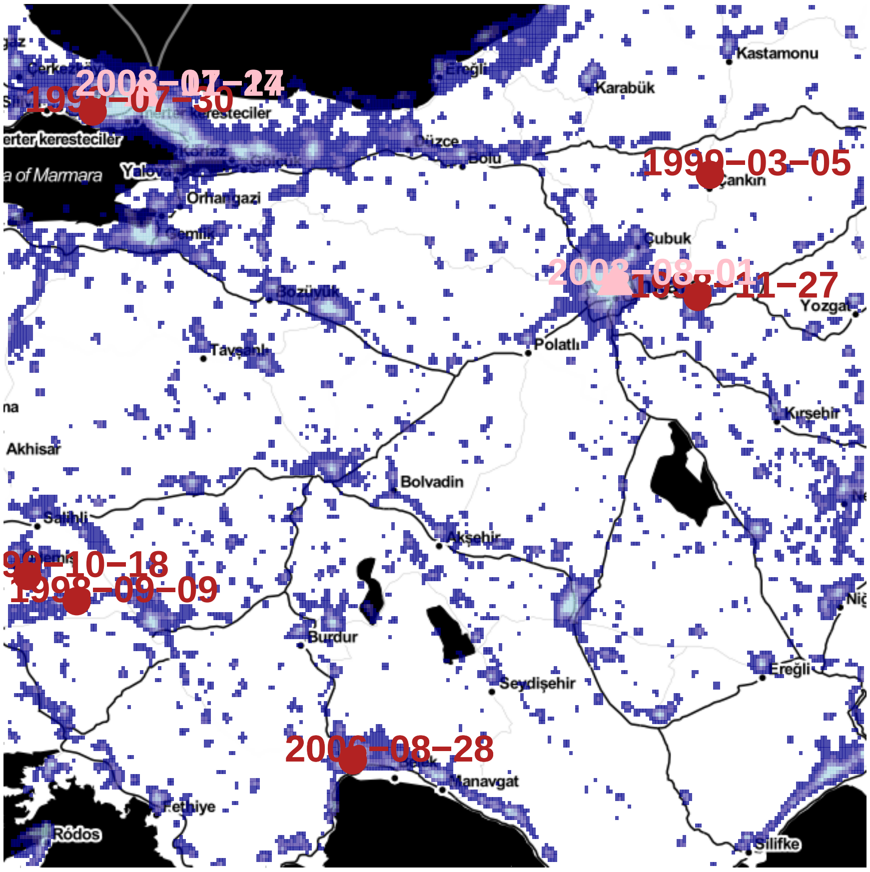

Figure 2: Road Accessability in Turkey and example attacks

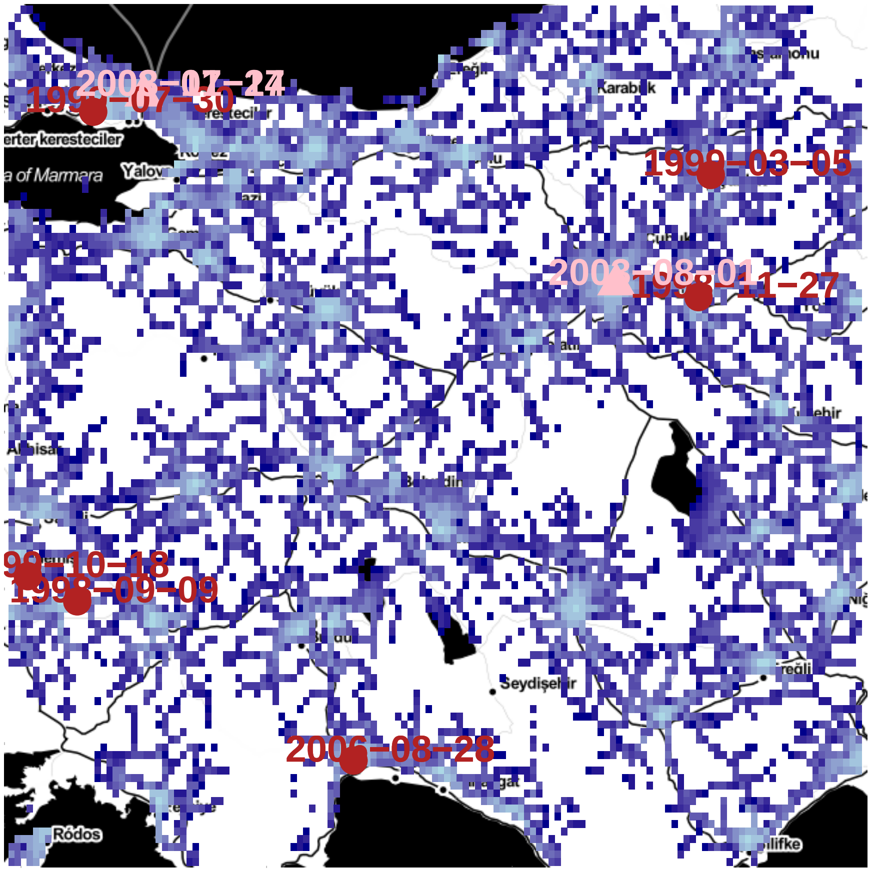

Figure 3: Distance to Coast of locations in Turkey and example attacks

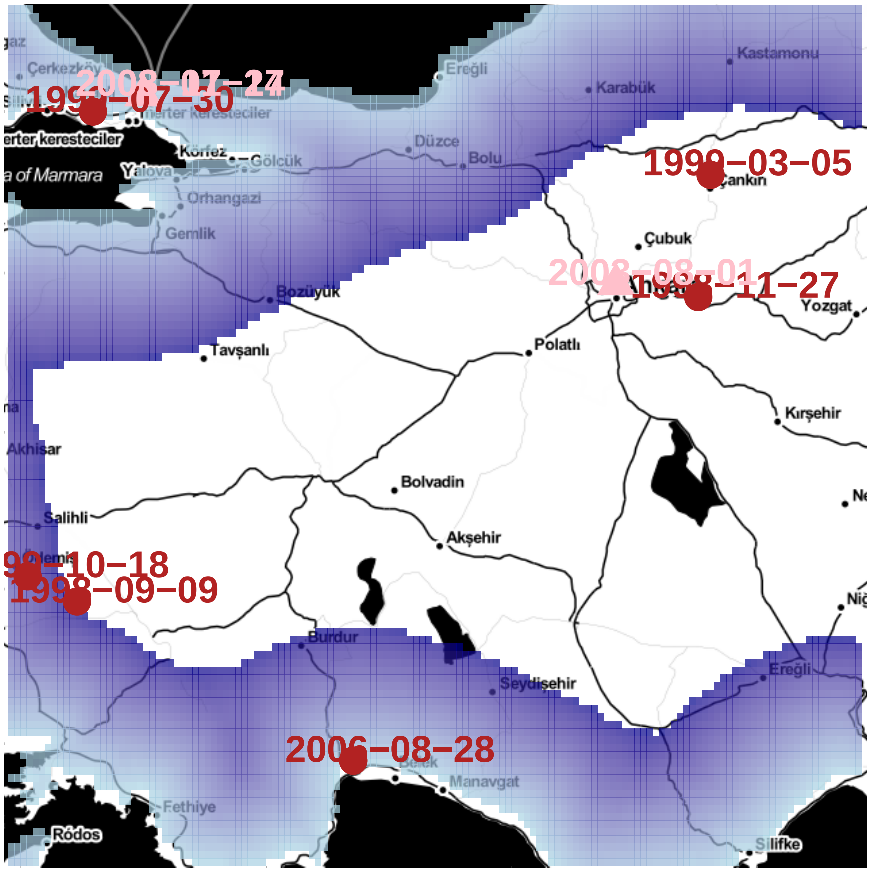

Figure 4: Population Density in Turkey and example attacks

Analysis

As of now, we were not able to clean the full GTD dataset and interpolate all missing date to enable full time variance. Therefore, we selected a subset of the merged and added to GTD as a base for our Panel Data analysis.

- First, we subsetted the GTD for attacks after 1998, because we did not find a suitable working solution for the change of collecting entitiy
- We also only selected countries in which the total number of human victims was greater than 40. We did this to save processing time and have results primarily based on countries with large terrorist activity, or terrorist activity with a high impact.
- Finally, we improve a weighting ratio on all the underlying variables for the IVs based on the data quality we achieved through cleaning the data as of now.

For the project as of now, we have one hypothesis:

H0: Terrorist attacks move to urban and/or connected and/or coastal and/or crowded environments faster than the general global urbanization trend.

Results

INCLUDE REGRESSION TABLE

IV.Time

We find neither a strong, nor a significant effect for the progress on time on any of our variables. The effect on DV.Target.Coastal seems to be the strongest, yet without any statistical significance. We do not find that surprising. While there is a global trend for urbanization, the trends are spatially diverse and it would not be plausible to expect a targeting practice effect just by the fact that time goes by.

IV.Urban.Share

With the exception of DV.Target.Coastal, we find rather strong and highly significant effects for the increase in urban population and attacks on urban environments. Surprisingly, these effects are negative. That would mean that instead of terrorist serving as a "vanguard" of urbanization, they are actually delayed. The minimal and insignificant effect on DV.Target.Coastal could be explained by a possible lack of correlation between a trend of urbanization and the fact that humans have always tend to live closer to coasts. Another apparent thing is that for IV.Urban.Share, most of our findings are significant at the 0.01 level. We think this is because for this IV, we have the most complete set of information over decades - we use several data sources, different interpolation methods and many different underlying variables, leading to the most precisely operationalized IV.

IV.Urban.Share_Year

We find no statistically significant or strong acceleration effect for the change of targeting behavior.

IV.Pop.Coastal.Dist

We find some minor, negative effect for most DVs, but only a high statistical significane for DV.Target.Coast that may be caused by endogenity. Similar to IV.Urban.Share, terrorists seem to follow general population movements rather than coming before them.

IV.Pop.Coastal.Dist_Year

Here, we find very weak, but somewhat statistical significant negative effect for most DVs, leading us to interprete that terrorista over years did even slow down more in following the general population movement.

Hypothesis Rejection & Further Analysis

With what we have found, we can now reject our H0. In Contradiction to what David Kilkullen stated, terrorists do not seem to be quicker than the general movement of people towards more urban, connected, crowded, and coastal environments. Due to the scale of our overall project, we still believe to face preliminary results. We have gathered vast amounts of data and have progressed very far with a very intensive data cleaning and interpolation method. However, we are still working on improving data quality and hope to achieve higher statistical significance for our findings on all DVs.

Conclusion

With our large-N Panel Data Analysis on a possible movement of terrorist attacks toward urban, connected, and littoral environments based on David Kilcullens theory of terrorist moving to such environments faster than the rest of the population, we were not able to confirm that prediction. Quite the opposite, we have to reject our Null-Hypothesis based on Kilcullens primary argument. We will however further continue to improve data quality to increase statistical significance of our findings.

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