

5-1-2018

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Recommended Citation

Brian Michael Jenkins and Bruce R. Butterworth. "An Analysis of Vehicle Ramming as a Terrorist Threat" *Mineta Transportation Institute Publications* (2018).

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An Analysis of Vehicle Ramming as a Terrorist Tactic

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Car-ramming attacks, or vehicular assaults, in which drivers deliberately plow their vehicles into public gatherings, pedestrians, or bicyclists, have become an increasingly common terrorist tactic. The numbers are still small, but they are clearly on the rise. A review of this tactic and recent uses of it leads to a number of observations:

- The number of car-ramming attacks and their lethality are increasing.
- These attacks reflect the current practice of terrorists remotely inspiring operatives rather than recruiting them. They also reflect the trend toward totally random violence—what might be called “pure terrorism.”
- The “weapon”—a motor vehicle—is easily obtainable, and a ramming attack requires little preparation and little skill.
- Car-ramming is effective, allowing attackers to achieve high body counts and cause widespread alarm. It is the one tactic whose lethality in the developed world comes close to that of attacks in the developing world, which normally have much higher levels of lethality.
- Attackers proclaiming allegiance to jihadist groups are more lethal than others—again, a reflection of ideology and strategy.
- As was the case with airline hijackings in the 1960s, many of the attackers turn out to be mentally disordered persons who may be inspired to copy terrorist attacks.

- The deadliest car-ramming incidents occur where vehicles mow down pedestrians at public gatherings such as open-air markets or on pedestrianized streets from which cars are prohibited but nevertheless can enter. Open-air markets and celebrations attract crowds, and foot traffic on pedestrianized streets is usually dense. This makes these venues lucrative targets for vehicular assaults.

LITTLE CHANGE IN TERRORIST TACTICS

Terrorist tactics have evolved incrementally over the past half-century. The basic terrorist repertoire—bombings, armed assaults, assassinations, hostage-taking—remains close to what it was in the early 1970s. Over time, heightened security measures have reduced certain tactics and attacks on certain target sets: Airline hijackings have become a rare event; terrorists no longer storm embassies; and fewer diplomats are kidnapped.

Terrorists have always preferred soft targets where they do not have to overcome security measures. Since unprotected targets are virtually unlimited, there is little pressure for terrorist innovation in tactics or weapons.

The terrorist arsenal has also remained stable for a half-century. Improvised explosives, assault rifles, and ordinary firearms are used in most attacks and account for most casualties. Recent knife and axe attacks and vehicular assaults reflect a trend toward more-primitive weapons and tactics. This, in turn, reflects recent changes in terrorist strategies and recruiting.

BIG CHANGES IN TERRORIST STRATEGIES AND RECRUITING

Terrorists escalated their violence by orders of magnitude between the 1970s and 2001, the year of the 9/11 attacks—from tens to hundreds to thousands. Terrorist tactics rely on shock value to attract attention. Staying in the headlines requires escalating violence.

The emergence of groups inspired by religion-based ideologies contributed to the escalation of violence. The substitution of God's will for political constituency eroded self-imposed constraints. Religious fanatics count only on heavenly approval for their actions. Condemnation by those regarded as unbelievers or infidels matters little, and undiluted commitment guarantees paradise. Among religiously inspired terrorists, suicide attacks became common.

Extrapolating from the 9/11 attacks led authorities to worry about future events that could produce tens or hundreds of thousands of casualties. Attacks of this scale could be achieved only with weapons of mass destruction, which many presumed would be the next terrorist step. But obtaining such weapons would require centralized enterprises with considerable resources and capabilities.

Terrorism has not followed the anticipated post-9/11 trajectory. Following the 9/11 attacks, al Qaeda was put under enormous pressure, and many of its leaders and key operatives were killed or captured, while its communications and control were disrupted, degrading its operational capabilities. On the run or hiding out, al Qaeda's central leadership was obliged to rely on the local initiative of its members to continue its global jihad. In this more-hostile operating environment, carrying out strategic strikes on the scale of 9/11 or even larger seemed less likely.

Until about 2006, al Qaeda alumni and allies were still able to carry out terrorist operations that were one or two orders of magnitude less than the 9/11 attacks but still spectacular—attacks in Tunisia, Indonesia, Kenya, Saudi Arabia, Morocco, Egypt, Turkey, and Jordan, in addition to major attacks in Spain and the United Kingdom. These attacks persuaded the countries affected to more vigorously suppress the local groups that threatened them directly and to cooperate more closely with other nations facing similar threats. Gradually the level of violence subsided, although lower-level attacks continued.

However, the political tumult that spread across North Africa and the Middle East in 2011 presented the jihadists with new opportunities, which al Qaeda was quick to exploit. Its comeback, however, was disrupted by a deadly internal schism that saw the emergence of a rival jihadist enterprise in Syria and Iraq—the Islamic State of Iraq and (greater) Syria, or ISIS.

ISIS took advantage of the civil war in Syria and continuing antipathy between the Sunnis and Shias in Iraq to sweep across the two countries and establish the Islamic State, which attracted expressions of support and pledges of loyalty from groups across the region. In contrast to al Qaeda’s priority of attacking the “far enemy,” ISIS remained focused on the local struggle—building the Islamic State and defending its territory. But like al Qaeda, ISIS used the Internet and, even more effectively, social media to attract recruits and inspire action abroad. Instead of the vertical escalation anticipated immediately after 9/11, the jihadists escalated laterally to remotely field a global army.

Recruiting into the ranks of the post-9/11 jihadists differed significantly from terrorist recruiting in the 1970s. The early cohorts of volunteers were vetted before being taken into tiny clandestine organizations, which had to survive underground in a hostile environment. The danger of infiltrators or of unreliable recruits posed operational and organizational risks. The groups remained small.

In contrast, jihadist recruiting relied on exhortation rather than traditional recruiting. Volunteers were urged via the Internet and social media to act on their own initiative. If they could make it to an al Qaeda training camp or, later, to the Islamic State, they would be welcome. Tens of thousands flocked to the Islamic State. It is unlikely that all of the arrivals were reliable, but this was not a serious problem where ISIS maintained absolute control—recruits could not easily betray the organization, and if judged unreliable, they could be dispatched to suicide missions.

Recruiting for operations abroad required no investment on the part of ISIS. Their online magazines and communicators on social media could reach a broad audience, providing potential recruits with inspiration and instructions. If they carried out an attack, their actions would bring applause and recognition—the remote conferral of membership as warriors. It was low-yield ore, producing a large but mostly virtual army and occasional low-level actions.

The change in recruiting methods produced changes in the local terrorist population and also affected tactics. The Internet attracted individuals—it did not create local groups. Terrorist campaigns were replaced by one-off attacks; there was no institutional learning, no improvement in operational skills over time. Instead, jihadists remained mostly unconnected individuals operating alone with limited resources. When they did reach out to join others, they risked being taken in by police undercover operations. Isolated jihadists could not sustain terrorist campaigns or inspire sufficient numbers to create a high volume of violence.

THE CAMPAIGN IN FRANCE AND BELGIUM WAS UNIQUE

The terrorist attacks carried out by ISIS-affiliated operatives in France and Belgium between 2014 and 2016 have been cited as an example of an ISIS-directed campaign, but they are the exception that proves the rule. The campaign was the product of a group of Belgian and French radicals led by Abdelhamid Abaaoud, a Belgian jihadist who traveled to Syria to join ISIS in 2014. While in Syria, Abaaoud recruited other Belgian and French volunteers who had come to join ISIS and sent them back to Europe to carry out attacks.

Abaaoud's network had a number of operational advantages. Many of the recruits came from a subculture that transcended the criminal underworld and the radicalized underground. A number of them had criminal backgrounds, had carried out violent crimes, and were accustomed to living on the run. They had connections with local confederates who provided them with logistics support. They knew and could trust one another.

Despite these capabilities, until November 2015, Abaaoud's network of operatives achieved no major successes. Some were arrested, and some were killed in shootouts with police. One accidentally shot himself and was arrested when he called for help. Another failed to operate his weapon correctly and was quickly subdued.

Abaaoud had to personally return to Europe to assemble the force of seasoned fighters returning from Syria and local volunteers that carried out the bloody attacks in Paris. Abaaoud himself was cornered and killed soon after those attacks. With police closing in, other members of the Abaaoud network carried out the suicide attacks in Brussels in March 2016, but by the end of 2016, the network was largely dismantled.

CAR-RAMMING ATTACKS REFLECT CURRENT CIRCUMSTANCES

Both al Qaeda and ISIS have urged the use of vehicles to mow down pedestrians. It is an ideal tactic for today's circumstances. Vehicles are a readily available "weapon." Limited skill is required, and the ability to drive is widespread. Little preparation is required for an attack. Cities filled with people and vehicles provide ample targets, which cannot easily be protected, and high body counts are potentially achievable. It is not surprising, then, that the number of car-ramming attacks has increased.

Information on trends and patterns of relevant cases of vehicular assaults may lead to better understanding of the tactic and could assist in making judgments about how best to deal with it. We have collected and analyzed the available data on such attacks and have outlined some possible measures for mitigating them in the future.¹

THE DATA ANALYZED IN THIS REPORT—WHAT'S IN AND WHAT'S OUT

Car rammings occur almost every day. Most of these are not vehicular assaults by terrorists, but rather rammings by criminals, drunks, drivers overcome by road rage, persons in the middle of arguments. The drivers deliberately crash into other cars, try to run over antagonists, and, increasingly, try to ram police cars. We exclude these events from our analysis. We also exclude vehicular attacks in which the primary purpose is to deliver an explosive device.

¹The database used in this analysis has been created by the authors and is not part of the terrorist databases held by either the Mineta Transportation Institute or the RAND Corporation.

Using the Global Terrorism Database maintained by START at the University of Maryland, some material provided by the RAND Corporation, and a few incidents contained in MTI's own database, along with our own searches, we identified about 120 terrorist car-ramming events. Our focus was on attacks directed against public targets, that is, those directed against pedestrians on public streets or adjacent public buildings, including tourist sites, hospitals, and restaurants; public gatherings, including street markets, spectator events, celebrations, and demonstrations; and surface transportation hubs, including bus stops and train or bus stations. We also included attacks against police or other security personnel guarding public places. We were especially interested in attacks by persons who expressed some kind of political motive, but we also included attacks by persons judged mentally disordered, recognizing that the line between the two types of attackers is sometimes a thin one.

We excluded attacks in war zones, where police or military personnel manning checkpoints are often targets. We also excluded ramming attacks on government buildings such as embassies or military bases, as well as attacks on private corporate buildings, all of which normally have their own security and to which access is not unrestricted. Also excluded were accidents—which, by definition, are not attacks—as well as ramming attacks that targeted a particular individual, such as altercations between motorists, and rammings connected with common criminals and car chases.

That left 78 attacks for analysis. We cannot claim that this represents the universe of car-ramming attacks—incidents with no or few casualties that occurred years ago in areas with little media coverage may be lost in the mist of time.

We collected the available information about the 78 attacks and sorted it according to date, country, nature of target, perpetrator, circumstances, casualties, and other attributes. In doing so, we relied primarily on media accounts from generally reliable sources. We did not use any classified information or detailed police or court reports. In some cases, we did not have accurate data on the vehicle type or weight or information about its speed, which would be useful. While there is still work to be done and errors are always possible, we are confident that we have a reasonably accurate record of the selected events.

OVERALL TRENDS—MORE FREQUENT AND MORE LETHAL

The 78 attacks occurred between January 1973 and the end of April 2018. They resulted in 281 deaths and approximately 1,200 injuries. The increasing frequency of vehicular attacks is shown in Figure 1, and the increasing lethality of those same attacks is shown in Figure 2.

Because there are relatively few events over a long period of time (more than 45 years), the trend lines can be misleading. However, the recent increase is obvious. There were 16 attacks between 1973 and 2007 and 62 attacks between 2008 and the end of April 2018. Thirty of these occurred in 2017 and the first four months of 2018 alone.

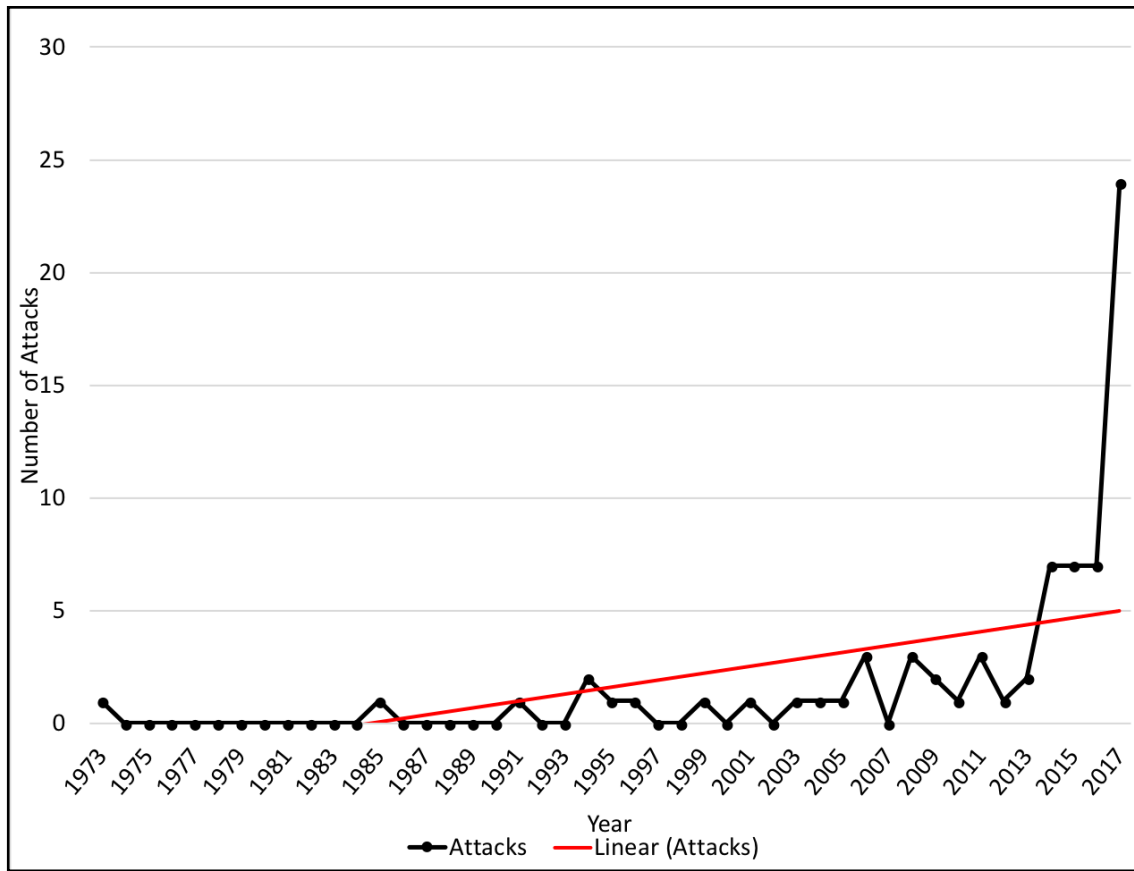


Figure 1: Vehicle Rammings Over Time, 1973-2017

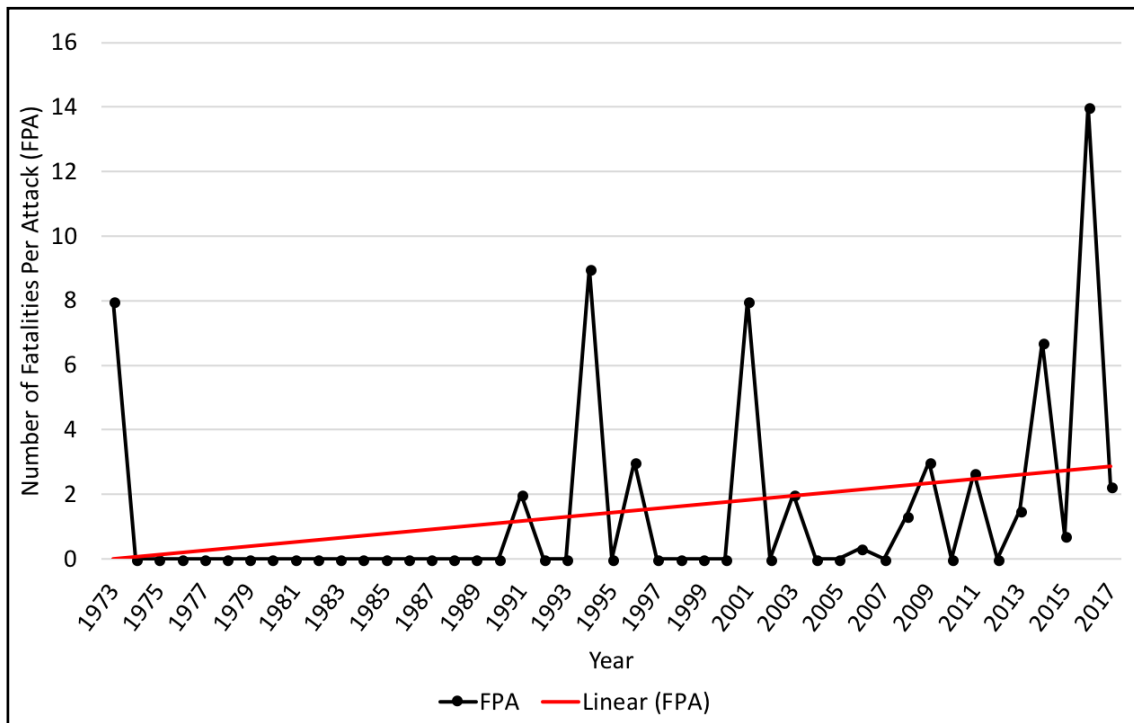


Figure 2: Vehicle Ramming Lethality Over Time, 1973-2017

The average fatality per attack (FPA) in the events we examined was 3.6. This is significantly higher than the 2.3 FPA for all attacks on surface transportation targets during the same period. It is also 0.6 higher than the 3.0 FPA for attacks on public surface transportation passengers.

This is significant, as public surface transportation targets have been attacked by terrorists seeking high body counts. While car-ramming attacks are not on the same scale as bombings, armed assaults, or derailment attempts, they appear to be an easy way for terrorists, especially those lacking firearms and explosives, to kill in quantity. We will return to this point later.

GEOGRAPHIC DISTRIBUTION OF CAR-RAMMING ATTACKS

As shown in Table 1, car-ramming attacks have been employed extensively by Palestinians against Israeli targets. Of the 78 attacks we examined, 28 (35.9 percent) occurred in Israel or the Occupied Territories. This reflects a continuing Palestinian resistance, constrained by its participants' inability to obtain firearms or explosives. Knife and car-ramming attacks were the only readily available means of continuing a terrorist campaign.

Table 1: Geographic Distribution of Attacks by 5-year Periods

5-year Period	All			Israel & Occupied Territories			Developed Countries ^a			Developing Countries ^b		
	#A ^c	#F ^d	FPA ^e	#A	#F	FPA	#A	#F	FPA	#A	#F	FPA
1973-1978	1	8	8	-	-	-	1	8	8	-	-	-
1979-1982	-	-	-	-	-	-	-	-	-	-	-	-
1983-1987	1	0	0	-	-	-	-	-	-	1	0	0
1988-1992	1	2	2	1	2	2	-	-	-	-	-	-
1993-1997	4	21	5.3	1	3	3	1	0	0	2	18	9
1998-2002	3	8	2.7	2	8	4	1	0	0	-	-	-
2003-2007	6	3	0.5	-	-	-	6	3	0	-	-	-
2008-2012	9	18	2	5	5	1	3	6	2	1	7	7
2013-Apr. 2018	53	221	4.2	19	13	0.7	32	163	5.1	2	45	22.5
<i>Summary</i>	78	281	3.6	28	31	1.1	48	180	5.1	6	70	11.7

^a OECD signatories.

^b Non-OECD signatories.

^c Number of attacks.

^d Number of fatalities.

^e Fatalities per attack.

However, the number of attacks occurring in developed countries² has been increasing. Since 2003, 41 attacks have occurred in economically more-advanced nations. The United States leads this list, with a total of 13 attacks, followed by France with 10 attacks, and the United Kingdom with 5.

² For purposes of this report, developed countries are categorized as those who are currently OECD signatories, and developing countries are categorized as those who are not currently OECD signatories; we have created a special category for Israel (an OECD signatory country) and the West Bank and Gaza Strip (a non-signatory country) because of the large number of attacks and the unique nature of the Palestinian campaign there.

LETHALITY OF CAR-RAMMING ATTACKS

As shown in Table 2, France has suffered the most fatalities from car-ramming attacks in developed countries, with a total of 88 fatalities. Almost all of these (86) resulted from a 2016 attack in Nice. China, where difficulties in obtaining explosives and firearms have led to more car-ramming, knife attacks, and attacks with incendiary devices, has the next-highest number of fatalities (52), followed by Israel with 26. Twelve people have died in car-ramming attacks in the United States, 8 of them in a 2017 attack in New York.

Table 2: Vehicle Attacks and Fatalities, by Country, in Order by Number of Attacks

Country	# Attacks	# Fatalities	FPA ^a
France	10	88	8.8
China	3	52	17.3
Israel	14	26	1.9
Haiti	2	18	9.0
Spain	2	15	7.5
Germany	2	14	7.0
United States	13	12	0.9
United Kingdom	5	12	2.4
Canada	2	10	5.0
Czechoslovakia	1	8	8.0
Sweden	2	7	3.5
Netherlands	1	6	6.0
West Bank and Gaza Strip	14	5	0.4
Australia	1	5	5.0
Austria	2	3	1.5
Belgium	1	0	0.0
Ireland	1	0	0.0
Japan	1	0	0.0
Sri Lanka	1	0	0.0
<i>Summary</i>	<i>78</i>	<i>281</i>	<i>3.6</i>

^a Fatalities per attack.

Figure 5 presents the same data, but ranked by lethality. The FPA in China was 17.3, the highest of any country, but this resulted from only three reported attacks. Haiti was next, with an FPA of 9.0 in two attacks, then France, with an FPA of 8.8. In all three cases, a single especially bloody incident drove the numbers.

Table 3: Vehicle Attacks and Fatalities, by Country, in Order by Fatality Per Attack

Country	# Attacks	# Fatalities	FPA ^a
China	3	52	17.3
Haiti	2	18	9.0
France	10	88	8.8
Czechoslovakia	1	8	8.0
Spain	2	15	7.5
Germany	2	14	7.0
Netherlands	1	6	6.0
Canada	2	10	5.0
Australia	1	5	5.0
Sweden	2	7	3.5
United Kingdom	5	12	2.4
Israel	14	26	1.9
Austria	2	3	1.5
United States	13	12	0.9
West Bank and Gaza Strip	14	5	0.4
Belgium	1	0	0.0
Ireland	1	0	0.0
Japan	1	0	0.0
Sri Lanka	1	0	0.0
<i>Summary</i>	<i>78</i>	<i>281</i>	<i>3.6</i>

^a Fatalities per attack.

Car rammings may be the only type of attack in the area of transportation in which lethality in the developed world is close to that of such attacks in the developing world. Car-ramming attacks in the developed countries have an average FPA of 4.2, while those in the developing world have an FPA of 5.0. (Including two attacks by Uighur separatists in China that together killed 50, however, raises the developing-countries average FPA to 11.7.)

This may be an anomaly resulting from very small numbers of incidents, which include a few major ones, and it may also reflect the fact that while vehicle-ramming attacks may occasionally result in mass-casualty outliers, there is something of a natural ceiling—rarely are such attacks a tactic of mass destruction. The average FPA in Israel and the Occupied Territories, which have experienced the most car-ramming attacks, is only 0.9. The median FPA, as opposed to the average FPA, for all car-ramming attacks is 0.5.

ARE SUICIDE CAR-RAMMING ATTACKS MORE LETHAL?

Several factors make it difficult to determine whether a vehicular attacker is more apt to be suicidal than attackers using other modes. A person who blows himself up is almost certainly suicidal (unless the person has been persuaded that he controls a device which is then detonated remotely). Many shooting attacks appear suicidal—the individual goes on killing until he takes his own life or is shot by police. However, some psychologists believe that such deaths are not truly suicidal.

As shown in Table 4, in which the data are organized by the number of attacks, six of the car-ramming attacks appear to have been suicidal; the nature of the attack made it very unlikely that the assailant would escape alive, or the driver took his own life.

In 37 cases, the assailant attempted to flee or promptly surrendered. These were not suicide attacks.

Between these two poles, there are 15 cases, most often where the attackers continued their attacks in locations where police or other security personnel were armed and firing; in one case, the attacker asked police to shoot him. These appear to fall on the suicide side of the spectrum, but whether attackers who depend on others to shoot them can be called suicidal is open to question. They are labeled as “possible.”

In the remaining 20 cases, we lack the detailed information to make a judgment about whether or not the attacker was suicidal. In 11 of these, the attacker was killed or injured but may not have been suicidal. In 9 cases, the attacker was not killed or injured but presumably was arrested. In none of the cases did the attacker get away, so a car-ramming attack apparently calls for a higher level of commitment than planting an explosive device or carrying out a gun attack where escape is possible. Obviously, the determination of whether these attacks were suicidal is a matter of judgment.

Table 4: Number of Attacks by Likelihood of Attacker Being Suicidal

Suicide Category	# Attacks	# Fatalities	FPA ^a
No	37	73	2.0
Possible	15	129	8.6
Unknown - Attacker(s) Injured or Killed	11	7	0.6
Unknown - Attacker(s) not Killed or Injured	9	25	2.8
Yes	6	47	7.8
<i>Summary</i>	78	281	3.6

^a Fatalities per attack.

The question is, does suicidal intent make any difference in terms of lethality? The same data on suicides, organized by lethality (Table 5), suggest that it does. Definite and possible suicide cases have a combined average FPA of 8.4. Attackers who definitely were not suicidal have an average FPA of 2.0. On the basis of these small numbers, suicide attacks appear to more than double the average lethality (3.6 FPA), increasing it by 4.8 FPA.

Table 5: Number of Attacks by Likelihood of Attacker Being Suicidal

Suicide Category	# Attacks	# Fatalities	FPA ^a
Possible	15	129	8.6
Yes	6	47	7.8
Unknown - Attacker(s) not Killed or Injured	9	25	2.8
No	37	73	2.0
Unknown - Attacker(s) Injured or Killed	11	7	0.6
<i>Summary</i>	78	281	3.6

^a Fatalities per attack.

Vehicular attackers can also do various things to increase casualties. They can swerve the vehicle back and forth to hit more targets, they can fire weapons or throw incendiary devices from the vehicle during the attack, or they can exit the vehicle and continue the attack with other weapons. Table 6 shows the effect on lethality of using some of these various ploys.

Table 6: Lethality Multipliers by Effect on Average FPA

Lethality Multiplier	# Attacks	# Fatalities	FPA ^a	FPA > Average ^b
Suicide+Swerving+Throwing IIDs from the Vehicle (e.g., Uighur Attack in China)	1	43	43.0	39.4
Suicide (Yes or Possible) Only	21	176	8.4	4.8
Vehicle Swerve only	25	190	7.6	4.0
Suicide+Swerving+Attack continued with Stabbings (e.g., London)	3	12	4.0	0.4
Attack Continued with Stabbings Only	10	21	2.1	-1.5
Attack Continued with Arson Only	4	0	0.0	-3.6

^a Fatalities per attack.

^b Difference between FPA and Average FPA (3.6).

In the attacks we examined, swerving alone more than doubled overall FPA. A single attack in China in which suicide attackers both swerved and threw incendiary devices from the vehicle increased average lethality by 39.4 FPA. In car-ramming attacks where non-suicide assailants continued the attack using only arson or stabbings, the effect on lethality was negative. In 10 cases, the driver continued the attack by stabbing; none continued the attack with firearms.

The size and weight of the vehicle and the ramming speed may end up being far more important in increasing lethality, but it is too early to determine the effects of this factor.

WHO ARE THE ATTACKERS?

Using the limited information available to us, we created 11 different attacker groups, including “Jihadist – Confirmed or Highly Likely,” “Jihadist – Possible,” “Mentally Disordered – Confirmed or Highly Likely,” and “Mentally Disordered – Possible.” The numbers and lethality of attacks by these groups are shown in Table 7.

Table 7: Number and Lethality of Attacks by Different Attacker Groups

Attacker Groups	# Attacks	# Fatalities	FPA ^a
Jihadist - Confirmed or Highly Likely	8	133	16.6
Jihadist - Possible	5	5	1.0
Mentally Disordered Individual - Possible	2	1	0.5
Mentally Disordered Individual - Confirmed or Highly Likely	17	33	1.9
Palestinian Group - Non-Jihadist	5	11	2.2
Palestinian without a Specific Islamic Group Affiliation	22	20	0.9
Right-Wing Extremist Individuals or Groups	8	19	2.4
Tamil Groups	1	0	0.0
Uighar Separatists	3	52	17.3
Irish Protestant Groups	1	0	0.0
Unknown Motive	6	7	1.2
<i>Summary</i>	<i>78</i>	<i>281</i>	<i>3.6</i>

^a Fatalities per attack.

We then placed these groups in four main attacker categories: those associated with the Palestinian cause, those motivated by jihadist ideologies, right-wing extremists, and mentally disordered attackers. The motives or affiliations of the remaining attackers (other than in the three attacks by Uighur separatists, one attack by Protestant Extremists in Northern Ireland, and one by Tamils in Sri Lanka) are unknown. Table 8 presents the attacks, fatalities, and average lethality in each main category for 5-year periods and for all periods combined.

Table 8: Attacks, Fatalities, and Lethality by Four Main Attacker Categories in 5-year Periods

5-year Period	Jihadist			Mentally Disordered			Palestinian			Right-Wing Groups or Extremists		
	#A ^a	#F ^b	FPA ^c	#A	#F	FPA	#A	#F	FPA	#A	#F	FPA
1973-1978	-	-	-	1	8	8	-	-	-	-	-	-
1978-1982	-	-	-	-	-	-	-	-	-	-	-	-
1983-1987	-	-	-	-	-	-	-	-	-	-	-	-
1988-1992	-	-	-	-	-	-	1	2	2	-	-	-
1993-1997	-	-	-	1	0	0	1	3	3	2	18	9
1998-2002	-	-	-	-	-	-	2	8	4	1	0	0
2003-2007	1	0	0	3	3	1	-	-	-	1	0	0
2008-2012	-	-	-	2	0	0	4	5	1.3	-	-	-
2013-Apr. 2018	12	138	11.5	12	23	1.9	19	13	0.7	4	1	0.3
<i>Summary</i>	<i>13</i>	<i>138</i>	<i>10.6</i>	<i>19</i>	<i>34</i>	<i>1.8</i>	<i>27</i>	<i>31</i>	<i>1.1</i>	<i>8</i>	<i>19</i>	<i>2.4</i>

^a Number of attacks.

^b Number of fatalities.

^c Fatalities per attack.

Palestinian attackers, who frequently attacked pedestrians and soldiers waiting at bus stops, account for 27 (34.6 percent) of the 78 cases. At the same time, the Palestinians have the lowest average FPA, 1.1.

Jihadists, both confirmed and probable, were responsible for 13 attacks (16.7 percent of the cases), 12 of which took place after 2013. They were the most lethal attackers, with an average FPA of 10.6, although this figure is driven by the single devastating attack in Nice. If this attack is not included, the FPA drops to 4.0, which is still the highest of any attacker category.

Right-wing extremists, including anti-abortion extremists, carried out only 8 attacks (10.3 percent of the cases). One of these, however, was particularly deadly, increasing the overall average FPA for this category of attackers to 2.4.

Attackers suffering mental disorders carried out 19 (24.4 percent) of the car-ramming attacks, making them the second most prominent category of attackers. Only two of the attacks occurred before 2003, so individuals in this category were responsible for 24.6 percent of the attacks after that year. The rise in car-ramming attacks by persons suffering mental disorders is similar to the recent rise of jihadist car-ramming attacks, raising the hypothesis that either such attacks were inspired by the same online propaganda that inspires jihadists or the recent highly publicized attacks by jihadists have inspired copycat attacks by the mentally disordered.

It is also interesting to see which of the groups are suicidal (either confirmed or likely). As shown in Table 9, among the main attacker groups, the suicide rate of the jihadists was the highest (46 percent); the rate for the mentally disordered was 26 percent; for Palestinian attackers, it was 22; and the rate for right-wing groups or extremists was the lowest, at 13 percent. (The highest suicide rate was for Uighur separatists—all three of the Uighur attackers were confirmed or likely suicidal.)

Table 9: Percentage of Suicide Attacks by Attacker Type

Attacker Type	Suicide Attacks	All Attacks	% of All Attacks
Jihadist	6	13	46%
Mentally Disordered	5	19	26%
Palestinian	6	27	22%
Right Wing	1	8	13%

VENUES AND TARGETS

We identified 15 different target groups. These groups appear to fall into three broad target categories:

1. *Public streets with vehicular access.* This category includes pedestrians on the street and bicyclists riding in bike paths. Groups waiting for public surface transportation (at train stations or bus stations and stops) are a subset of this category, as are attacks that ram buses to cause casualties. This category comprises 43 (55.1 percent) of the 78 cases.
2. *Public gatherings.* Attacks aimed at public gatherings (outdoor markets, celebrations, or gatherings on pedestrianized streets) comprise 21 of the cases (26.9 percent).
3. *Public buildings.* Public buildings, including restaurants, shopping malls, and tourist sites, or the people just outside of them were the targets of 14 attacks (17.9 percent of the cases).

Table 10 shows how targeting has evolved over the years. Although the numbers are very small, it appears that in the past ten years, attacks on public streets and public gatherings have been increasing as a proportion of the total number of attacks, underscoring the obvious observation that car-ramming attacks are about mass killing.

Table 10: Increase in Attacks on Target Categories Over 5-Year Periods

5 Year Period	All			Public Gatherings			Public Streets with Vehicular Access			Public Buildings		
	#A ^c	#F ^d	FPA ^e	#A	#F	FPA	#A	#F	FPA	#A	#F	FPA
1973-1977	1	8	8	-	-	-	1	8	8	-	-	-
1978-1982	-	-	-	-	-	-	-	-	-	-	-	-
1983-1987	1	0	0	-	-	-	-	-	-	1	0	0
1988-1992	1	2	2	-	-	-	1	2	2	-	-	-
1993-1997	4	21	5.3	2	18	9	2	3	1.5	-	-	-
1998-2002	3	8	2.7	-	-	-	2	8	4	1	0	0
2003-2007	6	3	0.5	1	2	2	1	1	1	4	0	0
2008-2012	9	18	2	3	6	2	5	12	2.4	1	0	0
2013-Apr. 2018	53	221	4.2	15	190	12.7	31	30	1	7	1	0.1
<i>Summary</i>	<i>78</i>	<i>281</i>	<i>3.6</i>	<i>21</i>	<i>216</i>	<i>10.3</i>	<i>43</i>	<i>64</i>	<i>1.5</i>	<i>14</i>	<i>1</i>	<i>0.1</i>

^a Includes markers, celebrations, pedestrianized public streets, etc.

^b Includes public surface transport.

^c Number of attacks.

^d Number of fatalities.

^e Fatalities per attack.

In most cases, the objective of a car-ramming attack appears to be causing casualties, particularly in sites where there are crowds or where pedestrians are confined and cannot easily escape—for example, on a bridge or a pedestrianized street. The venue may or may not have some symbolic value as well, as was the case in the attack near the Houses of Parliament in London, but this is probably a secondary consideration.

Even random attacks require some thought about the target—the attacker drives somewhere and aims his vehicle at something.

Attacks on these groups are shown in Table 11 (by number of attacks) and in Table 12 (by lethality). As Table 11 shows, 28 of the attacks (35.9 percent) targeted public streets.

People near public transportation facilities, especially bus stops, accounted for 24 (30.8 percent) of the attacks. People waiting at bus stops were the targets in 18 of the attacks. This tactic was particularly prevalent in Israel.

More than half (57.1 percent) of the 14 attacks on public buildings were aimed at medical and religious buildings. Finally, public gatherings were the target in 8 attacks.

Table 11: Target Groups by Frequency of Attacks

Target Group	# Attacks	# Fatalities	FPA
Bus Stations or Stops	18	22	1.2
Public Streets - Vehicle Access	15	25	1.7
Public Streets - Pedestrianized	10	34	3.4
Public Gathering - Demonstration, Other	5	110	22.0
Medical Facility	4	0	0.0
Religious Institution (or Guards protecting them)	4	0	0.0
Public Gathering - Market (religious or open)	3	55	18.3
Public Streets - Pedestrianized & Vehicle Access	3	17	5.7
Train Stations and Stops	3	10	3.3
Buses	3	5	1.7
Military or Police Forces protecting a public street	3	2	0.7
Area outside Public Building	3	1	0.3
Entertainment	2	0	0.0
Public Road Infrastructure	1	0	0.0
Public Stores	1	0	0.0
<i>Summary</i>	78	281	3.6

^a Fatalities per attack.

As Table 12 shows, attacks on public gatherings and pedestrianized streets offer terrorists using a vehicle as their weapon the greatest opportunities for causing high casualties. The data substantiate the obvious point that people crowded into a place that is unprotected by physical obstacles make an ideal target for vehicular attack.

Table 12: Target Groups by Lethality of Attacks

Target Group	# Attacks	# Fatalities	FPA
Public Gathering - Demonstration, Other	5	110	22.0
Public Gathering - Market (religious or open)	3	55	18.3
Public Streets - Pedestrianized & Vehicle Access	3	17	5.7
Public Streets - Pedestrianized	10	34	3.4
Train Stations and Stops	3	10	3.3
Public Streets - Vehicle Access	15	25	1.7
Buses	3	5	1.7
Bus Stations or Stops	18	22	1.2
Military or Police Forces protecting a public street	3	2	0.7
Area outside Public Building	3	1	0.3
Medical Facility	4	0	0.0
Religious Institution (or Guards protecting them)	4	0	0.0
Entertainment	2	0	0.0
Public Road Infrastructure	1	0	0.0
Public Stores	1	0	0.0
<i>Summary</i>	78	281	3.6

^a Fatalities per attack.

That point indicates a possible focus for designing mitigation strategies. Mitigation is the right term—pedestrians will remain vulnerable to vehicles. In the United States alone, approximately 6,000 pedestrians are killed by vehicles annually. In contrast, car-ramming attacks have killed 300 people since 1973. Thus, the emphasis should be placed on safety rather than on security measures, and there are limitations to mitigation.

POTENTIAL MITIGATION MEASURES

Car-ramming attacks on public streets with routine vehicular access have a low average FPA—less than 2.0. The deadliest incidents occur where vehicles mow down pedestrians at public gatherings such as open-air markets or on streets that are theoretically pedestrianized to allow people to gather, shop, promenade, and eat at restaurants without being bothered by automobile traffic.

Public gatherings on pedestrianized streets offer lucrative targets for vehicular assaults, but such streets can be more easily protected than ordinary public streets. Vehicle access to open-air markets can be restricted by permanent or temporary barriers and sometimes simply by parking trucks at access points. Pedestrianized streets can also be protected by permanent or temporary barriers. Open-air celebrations can be similarly protected.

Thus, while car-ramming attacks cannot easily be prevented, crowds of people can be better protected with relatively modest measures. If city planners create a particularly target-rich environment for understandable and laudable reasons, they unfortunately now have an obligation to consider how that environment might be protected.

Other ideas being proposed to mitigate car-ramming attacks include the following:

Armed police. More armed police could be deployed to increase surveillance and enable faster response to an attack. However, the time for a moving car or truck to suddenly veer into pedestrians is a matter of seconds—rapid response is good, but it cannot prevent carnage. There has been some discussion of allowing police to fire into a ramming vehicle, a tactic previously not permitted because of the risk to innocent life.

Increased surveillance. Theoretically, algorithms could be developed to help rental companies identify out-of-the-ordinary rentals, much like the algorithms airlines use to identify passengers meriting greater scrutiny. This could prompt cross-checking with existing databases. Such checks could focus not only on the attributes of the renter, but also on the size of the vehicle. (The Nice and Berlin attacks both involved trucks.) However, such measures raise civil liberty concerns, and they will not prevent terrorists from borrowing or stealing vehicles or using their own.

Pedestrian barriers. The fences between sidewalks and streets that now prevent jaywalking or street crossings at dangerous intersections could be strengthened and expanded. This would complicate street parking, but parked cars are themselves a barrier.

Traffic obstructions. Bollards or posts could be installed (or trees could be grown) to prevent any vehicle that jumps the curb from traveling more than 20 or 30 feet on a sidewalk.

Barriers at events. Trucks are now routinely parked to block streets hosting open-air markets. For instance, vehicle access is denied to the thousands who gather in New York’s Times Square on New Year’s Eve. Measures were also in place to protect those watching the fireworks on Bastille Day in July 2016 in Nice, but a security failure may have allowed an unchecked cargo truck to enter the protected area—and 86 people died in the attack. Crowd-protection measures must be strictly observed if they are to be effective.

Protecting public buildings. The threat of terrorist truck bombs has already resulted in road closures and the installation of barriers around government buildings. These measures could be expanded.

Widening the security circle. A more ambitious measure to protect against vehicular attacks would entail surrounding entire portions of cities by surveillance systems and physical barriers. During the Irish Republican Army’s terrorist campaign, “rings of steel” encircled downtown Belfast and, later, the financial district of London. Short of permanent measures, police could set up checkpoints and conduct random vehicle stops, as they do to detect drunken drivers or suspicious drivers and vehicles at airports.

Pedestrian walkways. More busy shopping streets and restaurant rows could be pedestrianized, already a popular trend. However, our analysis shows that pedestrianized streets can be turned into killing fields if unauthorized vehicles are not prevented from entering them.

Technological solutions. Various electronic means for remotely shutting down vehicles exist and could possibly be employed to prevent vehicular attacks. Looking ahead, autonomous vehicles could be programmed to preclude their use as weapons, although such vehicles could be prone to hacking. MTI research on the possibility of terrorists using vehicles carrying hazardous materials as weapons has explored this approach.³

These are ideas being discussed, not a catalog of practical or proven countermeasures. More analysis is required to determine whether these potential countermeasures to vehicular terrorism would be effective, to identify other countermeasures, and to examine their costs and potential consequences. This does not preclude a discussion of whether the potential results merit the disruption and investment such measures would entail.

³Brian Michael Jenkins and Bruce R. Butterworth, *Potential Terrorist Uses of Highway-Borne Hazardous Materials*, San Jose, CA: Mineta Transportation Institute, 2010. <http://transweb.sjsu.edu/research/potential-terrorist-uses-highway-borne-hazardous-materials>