

## **Lone-Actor Terrorists: A Residence-To-Crime Approach**

Environmental criminology is concerned with understanding the role of settings and geography more broadly in crime, as well as other related, proximal determinants of criminal activity with an emphasis on the role of person-situation interactions.<sup>1</sup> The approach has been very influential in shaping thinking and practice in crime prevention over the last forty years, growing hand in hand with the evidence-based policing movement.

Insights from environmental criminology are increasingly prevalent within the study of terrorist behaviour. Much of the attention has been on the degree to which terrorist attacks are spatially and/or temporally clustered.<sup>2</sup> Other studies have focused upon the geographic and situational determinants of terrorist risk in a given terrain<sup>3</sup>, whether attacks increase due to symbolic dates or special events<sup>4</sup>, the socio-spatial dependencies in terrorist networks<sup>5</sup> and the situational and individual predictors of target selection.<sup>6</sup>

Most pertinently for this article, previous studies also illustrate that terrorists display similar distance-to-crime patterns as ordinary criminals.<sup>7</sup> Such studies have typically looked at group-based actors. This study extends our knowledge of terrorist environmental decision-making by focusing upon lone-actor terrorists. Whilst great advancements have been made in our understanding of lone-actor terrorists in terms of their development,<sup>8</sup> radicalisation<sup>9</sup> and attack planning,<sup>10</sup> insight on environmental decision-making in the perpetration of an attack lags behind. For the purposes of this article, we define lone-actor terrorists as individuals who carried out or planned to carry out the terrorist attack alone. Lone actor terrorists can operate with or without command and control links. Some operate autonomously and independently of a group (in terms of training, preparation and target selection etc.). Within this group, some may have radicalized towards violence within a wider group, but left and engaged in illicit behaviours outside of a formal command and control structure. Those with command and control links, on the other hand, are trained and equipped by a group – which may also choose their targets – but attempt to carry out their attacks autonomously.

Geographical constraints may be amplified for lone actors, who may lack the resources and support of a larger network. Such constraints may limit the actor's capability<sup>11</sup> and may restrict the sophistication of the attack, which is dependent on the individual's level of expertise, skills and knowledge.<sup>12</sup> In this paper, we analyse 122 attacks committed by 70 lone-actor terrorists. After investigating whether the typical distance-decay curves are present, we test individual,

motivational and target-specific predictors of the distance travelled. The results provide insight into a range of prevention and disruption approaches embedded within current terrorist risk assessment and management practices.

## **Theory**

Environmental criminology is built around a number of key theoretical approaches. The rational choice perspective of crime is premised on the notion that offenders are rational and purposeful in their decision-making, calculating the costs and benefits of action alternatives before choosing to act or not.<sup>13</sup> Of course, this rationality is subject to limits and is guided by time, effort, experience and knowledge,<sup>14</sup> leading Cornish and Clarke to further posit that offenders (and people in general) are best understood as acting with limited rationality. Simon refined this reflection and eventually introduce the concept of bounded rationality<sup>15</sup>.

The routine activities perspective, proposed by Cohen and Felson, extends the notion of the bounded rationality into the physical world and states that crime occurs when a capable offender, a suitable target and a lack of a capable guardian, come together in space and time.<sup>16</sup> These three factors often come together as a result of an individual's daily routine. Building upon this insight, crime pattern theory introduces the concept of awareness space, positing that going to and from their daily activity nodes (such as place of work or education, places of socialising or recreation) increases an individual's familiarity with an area.<sup>17</sup> This familiarity increases the likelihood that, if they are motivated to do so, these individuals will offend within that space, as they are more aware of criminal opportunities, as well as associated risks, such as chances of detection and interdiction.

One of the most fundamental relationships in environmental criminology is that of spatial interaction and distance. Geospatial research is typically guided by the least effort principle,<sup>18</sup> which posits that when an offender is considering several options for action, he or she “selects the one closest to him in order to minimize the effort involved”.<sup>19</sup> Distance to the target will be one of the criteria the individual considers when choosing a target,<sup>20</sup> and it is likely that they will keep distances travelled minimal to increase the ultimate cost-benefit ratio of their attack.<sup>21</sup>

### ***Residence-to-Crime Patterns***

Traditional journey-to-crime research for offences such as burglary has illustrated clear and consistent patterns, with distance being a key criterion that the individual considers when choosing a target.<sup>22</sup> In 1932, White conducted the first systematic analysis of crime journey distances, and since then distance-to-crime has been studied extensively.<sup>23</sup> Typically, when considering traditional offences an offender's journey-to-crime will demonstrate the distance decay effect, whereby the chances of offending and frequency of offences will decrease as the distance from the individual's home increases. Where an individual has a number of equally attractive alternatives, they generally prefer the one that is closest to them, as it takes less time and effort to reach, and therefore offers more utility to the offender.<sup>24</sup>

For traditional crimes, mean journey lengths are generally short. The average journey-to-crime distance is less than two miles, and target locations are mostly within one mile of the offender's residence.<sup>25</sup> These results are consistent across crimes<sup>26</sup> as well as over time and space, with similar results for similar crime classifications demonstrated over four decades.<sup>27</sup> Results usually demonstrate a pattern in number of offences on a per-unit basis, whereby numbers per unit decrease as distance from the home location increases.<sup>28</sup> Most studies use police-recorded data of incidents, using Euclidean (straight line) or Manhattan (city block) methods to calculate the distance between the offender's home address and the location of the crime event. van Koppen and Jansen found strong support for this notion in their analysis of robberies in the Netherlands, which displayed a clear distance decay pattern.<sup>29</sup> Bernasco's findings also demonstrated the distance decay effect in both individual and group residential burglaries.<sup>30</sup>

The same results have been found for crimes against people, where the individual's motives and actions are guided by emotion.<sup>31</sup> The spatial behaviour of serial killers shows logic<sup>32</sup> and their target selection is strongly related to their awareness space, whereby they are most likely to come across their victims during their daily routines.<sup>33</sup> Evidence of distance decay behaviour has also been found for rapes and homicides.<sup>34</sup> Davies and Dale found that the majority of rapes occurred within the immediate vicinity of the offender's home, with a reduced frequency of offences as distance increases.<sup>35</sup> When examining individual cases rather than averages of a particular crime type, a similar result is found. LeBeau found that serial rapists returned to the same location to carry out their attacks in areas familiar to them.<sup>36</sup>

For group terrorism, proximity to the target has been considered a key feature of terrorist target selection<sup>37</sup> and will be one of the criteria that the individual considers when choosing a target.<sup>38</sup> Clarke and Newman's review of counter-terrorism strategies concluded that terrorists are limited by geographical constraints in the same way as ordinary criminals.<sup>39</sup> It is likely that they will keep distances travelled minimal to increase the utility of their attack.<sup>40</sup> However, many of these proposals are yet to be empirically tested. Terrorist organisations make carefully calculated choices that are value-maximising and guided by logic,<sup>41</sup> with the intention of increasing their probability of success.<sup>42</sup> There is evidence to suggest that there is a calculation of perceived risks in the selection of targets in terrorist organisations at the group and individual level.<sup>43</sup> LaFree, Yang and Crenshaw conclude that 96% of domestic anti-US attacks between 1970-2004 involved local targets close to terrorists' home.<sup>44</sup> Cothren et al. found that 44% of group attacks in the US took place within 30 miles of the home location, though this study may have had some limitations as only attacks in the US were examined.<sup>45</sup> A recent investigation of attacks by PIRA found that nearly two thirds of their sample travelled less than 4 miles to commit their attacks, with 40% of all attacks occurring within 1 mile of the offender's home location.<sup>46</sup>

Eby's analysis of 53 lone actors in the USA found large variations in distances between home and target locations.<sup>47</sup> Many of the actors remained in their hometowns in their attack attempts, but six individuals in the sample travelled extremely long distances. Becker examined 84 lone actors in the US between 1940 and 2012.<sup>48</sup> Most actors in his study appeared to select targets in a rational manner, but although the notion of the 'awareness space' of an individual was considered the methods used were mainly qualitative and there was no attempt to empirically examine spatial patterns. Sixty percent of the sample studied had an identifiable geographical connection to the target. However, this was not quantified, area limits were not defined, and Becker only states whether they were familiar with the target area.

Lone actors have a lower capability than terrorist groups due to a lack of skills, support and resources. Therefore, it is likely that distance will act as a constraining factor on their target selection. As such, it is hypothesized:

***H1: Lone-actor terrorist attacks will display a distance-decay function.***

Lone actors may not be part of, or actively supported by, extremist movements.<sup>49</sup> However, there is a consensus that these individuals are not all that 'alone'. Most are not completely

socially isolated, with many cases interacting with other extremists and wider networks either face to face or online.<sup>50</sup> Generally, a lone actor attack is considered by most scholars to be an attack by an individual who is not *directly instructed* to commit the attack by a group (but may have minor connections to, or be inspired by, a wider network).<sup>51</sup> From research into group terrorism it is clear that human capital is very valuable in terms of attack preparation and execution. A higher level of organisation and expertise is needed to successfully carry out complex attacks.<sup>52</sup> Individuals with command and control links with a wider network may travel further to more complicated targets if they have the support from others. More engagement with others is likely to lead to more skills and knowledge, and the ability to perpetrate a more complex attack. Given this, it is hypothesized:

***H2: Individuals with links to a wider network will travel further than those without.***

### ***Europe vs. US***

A limiting factor of previous research into terrorist target selection is that most studies only consider US cases. It is probable that the spatial patterns are different when comparing the US to Western Europe as the distribution of available and relevant targets is likely to be different. The US has a much lower population density, is a much larger country, and the distribution of ‘points of interest’ such as commercial centres is different. Many of the individuals in previous samples were living in rural or isolated areas, therefore it would make sense for them to travel greater distances.

Traditional residence-to-crime studies have found differences in distance travelled between crimes committed in the US and Europe. For example, when examining serial murderers, victims were killed an average of 1.5 miles from the home location of the perpetrator in Europe, compared with an average of 14 miles in the US.<sup>53</sup> Given these findings, it is hypothesized:

***H3: Individuals will make longer residence-to-attack journeys in the US than in Europe***

### ***Target Type***

For lone actors, it is likely that some consideration will be made regarding the availability of “good” targets which are also suitable for their goals (i.e. representative of their ideology) and

that they may travel further for targets of higher value. Regarding geographical constraints, there is likely to be a trade-off between costs and benefits in the selection of the target, with cost being the distance travelled and the benefit being the value of the target. It is likely that the balance of the value to be gained against the increased travel time required is assessed before selecting a final target.

Eby looked at the success of each attack in his sample and highlighted that there was a negative association between success and distance travelled.<sup>54</sup> However, 'success' was defined in terms of how many casualties occurred as a direct result of the attack. One of the main difficulties associated with lone actor attacks are their idiosyncrasy. It cannot be concluded that every individual's goal or aim is to cause mass casualties. Rather, it is likely that some attacks will be of a symbolic nature, in line with each individual's grievance.

In a study of Provisional IRA attacks, Gill et al. found targets deemed to be of high value were associated with much longer distances, than low value targets such as ordinary citizens.<sup>55</sup> It can be proposed that lone actors will travel furthest for an iconic target, as this has the most representative value:

***H4: Individuals will travel further for iconic targets than symbolic or arbitrary targets.***

Lone actors may choose to attack unfamiliar areas if the selected target is more in line with their ideology.<sup>56</sup> As such, it is hypothesized:

***H5: Individuals will travel further for symbolic targets than arbitrary targets***

The distance offenders are willing to travel for traditional crimes can vary depending on the characteristics of the crime event. Crimes against properties usually require more planning and tend to involve longer distances than crimes against individuals, which are often of an opportunistic nature.<sup>57</sup> Variations found in traditional journey to crime distances suggest that there is a real or perceived difference in opportunities for different crime types, and violent crimes against persons have shorter journey-to-crime distances than property crimes.<sup>58</sup> Traditional criminals will travel further if targeting specific victims or target types<sup>59</sup> for crimes that are more instrumental<sup>60</sup> and for sophisticated targets if the monetary incentive is higher.<sup>61</sup> Property crime is associated with longer distances travelled if the expected value of the

outcome is higher<sup>62</sup> with a positive relationship between distance travelled and the value of property stolen.<sup>63</sup>

Where terrorist attacks are concerned, there is often overlap in the targeting of people and property, and it is difficult to distinguish between these two groups. However, it can be proposed that, whenever persons are targeted within a symbolic building, the offender has chosen this location due to the perceived number of available and relevant targets associated with the building (for example if a mosque is targeted and individuals of the Muslim faith are attacked), and therefore the expected value of the outcome is higher.

***H6: Lone actors will travel further where a symbolic building is present compared with when a symbolic building is not present.***

### ***Grievance***

The main limitation of previous research is that lone actors are examined homogeneously, rather than disaggregating into subgroups reflective of ideology.<sup>64</sup> One of the factors that hinders the prevention of lone actor attacks is the wide spectrum of grievances and motivations of the perpetrators. Their varying ideological beliefs will influence their goals and thus will influence their target selection. Many distinguishable differences have been identified when comparing ideological subgroups of lone actors. This is not limited to demographics; factors such as variance in skill acquisition and preparation for the attacks are significantly different.<sup>65</sup>

Offenders will therefore be disaggregated by ideological group in an attempt to identify any differences in spatial patterns concerning target selection across different motivations. Target choices should be governed by the individual's grievance or ideology,<sup>66</sup> be reflective of the message they want to communicate,<sup>67</sup> and elicit a response from their target audience.<sup>68</sup> Therefore, it is likely that some consideration will be made regarding the availability of "good" targets that are also suitable for their cause. This will act as a further constraining influence on their selection of targets from an otherwise 'unlimited' choice set.

Those with single-issue grievances 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. For example, anti-abortionists in the US may be forced to travel to different states due to the varying legality of abortions in different states. 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 and as such it is hypothesized:

***H7: There will be differences in distance travelled between different ideological groups***

### ***Weapon***

Weapon choice is guided by cost-benefit analyses. Although bomb-making manuals and instructional videos are becoming more easily available online, it is still difficult for a lone individual to successfully build a bomb. The successful construction of an improvised explosive device (IED) is very complex<sup>69</sup> and requires more expertise and planning than other weapons.<sup>70</sup> Due to a lack of skills and resources lone actors tend to rely less on this weapon type than group actors,<sup>71</sup> and are more likely to use weapons that are easy to obtain and operate, such as firearms and edged weapons such as knives and axes.<sup>72</sup>

It can be inferred that generally lone actors lack the capability to pull off sophisticated attacks and that they are constrained by several factors, including limited skillsets and a lack of support and resources of a larger group. These limiting factors are reflected in their weapon choice and a tendency to attack softer targets such as civilians. The type of weapon used will have a constraining effect on the type of target that can be chosen, with different types being more or less appropriate for each weapon.<sup>73</sup> It is therefore hypothesized:

***H8: Individuals will travel further when using a bomb as their main weapon than when using a firearm or bladed weapon***

### **Data and Method**

To test the hypotheses and to perform the analyses, a database of lone offenders was constructed using parts of an existing dataset,<sup>74</sup> as well as additional data related to home location and distance travelled obtained from open source literature. The protocols for the accumulation of data are outlined below.

To qualify for inclusion, the attack had to be ideologically inspired and committed by a lone offender who was either apprehended and later convicted for, or killed in the commission of,



their offence in the US and western Europe since 1990. The cut-off date for inclusion was July 2016. Actors who were apprehended in the planning phase of their attack were removed from the dataset due to the nature of the analysis. To be included in the final working dataset, the actor's accurate home and attack(s) location had to be known. If the home location and attack location were in the same town or city and the street address for the home location was unknown, the case was removed from the dataset. In the very few instances where an accurate street address for the individual was unknown, but they travelled to a different town or city, the geometric centroid of their home town or city was used. Any other known location data were recorded if available, such as the individual's place of work or higher education, place of worship and previous address.

The final dataset consisted of 122 attacks committed by 70 individuals. A deidentified version of the data is available from the responding author for the purposes of replication upon request. Incidents included shootings, bombings, arsons and attacks committed using a vehicle as the main weapon. The number of observations for arson and vehicle attacks were insufficient and so these cases were removed for the analysis pertaining to weapon choice. Journey-to-attack distances were computed for each attack using the home and target locations using Euclidean straight-line distance (the shortest distance between two points). This technique was used as opposed to road network distance due to the retrospective nature of this study, and this is typical of other studies. Other known location data were recorded if available, such as the individual's place of work or higher education, place of worship and previous address. Target choices were coded as either iconic, symbolic or arbitrary. Iconic targets were defined as persons that were regarded as an ultimate representative symbol, or a unique building. Symbolic targets were other buildings or persons that would serve as a symbol of the individual's grievance. Examples of iconic buildings could include the Pentagon or the White House, or areas such as Times Square in New York City. An example of a symbolic building could be a mosque, synagogue or military base and a symbolic person could be an MP or member of the military. The single-issue subgroup included many anti-abortion activists. For these individuals, an iconic target was defined as a clinic or doctor that performed late term-abortions. All other abortion clinics and doctors were regarded as symbolic targets. The arbitrary subgroup included indiscriminate attacks where there was no obvious connection between the target of the attack and the individual's grievance. Cohen's K was run to determine the agreement between two coders' judgement on whether the targets should be considered as iconic, symbolic or arbitrary. The results reflected a substantial agreement between the two coders ( $k = .768$ ,  $p < 0.001$ ). The

disagreements were discussed and resolved and these resolved codes were used for the subsequent analyses.

For the symbolic subgroup, cases were coded as 'building' or 'persons'. Buildings included all cases where the attack took place at a symbolic building, regardless of whether the object of the attack was the building itself, and symbolic persons were defined as an event where no symbolic building was involved.

## Results

Table 1 summarises the accumulative percentages of attacks within different distance ranges. The mean distance of attacks from the actor's home was 90 miles (144km); however, more than half of all the attacks (56.5%) occurred within 10 miles (6km) of the individual's home location, and 36% of all attacks occurred within 2 miles (3km).

Individuals categorised in the single-issue group appeared to travel the furthest, with Jihadists travelling the shortest distance. Clear differences are evident for the mean journey lengths for Europe and the USA, and individuals appear to travel much further when attacking iconic targets.

[INSERT TABLE 1 HERE]

To test the first hypothesis, the distance values for each case were grouped into distance intervals and the frequencies of attack trips made to each of the different distances were calculated. The pattern displays a classic distance-decay curve, thus confirming H1. Attacks display a highly positively skewed distribution. As distance from an actor's home increases, the number of attacks decreases (see Figure 1). Due to the non-normal distribution of the data it was appropriate to use non-parametric tests for all subsequent analyses. A Spearman's correlation was run on this data to determine the relationship between the number of attacks and distance travelled. There was a strong, negative monotonic correlation ( $r = -.628$   $p < 0.01$ ) between distance travelled and number of attacks. Some attacks took place within the immediate vicinity to the home location and there was no apparent 'buffer zone' (a threshold in the area immediately surrounding the offenders home in which fewer number of crimes occur) that is typically detected in many crimes but is largely absent for crimes of passion<sup>75</sup> and crimes of a personal nature.<sup>76</sup>

[INSERT FIGURE 1 HERE]

Communication with others was associated with longer distances, thus supporting H2. Those who had interactions with a wider network travelled much longer distances (mean = 130 miles/209km) than those who did not (mean = 69 miles/111km). A Mann-Whitney  $U$  test indicated that this difference was highly significant ( $U = 1231.5$  ( $z = -3.322$ ),  $p = 0.001$ ).

To examine this finding in more detail chi square tests of independence were run to compare those who travelled short distances (up to 10 miles) and those who travelled long distances (11+ miles), based on a median split. A highly significant association was found between face-to-face interactions with members of a wider network and distance travelled,  $\chi(1) = 13.246$ ,  $p < .001$ . Based on the odds ratio, those who had face-to-face interactions were 4.04 times more likely to travel further than 10 miles than those who had no face-to-face interactions. However, there was no significant interaction between virtual interaction with members of a wider network and distance travelled,  $\chi(1) = 1.082$ ,  $p = .298$ .

The mean distance travelled for Europe was 15.5 miles, compared with ten times that amount, 155 miles, for the US. This confirms H3. 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. However, only 18.5% of attacks occurred within this vicinity for the US. 75.5% of attacks occurred within 10 miles in Europe, whereas just 40% of attacks occurred within this range in the USA. Only 3.5% of attacks took place over 100 miles from the home location in Europe, compared with a quarter of US cases. A Mann Whitney  $U$  test demonstrated that there was a highly significant difference between distance travelled for the US (mean rank = 75.35) and Europe (mean rank = 75.35),  $U = 952$  ( $z = -4.639$ ),  $p < .001$ .

Journeys to commit an attack in Europe followed a clear distance decay pattern (see Figure 2). A steep gradient of decline was found in the number of attacks adjusted to a per-mile basis from 0 to 4 miles from the last known home location of the actor. The number of attacks remained at a relatively stable, low number from the 10 mile point and became sporadic from 20 miles onwards. Very few offences ( $n = 5$ ,  $< 9\%$ ) were committed beyond 50 miles. A Spearman's correlation was run to determine the relationship between the number of attacks and distance travelled. There was a moderate, negative monotonic correlation ( $r = -.570$   $p < .01$ ).

[INSERT FIGURE 2 HERE]

On examination of attacks per mile for the USA the results do not appear to show the same distance decay curve as Europe (see Figure 3). However, this pattern becomes more apparent when transforming the intervals from 1 mile to 5 miles, and observing the journey lengths up to 50 miles (see Figure 4). This finding suggests that individuals travel further to commit attacks in the US, but that the decay pattern is still evident. This suggests that individuals are still affected by distance, but to a different degree than in Europe. This is consistent with traditional residence-to-crime studies, which have found differences in distance travelled between the USA and Europe. A Spearman's correlation was run to determine the relationship between the number of attacks and distance travelled. There was a strong, negative monotonic correlation distance travelled and attacks in the US ( $r = -.651$   $p < 0.01$ ).

The mean trip length for iconic targets was much longer than for symbolic or arbitrary targets thus confirming H4 (see Table 2). Those attacking arbitrary targets travelled the shortest distance of the three target types. A Kruskal-Wallis H test showed that there were statistically significant differences in distance between the different target types,  $\chi^2(2) = 19.084$ ,  $p < 0.001$ , with a mean rank of 89.78 for iconic targets, 59.79 for symbolic targets, and 36.11 for arbitrary targets (see Figure 5). This indicates that lone actors are willing to travel furthest for an iconic target, followed by symbolic targets and arbitrary targets thus confirmed H5. 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 actor saw anyone as a legitimate target, which supports the theory that an individual will only travel further when no appropriate targets are available.

[INSERT TABLE 2 HERE]

[INSERT FIGURE 5 HERE]

As most attacks could be considered symbolic further analyses were run to identify any distinguishing factors within this subgroup. A Mann Whitney U test revealed a highly significant difference for this group when comparing distance travelled for attacks in which a symbolic *building* was involved (mean rank = 39.17) and attacks where no symbolic building was involved (mean rank = 62.47),  $U = 541$  ( $z = -4.014$ ),  $p < 0.001$ . This confirms H6.

Two thirds of attacks on iconic targets were perpetrated by individuals with single issue

grievances, the other third by Islamist extremists. No right-wing cases in this study committed attacks on iconic targets. Right wing extremists, and a quarter by Islamists committed over half of the attacks on symbolic targets. The remaining 17% were by single issue actors. Single issue actors executed no attacks on arbitrary targets.

A Kruskal-Wallis H test showed that there was a statistically significant difference in distance between the different ideologies,  $\chi^2(2) = 13.899$ ,  $p = 0.001$ , with a mean rank of 57.71 for Islamists, 54.27 for right wing extremists and 84.74 for single issue terrorists. This confirms H7. Lone actors with single issue grievances travelled much further to their targets than the other two groups, with a mean distance of 856 miles, compared to right-wing extremists (mean = 35 miles) and Islamists (mean = 27 miles). There were noticeable differences when comparing single-issue actors in Europe (mean = 20 miles) to the US (mean = 1023 miles) (see Table 3 and Figure 6).

[INSERT TABLE 3 HERE]

[INSERT FIGURE 6 HERE]

There was no significant difference in distance travelled between the Islamist and right wing groups,  $U = 905.5$  ( $z = -1.152$ ),  $p = .249$ , suggesting that the effects of distance are similar for these two subgroups. Therefore, further analyses were conducted using only Islamist and right wing cases. The mean for the remaining cases was 31 miles (compared to 90 miles for all attacks). A Mann Whitney U test revealed a significant difference for this combined group when comparing distance travelled in Europe and the US,  $U = 647.5$  ( $z = -3.675$ ),  $p < 0.001$ . The distance decay curve for Islamist and right wing actors was to a higher degree than the analysis with all cases included, with a steeper gradient of decline (see Figure 7).

[INSERT FIGURE 7 HERE]

The mean trip length for attacks in which a bomb was used was higher than for a firearm or bladed weapon. To test for significance a Kruskal-Wallis H test was performed. The test was performed on the remaining three weapon types: firearms, bladed weapons and bombs. It demonstrated that there was a statistically significant difference in distance,  $\chi^2(2) = 7.845$ ,  $p < 0.05$ , with a mean rank of 54.29 for firearms, 45.14 for bladed weapons and 74.63 for bombs (see Table 4 and Figure 8). This confirms H8.

[INSERT TABLE 4 HERE]

[INSERT FIGURE 8 HERE]

## **Discussion**

This article provides a better understanding of the processes that underlie the spatial decision making of lone actors, and highlights how they are constrained by distance in the same way as traditional criminals. The analyses expand the empirical knowledge of lone actor target selection and add a practical element that could aid in the development of intervention strategies. The main underlying theme here is that, in any attempt to reveal insights into possible attack locations, each case needs to be considered individually according to the subgroups outlined above. It is also emphasized that there is a necessity to disaggregate lone actors in future research and to consider subgroups, and any interactions these subgroups may have, i.e. the relationship between single issue actors and iconic targets.

Distance can be highlighted as an important factor in target selection criteria, which is consistent with previous studies of terrorist activity<sup>77</sup> and traditional criminological studies.<sup>78</sup> The distance-decay function evident for traditional crimes is replicated for lone actors, with the results demonstrating that frequency of attacks decreases as distance from home locations increase. These findings emphasize the value of incorporating methods of environmental criminology when modeling terrorism target selection, and reiterates the notion that terrorists are rational thinkers when it comes to target selection. The results support Becker's findings that lone actors are more likely to attack within their awareness space,<sup>79</sup> and that an individual with the potential to commit an attack is likely to identify opportunities within their awareness space during their daily routines.<sup>80</sup> Whether the decision regarding the final object of attack happens before or after they have decided to attack a particular *type* of target is yet to be determined.

Individuals with links to a wider network travelled much further than those without. Those who had face-to-face interactions were over four times more likely to travel further than 10 miles. However, no significant difference was found for individuals who had virtual interactions with members of a wider network. This has important practical implications. If there is intelligence

that a suspected individual has had face-to-face interactions with a wider network, it can be inferred that they may have the capability to travel further.

The constraining effects of distance are different for the US and Europe. The results for both continents demonstrate the distance decay pattern, but to a different degree, with individuals in the US travelling much further than those in Europe. This finding held when examining Islamist and right-wing cases only, so it is not skewed by single-issue cases. The US is much larger than European countries and has a lower population density, meaning potential targets may be distributed differently. The descriptive findings of accumulative percentages for distance travelled in Europe are particularly interesting. They are extremely similar to a UK Home Office study into the geographical behaviour of stranger offenders in violent sexual crime.<sup>81</sup> They found 29% of attacks to occur within 1 mile, 52% within 2 miles, and 76% within 5 miles, compared with 35% of attacks within 1 mile, 56% within 2 miles and 70% within 5 miles (76% within 10 miles) for lone actor attacks. This provides further support for the notion that terrorists behave similarly to ordinary criminals in their spatial decision making.

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. Research has suggested that lone actors are not geographically constrained and are willing to travel long distances. However, the results show that due to the homogenous approach of previous studies, the findings are likely to be skewed by a small number of lone actors who 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, when the availability of relevant targets is limited.

Variations in distances for different target types reflected previous literature of traditional crimes.<sup>82</sup> Lone actors travelled much further for attacks where a symbolic building was present which is consistent with findings of traditional crimes that longer distances are travelled if the expected value of the outcome is higher<sup>83</sup> and further implies that some cost-benefit consideration is taken. These findings suggest that when considering any target that can be deemed as symbolic of the individual's grievance, a distinguishing factor in regards to spatial patterns is whether the target is a building or a person.

Over two thirds of attacks on iconic targets were perpetrated by individuals with single issue ideologies, demonstrating that attacks of this kind are more likely to be committed by members of this subgroup than Jihadist and right-wing extremists, most likely due to the nature of their grievances. Single-issue actors committed less than a fifth of the attacks on symbolic targets. None of the right-wing cases studied here attacked iconic targets, however this sample was not an extensive sample of all lone actors, so it may be subject to some bias. No significant difference was found in distance travelled for Islamist and right wing lone actors, and the results suggest that their spatial decision making when selecting targets is similar to traditional criminals. This provides a good starting point for further spatial analyses. Single issue terrorists should be treated as unique, as they often have specific targets and are therefore willing to travel further.

The significant differences concerning grievances provide a good starting point for further spatial analyses that may be useful for practical interventions. The findings suggest that Islamist and right wing lone actors may behave in a similar way to ‘traditional’ criminals in terms of spatial decision making when selecting targets. However, single issue actors do not seem to be constrained by distance in the same way, possibly as many of this subgroup have a limited choice set of targets to choose from. This demonstrates the need to consider the grievance of the individual before any attempts to narrow down possible targets are made in order to devise interdiction measures.

The identifiable effects of distance for subgroups may be beneficial for preventative techniques, especially when coupled with leakage. In a large majority of lone actor cases others are aware of the individual’s commitment to their extremist ideology, or intent to engage in a terrorism related activity.<sup>84</sup> If an individual has been identified as likely to engage in an imminent attack this knowledge may be useful to narrow down potential targets. If the individual does commit an attack but is not apprehended in the commission of their attack and manages to escape it could be beneficial for post-event investigative techniques.

Consistent with previous research,<sup>85</sup> firearms seemed to be the weapon of choice for these cases. Individuals travelled further when a bomb was used as their main weapon compared to firearms and bladed weapons. This may be reflective of capability, as 60% of lone actors who built a bomb had had face-to-face interactions with members of a wider network.



The main limitation of this study is the small sample. The cases used did not include all lone actor attacks, therefore it is inevitably subject to some bias. A larger sample would have been preferable; however, this was not possible as many incidents had to be removed from the original dataset due to inaccurate or inconclusive information regarding home or attack locations. This could mean that the sample used was not entirely representative and may limit the reliability of the results. A larger dataset would also have allowed for further disaggregation and additional statistical analyses to be run; for example, to examine distances from places of work and education, and previous addresses. Only cases in the US and Europe were used; therefore, additional analyses need to be done to establish whether these findings have utility for other countries. When using Euclidean distance, there is also a small likelihood that distances could be over or under estimated. However, the results are still useful.<sup>86</sup>

Some scholars argue that a problem associated with this type of analysis is the *distance decay ecological fallacy*, whereby the aggregated distance decay function may conceal clustering and variation at the individual level. If there is no individual distance decay, but the targets are dispersed randomly within the sample, it may incorrectly reveal a distance decay function<sup>87</sup> and therefore any inferences from the analyses may be inappropriate. To test for this, individual cases with more than one attack in a series were tested, (for example John Ausonius and Johan Peter Mangs). A similar distance decay curve was apparent in their attack series.

## **Conclusion**

Whilst the vast majority of our lone-actor terrorists travelled short distances, there are outliers worthy of discussion. We argue that many of these outliers might simply be depicted as such because ‘residence’ is sometimes an imprecise indicator of awareness space and that individuals may have awareness of other locations based on their daily routine activities or past residences. Further quantitative analyses regarding the whole node network of an individual, including all possible nodes such as previous addresses, places of work and education, as well as their present place of residence, were intended. However, this information could not be ascertained for every case, and therefore there was an insufficient amount of data to do so. Individuals who engage in traditional crimes such as residential burglaries, robberies, thefts from vehicles and assaults are much more likely to offend in an area that they have previously lived, than in comparable areas where they have not resided.<sup>88</sup> 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 minimises the effort of locating suitable targets.

The illustrative examples below highlight 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 actor and the target. Previous addresses, place of work/higher education need to be considered as well as the present.

Benjamin Nathaniel Smith was a right-wing extremist who killed 2 individuals and injured 10 in his targeted attacks on ethnic minorities over a 3-day period in 1999. Smith began his attacks on Friday 2<sup>nd</sup> July, in the neighbourhoods surrounding his childhood home in Wilmette, where he had recently returned to live. These neighbourhoods, Rogers Park and Skokie, were predominantly populated by Orthodox Jews as well as large numbers of immigrants. The following day, on the penultimate day of his spree, attacks took place at the first university he attended (University of Illinois in Urbana) as well as two of the closest towns to the university by direct route. He fired twice at black men on streets of Springfield and a black minister was shot from Smith's car in Decatur. Finally, on the Sunday, he waited outside a Korean Methodist church near Indiana University in Bloomington, Indiana, before killing a graduate student as the congregation emerged. Smith had just finished his third year of college at Indiana University, and was living in student accommodation less than half a mile away from this campus until a few months before his attacks.

This case highlights the importance of considering all locations in the individual's awareness space, including previous addresses, places of work and education, as well as the areas surrounding their home. Individuals who engage in traditional crimes such as residential burglaries, robberies, thefts from vehicles and assaults are much more likely to offend in an area that they have previously lived, than in comparable areas where they have not resided.<sup>89</sup> This case also concurs with previous research on traditional crimes which suggests that an offender's first offence location will be closest to their home.<sup>90</sup>

On 4<sup>th</sup> July 2002, Hesham Mohammed Hadayet approached the Israeli airline El Al's ticket counter at Los Angeles International Airport (LAX) and started shooting at the passengers in the line, killing 2 Israeli nationals. It was concluded that this attack was due to his contempt of Israel's policies towards Palestinians and their occupation of the West Bank. Hadayet had

intense anti-Israeli views that had developed over his time in the US. It is believed that his anger was only aimed at Israel, and not US civilians. Abdallatef Aboulzahab, a former employee of Hadayet, stated:

*“He blamed Israel for what was going on [in the Middle East]... He had nothing against Americans... He's not hateful for the American people on the street... He loved this country. He loved freedom of speech. He told me, 'I'd like to be a U.S. citizen.'”*

On first examination, the location of this attack seems relatively random as Hadayet lived 40 miles away in Irvine. However, Hadayet was a taxi and limo driver who frequently served LAX and John Wayne airports, and so it is likely that he was aware of the El Al counter from previous trips. It can be inferred that he did not want to kill an American citizen and so LAX provided the closest location in his awareness space that could provide a large number of legitimate targets. Hadayet bypassed other busy ticket counters in the airport, so it can be inferred that his objective was not to target random civilians, as he could have attacked other counters more easily. As the flights dealt with by El Al are only in and out of Israel and is owned by the Israeli government, it can be inferred that he made this choice as he specifically wanted to target Israelis.

On 11<sup>th</sup> December 2010, two bombs exploded in central Stockholm. Taimour Abdulwahab al-Abdaly. When considering his last known address in Luton, al-Abdaly travelled the furthest out of the European subgroup. However, prior to his attack he had recently returned to Sweden, visiting his parents in a small town called Tranas. The family had settled there as refugees after fleeing Iraq in 1992, when al-Abdaly was 11 years old. He lived there until 2001, before moving to the UK to study. On the morning of 11<sup>th</sup> December 2010, al-Abdaly left his parents' house and drove to Stockholm. It could be that Tranas, with a population of only 14,000 inhabitants, did not provide an adequate number of potential targets for the attack. A city with high urban density is much more attractive as a target, due to the increased number of potential victims and witnesses, as well as potential economic losses. There are two major cities close to Tranas, Stockholm and Gothenburg. Stockholm is the capital of Sweden so his attack would have more of an impact. This highlights the importance of the awareness space. It has been suggested that the bomb was intended to be triggered remotely, and that the explosives went off accidentally en-route to the intended target. The most likely target was the department store 'AhLens', located at the end of the street. AhLens is the largest department store in Stockholm,

and as Al-Abdaly's attack took place just before Christmas it is likely that there were an increased number of people in the area at that time.

Collectively, the statistical analysis and illustrative examples suggest that distance can be put forward as a constraining factor that governs the selection of targets. Lone actor target selection is a result of a confluence of distance and appropriate targets, whereby a target will be chosen where it is a) in the individual's awareness space, b) within close proximity to the individual's home location and c) is relevant to the individual's ideology. Further research might analyse the discrete choices terrorist make to discriminate between potentially legitimate targets within their awareness

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