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Frequency and Lethality of Attacks on Surface Transportation Systems of Developed Countries, by Time of Day

Brian Michael Jenkins Bruce R. Butterworth



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FREQUENCY AND LETHALITY OF ATTACKS ON SURFACE TRANSPORTATION SYSTEMS OF DEVELOPED COUNTRIES, BY TIME OF DAY

Brian Michael Jenkins Bruce R. Butterworth

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	Transit operators and security officials developed countries occur and when th Against Public Surface Transportation, States, Australia, Japan, and EU memil 1970 through 2020. Attacks by differer years, the lethality of such attacks in de deaths per attack (lethality) are the gre peak morning hours. This is particularly Sarin attack; the 2003 Daegu, South K The findings from this research should remote security presence, and quick re	often ask what time of day most attacks or ney kill the most people. Using the MTI data the report authors analyzed 504 attacks in pers states against passenger trains, train s at types of attackers are actually not concer- eveloped countries is not that great – the av- eatest during holiday peaks and also during y true if we include the four weekday attack orea, suicide arson attack; and the 2004 an be useful to those responsible for running sponse to attacks on transit systems.	n passenger train and bus systems in modern base of Terrorist and Serious Criminal Attacks more-developed countries such as the United tations, buses, and bus stations or stops from ntrated at peak hours. And, averaged over 51 erage is 0.4 deaths per attack. But deaths and weekday peak hours – particularly during the s that killed the most people: the 1995 Tokyo id 2005 jihadist attacks in Madrid and London. and overseeing transit operations, visible and					
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> Mineta Transportation Institute College of Business San José State University San José, CA 95192-0219

Tel: (408) 924-7560 Fax: (408) 924-7565 Email: mineta-institute@sjsu.edu

transweb.sjsu.edu

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KEY FINDINGS

- An analysis of 504 attacks on passenger rail and bus systems in economically advanced countries shows that, overall, more attacks occur during non-peak traffic hours than during peak hours: 63% of the attacks occurred in off-peak hours, and only 19% occurred during peak hours. The timing of the remaining 19% of attacks is unknown. It is important to note that these figures are for *all* of the attacks.
- If we consider only the 168 weekday attacks for which the specific time is known or can be estimated (there were 6 weekday attacks for which the time is not known), the proportions shift significantly. Figure F.1 shows the times at which the 168 attacks took place. Figure F.2 shows that the difference between the proportions of attacks in peak and non-peak hours is far narrower for these attacks than it is for *all* attacks: 55% in off-peak hours and 45% in peak hours.



Figure F.1. Number of Weekday Attacks, by Hour



Figure F.2. Number of Weekday Attacks, by Time Period

- The middle bar in Figure F.2 represents a 6-hour period, while the bars on either side (6 AM to 10 AM and 4 PM to 8 PM) represent 4-hour periods. The average number of attacks per hour in the 6 AM to10 AM block is 9.0, and the average number in the 4 PM to 8 PM block is 9.8; the average number of attacks in the 10 AM to 4 PM block is 8.2.
- Far more importantly, attacks occurring during peak hours cause significantly more deaths than attacks in off-peak hours, as shown in Figure F.3.



Figure F.3. Fatalities in Weekday Attacks, by Time Period



• Consequently, the lethality of peak hour attacks, measured in fatalities per attack (FPA), is much greater than that of off-peak hour attacks, as shown in Figure F.4.

Figure F.4. Lethality of Weekday Attacks, by Time Period

- The difference in lethality is not simply the result of a handful of large-scale incidents driving the numbers. Mindful of the possible distortion resulting from four major attacks—the 1995 Tokyo Sarin attack, which killed only 12 but injured 5,000; the 2003 arson attack on a subway in Daegu, South Korea, which killed 198; the 2004 bombing of commuter trains in Madrid, which killed 193; and the 2005 bombing of transportation targets in London, which killed 52—we omitted these outlier attacks from the data shown in the figures. If the four attacks were included, the differences in lethality would be even greater, in particular, the lethality of attacks in the morning rush hour, when all four of the outlier attacks occurred. If those attacks are included, their combined death toll would increase the lethality of all weekday attacks *by more than 5 times*, from 0.6 deaths per attack to 3.2 deaths per attack, and would increase the lethality of all morning rush hour attacks by more than 13 times, from 0.9 deaths per attack to 12.2 deaths per attack.
- Terrorists time their attacks to occur not only during weekday rush hours, but also during peak travel times associated with holidays and vacation travel. The most dramatic example of this is the 1980 bombing of the Bologna train station. The bombing occurred on a Saturday at the beginning of the traditional August vacation, when the station was filled with vacationers heading for the seashore or the mountains. Eighty people were killed in the attack. Even without the Bologna attack included, the 10 holiday peak attacks caused 4.4 deaths per attack— the highest of any time period. Including it increases the lethality by more than 2.5 times, to 11.7, about the same as the lethality of weekday morning rush hour attacks with the four outlier attacks included.
- The correlation between attacks and peak traffic times reflects the determination

of terrorists to cause maximum disruption or achieve high body counts. Right-wing extremists and jihadists are the most lethal attackers, even without consideration of the outlier events.

- Some attackers—left-wing groups and Basque separatists, for example—have avoided large-scale casualties and generally have carried out their attacks during off-peak hours, often at night to avoid detection. Although the Provisional Wing of the Irish Republican Army (PIRA) was capable of carrying out deadly attacks, PIRA bombings of transportation systems, especially in the 1970s, were aimed primarily at disruption.
- The pattern of attacks on train targets is quite different from that of attacks on bus targets, with more bus attacks occurring during non-peak hours; however, similar to weekday train attacks, almost all fatalities in weekday bus attacks occur in the peak traffic hours. In contrast to train attacks, attacks on bus targets in the afternoon rush hour are more lethal than those in the morning rush hour.

FREQUENCY AND LETHALITY OF ATTACKS ON SURFACE TRANSPORTATION SYSTEMS OF DEVELOPED COUNTRIES, BY TIME OF DAY

Police and security officials responsible for public surface transportation in the United States have, on several occasions, requested information on whether attacks are more likely to occur during peak traffic hours than on non-peak hours. It seems logical that terrorists seeking to cause maximum disruption or mass casualties would launch their attacks during times of day when passenger traffic was at its height. Large crowds during rush hours during the work day or during peak holiday traffic could provide attackers with greater opportunities for concealment prior to an attack and could also facilitate escape (if escape is part of the attackers' plan). The dark hours before the morning rush hour, when surveillance is less intense, could also provide time for last-minute preparation.

Not all attacks, however, reflect these objectives. Different categories of attackers have different motives. Some groups, for example, have little interest in casualties, and attacks by mentally unstable individuals may have no discernible pattern. (We wish to emphasize that the term "mentally unstable" is not a clinical assessment, and we are making no independent judgments. Also, our view is that far more proactive alerts and treatments are needed for these individuals, rather than punishment. Generally, the mentally disturbed are far more likely to be victims than victimizers.)

This analysis explores the distribution of attacks on public surface transportation primarily passenger trains and buses and the stations and stops they use—in economically developed countries, including the United States, by time of day. It examines how the timing of attacks may vary, depending on the specific target, tactic, and category of adversary. It specifically considers the effect of timing on lethality.

THE DATA SET: WHAT'S IN, WHAT'S OUT, AND WHY?

The analysis is based on data from the Mineta Transportation Institute (MTI) Database on Terrorist and Serious Criminal Attacks Against Public Surface Transportation. The events selected are the attacks on all scheduled passenger trains and buses and their stations, depots, and stops that are normally operated by transit authorities.

We excluded attacks on freight trains and on tracks used predominately for freight, as well as 27 attacks on charter, school, government, and company buses and on tourist trains or buses, because these are not normally the responsibility of urban transit agencies and because the vehicles may operate according to different schedules or have no particular schedules. We also excluded 91 attacks designed only to damage train tracks, tunnels, and bridges or other rail infrastructure, because it is often difficult to know exactly when infrastructure was sabotaged or explosives were placed, although logic would suggest this is almost always in non-peak hours when surveillance is less intense. Finally, we excluded 7 attacks on passenger ferries and terminals and 8 attacks on transportation company offices and buildings, although attacks against staff and security personnel are included.

The attacks we examined occurred between January 1, 1970, and December 31, 2020—a total of 51 years—and they all took place in economically advanced countries. Essentially, these countries are the members of the Organization for Economic Co-operation and Development (OECD), omitting Colombia, Israel, Turkey, and Mexico, each of which has unique circumstances that made it appropriate to exclude them. Our intention was to create a universe for analysis that would be most relevant to transportation operators in comparatively peaceful environments but that would not exclude terrorist events—in other words, environments similar to that in the United States, Canada, countries in the European Union, Japan, the Republic of Korea, the Republic of China (Taiwan), Australia, and New Zealand.

The information presented here should help transportation operators understand when most attacks occur, when the most lethal attacks occur, the targets that are attacked, the attackers, and the weapons they use.

We examined a total of 504 attacks. These attacks resulted in 720 fatalities and 9,963 injuries—an average of 1.4 fatalities per attack (FPA) and 19.8 injuries per attack (IPA). (We use FPA and IPA as our measures of average lethality so these are terms we will use a lot).

However, the average FPA (and, in one case, the IPA) is distorted by five events that resulted in very large numbers of deaths and injuries, or injuries alone: the February 2003 subway arson attack in Daegu, South Korea (198 dead); the March 2004 Madrid train bombing (193 dead); the August 1980 Bologna train station bombing (85 dead); the July 2005 London Transport bombing (52 dead); and the March 1995 Tokyo Sarin attack (12 dead and 5,000 injured). These five outliers account for 70% of the total fatalities in public surface transportation attacks and 79% of the total injuries, which skews the total results. Omitting them, the average FPA drops from 1.4 to 0.4, and the average IPA drops from 19.8 to 4.2. The omitted attacks, however, are re-inserted in certain charts to show the results when they are included.

We identified two categories of peak hours. The first category consists of workday rush hours between 6 AM and 10 AM and between 5 PM and 8 PM. Eighty of the attacks in our dataset occurred during these peak hours. We realize that these periods do not precisely match rush hours in all cities of the world. For example, during the October 2019 campaign of sabotage and arson in the Santiago, Chile, subway system, attacks took place during a noon rush hour and also in evening rush hours that extended beyond 8:00 PM. In these attacks, 80 of 136 subway stations were damaged by arson, and 11 were completely destroyed. Nevertheless, the attacks caused relatively few fatalities, as they were not intended to kill.¹

The second category of heavy traffic times identified by terrorist planners comprises holidays and high tourist-travel days. The 1980 bombing of the Bologna train station occurred at 10:25 AM on a Saturday morning. It was not a workday rush hour, but the date

¹ "Metro de Santiago: 80-estaciones dañadas o destruidas durante protestas [80 stations destroyed or damaged during protests]," Bnamericas, October 21, 2019 (<u>https://www.bnamericas.com/es/noticias/metro-de-santiago-80-estaciones-danadas-o-destruidas-durante-protestas</u>).

was August 2, the beginning of Italy's annual summer holiday, when the station was predictably filled with vacationers heading for the seashore or the mountains. This analysis considers 10 attacks during known holidays or high tourist-travel days, including New Year's Eve, a Christmas-season market day in Belgium, a holiday weekend in Sweden, and Constitution Memorial Day in Japan.

A summary of the most important results of our analysis is given in Table 1, which shows the attacks, fatalities, injuries, and lethality of attacks during the two peak hour periods (rush hour and holidays, combined and separated), non-peak hours, and unknown hours. The lethality of attacks is *5 times greater* during holiday peaks than during rush hour peaks, and the lethality of all peak hour attacks is *nearly 7 times greater* than that of attacks during non-peak hours. This is a significant finding, especially considering that the five major events listed above, all rush hour or holiday peak hour attacks, are not included.

Table 1.Frequency and Lethality of Attacks, by Peak/Non-Peak/Unknown Hours,
with the Five Major Attacks Excluded

Peak or Non-Peak	Att	acks	Fata	lities	Inju	iries	FPA	IPA
	#	%	#	%	#	%		
Combined Peak	90	18.0	116	64.4	1355	64.0	1.3	11.7
Rush Hour Peak	80	16.0	72	40.0	850	40.2	0.9	10.6
Holiday Peak	10	2.0	44	24.4	505	23.9	4.4	50.5
Non Peak	315	63.1	61	33.9	695	32.8	0.2	2.2
Unknown	94	18.8	3	1.7	66	3.1	0.0	0.7
Totals/Percentages/Averages	499	100.0	180	100.0	2116	100.0	0.4	4.2

If the outlier attacks are included, the difference between peak and non-peak hour lethality is much greater, as shown in Table 2.

Table 2.Frequency and Lethality of Attacks, by Peak/Non-Peak/Unknown Hours,
with the Five Major Attacks Included

Peak or Non Peak	Attacks		Fata	lities	Inju	iries	EDA	IDA
reak of Non-reak	# %		# %		# %		- FFA	IFA
Combined Peak	95	18.8	656	91.1	9202	92.4	6.9	14.0
Rush Hour Peak	84	16.7	527	73.2	8497	85.3	6.3	101.2
Holiday Peak	11	2.2	129	17.9	705	7.1	11.7	64.1
Non Peak	315	62.5	61	8.5	695	7.0	0.2	2.2
Unknown	94	18.7	3	0.4	66	0.7	0.0	0.7
Totals/Percentages/Averages	504	100.0	720	100.0	9963	100.0	1.4	19.8

While the FPA of holiday peak attacks is only about 2 times greater than that of the rush hour peak attacks when the outlier attacks are included, total peak hour lethality is nearly *36 times greater*. The peak hour attacks resulted in 540 more deaths and 7,847 more injuries, while deaths and injuries in the non-peak hour attacks were unchanged.

Table 3 shows the results of the analysis in terms of region, country, target group, target, general and more-specific attack methods, and attacker category when the five outliers

Table 3. Comparison of Frequency and Lethality of Attacks, with Inclusion and Exclusion of the Five Major Attacks

Categories and Groups	Attacks	Attacks	Change (X more)	Fatalities F	atalities	Change (X more)	Injuries	Injuries	Change (X more)	FPA	FPA	FPA Increase (X times)	IPA	IPA	IPA Increase (X times)
Region															
Europe	371	374	3	136	466	330	1616	4316	2700	0.4	1.2	3.4	4.4	11.5	2.6
East Asia	23	25	2	10	220	210	117	5264	5147	0.4	8.8	20.2	5.1	210.6	41.4
Country															
United Kingdom	82	83	1	23	75	52	332	1032	700	0.3	0.9	3.2	4.0	12.4	3.1
Italy	31	32	1	34	119	85	362	562	200	1.1	3.7	3.4	11.7	17.5	1.5
Spain	97	98	1	4	197	193	94	1894	1800	0.0	2.0	48.7	1.0	19.3	19.9
Republic of Korea	2	3	1	0	198	198	0	147	147	0.0	66.0	Null	0.0	49.0	Null
Japan	11	12	1	6	18	12	49	5049	5000	0.5	1.5	2.8	4.5	420.8	94.5
Target Group															
Passenger Trains	178	181	3	113	375	262	1342	7189	5847	0.6	2.1	3.3	7.5	39.7	5.3
Passenger Train Stations	142	144	2	27	305	278	453	2453	2000	0.2	2.1	11.1	3.2	17.0	5.3
Target															
Station, Passenger train Station (Enclosed)	38	40	2	15	293	278	200	2200	2000	0.4	7.3	18.6	5.3	55.0	10.5
Train, Subway	28	31	3	28	290	262	358	6205	5847	1.0	9.4	9.4	12.8	200.2	15.7
Attack Method															
Explosive Devices (IEDs, VBIEDS, etc.)	183	186	3	96	426	330	1423	4123	2700	0.5	2.3	4.4	7.8	22.2	2.9
Arson and Incendiary Devices	129	130	1	3	201	198	79	226	147	0.0	1.5	66.5	0.6	1.7	2.8
Unconventional Weapons	2	3	1	0	12	12	0	5000	5000	0.0	4.0	Null	0.0	1666.7	Null
Specific Attack Method															
IED, Unspecified	163	166	3	91	421	330	1315	4015	2700.5	0.6	2.5	4.5	8.1	24.2	3.0
Arson	67	68	1	3	201	198	43	190	147	0.04	3.0	66.0	0.6	2.8	4.4
Unconventional Weapons	2	3	1	0	12	12	0	5000	5000	0.0	4.0	Null	0.0	1666.7	Null
Attacker Category															
Right-Wing	18	19	1	36	121	85	430	630	200	2.0	6.4	3.2	23.9	33.1	1.4
Possible or Confirmed Jihadist	22	24	2	31	276	245	464	2964	2500	1.4	11.5	8.2	21.1	123.5	5.9
Confirmed Or Possibly Mentally Disturbed	81	82	1	45	243	198	455	602	147	0.6	3.0	5.3	5.6	7.3	1.3
Miscellaneous (Aum Shinrikyo, etc.)	16	17	1	7	19	12	17	5017	5000	0.4	1.1	2.6	1.1	295.1	277.8

Using information in the narratives of the attacks, we determined whether they took place during peak or non-peak hours. As indicated above, weekday peak hours were assumed to be between 6 AM and 10 AM and 4 PM and 8 PM. In some cases, a specific time was not provided, but the narrative indicated that the attack took place "in the busy morning rush hour." We also researched holidays for each country, and regardless of the hour when an attack took place, if it occurred on a holiday—weekend or weekday—it was considered peak.

If the narrative and the day of the week did not enable us to ascertain whether the attack was peak or non-peak, we explored further, using two slightly different methods for more recent and older attacks.

For the more recent attacks, those since January 1, 1995 (356, or 71% of the total), we took the following steps:

- 1. We conducted further internet searches. Where the time or estimated time could be found, or where it was clear that the hour was peak or off-peak, that information was entered. In some cases, initial reporting of the event allowed educated guesses as to peak/off-peak timing.
- 2. We assumed that whether attacks on intercity or international trains and buses occurred during peak or off-peak hours, the timing was likely to be random and therefore largely irrelevant. We also assumed that unless the narrative suggested otherwise, all of the attacks by Basque terrorists (ETA) were non-peak, because the usual modus operandi of the ETA was to attack buses, small trains, train stations, and train lines—often with incendiary devices, sometimes with smaller explosives— at night or during off-peak hours, to avoid fatalities. We made a similar assumption that in the absence of any other data, relatively few attacks by environmental groups in Europe would take place in off-peak hours.
- 3. Finally, where there was no information and none of these judgments could be made, the designation of peak or non-peak was entered as "unknown." This occurred for only 51 incidents (or 14% of the total).

We used the same process for the older 143 attacks (29% of the total)—those that occurred between January 1, 1970, and December 31, 1994—except that we did not attempt to find additional information to determine the time of day when the attacks took place. This was simply because additional information on attacks became increasingly difficult to obtain as the time since the attacks increased. Understandably, the percentage of the 143 attacks where the peak-hour designation could be made went up to 30% (43 attacks).

The number and percentage of attacks whose timing is "unknown" is shown in Table 4. Overall, the timing in 19% of all attacks was designated as "unknown."

•				
Time Period	# Attacks	% of all Attacks	# of Attacks at Unknown Time	% of Attacks at Unknown Time
On or Before 12/31/1994	143	28.7	43	30.1
On or After 1/1/1995	356	71.3	51	14.3
Totals/Percentages	499	100.0	94	18.8

Table 4.Number and Percentages of Attacks with "Unknown" Peak Hour
Designation

Table 5 summarizes the number and percentage of non-peak attacks and fatalities that occurred over the entire 51-year period. In more than half of the 315 attacks (188, or 60%), a specific determination of non-peak time could be made. In the remaining 40%, various assumptions were made. The lethality of the attacks about which assumptions were made was very low.

Table 5. Reasons for Non-Peak Designations

Peak or Non-Peak	Att	acks	Fata	FPA	
	#	%	#	%	-
Specific Day Indicates Weekend Non-Peak	94	29.8	20	32.8	0.2
Specific Time, Day and/or Narrative Indicates Weekday Off-Peak	93	29.5	27	44.3	0.3
Intercity or International Train	67	21.3	13	21.3	0.2
ET/Likely ETA Attack - Off-Peak/No Contrary Data	52	16.5	0	0.0	0.0
Intercity or International Bus	7	2.2	1	1.6	0.1
Environmental or Likely Environmental Attack - Off-Peak/No Contrary Data	2	0.6	0	0.0	0.0
Total/Percentages/Averages	315	100.0	61	100.0	0.2

In Figures 1 through 14 on pp. 26-33, we examine the 173 weekday peak (rush hour) and non-peak attacks that took place to determine relative frequency and lethality. We know or can reasonably estimate the time when 168 of these attacks occurred.

THE DATA SELECTED

This section provides an overview of the attacks. It shows where they occurred, the targets of the attacks, the methods of attack, and the kinds of attackers, These data provide the baseline against which we later measure the effect of the timing of attacks (peak and non-peak) on frequency and lethality. The data also provide an up-to-date overview of attacks on public surface transportation in developed countries.

Attacks, by Region

Table 6 shows the frequency and lethality of attacks, by region.

Pagian	At	Attacks		Fatalities		uries	EDA	IDA
Region	#	%	#	%	#	%	- FFA	IFA
Europe	371	74.3	136	76.0	1615	76.3	0.4	4.4
North America	61	12.2	26	14.5	277	13.1	0.4	4.5
South America	34	6.8	4	2.2	77	3.6	0.1	2.3
East Asia	23	4.6	10	5.6	117	5.5	0.4	5.1
Australasia & Oceania	9	1.8	2	1.1	22	1.0	0.2	2.4
Southeast Asia	1	0.2	2	1.1	7	0.3	2.0	7.0
Totals/Percentages/Averages	499	100.0	180	100.6	2116	100.0	0.4	4.2
Pagion	Attacks		Fatali	Fatalities		uries	EDA	IDA
Region	#	%	#	%	#	%	- FFA	IFA
Southeast Asia	1	0.2	2	1.1	7	0.3	2.0	7.0
East Asia	23	4.6	10	5.6	117	5.5	0.4	5.1
North America	61	12.2	26	14.4	277	13.1	0.4	4.5
Europe	371	74.3	136	75.6	1615	76.3	0.4	4.4
Australasia & Oceania	9	1.8	2	1.1	22	1.0	0.2	2.4
South America	34	6.8	4	2.2	77	3.6	0.1	2.3
Totals/Percentages/Averages	499	100.0	180	100.0	2116	100.0	0.4	4.2

Table 6. Frequency and Lethality of Attacks, by Region

Most of the attacks have occurred in Europe (74%), Canada, and the United States (12%) and South America—specifically Chile (7%), the only Latin American country in the dataset. The results for Europe largely reflect the number of terrorist and separatist groups operating in Europe, the density of Europe's population, and the public's heavy reliance on intercity and commuter trains and local transit.

Attacks in Southeast Asia have the highest average lethality, but this is due to two fatalities from a single attack. All other regions have lethality at or below the overall average.

Most of the 61 attacks in North America, which resulted in 26 fatalities, were carried out by unknown individuals and groups, criminals, and mentally disturbed persons, not by terrorists (see the text box on p. 13 for a discussion of attacks in the United States).

Lethality in Europe and East Asia is significantly increased if the five excluded outlier attacks are included (the three attacks in Europe increase FPA *by 3.4 times*, from 0.4 to 1.3, and the two attacks in East Asia increase FPA *by 20 times*, from 0.4 to 8.8, and IPA *by 41 times*, from 5.1 to 210.6).

Attacks, by Country

Table 7 shows the frequency of attacks in the countries where they occurred, and Table 8 shows their lethality.

Table 7. Countries Ranked by Frequency of Attacks

Country	Att	acks	Fata	alities	Inj	uries	EDA	IDA
Country	#	%	#	%	#	%	- FFA	IFA
Spain	97	19.4	4	2.2	94	4.4	0.0	1.0
United Kingdom	82	16.4	23	12.8	332	15.7	0.3	4.0
United States	53	10.6	22	12.2	246	11.6	0.4	4.6
Germany	46	9.2	7	3.9	102	4.8	0.2	2.2
France	43	8.6	26	14.4	362	17.1	0.6	8.4
Chile	34	6.8	4	2.2	77	3.6	0.1	2.3
Italy	31	6.2	34	18.9	362	17.1	1.1	11.7
Greece	15	3.0	1	0.6	0	0.0	0.1	0.0
Japan	11	2.2	6	3.3	49	2.3	0.5	4.5
Canada	8	1.6	4	2.2	31	1.5	0.5	3.9
Australia	8	1.6	2	1.1	22	1.0	0.3	2.8
Ireland	8	1.6	0	0.0	4	0.2	0.0	0.5
Belgium	6	1.2	24	13.3	301	14.2	4.0	50.2
Republic of China	6	1.2	4	2.2	50	2.4	0.7	8.3
Switzerland	6	1.2	2	1.1	8	0.4	0.3	1.3
Sweden	5	1.0	2	1.1	0	0.0	0.4	0.0
Austria	5	1.0	0	0.0	8	0.4	0.0	1.6
Czech Republic	5	1.0	0	0.0	4	0.2	0.0	0.8
Netherlands	4	0.8	9	5.0	3	0.1	2.3	0.8
Hong Kong	4	0.8	0	0.0	18	0.9	0.0	4.5
Hungary	3	0.6	0	0.0	10	0.5	0.0	3.3
Norway	2	0.4	3	1.7	0	0.0	1.5	0.0
Finland	2	0.4	0	0.0	0	0.0	0.0	0.0
Poland	2	0.4	0	0.0	13	0.6	0.0	6.5
Republic of Korea	2	0.4	0	0.0	0	0.0	0.0	0.0
Slovak Republic	2	0.4	0	0.0	3	0.1	0.0	1.5
Slovenia	2	0.4	0	0.0	0	0.0	0.0	0.0
Singapore	1	0.2	2	1.1	7	0.3	2.0	7.0
Estonia	1	0.2	1	0.6	10	0.5	1.0	10.0
Croatia	1	0.2	0	0.0	0	0.0	0.0	0.0
Denmark	1	0.2	0	0.0	0	0.0	0.0	0.0
Lithuania	1	0.2	0	0.0	0	0.0	0.0	0.0
New Zealand	1	0.2	0	0.0	0	0.0	0.0	0.0
Yugoslavia	1	0.2	0	0.0	0	0.0	0.0	0.0
Totals/Percentages/Averages	499	100.0	180	100.0	2116	100.0	0.4	11.4

Country	Att	acks	Fata	alities	Inju	uries	EDA	IDA
Country	#	%	#	%	#	%	- FFA	IFA
Belgium	6	1.2	24	13.3	301	14.2	4.0	50.2
Netherlands	4	0.8	9	5.0	3	0.1	2.3	0.8
Singapore	1	0.2	2	1.1	7	0.3	2.0	7.0
Norway	2	0.4	3	1.7	0	0.0	1.5	0.0
Italy	31	6.2	34	18.9	362	17.1	1.1	11.7
Estonia	1	0.2	1	0.6	10	0.5	1.0	10.0
Republic of China	6	1.2	4	2.2	50	2.4	0.7	8.3
France	43	8.6	26	14.4	362	17.1	0.6	8.4
Japan	11	2.2	6	3.3	49	2.3	0.5	4.5
Canada	8	1.6	4	2.2	31	1.5	0.5	3.9
United States	53	10.6	22	12.2	246	11.6	0.4	4.6
Sweden	5	1.0	2	1.1	0	0.0	0.4	0.0
Switzerland	6	1.2	2	1.1	8	0.4	0.3	1.3
United Kingdom	82	16.4	23	12.8	332	15.7	0.3	4.0
Australia	8	1.6	2	1.1	22	1.0	0.3	2.8
Germany	46	9.2	7	3.9	102	4.8	0.2	2.2
Chile	34	6.8	4	2.2	77	3.6	0.1	2.3
Greece	15	3.0	1	0.6	0	0.0	0.1	0.0
Spain	97	19.4	4	2.2	94	4.4	0.0	1.0
Ireland	8	1.6	0	0.0	4	0.2	0.0	0.5
Austria	5	1.0	0	0.0	8	0.4	0.0	1.6
Czech Republic	5	1.0	0	0.0	4	0.2	0.0	0.8
Hong Kong	4	0.8	0	0.0	18	0.9	0.0	4.5
Hungary	3	0.6	0	0.0	10	0.5	0.0	3.3
Finland	2	0.4	0	0.0	0	0.0	0.0	0.0
Poland	2	0.4	0	0.0	13	0.6	0.0	6.5
Republic of Korea	2	0.4	0	0.0	0	0.0	0.0	0.0
Slovak Republic	2	0.4	0	0.0	3	0.1	0.0	1.5
Slovenia	2	0.4	0	0.0	0	0.0	0.0	0.0
Croatia	1	0.2	0	0.0	0	0.0	0.0	0.0
Denmark	1	0.2	0	0.0	0	0.0	0.0	0.0
Lithuania	1	0.2	0	0.0	0	0.0	0.0	0.0
New Zealand	1	0.2	0	0.0	0	0.0	0.0	0.0
Yugoslavia	1	0.2	0	0.0	0	0.0	0.0	0.0
Totals/Percentages/Averages	499	100.0	180	100.0	2116	100.0	0.4	11.4

Table 8. Countries Ranked by Lethality of Attacks

The United Kingdom has the highest frequency of attacks (19% of the total), followed by Spain (16% of the total), clearly reflecting the terrorist campaigns by the Provisional Wing of the Irish Republican Army (PIRA) and the Basque separatists (ETA). Most of the attacks in the United States, the third-ranking country (with 11%), were, as mentioned earlier, carried out by criminals or mentally unstable attackers rather than terrorists.

Germany, France, Chile, Italy, and Greece, each of which had between 3% and 9% of the attacks, endured left- and right-wing extremist attacks in the 1970s and 1980s and environmental and jihadist attacks in more recent years. The only other countries with more than 10 attacks are Japan and Ireland (attacks in Japan include Red Army and environmental attacks, and those in Ireland reflect PIRA activity).

Of the countries with more than 10 attacks, the only ones with an FPA higher than the overall average of 0.4 are Japan, Italy, and France. Interestingly, the United Kingdom's FPA is lower than the overall average, indicating the generally low lethality of PIRA attacks.

If the five omitted attacks were added back in, the United Kingdom's FPA would increase by 3.2 times, to 0.9; Italy's by 3.4 times, to 3.7; and Spain's by 48.7 times, to 2.0. The lethality of attacks in the Republic of Korea would increase from 0 to 66.0, and in Japan by 2.8 times, from 0.5 to 1.5.

Attacks, by Target Group

Table 9 shows that the most attacks were directed against passenger trains 36%, followed by 28% against passenger train stations and 27% against buses. (Other target categories have a very low share of the total.)

The only two target groups that have an FPA above the overall average are passenger trains and bus stations and stops; both have an FPA of 0.6, which is only slightly above the overall average. The other target groups are considerably below.

If the five omitted attacks are added back in, passenger train lethality jumps by 3.3 times, to 2.1, and lethality at passenger train stations increases by 11.1 times, also to 2.1. What is going on in America? The third-place U.S. ranking in terms of frequency of attacks is misleading, especially given the country's population. Though they could happen, neither a terrorist wave nor mass killings are reflected in the data, which show only 0.4 deaths per attack. Most of the attacks were against passenger trains and stations and buses and bus stations, the most frequent targets in developed countries. And not surprisingly, given the ability to acquire automatic and semi-automatic weapons in the United States, 14 of the attacks were armed assaults, explosives were used in 11 attacks, and 8 involved stabbings, representing more than 60% of all attacks.

But more than three-quarters (77%) of the attacks were by criminals and mentally disturbed individuals. While mentally disturbed individuals, like the person who shot and killed 6 people and injured many more on the Long Island Railroad in 1993, can be lethal, the majority are not. Seven of the attacks were by unknown individuals, and only 4 attacks—3 by individuals with right-wing leanings or affiliations and 1 by a jihadist, together resulting in 4 deaths—could be considered terrorist attacks.

If there is a wave of violence in the United States, it is not a terrorist wave; it appears to be a growing level of antisocial violence in trains and buses and in stations and stops, carried out with physical force, knives, and automatic or semi-automatic weapons. MTI data capture only some of the most egregious of these cases, but 15% of the attacks have been made against drivers, transit personnel, and security officials.

This is a disturbing trend that U.S. authorities must contend with while keeping an eye on terrorists.

Torract Crown	A	ttacks	Fat	alities	Inj	uries	EDA	IDA
Target Group	#	%	#	%	#	%	- FFA	IFA
Passenger Trains	178	35.7	113	62.8	1342	63.4	0.6	7.5
Passenger Train Stations	142	28.5	27	15.0	453	21.4	0.2	3.2
Buses	133	26.7	23	12.8	122	5.8	0.2	0.9
Bus Stations or Stops	20	4.0	11	6.1	181	8.6	0.6	9.1
Operating or Security Personnel and Facilities	19	3.8	6	3.3	18	0.9	0.3	0.9
Unspecified	7	1.4	0	0.0	0	0.0	0.0	0.0
Totals/Percentages/Averages	499	100.0	180	100.0	2116	100.0	0.4	4.2
		Attacks						
Target Group	A	ttacks	Fat	alities	Inj	uries	EDA	IDA
Target Group	A	ttacks %	Fat #	alities %	lnj #	uries %	- FPA	IPA
Target Group Passenger Trains	A # 178	ttacks % 35.7	Fat # 113	alities % 62.8	Inj # 1342	uries % 63.4	- FPA 0.6	IPA 7.5
Target Group Passenger Trains Bus Stations or Stops	A # 178 20	ttacks % 35.7 4.0	Fat # 113 11	alities % 62.8 6.1	Inj # 1342 181	uries % 63.4 8.6	- FPA 0.6 0.6	IPA 7.5 9.1
Target Group Passenger Trains Bus Stations or Stops Operating or Security Personnel and Facilities	A # 178 20 19	ttacks % 35.7 4.0 3.8	Fat # 113 11 6	alities % 62.8 6.1 3.3	lnj # 1342 181 18	uries % 63.4 8.6 0.9	- FPA 0.6 0.6 0.3	IPA 7.5 9.1 0.9
Target Group Passenger Trains Bus Stations or Stops Operating or Security Personnel and Facilities Passenger Train Stations	A 178 20 19 142	ttacks % 35.7 4.0 3.8 28.5	Fat # 113 11 6 27	alities	lnj # 1342 181 18 18 453	uries % 63.4 8.6 0.9 21.4	- FPA 0.6 0.6 0.3 0.2	IPA 7.5 9.1 0.9 3.2
Target Group Passenger Trains Bus Stations or Stops Operating or Security Personnel and Facilities Passenger Train Stations Buses	A 178 20 19 142 133	ttacks % 35.7 4.0 3.8 28.5 26.7	Fat # 113 11 6 27 23	alities % 62.8 6.1 3.3 15.0 12.8	lnj # 1342 181 18 453 122	uries % 63.4 8.6 0.9 21.4 5.8	 FPA 0.6 0.6 0.3 0.2 0.2 	IPA 7.5 9.1 0.9 3.2 0.9
Target Group Passenger Trains Bus Stations or Stops Operating or Security Personnel and Facilities Passenger Train Stations Buses Unspecified	A # 178 20 19 142 133 7	ttacks % 35.7 4.0 3.8 28.5 26.7 1.4	Fat # 113 11 6 27 23 0	alities % 62.8 6.1 3.3 15.0 12.8 0.0	Inj # 1342 181 18 453 122 0	wries % 63.4 8.6 0.9 21.4 5.8 0.0	 FPA 0.6 0.6 0.3 0.2 0.2 0.0 	IPA 7.5 9.1 0.9 3.2 0.9 0.0

Table 9. Frequency and Lethality of Attacks on Target Groups

Tables 10 and 11 present a more detailed breakdown of the frequency and lethality of attacks on specific targets.

Table 10. Frequency and Lethality of Attacks on Specific Targets, Ordered by
Number of Attacks

Tornot	At	tacks	Fata	Fatalities		Injuries		IPΔ
Target	#	%	#	%	#	%	- FFA	IFA
Train, Passenger (Intercity or Commuter)	134	26.9	79	43.9	931	44.0	0.6	6.9
Bus, Scheduled	122	24.4	13	7.2	107	5.1	0.1	0.9
Station, Train Passenger - Unspecified	49	9.8	6	3.3	99	4.7	0.1	2.0
Station, Train Passenger - Enclosed	38	7.6	15	8.3	200	9.5	0.4	5.3
Train, Subway	28	5.6	28	15.6	358	16.9	1.0	12.8
Subway Station, Enclosed	27	5.4	2	1.1	113	5.3	0.1	4.2
Subway station, Unspecified	20	4.0	1	0.6	71	3.4	0.1	3.6
Security Personnel	14	2.8	2	1.1	16	0.8	0.1	1.1
Bus Stop	13	2.6	11	6.1	177	8.4	0.8	13.6
Minivan or Minibus, Scheduled	9	1.8	10	5.6	15	0.7	1.1	1.7
Station or Stop, Tram or Train Trolley	9	1.8	0	0.0	4	0.2	0.0	0.4
Train, Tram or Trolley	7	1.4	5	2.8	13	0.6	0.7	1.9
Multiple Targets, Track	6	1.2	0	0.0	0	0.0	0.0	0.0
Bus Personnel	5	1.0	3	1.7	2	0.1	0.6	0.4
Bus Station, Unspecified	5	1.0	0	0.0	0	0.0	0.0	0.0
Subway Station, Open Air	3	0.6	3	1.7	2	0.1	1.0	0.7
Station, Train and Bus	2	0.4	1	0.6	3	0.1	0.5	1.5
Bus Station, Enclosed	2	0.4	0	0.0	4	0.2	0.0	2.0
Station, Train Passenger - Open Air	2	0.4	0	0.0	1	0.0	0.0	0.5
Railway PersonneL	1	0.2	1	0.6	0	0.0	1.0	0.0
Bus, Trolley	1	0.2	0	0.0	0	0.0	0.0	0.0
Multiple Targets, Bus	1	0.2	0	0.0	0	0.0	0.0	0.0
Multiple Targets, Train	1	0.2	0	0.0	0	0.0	0.0	0.0
Totals/Percentages/Averages	499	100.0	180	100.0	2116	100.0	0.4	4.2

Townst	At	tacks	Fata	lities	Inj	uries	ED4	IDA
Target	#	%	#	%	#	%	FPA	IPA
Minivan or Minibus, Scheduled	9	1.8	10	5.6	15	0.7	1.1	1.7
Railway Personnel	1	0.2	1	0.6	0	0.0	1.0	0.0
Subway Station, Open Air	3	0.6	3	1.7	2	0.1	1.0	0.7
Train, Subway	28	5.6	28	15.6	358	16.9	1.0	12.8
Bus Stop	13	2.6	11	6.1	177	8.4	0.8	13.6
Train, Tram or Trolley	7	1.4	5	2.8	13	0.6	0.7	1.9
Bus Personnel	5	1.0	3	1.7	2	0.1	0.6	0.4
Train, Passenger (Intercity or Commuter)	134	26.9	79	43.9	931	44.0	0.6	6.9
Station, Train and Bus	2	0.4	1	0.6	3	0.1	0.5	1.5
Station, Train Passenger - Enclosed	38	7.6	15	8.3	200	9.5	0.4	5.3
Security Personnel	14	2.8	2	1.1	16	0.8	0.1	1.1
Station, Train Passenger - Unspecified	49	9.8	6	3.3	99	4.7	0.1	2.0
Bus, Scheduled	122	24.4	13	7.2	107	5.1	0.1	0.9
Subway Station, Enclosed	27	5.4	2	1.1	113	5.3	0.1	4.2
Subway station, Unspecified	20	4.0	1	0.6	71	3.4	0.1	3.6
Bus Station, Enclosed	2	0.4	0	0.0	4	0.2	0.0	2.0
Bus Station, Unspecified	5	1.0	0	0.0	0	0.0	0.0	0.0
Bus, Trolley	1	0.2	0	0.0	0	0.0	0.0	0.0
Multiple Targets, Bus	1	0.2	0	0.0	0	0.0	0.0	0.0
Multiple Targets, Track	6	1.2	0	0.0	0	0.0	0.0	0.0
Multiple Targets, Train	1	0.2	0	0.0	0	0.0	0.0	0.0
Station or Stop, Tram or Train Trolley	9	1.8	0	0.0	4	0.2	0.0	0.4
Station, Train Passenger - Open Air	2	0.4	0	0.0	1	0.0	0.0	0.5
Totals/Percentages/Averages	499	100.0	180	100.0	2116	100.0	0.4	4.2

Table 11. Frequency and Lethality of Attacks on Specific Targets, Ordered byFPA of Attacks

Table 10 shows that the greatest number of attacks were against intercity and commuter trains (27%), followed by a variety of train and subway stations (27% in total), scheduled buses (24%), and finally, subway trains (6%). There are no surprises here.

The only targets with an above-average FPA are a set of bus targets (bus stops and scheduled minivans), train and subway targets (subway trains, open-air subway stations, train/tram/trolleys, intercity or commuter trains, passenger trains, and open-air stations), and operating and security personnel. If the five omitted outlier attacks are added back in, the FPA of attacks on enclosed train stations increases from 0.4 to 7.3 (*18.6 times greater*), and that of subway train attacks increases from 1.0 to 9.4 (*9.4 times greater*).

Attacks, by Attack Method

Tables 12 and 13 show frequency and lethality of attacks, by attack methods. Table 12 shows that 81% of all attacks used one of four methods: explosives (37%), arson and incendiary devices (26%), stabbings (10%), and derailment (8%).

Attack Mathed	Att	acks	Fata	alities	Inju	uries	EDA	IPΔ
Attack Method	#	%	#	%	#	%	- FFA	IFA
Explosive Devices (IEDs, VBIEDS, etc)	183	36.7	96	53.3	1422.5	67.2	0.5	7.8
Arson and Incendiary Devices	129	25.9	3	1.7	79	3.7	0.0	0.6
Stabbings	50	10.0	23	12.8	136	6.4	0.5	2.7
Derailment Attempts (Mechanical and IED)	41	8.2	7	3.9	207	9.8	0.2	5.0
Kidnapping, Hijacking, Robbery	32	6.4	9	5.0	11	0.5	0.3	0.3
Armed Assaults	23	4.6	21	11.7	54	2.6	0.9	2.3
Unarmed and other Assaults	17	3.4	12	6.7	32	1.5	0.7	1.9
Mechanical Sabotage	10	2.0	1	0.6	3	0.1	0.1	0.3
Multiple Weapons	6	1.2	6	3.3	131	6.2	1.0	21.8
Vehicle Rammings	4	0.8	2	1.1	34	1.6	0.5	8.5
Conventional Chemicals, e.g., Acids	2	0.4	0	0.0	6	0.3	0.0	3.0
Unconventional Weapons	2	0.4	0	0.0	0	0.0	0.0	0.0
Totals/Percentages/Averages	499	100.0	180	100.0	2116	100.0	0.4	4.2

Table 12. Attack Methods, by Frequency

As shown in Table 13, the only attack methods used more than 10 times that have higher lethality than the overall average of 0.4 are armed assaults, unarmed and other assaults, explosives, and stabbings; however, primitive methods such as stabbings can sometimes be deadly. Stabbings at transportation venues have significantly increased recently and are the subject of a 2019 MTI report.²

If to the outlier attacks are included, the lethality of explosives—used in Madrid, Bologna, and London—increases *by 4.4 times*, from 0.5 to 2.3; and that of arson and incendiary devices, *by 66.5 times*, from 0.0 to 1.5. The lethality of unconventional weapons (specifically Sarin) increases FPA from 0 to 4.0, and the occurrence of injuries increases IPA from 0 to 1,666.7. The lethality of explosives and arson and incendiary devices then becomes acutely dominant.

Attack Mathed	Att	acks	Fata	alities	Inju	uries	EDA	IPA
	#	%	#	%	#	%	FFA	IFA
Multiple Weapons	6	1.2	6	3.3	131	6.2	1.0	21.8
Armed Assaults	23	4.6	21	11.7	54	2.6	0.9	2.3
Unarmed and other Assaults	17	3.4	12	6.7	32	1.5	0.7	1.9
Explosive Devices (IEDs, VBIEDS, etc)	183	36.7	96	53.3	1423	67.2	0.5	7.8
Vehicle Rammings	4	0.8	2	1.1	34	1.6	0.5	8.5
Stabbings	50	10.0	23	12.8	136	6.4	0.5	2.7
Kidnapping, Hijacking, Robbery	32	6.4	9	5.0	11	0.5	0.3	0.3
Derailment Attempts (Mechanical and IED)	41	8.2	7	3.9	207	9.8	0.2	5.0
Mechanical Sabotage	10	2.0	1	0.6	3	0.1	0.1	0.3
Arson and Incendiary Devices	129	25.9	3	1.7	79	3.7	0.0	0.6
Conventional Chemicals, e.g., Acids	2	0.4	0	0.0	6	0.3	0.0	3.0
Unconventional Weapons	2	0.4	0	0.0	0	0.0	0.0	0.0
Totals/Percentages/Averages	499	100.0	180	100.0	2116	100.0	0.4	4.2

Table 13. Attack Methods, by Lethality

Tables 14 and 15 examine these attack methods in more detail. Table 14 shows that 83% of the attacks used 8 specific attack methods: unspecified improvised explosive devices [IEDs] (32.7%); arson (13.4%); improvised incendiary devices [IIDs] (12.4%); knives (10%); automatic or semiautomatic weapons (4.5%); bomb derailments (4.4%): mechanical derailment attempts (3.0%); and vehicle-borne explosive devices (2%).

² Brian Michael Jenkins, Bruce R. Butterworth, Jean-François Clair, and Joseph E. Trella III, An Exploration of Transportation Stabbing Attacks, San Jose, CA: Mineta Transportation Institute, 2019 (<u>https://transweb.sjsu.edu/research/SP0319-Terrorist-Stabbing-Attacks-Public-Transportation</u>).

Specific Attack Method	At	acks	Fata	alities	Injuries		EDA	IPA
Specific Attack Method	#	%	#	%	#	%	- FPA	IPA
IED, Unspecified	163	32.7	91	50.6	1315	62.1	0.6	8.1
Arson	67	13.4	3	1.7	43	2.0	0.0	0.6
IID (Improvised Incendiary Device)	62	12.4	0	0.0	36	1.7	0.0	0.6
Assault, Stabbings	50	10.0	23	12.8	136	6.4	0.5	2.7
Assault, Automatic or Semi-Automatic Weapons	23	4.6	21	11.7	54	2.6	0.9	2.3
Derailment, Track Bomb - IED, Unspecified	22	4.4	6	3.3	55	2.6	0.3	2.5
Derailment, Bolts/Tracks Removed	15	3.0	1	0.6	143	6.8	0.1	9.5
VBIED	10	2.0	2	1.1	97	4.6	0.2	9.7
Sabotage, Other	10	2.0	1	0.6	0	0.0	0.1	0.0
Assault, Unspecified or Other	9	1.8	10	5.6	4	0.2	1.1	0.4
Hijacking, Automatic or Semi-Automatic Weapons	9	1.8	5	2.8	2	0.1	0.6	0.2
Hijacking, Unarmed	9	1.8	1	0.6	1	0.0	0.1	0.1
Assault, Unarmed	8	1.6	2	1.1	28	1.3	0.3	3.5
Hijacking, Knives or Sharp Objects	5	1.0	2	1.1	3	0.1	0.4	0.6
Multiple Weapons, Other	4	0.8	2	1.1	6	0.3	0.5	1.5
Vehicle Used as Weapon	4	0.8	2	1.1	34	1.6	0.5	8.5
Derailment, Other or Unknown	4	0.8	0	0.0	12	0.6	0.0	3.0
Hijacking, Other Weapons/Threats	4	0.8	0	0.0	1	0.0	0.0	0.3
IED, Hoax Device	4	0.8	0	0.0	0	0.0	0.0	0.0
Grenade	3	0.6	3	1.7	11	0.5	1.0	3.7
Conventional Chemicals, e.g., Acids	2	0.4	0	0.0	6	0.3	0.0	3.0
IED, Other	2	0.4	0	0.0	0	0.0	0.0	0.0
Unconventional weapons	2	0.4	0	0.0	0	0.0	0.0	0.0
Multiple Weapons, Grenades & Automatic or Semi-Automatic Weapons	1	0.2	4	2.2	125	5.9	4.0	125.0
Robbery, Automatic or Semi-Automatic Weapons	1	0.2	1	0.6	0	0.0	1.0	0.0
Hijacking, Grenades or IED, Unspecified	1	0.2	0	0.0	0	0.0	0.0	0.0
Hoax Device/Substance, Unconventional Weapon	1	0.2	0	0.0	0	0.0	0.0	0.0
Kidnapping, Automatic or Semi-Automatic Weapons	1	0.2	0	0.0	0	0.0	0.0	0.0
Kidnapping, Other Weapons/Threats	1	0.2	0	0.0	2	0.1	0.0	2.0
Multiple Weapons, IED/IID & Other	1	0.2	0	0.0	0	0.0	0.0	0.0
Robbery, Unarmed	1	0.2	0	0.0	2	0.1	0.0	2.0
Totals/Percentages/Averages	499	100.0	180	100.0	2116	100.0	0.4	4.2

Table 14. Specific Attack Methods, by Frequency

Table 15 shows that only 3 specific attack methods used more than 10 times have higher lethality than the overall average: automatic or semiautomatic weapons, unspecified IEDs, and stabbings. If the five more-lethal attacks are included, the lethality shifts are relatively parallel to those of the other attack methods. The lethality of IEDs increases by 4.4 times, from 0.5 to 2.3, and that of arson, by 66.5 times, from 0.04 to 3.0. Conventional weapons, which were not lethal in attacks other than the five outliers, now appear, with lethality increased from 0 to 4.0 and injuries increased from 0 to 1,666.7.

On a sife Attack Mathand	Att	acks	Fata	alities	Inju	iries	ED A	IPA
Specific Attack Method	#	%	#	%	#	%	- FPA	IPA
Multiple Weapons, Grenades & Automatic or Semi-Automatic Weapons	1	0.2	4	2.2	125	5.9	4.0	125.0
Assault, Unspecified or Other	9	1.8	10	5.6	4	0.2	1.1	0.4
Grenade	3	0.6	3	1.7	11	0.5	1.0	3.7
Robbery, Automatic or Semi-Automatic Weapons	1	0.2	1	0.6	0	0.0	1.0	0.0
Assault, Automatic or Semi-Automatic Weapons	23	4.6	21	11.7	54	2.6	0.9	2.3
IED, Unspecified	163	32.7	91	50.6	1315	62.1	0.6	8.1
Hijacking, Automatic or Semi-Automatic Weapons	9	1.8	5	2.8	2	0.1	0.6	0.2
Multiple Weapons, Other	4	0.8	2	1.1	6	0.3	0.5	1.5
Vehicle Used as Weapon	4	0.8	2	1.1	34	1.6	0.5	8.5
Assault, Stabbings	50	10.0	23	12.8	136	6.4	0.5	2.7
Hijacking, Knives or Sharp Objects	5	1.0	2	1.1	3	0.1	0.4	0.6
Derailment, Track Bomb - IED, Unspecified	22	4.4	6	3.3	55	2.6	0.3	2.5
Assault, Unarmed	8	1.6	2	1.1	28	1.3	0.3	3.5
VBIED	10	2.0	2	1.1	97	4.6	0.2	9.7
Hijacking, Unarmed	9	1.8	1	0.6	1	0.0	0.1	0.1
Sabotage, Other	10	2.0	1	0.6	0	0.0	0.1	0.0
Derailment, Bolts/Tracks Removed	15	3.0	1	0.6	143	6.8	0.1	9.5
Arson	67	13.4	3	1.7	43	2.0	0.0	0.6
Conventional Chemicals, e.g., Acids	2	0.4	0	0.0	6	0.3	0.0	3.0
Derailment, Other or Unknown	4	0.8	0	0.0	12	0.6	0.0	3.0
Hijacking, Grenades or IED, Unspecified	1	0.2	0	0.0	0	0.0	0.0	0.0
Hijacking, Other Weapons/Threats	4	0.8	0	0.0	1	0.0	0.0	0.3
Hoax Device/Substance, Unconventional Weapon	1	0.2	0	0.0	0	0.0	0.0	0.0
IED, Hoax Device	4	0.8	0	0.0	0	0.0	0.0	0.0
IED, Other	2	0.4	0	0.0	0	0.0	0.0	0.0
IID (Improvised Incendiary Device)	62	12.4	0	0.0	36	1.7	0.0	0.6
Kidnapping, Automatic or Semi-Automatic Weapons	1	0.2	0	0.0	0	0.0	0.0	0.0
Kidnapping, Other Weapons/Threats	1	0.2	0	0.0	2	0.1	0.0	2.0
Multiple Weapons, IED/IID & Other	1	0.2	0	0.0	0	0.0	0.0	0.0
Robbery, Unarmed	1	0.2	0	0.0	2	0.1	0.0	2.0
Unconventional weapons	2	0.4	0	0.0	0	0.0	0.0	0.0
Totals/Percentages/Averages	499	100.0	180	100.0	2116	100.0	0.4	4.2

Table 15. Specific Attack Methods, by Lethality

Attacks, by Attacker Categories

Tables 16 shows the frequency of attacks, by categories of attackers.

Table 16. Frequency of Attacks, by Attacker Category

Attacker Cotogony	A	ttacks	Fat	alities	Inj	uries	EDA	IDA
Allacker Calegory	#	%	#	%	#	%	- FFA	IFA
Unknown Groups or Individuals	157	31.5	9	5.0	61	2.9	0.1	0.4
Confirmed Or Possiblly Memtally Disturbed	81	16.2	45	25.0	455	21.5	0.6	5.6
Criminal	63	12.6	11	6.1	130	6.1	0.2	2.1
Irish Republican or Protestant Groups	53	10.6	22	12.2	293	13.8	0.4	5.5
Left-Wing Groups	38	7.6	14	7.8	142	6.7	0.4	3.7
Basque Groups	22	4.4	4	2.2	88	4.2	0.2	4.0
Possible or Confirmed Jihadist	22	4.4	31	17.2	464	21.9	1.4	21.1
Right-Wing Groups	18	3.6	36	20.0	430	20.3	2.0	23.9
Environmental/Anarchist or Labor or Civilian Protesters	17	3.4	0	0.0	15	0.7	0.0	0.9
Miscellaneous Groups	16	3.2	7	3.9	17	0.8	0.4	1.1
Non-Jiadist Islamic Extremists	12	2.4	1	0.6	21	1.0	0.1	1.8
Totals/Percentages/Averages	499	100.0	180	100.0	2116	100.0	0.4	4.2

The identity of the groups or individuals responsible for 32% of the attacks is unknown. Individuals described in the narratives as manifesting some type of mental instability or disturbance were involved in 16% of the cases.

Criminals committed 13% of the attacks, and PIRA and other groups engaged in the conflict in Northern Ireland accounted for 11%. The remaining categories of attackers accounted for between 2% and 8%.

Attacker Category	A	ttacks	Fat	alities	Inj	uries	EDA	IDA
Attacker Galegory	#	%	#	%	#	%	- FFA	IFA
Right-Wing Groups	18	3.6	36	20.0	430	20.3	2.0	23.9
Possible or Confirmed Jihadist	22	4.4	31	17.2	464	21.9	1.4	21.1
Confirmed Or Possiblly Memtally Disturbed	81	16.2	45	25.0	455	21.5	0.6	5.6
Miscellaneous Groups	16	3.2	7	3.9	17	0.8	0.4	1.1
Irish Republican or Protestant Groups	53	10.6	22	12.2	293	13.8	0.4	5.5
Left-Wing Groups	38	7.6	14	7.8	142	6.7	0.4	3.7
Basque Groups	22	4.4	4	2.2	88	4.2	0.2	4.0
Criminal	63	12.6	11	6.1	130	6.1	0.2	2.1
Non-Jiadist Islamic Extremists	12	2.4	1	0.6	21	1.0	0.1	1.8
Unknown Groups or Individuals	157	31.5	9	5.0	61	2.9	0.1	0.4
Environmental/Anarchist or Labor or Civilian Protesters	17	3.4	0	0.0	15	0.7	0.0	0.9
Totals/Percentages/Averages	499	100.0	180	100.0	2116	100.0	0.4	4.2

Table 17. Attacker Categories, by Lethality of Attacks

As shown in Table 17, the only groups that had higher-than-average lethality are rightwing extremists, jihadists, and the mentally disturbed. If the Madrid and London attacks are included, the lethality of jihadist attacks increases *by 8.3 times*, from 1.4 to 11.5. If the single suicide attempt by arson in Daegu, South Korea, is included, the FPA of attacks by mentally disturbed individuals increases *by 5.3 times*, from 0.6 to 3.0; if the Bologna train station bombing is included, right-wing attackers' FPA increases *by 3.2 times*, from 2.0 to 6.4; and if the Tokyo Sarin attack is included, the FPA of miscellaneous groups, such as Aum Shinrikyo, increases *by 2.6 times*, from 0.4 to 1.1, and the IPA increases *by 277.8 times*, from 1.1 to 295.1.

ADDING PEAK HOURS TO THE MIX

This section examines whether certain tactics are more or less likely to be employed during peak hours (defined here as between 6 AM and 10 AM and between 4 PM and 8 PM or any time of day during holidays when public transport can experience peak hour traffic) and how timing affects not just the frequency, but also the lethality of attacks in various venues. (Tables with additional data, including the injuries resulting from attacks on public transit during peak and off-peak hours and other less-relevant categories, are presented in the Appendix.)

Table 18 addresses timing and its effects on lethality in terms of target groups (the groups shown in Table 9). These include passenger trains (of all types); passenger train stations; buses, bus stations, and stops; and all operating or security personnel and facilities (7 attacks against targets not belonging to any of these groups are not included). The first two green rows in the table combine trains and train stations into "all train targets" and buses and bus stations into "all bus targets." Lethality is indicated by FPA. Table A.1 in the Appendix presents the same information, along with data on injuries (IPA), for all attack categories.

Torret Crown	Att	acks	Fat	EDA	
Target Group	#	%	#	%	FFA
All Train Targets	320		140		0.4
Peak Hours	64	20.0	90	64.3	1.4
Non-Peak Hours	203	63.4	48	34.3	0.2
Unknown	53	16.6	2	1.4	0.0
Passenger Trains	178		113		0.6
Peak Hours	30	16.9	77	68.1	2.6
Non-Peak Hours	123	69.1	35	31.0	0.3
Unknown	25	14.0	1	0.9	0.0
Passenger Train Stations	142		27		0.2
Peak Hours	34	23.9	13	48.1	0.4
Non-Peak Hours	80	56.3	13	48.1	0.2
Unknown	28	19.7	1	3.7	0.0
All Bus Targets	153		34		0.2
Peak Hours	21	13.7	24	70.6	1.1
Non-Peak Hours	96	62.7	9	26.5	0.1
Unknown	36	23.5	1	2.9	0.0
Buses	133		23		0.2
Peak Hours	16	12.0	16	69.6	1.0
Non-Peak Hours	86	64.7	6	26.1	0.1
Unknown	31	23.3	1	4.3	0.0
Bus Stations or Stops	20		11		0.6
Peak Hours	5	25.0	8	72.7	1.6
Non-Peak Hours	10	50.0	3	27.3	0.3
Unknown	5	25.0	0	0.0	0.0
All Operating or Security Personnel and Facilities	19		6		0.3
Peak Hours	5	26.3	2	33.3	0.4
Non-Peak Hours	10	52.6	4	66.7	0.4
Unknown	4	21.1	0	0.0	0.0
All Targets Total/Percentage/Average	90	18.0	116	64.4	1.3
All Targets Total/Percentage/Average - Non-Peak *Includes 6	215	62.1	61	22.0	0.2
Attacks without Target Group	313	03.1		55.9	0.2
All Targets Total/Percentage/Average -Unknown *Includes 1 Attacks without Target Group	94	18.8	3	1.7	0.0

Table 18. Frequency and Lethality of Targets Attacked, by Timing of Attack

As shown in Table 18, 18% of the attacks took place during peak hours, 63% took place during non-peak hours, and 19% took place during unknown hours. This pattern is more or less the same in all of the target groups. However, as Figures 1 and 2 below will show, when we eliminate the events in which the time of the attack is unknown, there is much less difference in frequency of attacks on weekdays between peak and non-peak hours, and the lethality of peak hour attacks is significantly greater.

For all train targets, 20% of the attacks took place during peak hours. For attacks on passenger trains, the percentage is 16.9%, and for passenger train stations, it is 23.9%. A lower percentage of the attacks on all bus targets —13.7%—took place during peak hours; the percentage for buses is 12%, and that for bus stations and bus stops is 25%.

Attacks on operating staff and security personnel constituted a very small percentage of the total attacks (there were only 19 such attacks), so it was difficult to confidently draw conclusions concerning them. However, the distribution between peak and non-peak hour attacks is similar to that for all attacks: 26% during peak hours and 53% during non-peak

hours. This reflects a common scenario in which adversaries enter a station or depot and then attack a staff member or security official.

In contrast, the lethality of attacks differs significantly by time of day. The FPA of peak hour attacks, 1.3, is *5.8 times higher* than the 0.2 FPA of non-peak hour attacks. The FPA of attacks whose time is unknown is near zero—only 3 fatalities in 93 attacks—strongly suggesting these were non-peak hour attacks and/or were not aimed at achieving high body counts.

The same pattern was found for attacks on all train targets—the FPA of attacks during peak hours is 1.4, which is *seven times higher* than the FPA of attacks during non-peak hours; the FPA of attacks on passenger trains (including subway trains) in peak hours is 2.6, which is *8.5 times higher* that of non-peak hour attacks, while the 0.4 FPA of peak hour attacks on train stations is only twice that of attacks during non-peak hours.

The FPA of attacks on all bus targets during peak hours is only 1.1, but it is *more than 10 times* the FPA of attacks during non-peak hours. The results are about the same for attacks on buses alone, while the FPA for attacks on bus stations during peak hours is 1.6, which is *5 times higher* than the FPA for non-peak hours.

The complete story of lethality is significantly different when the fatalities of the five outlier attacks are added back into the calculations. Three of those attacks—London, Daegu, and Tokyo—targeted passenger trains (specifically, subway trains). All three took place during peak hours, increasing the peak hour FPA from 2.6 to 10.9, which is *34 times higher* than the non-peak FPA of 0.3 when the attacks are not included. The other two attacks— Bologna and Madrid—were against train stations, and both took place during peak hours. In Madrid, where the March 11, 2004, attacks were timed to bring down the Atocha train station, the peak-period lethality of attacks on passenger train stations was 8.1, which is *40 times greater* than the non-peak hour FPA of 0.2.

Table 19 shows the timing of the six most-relevant attack methods—those used in at least 25 attacks (5% of all attacks)—during peak and off-peak hours. Table A.2 in the Appendix presents the same information for all attack categories, along with data on injuries.

Attack Method		acks	Fata	ED4	
		%	#	%	г гра
Explosive Devices (IEDs, VBIEDS, etc)	183		96		0.5
Peak Hours	43	23.5	79	82.3	1.8
Non-Peak Hours	90	49.2	15	15.6	0.2
Unknown	50	27.3	2	2.1	0.0
Arson and Incendiary Devices	129		3		0.0
Peak Hours	12	9.3	1	33.3	0.1
Non-Peak Hours	91	70.5	2	66.7	0.0
Unknown	26	20.2	0	0.0	0.0
Stabbings	50		23		0.5
Peak Hours	12	24.0	11	47.8	0.9
Non-Peak Hours	35	70.0	12	52.2	0.3
Unknown	3	6.0	0	0.0	0.0
Derailment Attempts (Mechanical and IED)	40		7		0.2
Peak Hours	0	0.0	0	0.0	0.0
Non-Peak Hours	38	95.0	7	100.0	0.2
Unknown	2	5.0	0	0.0	0.0
Kidnapping, Hijacking, Robbery	32		9		0.3
Peak Hours	7	21.9	7	77.8	1.0
Non-Peak Hours	19	59.4	2	22.2	0.1
Unknown	6	18.8	0	0.0	0.0
Armed Assaults	23		21		0.9
Peak Hours	5	21.7	1	4.8	0.2
Non-Peak Hours	17	73.9	20	95.2	1.2
Unknown	1	4.3	0	0.0	0.0

Table 19. Most Frequently Used Attack Methods, by Timing of Attack

About one-fourth (23.5%) of the explosives attacks occurred during peak hours, and the proportion is roughly the same for stabbings (24%), armed assaults (21.7%), and kidnapping, hijacking, and robbery attempts (21.9%) This is the equivalent of a random distribution and therefore is not significant. In other words, these tactics, which are aimed at people, do not show clear patterns of timing.

Only 9.3% of the arson and incendiary attacks occurred during peak hours, probably indicating that most of the arson attempts at train yards and bus sheds occur during hours of darkness. None of the derailments took place during peak hours, indicating that this is clearly a stealth activity.

Once again, however, lethality is dramatically different between peak and non-peak hour attacks. When explosives were used, the peak hour attacks were 9 *times more lethal*; peak hour kidnappings, robberies, and hijackings were 9.5 *times more lethal*; peak hour arson attacks were 3.8 *times more lethal*; and peak hour stabbings were 2.7 *times more lethal*.

The results are even more dramatic when we include the five outlier attacks. When the Daegu suicide arson attack, which killed 198 people, is included, the FPA of arson and incendiary attacks during peak hours increases *by 153 times*, from an average of 0.01 to 15.3. Including the bombings in Madrid, London, and Bologna increases the peak hour FPA for explosives attacks to 8.9, which is *44.5 times higher* than the non-peak hour FPA of 0.2. (This is statistically more relevant in that three attacks are involved, rather than just one.) Finally, if we include the 1995 Tokyo Sarin attack, which resulted in 12 deaths and

5,000 injuries, the FPA (which during non-peak hour attacks was 0) and IPA increase to 6.0 and 1,666.6.

Table 20 shows the frequency and lethality of the attacks by the attacker categories that struck at least 25 times or that were less frequent yet were particularly lethal. The same data, along with data on injuries for all attacker types, are presented in Table A.3 in the Appendix.

Attacker Cotorom		acks	Fata	EDA	
Allacker Calegory	#	%	#	%	FFA
Unknown Groups or Individuals	157		9		0.1
Peak Hours	10	6.0	0	0.0	0.0
Non-Peak Hours	110	65.9	7	77.8	0.1
Unknown	37	22.2	2	22.2	0.1
Confirmed Or Possibly Mentally Disturbed	81		45		0.6
Peak Hours	23	28.4	22	48.9	1.0
Non-Peak Hours	49	60.5	23	51.1	0.5
Unknown	9	11.1	0	0.0	0.0
Criminal	63		11		0.2
Peak Hours	11	17.5	5	45.5	0.5
Non-Peak Hours	43	68.3	6	54.5	0.1
Unknown	9	14.3	0	0.0	0.0
Irish Republican or Protestant Groups	53		22		0.4
Peak Hours	18	34.0	20	90.9	1.1
Non-Peak Hours	24	45.3	2	9.1	0.1
Unknown	11	20.8	0	0.0	0.0
Left-Wing Groups	38		14		0.4
Peak Hours	9	23.7	7	50.0	0.8
Non-Peak Hours	19	50.0	6	42.9	0.3
Unknown	10	26.3	1	7.1	0.1
Possible or Confirmed Jihadist	22		31		1.4
Peak Hours	11	50.0	29	93.5	2.6
Non-Peak Hours	10	45.5	2	6.5	0.2
Unknown	1	4.5	0	0.0	0.0
Right-Wing Groups	18		36		2.0
Peak Hours	2	11.1	28	77.8	14.0
Non-Peak Hours	14	77.8	8	22.2	0.6
Unknown	2	11.1	0	0.0	0.0
Miscellaneous Groups (Includes Aum Shinrikyo)	16		7		0.4
Peak Hours	3	18.8	5	71.4	1.7
Non-Peak Hours	6	37.5	2	28.6	0.3
Unknown	7	43.8	0	0.0	0.0

Table 20. Most Frequent or Lethal Attacker Categories, by Timing

In general, non-peak hour attacks are more frequent than peak hour attacks. But there are important differences. The attackers that carried out the highest percentage of attacks in peak hours (50%) were jihadists—their attacks tend to focus on rush hours to achieve high body counts. PIRA and other groups involved in the Northern Ireland conflict were responsible for 34% of the peak hour attacks, followed by the mentally disturbed (28.4%), miscellaneous groups (25%), and left-wing groups (23.7%).

At the other end of the spectrum, only 6.4% of the peak hour attacks were made by unknown individuals or groups, 11.1% were made by right-wing groups, and 17.5% were made

by criminals. Environmental/anarchist aroups and Basque separatists carried out few attacks during peak hours (11.8% and 4.5%, respectively). Furthermore, the peak-hour attacks of these groups seem to have been designed to disrupt and result in no or few fatalities. The Basque ETA has carried out deadly attacks, so the low number of fatalities in most ETA attacks is not a matter of lacking capabilities. Instead, it appears to reflect a strategic or tactical decision.

Similarly, PIRA carried out attacks with large explosives at government and military targets and—particularly during one period in the 1970s targeted civilians in Great Britain, thus demonstrating the group's capacity for greater violence when it chose. However, PIRA attacks against passenger train and bus targets seem to have been designed to achieve disruption rather than mass casualties.

Indeed, the intentions of attackers are more important than the hour in which attacks took place. The text box on this page describes a contrast between two terrorist campaigns that illustrates this point. Both campaigns featured many peak hour attacks, but they had vastly different results. Attacks on surface transit in Paris and Santiago: A Contrast. Most of the six bombings of Paris subway and commuter train stations in 1995 by the Armed Islamic Group (GIA) considered pre-jihadist—took place during peak hours and were intended to kill. The fact that only 9 people were killed and around 240 were injured has more to do with the intervention of French intelligence and police than with attacker intent.

In contrast, in October 2019, protesters generally aligned with a confluence of anarchist and anti-government causes conducted a series of unarmed and arson attacks against the Santiago, Chile, subway system; the majority took place during non-rush hours, but they were many. The MTI database records five specific days when attacks took place, sometimes at different locations and sometimes in Santiago's fairly unique midday rush hour, but there were undoubtedly many more attacks-80 stations were damaged, and 11 of them were destroyed. Despite the intensity of the attack campaign, which was provoked by an increase of metro fares (evidently seen as the "final straw" for groups with different grievances), there were relatively few fatalities in the attacks.

GIA in Paris aimed to kill. Protesters in Santiago aimed to disrupt.

Despite the small number of attacks by right-wing groups, these groups achieved the highest lethality, particularly in Italy during the 1970s and 1980s. The average FPA of peak hour right-wing attacks was 14.0, which is *24.5 times greater* than that of non-peak hour attacks. Right-wing groups in Italy at the time aimed at body counts.

The next greatest lethality during peak hour attacks was achieved by jihadists, with an FPA of 2.6, which is *13.2 times greater* than the FPA of non-peak hour jihadist attacks.

Although the 1.1 FPA of peak-hour PIRA attacks is low, it is *13.3 times higher* than that of PIRA attacks during non-peak hours; the peak hour attack FPA of 1.7 for various miscellaneous attackers is *5 times higher* than that of non-peak attacks; and the 0.5 FPA of peak hour criminal attacks *is 3 times higher* that of non-peak hour criminal attacks.

Including the five outlier attacks results in significant changes. First, the Madrid attack in 2004 and the London attack in 2005 were both peak hour attacks by jihadists. Including these attacks increases the FPA of peak hour jihadist attacks to 21.1, *105 times higher* than the 0.2 FPA of non-peak hour jihadist attacks. Including the 1980 attack by right-wing extremists in Bologna has a similar effect, pushing the peak hour FPA to 37.7, *almost 63 times* higher than the FPA of non-peak hour right-wing attacks. Including the single suicide-by-fire attempt by a mentally disturbed man in Daegu, South Korea, which killed 198, pushes the peak hour FPA for mentally disturbed individuals up to 9.2, which is *18.3 times higher* than the 0.5 FPA of non-peak hour attacks. Finally, including the 1995 Sarin attack in Tokyo increases the FPA for attacks by miscellaneous groups to 4.3, which is *14 times* that of non-peak attacks, and the IPA also increases dramatically.

PEAK AND NON-PEAK HOUR DISTRIBUTION OF WEEKDAY ATTACKS, BY FREQUENCY AND LETHALITY

This section examines the relatively few attacks that not only took place during weekdays but occurred at a time that we know or can reasonably estimate. We have determined that 173 attacks were weekday peak or non-peak attacks, and for 168 of them—the overwhelming majority—we know or can estimate the specific time of the attack.

Figure 1 shows the distribution of the passenger train and train station attacks and bus attacks, by hour. Figure 2 shows the fatalities and lethality (FPA only) of the attacks, by blocks of time:

- 1. Midnight to 6 AM (non-peak)
- 2.6 AM to 10 AM (morning peak)
- 3. 10 AM to 4 PM (midday non-peak),
- 4.4 PM to 8 PM (late afternoon/early evening peak)
- 5. 8 PM to midnight (late night non-peak)

Three of the blocks (the peak periods and the late night non-peak) are 4 hours long, and two blocks (the early morning and midday non-peaks) are 6 hours long. We believe that these are relatively distinct periods for purposes of attack planning.

There is much less difference between peak and non-peak hour weekday attacks, with 55% taking place in off-peak hours and 45% taking place in peak hours. However, it is clear that there are peaks in daytime travel during the morning and evening rush hours.



Figure 1. Weekday Attacks, by Hour



Figure 2. Weekday Attacks, by Time Block

Figure 3 shows fatalities, by time block. The number of fatalities increases significantly during peak hours.



Figure 3. Weekday Attack Fatalities, by Time Block

Figure 4 shows the effect of including the four omitted weekday attacks (London, Daegu, Madrid, and Tokyo), all of which occurred in the morning peak (note that the scale in Figure 4 is different from that in Figure 3). The change in the actual number of attacks is not shown, as the total increase is very low.





Figure 5 shows that the average FPA for the 168 weekday attacks is much higher during peak hours. Figure 6 shows the dramatic increase of FPA of attacks in the morning peak hours when the four outlier attacks are included.



Figure 5. FPA of Weekday Attacks, by Time Block





Figure 7 shows the distribution of weekday attacks against passenger trains and passenger train stations, which were the targets of the four outlier attacks, by hour, and Figure 8 shows the attacks by time block. Figures 9 and 10 show fatalities in these attacks by time block, and Figures 11 and 12 follow the same sequence for FPA. Once again, the scale in the figures is changed when the outlier attacks are included. Clearly, the morning time block is the most lethal period, even without the inclusion of the four outlier attacks, and especially with them. The FPA of attacks within that time block are as follows:

6 AM to 7 AM: 5 attacks, 2 fatalities, FPA = 0.4 7 AM to 8 AM: 8 attacks, 209 fatalities, FPA = 26.1 8 AM to 9 AM: 8 attacks, 52 fatalities, FPA = 6.5 9 AM to 10 AM: 8 attacks, 220 fatalities, FPA = 27.5

Four of the 10 attacks between 11 AM and noon involved a device that could have been meant for the morning rush hour and failed or for the afternoon/early evening rush hour, and one involved a Santiago midday rush hour (15 of the 173 events involved the discovery of such a device, 9 in non-peak hours and 6 in peak hours). In some cases, authorities may know or have guessed when the device was timed to detonate.



Figure 7. Passenger Train and Train Station Attacks, by Weekday Hour



Figure 8. Passenger Train and Train Station Fatalities, by Weekday Time Block





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Figure 10. FPA of Attacks on Passenger Trains and Train Stations, by Weekday Time Block





The 49 attacks on buses and bus stations and stops were scattered among peak and nonpeak hours. The proportions of those attacks that happened in off-peak hours (33 attacks, or 67%) and peak hours (16 attacks, or 33%) are closer to the percentages for all attacks, in contrast to attacks on passenger trains and train stations. However, only 3 of the 21 fatalities in bus attacks occurred outside of peak hour periods, suggesting that the off-peak hour attacks were meant to disrupt rather than kill. The bus attacks with highest lethality (1.8 FPA) occurred in the afternoon/evening rush hour, in contrast to attacks on passenger trains and train stations, the most lethal of which occurred in the morning rush hour.

Figure 12 shows the numbers of weekday bus and bus station/stop attacks, by hour. Figure 13 shows the fatalities of those attacks, by time block, and Figure 14 shows their FPA, by time block.



Figure 12. Number of Weekday Bus and Bus Station/Stop Attacks, by Hour



Figure 13. Fatalities in Weekday Bus and Bus Station/Stop Attacks, by Time Block



Figure 14. FPA of Weekday Bus and Bus Station/Stop Attacks, by Time Block

ADDITIONAL OBSERVATIONS

The figures in this section do not include the 50 attacks that took place during non-holiday weekends, in which 11 people were killed, or the 10 attacks that took place during holidays, in which 44 people were killed. Attacks during busy holidays are clearly more lethal than attacks on non-holiday weekends. If the Bologna attack is included, the death toll for only 11 attacks is 129, or 11.7 deaths per attack.

In 2012, MTI published a study of terrorist plots targeting public surface transportation systems.³ The study assumed that terrorist plots can provide insights into terrorist ambitions, which are often difficult to discern when an attack has succeeded and its perpetrators are dead or have fled. Most of the plots examined were interrupted before the plotters had decided on the date and time of the attack. Where information was available, it indicated that terrorists (all of whom were jihadists) wanted their attacks to cause a large number of casualties, and therefore they favored rush hours, particularly the morning rush hour. The present analysis confirms this preference and confirms that the plotters were correct in their planning: Attacks during morning rush hours are the most lethal and cause the most casualties.

Law enforcement deployments and the presence of security personnel are determined by a number of factors, including the volume of passenger traffic, patterns of criminal and antisocial behavior, threat assessments, and intelligence warnings. The research presented here suggests that well-established historical patterns of terrorist attacks and the risk of large-scale casualty events should be included in those calculations.

³ Brian Michael Jenkins and Joseph Trella, Carnage Interrupted: An Analysis of Fifteen Terrorist Plots Against Public Surface Transportation, San Jose, CA: Mineta Transportation Institute, 2012 (<u>https://transweb.sjsu.edu/sites/default/files/2979-analysis-of-terrorist-plots-against-publicsurface-transportation.pdf</u>).

APPENDIX

Table A.1.	Table A.1. Fatalities and Injuries Caused by Attacks on All Target Groups,
	by Timing

Target Group	Attacks		Fatalities		Injuries			IDA
Target Group	#	%	#	%	#	%	FFA	IFA
All Train Targets	320		140		1795		0.4	5.6
Peak Hours	64	20.0	90	64.3	1176	65.5	1.4	18.4
Non-Peak Hours	203	63.4	48	34.3	572.5	31.9	0.2	2.8
Unknown	53	16.6	2	1.4	46	2.6	0.0	0.9
Passenger Trains	178		113		1342		0.6	7.5
Peak Hours	30	16.9	77	68.1	915	68.2	2.6	30.5
Non-Peak Hours	123	69.1	35	31.0	404.5	30.2	0.3	3.3
Unknown	25	14.0	1	0.9	22	1.6	0.0	0.9
Passenger Train Stations	142		27		453		0.2	3.2
Peak Hours	34	23.9	13	48.1	261	57.6	0.4	7.7
Non-Peak Hours	80	56.3	13	48.1	168	37.1	0.2	2.1
Unknown	28	19.7	1	3.7	24	5.3	0.0	0.9
All Bus Targets	153		34		303		0.2	2.0
Peak Hours	21	13.7	24	70.6	171	56.4	1.1	8.1
Non-Peak Hours	96	62.7	9	26.5	115	38.0	0.1	1.2
Unknown	36	23.5	1	2.9	17	5.6	0.0	0.5
Buses	133		23		122		0.2	0.9
Peak Hours	16	12.0	16	69.6	8	6.6	1.0	0.5
Non-Peak Hours	86	64.7	6	26.1	97	79.5	0.1	1.1
Unknown	31	23.3	1	4.3	17	13.9	0.0	0.5
Bus Stations or Stops	20		11		181		0.6	9.1
Peak Hours	5	25.0	8	72.7	163	90.1	1.6	32.6
Non-Peak Hours	10	50.0	3	27.3	18	9.9	0.3	1.8
Unknown	5	25.0	0	0.0	0	0.0	0.0	0.0
All Operating or Security Personnel and Facilities	19		6		18		0.3	0.9
Peak Hours	5	26.3	2	33.3	8	44.4	0.4	1.6
Non-Peak Hours	10	52.6	4	66.7	7	38.9	0.4	0.7
Unknown	4	21.1	0	0.0	3	16.7	0.0	0.8
All Targets Total/Percentage/Average	90	18.0	116	64.4	1355	64.0	1.3	15.1
All Targets Total/Percentage/Average - Non-Peak *Includes 6 Attacks without Target Group	315	63.1	61	33.9	695	32.8	0.2	2.2
All Targets Total/Percentage/Average -Unknown *Includes 1 Attacks without Target Group	94	18.8	3	1.7	66	3.1	0.0	0.7

Table A.2. Fatalities and	I Injuries Caused by the Most Frequent or Lethal	Attack
Methods, by	Timing	

	Attacks		Fatalities		Iniuries				
Attack Method	#	%	#	%	#	%	— FPA	IPA	
Explosive Devices (IEDs, VBIEDS, etc)	183		96		1423		1	8	
Peak Hours	43	23.5	79	82.3	1125	79.1	1.8	26.2	
Non-Peak Hours	90	49.2	15	15.6	260.5	18.3	0.2	2.9	
Unknown	50	27.3	2	2.1	37	2.6	0.0	0.7	
Arson and Incendiary Devices	129		3		79		0	1	
Peak Hours	12	9.3	1	33.3	19	24.1	0.1	1.6	
Non-Peak Hours	91	70.5	2	66.7	51	64.6	0.0	0.6	
Unknown	26	20.2	0	0.0	9	11.4	0.0	0.3	
Stabbings	50		23		136		0	3	
Peak Hours	12	24.0	11	47.8	49	36.0	0.9	4.1	
Non-Peak Hours	35	70.0	12	52.2	82	60.3	0.3	2.3	
Unknown	3	6.0	0	0.0	5	3.7	0.0	1.7	
Derailment Attempts (Mechanical and IED)	41		7		210		0	5	
Peak Hours	0	0.0	0	0.0	0	0.0	0.0	0.0	
Non-Peak Hours	39	97.5	7	100.0	198	95.7	0.2	5.1	
Unknown	2	5.0	0	0.0	12	5.8	0.0	6.0	
Kidnapping, Hijacking, Robbery	32		9		11		0	0	
Peak Hours	7	21.9	7	77.8	3	27.3	1.0	0.4	
Non-Peak Hours	19	59.4	2	22.2	7	63.6	0.1	0.4	
Unknown	6	18.8	0	0.0	1	9.1	0.0	0.2	
Armed Assaults	23		21		54		1	2	
Peak Hours	5	21.7	1	4.8	9	16.7	0.2	1.8	
Non-Peak Hours	17	73.9	20	95.2	45	83.3	1.2	2.6	
Unknown	1	4.3	0	0.0	0	0.0	0.0	0.0	
Mechanical Sabotage	10		1		0		0	0	
Peak Hours	2	20.0	0	0.0	0	0.0	0.0	0.0	
Non-Peak Hours	6	60.0	0	0.0	0	0.0	0.0	0.0	
Unknown	2	20.0	1	100.0	0	0.0	0.5	0.0	
Unarmed and other Assaults	17		12		32		1	2	
Peak Hours	4	23.5	12	100.0	3	9.4	3.0	0.8	
Non-Peak Hours	11	64.7	0	0.0	27	84.4	0.0	2.5	
Unknown	2	11.8	0	0.0	2	6.3	0.0	0.0	
Multiple Weapons	6		6		131		1	22	
Peak Hours	2	33.3	4	66.7	127	96.9	2.0	63.5	
Non-Peak Hours	3	50.0	2	33.3	4	3.1	0.7	1.3	
Unknown	1	16.7	0	0.0	0	0.0	0.0	0.0	
Vehicle Rammings	4		2		34		1	9	
Peak Hours	2	50.0	1	50.0	20	58.8	0.5	10.0	
Non-Peak Hours	2	50.0	1	50.0	14	41.2	0.5	7.0	
Unknown	0	0.0	0	0.0	0	0.0	0.0	0.0	
Conventional Chemicals (Acids, etc)	2		0		6		0	3	
Peak Hours	0	0.0	0	0.0	0	0.0	0.0	0.0	
Non-Peak Hours	1	50.0	0	0.0	6	#	0.0	6.0	
Unknown	1	50.0	0	0.0	0	0.0	0.0	0.0	
Unconventional Weapons	2		0		0		0	0	
Peak Hours	1	50.0	0	0.0	0	0.0	0.0	0.0	
Non-Peak Hours	1	50.0	0	0.0	0	0.0	0.0	0.0	
Unknown	0	0.0	0	0.0	0	0.0	0.0	0.0	

Table A.3. Fatalities and Injuries Caused by the Most Frequent or Lethal AttackerCategories, by Timing

	Attacks		Fatalities		Injuries			
Attacker Category	#	%	#	%	#	%	- FPA	IPA
Unknown Groups or Individuals	157		9		61		0.1	0.4
Peak Hours	10	6.4	0	0.0	4	6.6	0.0	0.4
Non-Peak Hours	110	70.1	7	77.8	42	68.9	0.1	0.4
Unknown	37	23.6	2	22.2	15	24.6	0.1	0.4
Confirmed Or Possibly Mentally Disturbed	81		45		455		0.6	5.6
Peak Hours	23	28.4	22	48.9	247	54.3	1.0	10.7
Non-Peak Hours	49	60.5	23	51.1	190	41.8	0.5	3.9
Unknown	9	11.1	0	0.0	18	4.0	0.0	2.0
Criminal	63		11		130		0.2	2.1
Peak Hours	11	17.5	5	45.5	7	5.4	0.5	0.6
Non-Peak Hours	43	68.3	6	54.5	118	90.8	0.1	2.7
Unknown	9	14.3	0	0.0	5	3.8	0.0	0.6
Irish Republican or Protestant Groups	53		22		293		0.4	5.5
Peak Hours	18	34.0	20	90.9	251	85.7	1.1	13.9
Non-Peak Hours	24	45.3	2	9.1	39	13.3	0.1	1.6
Unknown	11	20.8	0	0.0	3	1.0	0.0	0.3
Left-Wing Groups	38		14		142		0.4	3.7
Peak Hours	9	23.7	7	50.0	67	47.2	0.8	7.4
Non-Peak Hours	19	50.0	6	42.9	71	50.0	0.3	3.7
Unknown	10	26.3	1	7.1	4	2.8	0.1	0.4
Basque Groups	22		4		88		0.2	4.0
Peak Hours	1	4.5	0	0.0	34	38.6	0.0	34.0
Non-Peak Hours	19	86.4	4	100.0	43	48.9	0.2	2.3
Unknown	2	9.1	0	0.0	11	12.5	0.0	5.5
Possible or Confirmed Jihadist	22		31		464		1.4	21.1
Peak Hours	11	50.0	29	93.5	446	96.1	2.6	40.5
Non-Peak Hours	10	45.5	2	6.5	17	3.7	0.2	1.7
Unknown	1	4.5	0	0.0	1	0.2	0.0	1.0
Right-Wing Groups	18		36		430		2.0	23.9
Peak Hours	2	11.1	28	77.8	298	69.3	14.0	0.0
Non-Peak Hours	14	77.8	8	22.2	131.5	30.6	0.6	9.4
Unknown	2	11.1	0	0.0	0	0.0	0.0	0.0
Environmental/Anarchist or Labor or Civilian Protesters	17		0		15		0.0	0.9
Peak Hours	2	11.8	0	0.0	1	6.7	0.0	0.0
Non-Peak Hours	14	82.4	0	0.0	14	93.3	0.0	1.0
Unknown	1	5.9	0	0.0	0	0.0	0.0	0.0
Miscellaneous Groups (Includes Aum Shinrikyo)	16		7		17		0.4	1.1
Peak Hours	3	18.8	5	71.4	0	0.0	1.7	0.0
Non-Peak Hours	6	37.5	2	28.6	14	82.4	0.3	2.3
Unknown	7	43.8	0	0.0	3	17.6	0.0	0.4
Non-Jihadist Islamic Extremists	12		1		21		0.1	1.8
Peak Hours	0	0.0	0	0.0	0	0.0	0.0	0.0
Non-Peak Hours	7	58.3	1	100.0	15	71.4	0.1	2.1
Unknown	5	41.7	0	0.0	6	28.6	0.0	1.2

ABOUT THE AUTHORS

BRIAN MICHAEL JENKINS

Brian Michael Jenkins is the director of the Mineta Transportation Institute's Allied Telesis National Transportation Security Center and, since 1997, has directed the Institute's continuing research on protecting surface transportation against terrorism and other serious forms of crime.

BRUCE R. BUTTERWORTH

Bruce R. Butterworth is a Senior Transportation Security Researcher at MTI and former Director of Aviation Security Operations at the Federal Aviation Administration. Bruce has taken a leading role in creating MTI's unique database of attacks on public surface transportation.

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Therese McMillan Executive Director Metropolitan Transportation Commission (MTC)

Jeff Morales Managing Principal InfraStrategies, LLC

Dan Moshavi, PhD* Dean, Lucas College and Graduate School of Business San José State University

Toks Omishakin* Director California Department of Transportation (Caltrans)

Takayoshi Oshima Chairman & CEO Allied Telesis, Inc.

Paul Skoutelas* President & CEO American Public Transportation Association (APTA) **Beverley Swaim-Staley** President Union Station Redevelopment Corporation

Jim Tymon* Executive Director American Association of State Highway and Transportation Officials (AASHTO)

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Brian Michael Jenkins National Transportation Security Center Director

