Spatial analysis of patient care site selection: introducing a TRACK-based framework

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Abstract

Guided by previous research and recent empirical analyses, this paper gives insight into elements that characterize the spatial decision making of terrorist target selection. Five key factors explain why targets are chosen by terrorists. The authors propose that, generally, targets will be selected when they are *Tolerable, Relevant, Accessible, Close and/or Known.* This is followed by a discussion of attacks witnessed between January 2013 and December 2018 in the United Kingdom, and implications.

Introduction

To date, the predominant way of understanding terrorist decision-making in regards to targeting strategies has been through an ideological lens. This is true for both media-driven explanations and academically-informed understandings. Drake[1] is one prominent example of the latter. He argues ideology constructs a terrorist's views of events, other people, sets legitimate targets, and helps displace responsibility for the violence. Drake's thesis proved highly influential. It helped spawn a great deal of, largely political science-oriented, quantitative research testing this relationship. For example, studies showed ideological predictors of terrorist group lethality[2], target choice[3] and terrorist group cooperation[4]. Case-study driven approaches also provide support.[5]

Drake acknowledges however that ideology "is not the only factor which determines whether a potential target is attacked" and only "provides an initial range of legitimate targets"[6]. For more granular understandings, we need insights from elsewhere. Recently, criminological approaches entered this discussion. Rather than focusing on an attack's ideological alignment with the terrorist group's strategic goals, criminological approaches tend to focus on the more behavioral or tactical underpinnings of terrorist attacks. Whilst ideology sets out a range of potential targets, criminological understandings may help us understand why a particular target was chosen over ostensibly similar others. For example, criminological approaches have examined spatial, temporal and spatio-temporal patterns[7], the distances travelled to commit an attack[8], the influence of local infrastructure[9] and situational crime prevention[10]. Collectively, the studies suggest the process is similar to criminal decision making.[11]

Prior to much of this research, Clarke and Newman[12] developed the 'EVIL DONE' framework to explain terrorist decision making regarding targeting. The framework suggests terrorists are influenced by the degree to which a target is *exposed, vital, iconic, legitimate, destructible, occupied, near* and *easy*. This paper builds on EVIL DONE's foundations by incorporating recent empirical research and by accounting for the very different operational dynamics of terrorism present in the ISIS-inspired era. We suggest a terrorist's spatial decision-making process is shaped by the degree to which a potential target is *Tolerable, Relevant, Accessible, Close and/or Known (TRACK)*. We provide the empirical grounding for the model's development and apply the model to recent terrorism cases in the United Kingdom.

Overview

Terrorist tactics and strategies are continuously changing in response to increased counter-terrorism capability. There has been a clear shift from attacks on high impact high security targets to high impact low security targets with numerous casualties[13]. From a rational perspective, targets with less situational protective measures may be value maximising due to the ease of operation. Recent high-profile ISIS-inspired terrorist attacks heightened national security concerns in Europe. The 2017 attacks in the UK especially demonstrated a relatively low level of sophistication that went undetected. Lone actors especially pose several challenges for law enforcement. Given the recent substantial increase in the number and diversity of lone actor attacks, it is important to establish patterns related to target selection to aid prevention and investigation efforts.

Committing an act of terrorism, whether under the guidance of a wider network or as a lone attacker, is a purposeful behavior that is guided by rationality. Terrorists make carefully calculated cost–benefit decisions that are utility maximizing and likely to increase their probability of success in much the same way as 'ordinary' criminals[14]. Although the 'best' choice may not be taken, a deliberative process of purposive thinking will have been engaged with. All types of terrorist attack depend on a combination of multiple opportunities. In turn, each specific attack type offers its own set of environmental opportunities that can be manipulated with the intention of impacting the offender's cost–benefit calculus and disrupting the terrorist act. Terrorists, be it group or lone actors, may potentially have an unlimited number of targets they could select from. However, they do not all offer the same opportunity for attack.

Collectively, rational choice perspectives, routine activity theory and crime pattern theory suggest offenders will actively select areas and targets in a way that minimizes effort and risks and maximizes rewards[15]. If terrorists are selecting targets in a rational manner, then the spatial distribution of attacks should be non-random. When examining terrorist acts, it is evident that, just like more traditional crimes, attacks do not occur randomly across time and place.[16]

Typically, terrorists focus on tactics that offer them the most utility. However, if they will be more effective, terrorist decision-making demonstrates an acceptance of riskier tactics[17]. Terrorists tend to use suicidal tactics where the probability of being detected and apprehended is high[18]. For example, suicide attacks are common inside Israel, where security levels are very high, but are rarely used in the West Bank and Gaza. Hit-and-run attacks are more practical due to the large choice set of soft targets, such as soldiers travelling on roads that pass through heavily populated areas.[19]

There have been very few attempts to develop models that give a better understanding of why targets are selected by terrorists. At present, the most commonly used model of terrorist target selection is Clarke and Newman's 'EVIL DONE', introduced in their 2006 book entitled 'Outsmarting the Terrorists'[20]. The model is based on situational crime prevention (SCP), relating to the proximal characteristics that allow the perpetrator to successfully complete an attack. Target attractiveness is considered by the following factors: *exposed, vital, iconic, legitimate, destructible, occupied, near* and *easy*. A limitation of Clarke and Newman's work is that, due to the time at which it was introduced, much of it is anecdotal and not guided by empirical evidence.

The present model should not be viewed as a criticism of Clarke and Newman's 'EVIL DONE', as its focus on high impact attacks by foreign based terrorists was appropriate at the time it was

introduced. Terrorist strategies are continuously changing in response to increased counter-terrorism capability. Most recent attacks have been of low risk and on soft targets, meaning EVIL DONE's high level focus, and certain factors of the model such as *vital, iconic* and *destructible,* may now be less pertinent.

TRACK

The following framework is based on five factors that may increase the attractiveness of a potential target: *tolerable, relevant, accessible, close* and/or *known (TRACK)*. These five elements are not a definitive list of features of attack commission (preventive actions should be focused on specific types of attacks to maximize effectiveness) but are designed to give an insight into an offender's spatial decision making. They may be more or less relevant in different contexts and are intended to cover all types of terrorist related incidents, by both group and lone actors. As such, some elements of the model may be more pertinent for some types.

Tolerable

Is the individual able to reach the point of attack at this target without being overcome by fear/anxiety? How high is the risk of detection (up to the point of attack implementation, i.e. not during or post attack)?

Situational factors that increase the risks associated with a criminal opportunity can strongly influence criminal decision-making. In a study of terrorist autobiographies, Gill et al[21] found that, no matter the length of the planning process, terrorists weighed up various risks and benefits during the planning phase. Several potential targets were kept in mind before the one with the relatively fewest risks was chosen. The factors considered by the terrorist offenders encompassed both subjective and objective factors and reflected many criminological findings related to criminal cost–benefit decision making. There were numerous depictions of how fear and nerves negatively impacted the decision-making processes in planning and carrying out an attack. These appeared to be most intense during the commission of an attack.

The weighing of security features may necessitate hostile reconnaissance, which itself offers risk to the terrorist in terms of detection. Gill et al[22] found that the conscious awareness of these objective security factors often led to doubts, irregular behavior, and an almost paranoid state where the terrorists often over-exaggerated the degree to which they were being watched and the number of security measures present. Perceptions of how effectively deployed the security was important in this process.

For events such as criminal damage acts committed by domestic extremists, the effects of situational crime prevention measures may be less of a deterrent. This may be because this is a low risk event, and the individuals involved believe that the rewards outweigh the risk. A recent analysis demonstrated that the presence of lighting and CCTV did not deter domestic extremists from committing criminal damage[23]. It is also possible that the target selected was one of many targets, and that the one selected was the one perceived as the least risky (or most convenient). How the offenders perceive the effectiveness of proximal security measures is important. Criminological studies generally highlight that offenders' perceptions of how security is deployed as opposed to solely their presence is what matters in their risk calculus.[24]

Complex attacks, such as those on iconic targets with high levels of security are likely to be beyond most lone actors' individual capability. The level of protection and difficulty in

accessing these types of targets increases the complexity of the attack, which is amplified for lone actors as they lack human capital. Sixty per cent of Becker's[25] sample chose civilian targets; hard targets, such as governmental or military targets, tend to be avoided.[26]

Relevant

Is the target relevant to the ideology of the individual/group?

As with ordinary criminals, terrorists make a series of cost-benefit analyses to judge whether a particular offence is worth committing. Unlike ordinary criminals, their decision also has to fit their overarching ideological goals. it should be therefore assumed that the spatial decision making of an individual regarding target selection will be influenced by interpretation of ideology in some way. Terrorists, being utility maximising, will target areas that they perceive will offer the highest rewards. Rewards may be dependent on the availability of suitable victims. Specific structures will increase the attractiveness of the area, as the likelihood that a suitable target is present will increase.

The subject(s) of an attack may not always be explicitly symbolic, but attacks will generally be designed to communicate a message. As Asal et al[27] state *"the image of civilians dying can be much more powerful than the image of an attack on soldiers or police officers, as this risk is considered to be an element of the job."* For ISIS, anyone who rejects Sharia law can be considered a legitimate target. Scholars have argued that this 'us vs them' dichotomy between members and non-members of an organization eases the process of viewing civilians as legitimate targets.[28] This mindset and legitimization of civilian targets may lead to an increase in attacks against softer targets, as they are not worried or constrained by fear that the use of excessive violence will lead to condemnation.[29]

In a recent study of the target selection of lone actors in the US and Western Europe, most selected targets that could be considered 'symbolic', i.e. buildings or persons that would serve as a symbol of the individual's grievance.[30] Those with single issue grievances tended to attack 'iconic' targets. They may have a limited choice set when compared to other grievances and may be more likely to travel further afield and beyond their awareness spaces. The individual may be willing to travel further, and to unfamiliar areas, to commit an attack on these targets. Ideology can therefore be considered a limiting factor in target selection.

Individuals travelled further for iconic targets than symbolic or arbitrary targets, and further for symbolic targets than arbitrary targets. This suggests that a consideration of costs vs. benefits may take place in decision making regarding target selection, and that there is a trade-off between distance to the target and the representative value of the target, as lone actors are willing to travel further for targets that are more in line with their grievance.

For urban crime, offenders will travel further if they feel the potential value is higher. Crimes against properties usually require more planning and tend to involve longer distances than crimes against individuals, which are often of an opportunistic nature. This was supported for lone-actor terrorist attacks in Marchment et al.[31] Those who attacked symbolic buildings travelled much further than those who attacked symbolic persons.

Marchment and Gill[32] (found that, all else being equal, an area was 14 times more likely to be selected to target if it contained an army base or police station. These features may have

increased the likelihood of an attack due to the availability of targets in line with their ideology in the surrounding areas, i.e. officers travelling to and from work.

Accessible

Is the target itself, whether it be a building or an individual, easily accessible? Is it easy for the offender to get to the target from their origin, i.e. via major roads?

Target accessibility may be another crucial component of target selection. It is likely that areas that are more connected to other parts of the city will experience more attacks than those that are not. For example, the existence of a major thoroughfare in the area may influence the likelihood of an area being chosen. Major roads facilitate travel around the city and are therefore more likely to be travelled on more often than other smaller streets. Thus, an individual's familiarity with the area surrounding major thoroughfares is increased.[33] This in turn increases both their awareness of opportunities and their awareness of entry and exit points.

Similar previous research into more traditional crimes such as burglaries suggests that the risk is higher in places that are more connected to others, as they are more likely to feature in an offender's route[34]. The types of streets least likely to experience urban crimes are cul-de-sacs and private roads[35], even when accounting for factors such as levels of deprivation.

Gruenewald et al[36] found a preference for 'accessible' and 'easy' targets for eco-terrorists in the United States. Schuurmann et al[37] found that in cases where lone actors considered several targets, a constraining factor was the accessibility of the target. Ozer and Akbas[38] suggest the reason one of the major police stations in Istanbul is targeted by terrorists is because this station is connected by major streets. They found that all of the buildings targeted by the Partiya Karekeren Kurdistan (PKK) during the period studied were easily accessible. Likewise, Marchment and Gill[39] found that the likelihood of an area being selected by PIRA to target increased if the area contained a major road. Marchment[40] also found that areas in Belfast that experienced incidents committed by dissident Republicans were significantly more likely to be in closer proximity to major roads than those that didn't.

Zhukov[41] demonstrated the importance of road networks in a study of insurgent activity in North Caucasus and concluded that they were the most important determining factor for the location of attacks. Roislien and Roislien[42] also highlight the importance of accessibility in the target selection process: *"*Settlers and soldiers use roads that pass through heavily populated areas or through terrain that is easily attacked. . .. The result is that an attacker can fire a weapon or detonate a bomb remotely in such a way that makes escape relatively easy afterwards. . .. In contrast, targets on the Israeli side of the 'green' line are much 'harder', posing much greater risks for the attacker.*"*

Torres-Soriano[43] used a case study of a terrorist cell in Barcelona to examine processes of target selection. They found that the flow of traffic around the city determined which buildings the terrorists could photograph from their cars, which had an influence on the ones they could potentially target. They found that the distance the terrorists could walk from their meeting point at the central train station in Barcelona had a conditioning effect on the targets that would or would not appear in their sights. The authors also note that one member of the cell, Said Touay, focused on a particular police station as it was visible from the car on a routine journey he made.

Close and/or Known

Is the target close to the home location or other activity nodes of the offender? Is the target known to the individual through their awareness space or hostile reconnaissance?

One of the most fundamental relationships in environmental criminology is that of spatial interaction and distance. Collectively, the rational choice perspective, the routine activity approach and crime-pattern theory suggest offenders will actively select areas and targets in a way that minimizes effort and risks and maximizes rewards[44]. Offenders are more likely to attack within their awareness space. Awareness space includes the area close to their home and other activity nodes such as place of work/education, previous addresses and places of recreational activity. Most geospatial research is guided by the least effort principle[45] which intimates that when considering a *"number of identical alternatives for action, an offender selects the one closest to him in order to minimize the effort involved".* [46]

As well as considering effort, the risk of interception before an attack will also be deliberated. Racial or ethnic barriers may also further restrict an individual's willingness or capability to travel further from their home to commit an offence. Bernasco and Block discuss how travelling to unknown areas may increase risk, "for individuals who plan illegal activities, it may be outright dangerous. Strangers 'stand out' more easily in unknown territory, that is, in places where they do not know the customs and rules of the street and possibly dress and behave in ways that attract the attention of the local residents …. In segregated cities, those who cross racial or ethnic boundaries cannot blend in easily are likely to be recognized as strangers in the community and be subjected to the 'social eyes' of the local population." [47]

Distance is consistently highlighted as an important factor in terrorist target selection criteria.[48] The distance decay function that is evident when examining urban crimes has been replicated in group and lone-actor terrorists, with frequency of attacks decreasing as distance from home locations increases. As well as considering effort, the risk of interception before an attack will also be deliberated.[49]

Proximity to a terrorist's home location has shown potential to be a useful predictor of where an attack may take place for group-based terrorism. Cothren et al[50] found that just under half of group-based attacks occurred within 30 miles of the offender's home location, while Clarke and Newman[51] argue that "proximity to the target is the most important target characteristic to terrorists". A distance decay pattern has also been identified when examining the activities of the Provisional Irish Republican Army (PIRA). Nearly two thirds of a sample of core active members travelled less than 4 miles to commit their attacks, with 40% of all attacks occurring within 1 mile of the offender's home location.[52] Using the discrete choice approach Marchment and Gill[53] treated distance as an explanatory variable, rather than a dependent, alongside other decision criteria to analyze PIRA's target selection. A one-kilometre increase in distance decreased the likelihood an area would be attacked by a factor of 0.61.

Geographical constraints may be amplified for lone-actor terrorists. As lone actors lack the resources and support of a wider network it is likely that they will keep distances travelled minimal, to increase the utility of their attack.[54] LaFree, Yang and Crenshaw[55] concluded that 96% of domestic anti-US attacks between 1970-2004 involved local targets close to terrorists' home. Cothren et al[56] found that 44% of group attacks in the US took place within 30 miles of the home location.

Marchment et al[57] found lone-actor terrorist attacks in Europe followed a clear distance decay pattern. They found a high concentration of attacks occurred around the actor's home in Europe, with more than half (56%) of all the attacks occurring within 2 miles of the home location. The mean trip length for iconic targets was much longer than for symbolic or arbitrary targets. Those attacking arbitrary targets travelled the shortest distance of the three target types studied. These differences were statistically significant. It is likely that the attacks on arbitrary targets were more spontaneous and involved less planning than the other attacks and therefore occurred closer to home. Also, as the targets were not symbolic, it could be that the terrorist saw anyone as a legitimate target, which supports the theory that an individual will only travel further when no appropriate targets are available. The distance decay pattern of Islamist and right-wing extremists was similar to that of urban criminals and group terrorists. Single issue terrorists travelled further. This may be because they have a limited choice set of relevant targets to select from when compared to other ideologies. They therefore may be more likely to travel beyond their awareness spaces into unfamiliar areas further afield. For example, anti-abortionists in the U.S. may be forced to travel to different states due to the varying legality of abortions in different states. Ideology can therefore be considered a limiting factor in target selection.

Whilst the vast majority of the lone-actor terrorists in Marchment's et al's study travelled short distances, they note that there were outliers worthy of discussion[58]. Many of these outliers might simply be depicted as such because "residence" can be an imprecise indicator of awareness space. An individual's full awareness space is guided by other locations of their daily routine activities or past residences. Individuals have a range of routine activities, involving home, work, school, recreation etc., which increase their awareness space. This familiarity and increased knowledge of an area allows for a better evaluation of risks and minimizes the effort of locating suitable targets. This highlights the importance of considering the whole awareness space of an individual. Even when individuals travel great distances, and the attacks are seemingly random, there is a strong likelihood of some identifiable geographical connection between the terrorist and the target. Previous addresses, place of work/higher education also warrant consideration.

Eby's[59] analysis of 53 lone-actor terrorists in the USA found a large range of distances between home and target locations. It was illustrated that many of the actors remained in their hometowns in their attack attempts, although six of his sample travelled extremely long distances. Becker found that lone actors were more likely to attack within their awareness space. Previous research such as this had concluded that lone actors are not geographically constrained and willing to travel long distances to commit their attack. However, the findings of Marchment et al[60] suggest that this was due to the homogenous approach of previous studies. The findings of these studies are likely to be skewed by a small number of lone actors with single issue grievances who may have also attacked iconic targets. When these cases are removed and symbolic targets are considered, it is proposed that lone actors will travel further when it is necessary for them to do so because the availability of relevant targets is limited.

Gill et al's[61] study on terrorist decision making also found that previous successful experiences decreased averseness to risk. Results from a recent study[62] of risk factors of violent dissident Republican bombings and bomb hoaxes indicated that they were more likely to occur in areas where other dissident Republican activity, such as punishment attacks, protests and riots had previously occurred. This suggests that individuals are more likely to attack in places they know.

If the target is not known to the individual through their awareness space, they often conduct hostile reconnaissance of the target prior to the attack, to evaluate the security features in place. Schuurmann et al[63] found that 49% of lone actors in their study conducted reconnaissance of their target either online or in person.

This type of behavior offers opportunities for disruption. Eric Rudolph entered Centennial Park a few days before his bombing to assess the security measures in place at the entrance. He discovered that it would be very difficult for him to avoid being seen by one of the security cameras and as such decided to wear a disguise on the day of his attack.

Domestic extremists tend to conduct reconnaissance at the target location, and research situational conditions that may affect their plans[64] . This process of planning and preparation often incorporates the use of tactics to mitigate the risk of detection. Domestic extremists may also be influenced by 'training' from groups, which makes them more forensically aware[65]. For example, the Anarchist Black Cross Federation offers training in direct action tactics as well as counter-surveillance, forensics and policing tactics to avoid apprehension.[66]

Illustrative Examples

This section provides an analysis of terrorist incidents in the UK between January 2013 and December 2018, to see if the factors put forward in the TRACK framework were reflected in attacks. This starting point was chosen due to a notable increase of frequency and lethality in attacks in the UK.

Inclusion Criteria

Only those attacks resulting in injuries or fatalities in the UK between January 2013 and December 2018 were considered. For an attack to be considered *tolerable* there were low situational security measures present at the target, as well as a low risk of detection or apprehension before attack implementation. To be *relevant* the target was considered to be symbolic of the ideology of the individual and designed to send a message. *Accessible* referred to the targeted building or individual being in an easily accessible area of the city, i.e. adjacent to or on a major road. For the London attacks, it was possible to quantify accessibility using a betweenness centrality measure of the road network [67]. The higher the betweenness score, the more likely it is that it will be travelled upon. Scores ranged from 0 to 581642044. These were divided into five levels according to Jenks natural breaks optimization to minimise the variance within classes and maximise the variance between classes.[68] These were as follows: very low (0 – 19814298); low (19814299 – 63524352); medium (63524353 – 124349532); high (124349533 – 214476388) and very high (214476389 – 581642044). To be considered as *close* the target was within 10 miles of the perpetrator's home address, based on findings from Marchment et al.[69] In the case of more than one attacker, the mean distance was used. Evidence of previous history of the perpetrator(s) at attack location i.e. place of work, education, previous address, etc., or evidence of hostile reconnaissance was used to determine whether the target could be considered as *known.* Table 1 outlines the results.

[TABLE 1 ABOUT HERE]

On 22nd May 2013, Michael Adebolajo and Michael Adebowale attacked fusilier Lee Rigby near the Royal Artillery Barracks in Woolwich, London. The victim was run over by Adebolajo and Adebowale before being stabbed to death. They dragged his body into the road, where they remained until the police arrived. Both perpetrators were non fatally shot when they charged at armed officers.

Tolerable: It can be inferred that Adebolajo and Adebowale did not directly attack within the barracks as they knew they would be unable to get on site due to the high security in place. However, the barracks' surrounding areas would have offered several potential targets, i.e. soldiers travelling to and from the base.

Relevant: The victim was returning to the Royal Artillery barracks after working at a recruitment fair for the 'Help for Heroes' charity, when he was spotted by Adebolajo and Adebowale. 'Help for Heroes' is a well-known U.K. charity that provides support for armed forces veterans and their families. As he crossed Wellington Street, the road adjacent to the barracks, they noticed his military backpack and 'Help for Heroes' sweatshirt. Adebolajo and Adebowale told witnesses of the attack that they had selected a member of the British armed forces to avenge the killing of Muslims. He proclaimed, "We must fight them as they fight us. An eye for an eye, a tooth for a tooth", and "The only reason we have killed this man today is because Muslims are dying daily by British soldiers. And this British soldier is one...". Adebolajo told detectives they were determined to murder a soldier because they were "the most fair target", and that they attacked the victim because "it just so happened that he was the soldier that was spotted first".

Accessible: The barracks are immediately adjacent to a major road (A205). The victim was returning to Woolwich barracks after working at the Tower when he was spotted by his killers in Wellington Street at around 2.20pm. CCTV shows Adebolajo and Adebowale driving around the barracks searching for a target for around an hour before the attack. The road adjacent to the barracks has a high betweenness measure (124349534).

Close/Known: Adebolajo and Adebowale were both born in London: the former in Lambeth, and the latter in Greenwich. Adebolajo attended the University of Greenwich. Greenwich is approximately 3 miles from The Royal Artillery Barracks where the attack occurred. One report places Adebolajo as a regular volunteer at an extremist stall outside a bank in Woolwich High Street, where he would distribute Islamist propaganda. Woolwich High Street is less than 1 mile from the barracks. Another witness states that Adebolajo had been seen outside a nearby community center encouraging people to fight in Syria, which is around half a mile from the barracks.

Thomas Mair

On 16th June 2016, Thomas Mair killed Member of Parliament Helen Joanne Cox (known as Jo) outside a library in Birstall, Yorkshire. Cox was shot and stabbed multiple times. A local resident, a 77-year-old man named Bernard Kenny, was also stabbed in the stomach but survived his injuries. Mair was arrested shortly after the attack.

Tolerable: Mair chose to attack Cox outside his local library where he knew she was due to hold a constituency surgery. He carried a firearm and bladed weapon on his person which may have increased fear of detection, but as he travelled a very short distance to commit his attack

(around 1 mile) it was unlikely that he would have been disrupted. The attack occurred while Cox was on her way to the surgery.

Relevant: Mair had links to far-right extremism, including the National Front and English Defence League. He believed individuals who were liberal and left-wing to be the 'cause of the world's problems'. A witness stated that Mair shouted "This is for Britain. Britain will always come first". He targeted Cox as he believed her to be a "passionate defender" to the European Union and a "traitor" to white people.

Accessible: The library is on the main road that runs through the center of the town and connects it to the next town.

Close/Known: Mair lived 1 mile away from the library where he attacked Cox.

Khalid Masood

On 22nd March 2017, Khalid Masood used a sport utility vehicle to drive into pedestrians on the pavement of Westminster Bridge in London, before driving into the perimeter fence of the Palace of Westminster. 5 individuals were killed, including an unarmed police officer, and 49 non-fatally injured. He was shot by an armed police officer and died at the scene.

Tolerable: Masood was shot by an armed officer and died at the scene. It can be inferred that he did not attempt to directly attack individuals inside the Palace of Westminster, or the building itself, due to the visible security including multiple armed officers. There were no restrictions in place for the hire or purchase of this type of vehicle, so the risk of detection through suspicious purchases or behavior was low.

Relevant: The Palace of Westminster is the meeting place of the houses of the Parliament of the U.K.: the House of Commons and the House of Lords. In the last 'WhatsApp' message sent before he committed the attack, Masood reportedly stated that he was waging jihad in revenge for Western military action in Muslim countries of the Middle East. He had also written a document named "Jihad in the Quran and Sunnah", which was sent to numerous contacts a few minutes before the attack. His photograph was on the front page and it contained multiple extracts from the Quran that could be seen as supportive of jihad and martyrdom. The attack occurred exactly 1 year after the bombings at Brussels airport and Maalbeek metro station in Belgium (22nd March 2016), which were claimed by ISIS.

Accessible: Westminster Bridge is one of the relatively few public roads connecting the north and south of the River Thames. The betweenness score for Westminster Bridge is high (205006642).

Close/Known: Three days before the attack, on 19th March, Masood conducted reconnaissance of Westminster Bridge in person as well as online. At the time of the attack Masood was based in Birmingham. He had previously lived and worked in Luton (around 30 miles from Westminster bridge).

Salman Abedi

On 22nd May 2017, suicide bomber Salman Abedi detonated an improvised explosive device laden with shrapnel in the foyer of Manchester Arena as people were leaving an Ariana Grande concert. 22 people were killed and 139 were wounded, more than half of which were children.

Tolerable: Abedi attacked in the foyer of the arena once the concert had finished. At this point, bag checks were no longer being conducted so there was a low likelihood that the bomb would be detected before detonation. Old Trafford, the home stadium of the premier league football club Manchester United, is around the same distance as the arena from Abedi's home address. However, Abedi decided against Old Trafford due to situational protective measures such as metal detectors.

Relevant: Abedi had links to ISIS and regularly attended a mosque in Manchester that has links to the Muslim Brotherhood. The date of the attack was the four-year anniversary of Lee Rigby's murder.

Accessible: The arena is adjacent to the Manchester ring road that encircles the city center.

Close/Known: Abedi was born in Manchester in 1994 and lived 4 miles away from the arena.

Khuram Butt, Rachide Redouane and Youssef Zaghba

On 3rd June 2017, Khuram Butt, Rachide Redouane and Youssef Zaghba deliberately drove a van into pedestrians on London Bridge before stabbing individuals in and around pubs and restaurants in the Borough Market area. 8 people were killed and 48 were injured, including four armed officers.

Tolerable: MI5 report that Butt was aware of operational security and took measures to avoid detection prior to the attack. As this was a run-over attack there was little chance that the van would be intercepted and searched before the attack. There were also no restrictions in place for the hire of the vehicle.

Relevant: Butt's wife's cousin, Fahad Khan, said Butt openly expressed extremist views at family gatherings. He stated that Butt watched propaganda videos made by ISIS and wanted to travel to Syria.

Accessible: Like that of Masood's attack, London Bridge is a major public road connecting the north and south of the River Thames. The betweenness measure for London Bridge is very high (581222902).

Close/Known: Redouane lived in a bedsit in Barking, London. It is believed that the trio made preparations for the attack in this location. Butt lived nearby, also in Barking. The area of Barking is 8.5 miles from London Bridge. Zaghba lived in Ilford, east London which is around the same distance away. One eyewitness said they saw Butt conducting reconnaissance of the London Bridge area, Trafalgar Square and Oxford Street in the days leading up to the attack. Butt had also previously worked on Oxford Street. On the night of the attack, the attackers conducted a 'dry run', driving over London Bridge 9 minutes before they commenced their attack. Two years before the London attacks Butt and Redouane are thought to have carried out reconnaissance of several prominent locations for a possible attack in Ireland.

Darren Osborne

On 19th June 2017, Darren Osborne drove a van into pedestrians in Finsbury Park, London, near the Muslim Welfare House and Finsbury Park Mosque. The attack caused one death and 9 people were injured. The attacker was restrained at the scene by passers-by until police arrived.

Tolerable: There were no security measures in place at the mosque or the surrounding areas. Like the other vehicular attacks, there were no restrictions in place for the hire of the vehicle. Staff at the company in Wales where Osborne rented the van said there appeared to be nothing unusual about the transaction and that Osborne was "polite and well-mannered".

Relevant: The attack occurred during Ramadan, the ninth month of the Islamic calendar, in which Muslims fast (Sawm) to commemorate the first revelation of the Quran to Muhammad according to Islamic belief. Osborne had accessed far right anti-Muslim material in the weeks leading up to the attack. He had also received at least two messages from Tommy Robinson (real name Stephen Yaxley Lennon), the far-right former English Defence League leader. Scotland Yard's counter terrorism command stated that online material from Robinson played a "significant role" in Osborne's radicalization. Osborne was overheard telling drinkers at a pub in Cardiff that he was a "soldier", claiming "all Muslims are terrorists", and he would "kill Muslims", the night before the attack. A handwritten note was found in the cab of the van after the attack. The note detailed complaints about terrorists on the streets and the Rotherham grooming scandal, and branded Labour Party leader Jeremy Corbyn a "terrorist sympathizer".

Accessible: In court**,** Osborne stated that road blocks had "thwarted" plans to attack the pro-Palestinian Al-Quds Day march in Mayfair, which was his intended target. He then travelled across London in search of a mosque, leading to the attack in North London later in the day. Finsbury Park Mosque is adjacent to an A-road and has a high betweenness score of (184318823 high).

Close: Osborne's home was around 150 miles away from the mosque. He stated that he had initially hoped to "plough through" as many people as possible at the Al-Quds Day march and hoped it would be attended by Jeremy Corbyn. It could be that Osborne travelled so far due to the increased amount of potential value the march offered.

Known: There is no evidence to suggest that the target area was known to Osborne.[70]

Implications

This paper has demonstrated that paradigms from environmental criminology are useful in the study of terrorism and determined that target selection is the confluence of multiple factors that should be considered when assessing risk. The TRACK framework provides a good starting point for more in-depth frameworks tailored to specific attack types. Most attacks studied in the illustrative examples demonstrated all elements of the framework, and all of them displayed the first three of the five factors: *tolerable, relevant* and *accessible*. This indicates that the first two SCP techniques - *increase the effort* and *increase the risks* - could be particularly pertinent for the proximal prevention of terrorist incidents. For terrorists, the latter three principles – reduce the rewards, reduce the provocations and remove the excuses – may require more distal measures.

Reducing the opportunities for terrorism via environmental design is a valid and worthwhile pursuit. Each type of terrorist attack, be it a vehicular assault or a bombing, depends on a crystallization of multiple opportunities. In turn, each specific attack type offers its own set of environmental opportunities that can be manipulated with the intention of impacting the terrorist cost–benefit calculus. Such endeavors increase the effort via target hardening, controlling access to facilities, deflecting offenders, and controlling access to the necessary weapons. They also increase the risks by extending guardianship, assisting with natural surveillance, increasing surveillance.

The presence of situational factors providing guardianship increases the risk of apprehension. The weighing of security features necessitates hostile reconnaissance which itself offers risk to the terrorist in terms of detection. An important mechanism for disruption is the perception of the offender that their inappropriate behaviors could be observed and thus increase their risk of detection[71]. The offender's perception of a situation and how this relates to their decision to commit the attack is essential. Therefore, it logically makes sense that proxy measures such as CCTV (whether manned or otherwise) or factors that make it more likely that a guardian will observe the crime should be incorporated within the concept of 'guardianship'. These levels of guardianship indicate an increased amount of risk alluding to risk of apprehension, increasing fear in the offender.

The opportunity to commit an attack depends on finding a suitable target that is insufficiently guarded[72]. Softer targets, for example areas where people are likely to congregate, should be target hardened to increase the effort required to execute an attack. Security measures such as barriers, gates and the increased presence of police officers may be effective tools in achieving this. There are several measures that can be implemented in a subtle fashion. Anti-ramming landscape features are now prevalent in the architectural design of London and other major cities. Reinforced concrete planters, bollards, and/or benches that can withstand vehicle-borne impact are placed in-between roads and important buildings, acting as a 'standoff' buffer zone. At London's Whitehall (the center for the U.K. government), steel sandwich bollards are used. Also in London, the Emirates Stadium (home to Arsenal football club) has several SCP measures in place. Large concrete letters spelling out the word 'Arsenal' at the stadium's main entrance act as a barrier to vehicles. There are also concrete benches on the forecourt, designed to prevent a vehicle from weaving across, and giant ornate cannons form an obstacle for vehicles driving towards the stadium building.

Access to populous areas could be controlled through checkpoints to increase the risk of interdiction. Levels of guardianship indicate an increased amount of risk, alluding to risk of apprehension and increasing fear in the offender. This conscious awareness of these objective security factors often leads to doubts and irregular behaviour that can be detected. It should also be considered that attacks will not always be in densely populated areas with the aim of causing mass casualties, which highlights the importance of protecting buildings and individuals that could be considered as symbolic, through increased physical security and surveillance.

We should not just be thinking about vulnerability in terms of the actual target building/person, but wider areas of vulnerability, e.g. relevant targets in accessible and tolerable areas.

Conclusions

This paper provides important insights into the spatial decision making of terrorist offenders when it comes to target selection. The factors collectively indicate that target selection is guided by an inherent logic, and that terrorists are rational in their spatial decision making. These insights are valuable for prevention and disruption efforts and could be useful for policing and the allocation of resources in response to threats. The use of this framework could be an effective starting point in narrowing down potential targets or identifying areas that would benefit from increased security such as target hardening.

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Table 1. Presence of TRACK Framework Characteristics in UK Cases

Perpetrator(s)	**Date**	**Target(s)**	**T**	**R**	**A**	**C**	**K**
Michael Adebolajo, Michael Adebowale	22nd May, 2013	Fusilier Lee Rigby	Y	Y	Y	Y	Y
Thomas Mair	16th June, 2016	MP Jo Cox	Y	Y	Y	Y	Y
Khalid Masood	22nd March, 2017	Westminster Bridge	Y	Y	Y	N	Y

Salman Abedi	22nd May, 2017	Manchester Arena	Y	Y	Y	Y	Y
Khuram Butt, Rachide Redouane, Youssef Zaghba	03rd June, 2017	London Bridge	Y	Y	Y	Y	Y
Darren Osborne	19th June, 2017	Finsbury Park Mosque	Y	Y	Y	N	N