

Abstract

There is a dearth of information on non-terror related vehicle weaponization and the public's perception of this emerging phenomena. The recent unprecedented 2018 Toronto vehicle ramming attack (VRA) incident captured the attention of the public who turned to social media to seek and tweet information about the incident, show solidarity for the victims and stand with the City of Toronto.

This research investigated the public perception of the 2018 Toronto VRA using Twitter. The tweets were used to examine the public's perception of the Toronto van attacks of April 23, 2018, and how the attributes of VRAs and terrorism frames shaped how the public without verified information, perceived the perpetrator's motive as terrorism and identity as Muslim. Analyses performed on the Twitter dataset revealed that the public perceived the motive as terrorism and identity as Muslim even after the facts of the incident was revealed that the suspect was of Armenian descent and his motive was incel-inspired. Six related overarching themes were discussed perceived identity, perceived motive, confirmed identity, confirmed motive, international incidents, Canadian incidents and community and support.

The study reveals insights into public perceptions of the 2018 Toronto Van Attack, identifying that perceptions were formed based on terrorism frames from past events. The study highlights the need for emergency management professionals to have strategies on social media to consistently disseminate information to counter dis/misinformation.

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Barlu Dumbuya

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#Breaking Witness to truck ramming into pedestrians tells local TV station that the driver looked wide-eyed, angry and Middle Eastern (@NatashaFatah, 2018)

1. INTRODUCTION

Public perception matters, and during disasters and emergencies, public perceptions can have an insidious impact on response and recovery, particularly risk communications and management.

When an emergency occurs, the public's perception of the risk is dependent on a number of factors like the type of hazard (Sjöberg, 2000), previous experience with and knowledge of a similar incident and media coverage (Fellenor et al, 2018; Wolff & Larsen, 2014; Lemyre, Turner, Lee & Krewski, 2006). On April 23, 2018, during the busy lunch time on one of Toronto's busy streets, a man drove a white van on the side walk plowing innocent pedestrians and everything along its path (Hayes, Friesen and Moore, 2018). This was unprecedented in Canada, where in the last decade only two vehicle-ramming-attack (VRA) incidents have been recorded. The April 2018 vehicle attack incident was the first major VRA of this magnitude in Canada. Canada's emergency line, 911, received the first phone call about a vehicle driving erratically and ramming into people at 1:25 pm. The police were at the scene almost immediately and seven minutes later had arrested the suspect.

Immediately after his arrest however, the police could only confirm that the incident was deliberate and had no other detail about the perpetrator's motive or identity. It is not unusual that when an incident occurs, the many moving parts make it difficult for public officials and for emergency response professionals to know and have details to inform the public. This was a recipe for speculation about the perpetrator's identity and motive as the public tried to make sense of the inexplicable. As in most of these types of emergency events, speculation and

presumptions reverberates across national boundaries, and communities come together in solidarity and support both offline and online (Eriksson, 2016).

An important concern for emergencies and crises is information. The period immediately after emergencies is often characterized by an information vacuum with lack of complete details about the incident (Imran, Castillo, Diaz & Vieweg, 2015). Stakeholders – the public, emergency management, government officials, victims, family, media - seek and provide information to satisfy a diversity of information needs. Emergency managers and responders need critical information – the who, what, where and why - about the event for response and recovery. The media seeks the same information for the purposes of reporting on the incident. The public seeks information about loved ones, and to determine their level of personal risk in order to take appropriate action (Gray, Weal & Martin, 2017). As with most violent crimes, the public's need to know takes on a high urgency. And with the internet and online news, the public does not have to wait for news and updates from mainstream media or press conferences from public safety officials. Instead, they actively seek information and updates about the event from a myriad of social media sources from their internet connected devices (Shklovski, Palen & Sutton, 2008; Gray et al, 2017), and make their own judgement and opinions about the event, whether justified or factual (Westerman, Spence & Van Der Heide, 2014; Shklovski, Palen & Sutton, 2008).

The initial phase of a crisis is characterized by disinformation. Disinformation and rumors can affect the public's perception and seriously hinder risk communications and management (Gray, Weal and Martin, 2017; Gray et al, 2016). For example, the immediate aftermath of the 2013 Boston marathon bombings was chaotic and characterized by disinformation - a manhunt ensued

for the persons responsible at the same time as rumors that the perpetrators were of Arab descent was going virile (Starbird, Maddock, Orand, Achterman, & Mason, 2014). Three days after sufficient information from eyewitness accounts and surrounding surveillance had been collected, public officials published photographs of the suspects (Starbird, Maddock, Orand, Achterman, & Mason, 2014). The police later revealed that the urgency to publish the identity of the suspect was driven by the need to stymie the disinformation that had been spreading on social media and to prevent retaliation against other persons (Starbird et al., 2014; Klontz & Jain, 2013).

The tweet from @NatasFatah above presumes that the 2018 Toronto VRA was an act of terrorism committed by an “angry and Middle Eastern” person. This incorrect eyewitness account continued to propagate on Twitter long after the police confirmed the suspect’s identity and motive for the attack. Disinformation can be detrimental for the public and for emergency response. The spread of disinformation about the motive and identity of the perpetrator can be explained by: 1) the information gap (the period between the event occurring and when the facts about the who, what and why become known) during which the public had an urgent desire to get more details, 2) the extreme fear and outrage deliberate violent incidents engender and the need for someone to be punished and, 3) recall of similar past events. Furthermore, the media - local, national and international - framing of the incident as “deliberate” was on the presumption that if the incident is violent and deliberate, then it must be an act of terrorism committed by a person of Middle Eastern descent, whose hatred of the West drives them to cause harm.

This is the point of departure for this study. Who did the public believe was responsible for and why they committed this violent act? Did the public perceive the incident as an emerging risk? This study looks at social media, specifically Twitter, for answers to these questions. The recent surge in VRAs in Europe and Canada have certainly raised the public's awareness about VRAs and societal risk. In trying to make sense of this incident, they have drawn on similar past incidents, like the 2016 Nice, France VRA incident that involved a truck and was committed by a resident of France of Tunisian descent; the 2017 London Mosque vehicle attack that was committed by a white male claiming to revenge a previous Muslim related London Bridge attack; and the 2017 Edmonton, Canada vehicle attack by a Somali-Canadian. The challenge for government and emergency management organizations is how to mitigate and manage the increasing occurrence of VRA hazard and the public's perception of this risk.

1.1 Purpose

The purpose of the paper is to explore and understand the public's perception of the Toronto VRA incident. Who was the perpetrator? What was their motive? What was their perception of the VRA as an emerging risk with respect to past incidents? Even though a plethora of research exists on public perception and human-caused technological risks like terrorism, not much exists about the perception of non-terror related vehicle ramming attacks. This study uses social media analysis to explore the public perception of the April 23, 2018 deadly van incident. In particular, how the attributes of VRAs and how terrorism frames affect the public's concern about these types of events. A contextual analysis of tweets captured after the vehicle ramming attack will help investigate the public's perception and provide insights into this unprecedented event. This study theorizes that the public's perception of the event can best be understood by first, the extreme fear and outrage this type of event evokes and second, the dominant terrorism frames that have been used to understand and interpret VRAs.

To gain an insight into the public's perception of VRAs, tweets are analyzed and coded. In relation to terrorism frames, I want to see whether past VRA or violent incidents factor in the public's tweets about the incident being studied. Tweets are therefore coded using framing analysis particularly terrorism frames which reference Muslim extremism or terrorist groups associated with Muslim organizations like ISIS. In addition, to understand the context and make comparisons, tweets are coded for the suspect's confirmed motive and identity. Furthermore, sense of community solidarity and support are considered because these types of events tend to bring people together.

1.2 Research Questions

The objective of this study is to investigate the public perception of the non-terror related VRAs.

The following research questions will be addressed:

- What does the analysis of Twitter tell us about how the public perceived the 2018 Toronto VRA incident in terms of the motive and identity of the perpetrator?
- What does Twitter tell us about the perception of the diversity of users ?
- What media frames were present on Twitter and did they shape the public's perception of the VRA incident?

1.3 Structure of the Paper

This study has been organized into five chapters:

- an introduction
- a theoretical framework and literature review section
- a methodology section
- a results section
- a discussion section
- and a conclusion section.

The introduction section outlines the case study of Toronto Van attack tweets. The literature review outlines VRA incidents as an emerging risk; how risk perception and terrorism framing may have shaped public perception of the 2018 Toronto VRA incident; and how social media analysis specifically Twitter can be used to understand public perception of VRAs. The Methodology section is about the data collection and methods used for the study. The Results section outlines the results of the content analysis of the 2018 Toronto van attack tweets. The discussion and conclusion provides an analysis of the results and gives a conclusion to the study.

1.4 Background: The Toronto Van Attack

On April 23rd 2018, around lunch time on Yonge street, one of the City of Toronto's busiest streets was struck by an unprecedented act of violence. It caught Torontonians, Canadians and the rest of the world by surprise. Canada had been relatively immune to violent attacks of this nature, but now had its first major vehicular ramming attack. On this fateful day, a man in a white rental cargo van from the rental company Ryder, drove indiscriminately along Yonge street and the sidewalks, plowing pedestrians in his path. At approximately 1:25 pm, he started driving the truck south on Yonge street, North York for approximately one kilometre at speeds of 60 to 70 km/hour according to eyewitness accounts. He came to a stop minutes later, exiting the truck and confronting police, pointing something he took out of his pocket (which later turned out to be his wallet) at police Const. Ken Lam. After a very brief standoff, Const. Lam arrested the suspect without incident. Const. Lam received a lot of praise for arresting the suspect without incident. Hours later, the police updated the public confirming that 10 people were deceased and 16 injured as a result of this incident. The suspect was later identified as 25-year-old Richmond

Hill, Ontario resident Alek Minassian, of Armenian descent (Tait, 2018; Global News, 2018; Kennedy, 2018).

1.5 The Response

Paramedics and other first responders arrived at the scene to triage and deal with the injured victims and deceased. Sunnybrook Health Science Centre activated their emergency response plan which enables them to deal with large numbers of victims injured in an emergency. Other hospitals also activated their plans to give them the ability to take other urgent care patients. A large segment of Yonge Street was cordoned off for the investigation. The TTC diverted service along Yonge street. Within hours, public spaces like Union Station had large barriers installed to guard against further possible planned attacks. Official communications about the incident was that the suspect's actions were deliberate but his motive was unknown and the nation's security level remain unchanged. Police continued to work to piece together the events of that day from eyewitness accounts, other pedestrians, bystanders and drivers.

As news of the VRA incident dominated the news in the evening of April 23rd and morning of April 24th, and with no confirmed motive, the public turned to Twitter making links with past events, drawing connections and concluding that the VRA incident was a terrorism inspired incident. Even with confirmation of the suspect's identity as Armenian, it was evident that on Twitter the public perceived that the perpetrator was Muslim or belonged to groups like ISIS and Al Qaeda. The @NatashFarah tweet about the eyewitness account that the perpetrator was Middle Eastern and was wide-eyed and angry while plowing his victims was retweeted many times. Another tweet claimed that the perpetrator yelled "Allah is Great" as he mowed down his victims was also retweeted many times.

A friend of mine was a witness. The driver was heard screaming praise Allah!
JustinTrudeau Absolutely disgusting this is happening in Canada #terrorism
?!AndrewScheer realDonaldTrump <https://t.co/16cDxq61o2>

— CanadianBorn (AlexandraRaeNem) April 23, 2018. (@TwitterMoments, 2018)

These are familiar media frames of terror related incidents that the media uses to condition the public to make links and connect disparate events such that the current incident is viewed as an extension of past incidents.

Figure 1 is a timeline of key events as they unfolded in the first 24 hours of the van attack. It was later confirmed that the suspect was incel-inspired and reportedly Minissian, the suspect, had posted on Facebook earlier in the morning before the rampage, “The incel rebellion has already begun! We will overthrow all Chads and Stacy’s” (Zimmerman, Ryan and Duriesmith, 2018).

The first tweet about the incident was posted at 1:34 pm:

Collision, numerous pedestrians have been struck by a white van on Yonge St and Finch area. further when I get more. #GO725711 ^gl (TPSOperations, 2018)

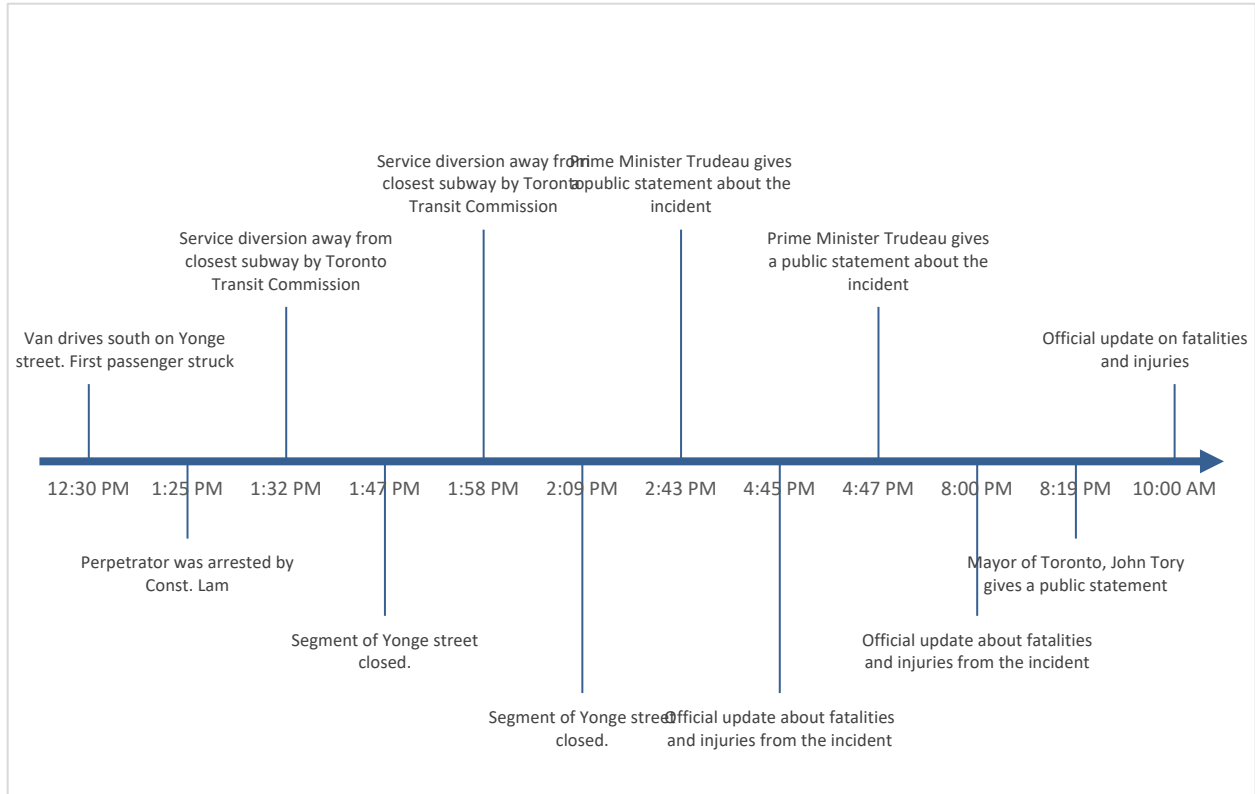


Figure 1. Timeline of the 2018 Toronto Van Ramming Attack Incident.

(Source: Global News, 2018, retrieved at <https://globalnews.ca/news/5177737/toronto-van-attack-anniversary-timeline/>)

Literature Review

The literature review is divided into four major themes, vehicle weaponization, framing terrorism, risk perception and social media, representing the literature most pertinent to this study. I define and review vehicle weaponization as an emerging threat. Next, I look at how the media framing of terrorism helps shape public perception. I then look at the factors that can influence risk perception. And finally, I explore social media use during crisis events.

2.1 Vehicle Weaponization

Western disaster research has long focused on the likelihood that technologies (chemical, biological, radiological, nuclear and explosives (CBRNE) would be weaponized. For example, biological hazards like the anthrax attacks in the US that occurred right after the 9/11 attack. After the events of 9-11, however, all that changed. In the Middle East, for countries like Iran, Iraq, Afghanistan and Israel, unconventional technologies are weaponized on a regular basis including suicide bombings, car bombs, and other incendiary devices. While CBRNE is still considered a major threat, other forms of violence have received much attention as an emerging threat because of the increasing number of incidents taken place. On September 11, 2001, the world saw in real-time the sophisticated deployment of a vehicle as an improvised explosive device (IED) to cause mass destruction. When the planes were flown into the World Trade Centre, over 90,000 litres of jet fuel in essence was used as explosives to bring down the twin towers and cause the most fatalities of over 3,000 people (Freitas, 2012). This became a turning point for national security in the West because mass casualties had been achieved without the use of conventional technological weapons of CBRNE (Norris et al, 2004). Studies show that the public perception of terrorism shifted dramatically after the 9/11 terrorist attack (Lee & Lemyre,

2009; Woods, 2011; Norris et al., 2004). A majority of Americans perceived that they were at an increased risk of a terrorist attack and reported that it was a source of major worry.

The weaponization of vehicles is not a novel phenomenon. Vehicles have been used and continue to be used to commit a myriad of violent and criminal acts. For the purpose of this study, vehicle weaponization is defined as the use of a vehicle - outside its normal use as a mode of transportation - as a weapon to commit a crime that includes breaching buildings and killing and injuring people (Jenkins, 2006). Vehicles have been weaponized by both individuals and organized groups. They have been used by criminals for vandalism; by drivers consumed with road rage to run down fellow drivers - for example in New Brunswick, Canada, a man was charged and found guilty of driving his vehicle into a pedestrian (The Canadian Press, 2017); by robbers and burglars to ram vehicles into banks, bank machines and store fronts (Rothe, 2008); and by terrorists who either modify vehicles into vehicle-borne improvised explosive devices (VBIEDs) or just drive vehicles into pedestrians and other public spaces (TSA, 2017; Jenkins & Butterworth, 2018). While all of these incidents sometimes result in fatalities, injuries and/or damage, it is the use of a vehicle as a weapon and tool for terrorism that draws the most attention (Jenkins & Butterworth, 2018; Rothe, 2008).

Vehicles as weapons of terror have evolved from their use as VBIEDs to their use as plowing machines. VBIEDs involve the modification of a vehicle with explosive devices which can either be detonated remotely or by a suicide bomber. VBIEDs, however, involves taking the modified vehicle as close to the target as possible which is quite difficult to pull off without getting caught. It also involves a particular skill set and time to plan and execute. For these reasons, the

increasing tactic of choice is vehicle ramming by targeting large crowds for impact which requires zero planning or skills to execute. Terrorists' weaponization of vehicles as IEDs has evolved to a more simplistic use as weapons to ram into soft targets - people and property (Jenkins and Butterworth, 2017). Recent increase in vehicle ramming attack incidents has made it an emerging risk (Eriksson Krutrök & Lindgren, 2018). The most recent widely covered VRA incident took place in Nice, France in 2016 where 86 people died and 458 were injured, the most VRA related fatalities and injuries since 2006 (CEP, 2019; Corporate Risk Services (CSR), 2017; Bouchard, 2018; Jenkins & Butterworth, 2017; Criminol, 2019; Miller & Hayward, 2018). Subsequent incidents have taken place in other countries including United Kingdom, Spain, the United States, Israel and Palestine.

The use of vehicles for ramming into pedestrians has gained popularity for terrorists and other radicalized individuals. This rising popularity can be attributed to their ubiquity, easy accessibility, little to no advance planning or skills required like the levels to develop IEDs, no coordination required, individualized nature which is very attractive for "lone wolf" incidents (Jenkins & Butterworth, 2018). A lone wolf is an individual who plans and commits crimes without assistance (Perry, Hasisi & Perry, 2018). Because vehicular attacks are opportunistic and individualistic, they are very difficult to predict or counter and is an increasing challenge for public safety officials (Jenkins & Butterworth, 2018). These crimes of opportunity are carried out by a diversity of perpetrators in terms of their ideology, background, mental state and geographic location (Miller and Hayward, 2018; Jenkins & Butterworth, 2018), the primary aim of which is to induce fear and dread in the general public and cause fatal injuries (Jenkins & Butterworth, 2018).

According to the National Research Council (2002), VRAs are intentional acts to inflict physical harm, unlike other manmade technological disasters that are outcomes of human negligence, laziness and the need to cut corners. The Transportation Security Administration (TSA) (2017) defines vehicle ramming as the deliberate aiming of a moving vehicle (without modification) with force at soft targets (people and property) with the intent to inflict fatal injuries and significant property damage. Another definition by Karlos, Larcher & Solomos (2017) qualifies vehicles as “cars, vans and trucks” and perpetrators as “terrorists and other types of extremists”. Witherspoon (2017) refers to the use of basic technology to deliberately and indiscriminately harm the public as “low-level terrorism”. VRAs are also referred to as vehicular terrorism (Ladan-Baki & Enwere, 2018) vehicle-bourne threats (Foreman, Evans & Heward, 2009), car-ramming attacks, vehicle-ramming or vehicular assaults (Jenkins & Butterworth, 2018).

VRAs can be classified as a type of terrorism for a number of reasons. First, based on the definitions above and the definition of terrorism. The Global Terrorism Database (GTD) defines terrorism as

“The threatened or actual use of illegal force and violence by a non-state actor to attain a political, economic, religious, or social goal through fear, coercion, or intimidation”.

Section 83.01 of the Criminal Code of Canada describes terrorist activity as ((*Criminal Code*, 1985, s 83.01):

an act or omission, inside or outside of Canada, committed for a political, religious, or ideological purpose that is intended to intimidate the public...that intentionally causes death or serious bodily harm to a person by the use of violence, endangers a person’s life, causes a serious risk to the health or safety of

the public or any segment of the public, causes substantial property damage, whether to public or private property.

VRAs can be classified as terrorist acts because they share similar attributes including illegal use of force and violence with the primary aim to induce fear and dread in the general public and cause fatal injuries.

Second, VRAs is a recommended tactic in a manifesto published by ISIS (Jenkins & Buttersworth, 2018; Witherspoon, 2017; Counter Extremism Project CEP, 2019). As a result, research about VRA incidents has been from the terrorism discourse. Vehicle weaponization dramatically increased since 2006 (CEP, 2019). According to the Global Terrorism Database (GTD) (START, 2012), the incidence of VRAs are on the rise in urban areas in Europe, Middle East and North America (Jenkins & Butterworth, 2018). The GTD (START, 2012) shows 53 VRA incidents since 2013, 35 (60%) of which were terrorist related had a combined fatality of 197 people and 1078 injuries (CEP, 2019; TSA, 2017; START, 2012; Witherspoon, 2017). The years 2014 to 2017 were the most lethal with 17 vehicle attacks accounting for 173 fatalities and 667 injuries (CEP, 2019).

Canada has experienced very few VRAs since this rising global trend. A majority of Canadians perceive their risk to terrorism or related incidents as less likely acknowledging that the risk of terrorism is uncertain, out of their control and unacceptable (Lemyre et al, 2006). The few incidents that have taken place in Canada were localized with very low fatalities and injuries. The 2014 Quebec vehicle attack was jihadist inspired resulting in the deaths of two Canadian soldiers. The other vehicle attack took place in Edmonton in 2017 and resulted in zero fatalities but injured one police officer (CEP, 2019). The assailant in this incident, on two separate

occasions used a car and a truck to ram into pedestrians, injuring a total of five people. The April 23rd VRA incident is the largest of its kind in fatalities and injuries, and demonstrates this rising trend of VRA incidents where vehicles are used to violently and willfully attack pedestrians and damage property.

The attributes of VRAs makes it difficult to predict and protect against VRAs. Several counter measures to help reduce the impact of VRAs have been suggested by experts. The challenge with VRAs, according to the experts is that they cannot be prevented (Witherspoon, 2017; Jenkins & Butterworth, 2018), therefore the best alternative is to protect pedestrians by limiting vehicle access to pedestrian areas. Mitigation and countermeasures recommendations requires risk and emergency managers to understand the public's risk at public gatherings and open spaces (Jenkins & Butterworth, 2017; Jenkins, 2017). Counter measures are often recommended based on the type of target. Recommendation for public gatherings in open spaces include: placing barriers or large vehicles at entrances to these spaces, increased surveillance and monitoring, additional police presence, positioning of protected concrete posts or bollards, or planting of trees at entrances or in front of public spaces and buildings (Jenkins & Butterworth, 2018). The challenge is that some of these mitigation measures are quite expensive, limiting and intrusive for the public.

2.2 Framing Terrorism

Framing is the intentional presentation of an incident such that certain facts are more salient. Entman (1996) states that frames purposely cover an incident in a way that emphasizes some facts while obscuring others in order to skew the public's understanding of the events, that is, how the event ought to be understood instead of what the facts are. They can be described as

news templates. Consistent use of templates to report disparate incidents over time gives the appearance of one homogeneous string of incidents (Entman, 1996; Krutrok & Lindgren, 2018). When an individual recalls the event, they recall it in the same way that it was received. It has proven to be an effective way of influencing public opinion.

Frames can be used as a basis for understanding risk perception and communications during an emergency event. The stakeholders during a disaster are diverse – victims, emergency responders, media, the public, government. Stakeholders have different information needs and use frames that suit their information requirements in a symbiotic way to interpret, understand and communicate about the emergency. Emergency responders use frames to report on the incident to reduce confusion and disinformation and to convey the appearance of control over the situation (Falkheimer and Olsson, 2014). Politicians use “talking points” – keywords that they have tested which can influence the public views in support of public policy like national security and legislation against terrorism (O’Connor, Balasubramanyan and Routledge, 2010). The media uses frames to report on the who, what and why in a national security context. The public utilizes the mental images they have formed over time from their experience and the environment (Norris et al, 2004). Breaking news are viewed with preconceived notions and frames of similar past events, obscuring the facts and their understanding, that is, the public understands events through pre-existing lens (Norris et al, 2004). Furthermore, the public uses media, emergency management and government frames to make sense, understand and assess their personal and societal risk (Falkheimer and Olsson, 2014). Sense-making brings communities together both face to face and online across international boundaries (Eriksson, 2015).

Frames are repetitive and inherently biased. Specific keywords, images and phrases are used to frame news headlines which serve as triggers and cues to help the public understand similar events in the future (Norris et al, 2004). Media frames shape the public's perception of terrorism events (Nellis & Savage, 2012, Norris et al., 2004). Terrorism is a pejorative of the terrorist's identity as Muslim extremist whose motive is violence against the West (Powell, 2011; Norris et al, 2004; Kanji, 2018; Woods, 2010;).

VRAs are considered terrorism tactics not only because they are primarily used by terrorists but because of the media framing of past VRAs. After the September 11 terrorist attacks, the media has played a more significant role in shaping perception of terrorism. Pre-September 11, the media framed terrorism as acts of violence that outsiders wanted to inflict on its citizens (Brinson & Stohl, 2012). Post September 11, the dominant media frames were "war on terror" and homegrown terrorism (Powell, 2018). Homegrown terrorism refers to terrorists with US citizenship and practiced Islam living in the US (Powell, 2018; Jenkins, 2018). The "war on terror" frame associated perpetrator identity with religious ideology, ethnicity and culture and how these violent acts are categorized as terrorism (Falkheimer & Olsson, 2014). Even though, VRAs are used in other crimes like burglary and road rage (Jenkins & Butterworth, 2018), the public conceptualizes VRAs using terrorism frames.

The media is biased in their coverage of violent events that are committed by Muslims. A majority of criminal acts are labelled as terrorism and linked to Muslim extremism regardless of whether the facts bear it out or not. A comparative study about the Canadian media coverage of events perpetrated by Muslims and non-Muslims conducted by Azeesah Kanji (2018), shows that

the average coverage of Muslim perpetrated events were 1.5 times more than that of non-Muslims perpetrated events even though the latter resulted in 11 more fatalities. She concludes that this bias in coverage amplifies the public's perception of these racialized group as terrorists. The public associates these labels and stereotypes to ascribe motive and responsibility. Another study by Woods (2010), found that public's risk perception was high in nations where "radical Islamic" group frames are used.

Media frames have been pivotal in shaping the public's perception of the terrorist identity, and it is crucial to consider how this shapes the public's response when a manmade incident occurs. Media frames of terrorism constructs synonyms which the public perceives as synonymous to Islam (Kanji, 2018; Poole, 2018; Patrick, 2014). Kanji (2018) also talks about the racialization of the word terrorism. Her study finds that terrorism was 23 time more likely to be characterized as a Muslim related incident. In her study, she writes that the Canadian news media's negative coverage has shaped the concept of the "Muslim terrorist".

Media coverage affects risk judgement. When an emergency takes place, the public relies on mainstream media for information and cues to make sense of the event (Falkheimer & Olsson, 2014). A survey in Canada revealed that Canadians trust the media more than the government as a reliable source for news about terrorism

2.3 Risk Perception

events (Lemyre et al., 2006). The nature of the risk causes the public to believe the media framing. While mainstream media influences and shapes public perception, it is not the only factor that shapes public perception. The public's perception is also influenced by - the

hazard/risk category. Catastrophic emergency events that invoke extreme fear and for which there is not enough knowledge or understanding are perceived as high risk events (Fischhoff et al, 1978). The fear prompts the public to seek more information in order to get a better understanding about the risk event. Studies have found that public perception is an important piece of risk management and that there is a gap between expert and public perception of the same risk (Jenkins, 2006). Expert perception of risk is often closer to reality and the public's is an under or over perception of the risk (Jenkins, 2006). For successful management of risk, it is therefore important to understand the public's perception and factors that may affect that risk. Efforts to understand the public's perception of vehicular attacks can benefit risk management policies for this hazard as an emerging risk. The public's perception of risk can also be influenced by social factors which can amplify the public's perceived risk. Kaspersen et al (1988) in their social amplification of risk framework contextualizes how risk can be overestimated based on social factors. These social factors include but are not limited to media coverage, the existing public trust in institutions and personal experience.

Risk perception is a personal and subjective process influenced by previous experience, knowledge and the type of hazard and its attributes (Sjoberg, 2000). The increased frequency of VRAs over the past few years and the media coverage of them has increased the public's awareness. While the data shows this hazard as relatively low in terms of fatality and number affected, its high impact, lack of predictability and media coverage gives the perception of a high-risk incident (Fischhoff et al, 1978). The Risk Matrix or Psychometric Model (Fischhoff et al, 1978) explains the dread and fear associated with unfamiliar events like terrorist incidents and can be applied to explain a similar dread and fear associated with vehicular ramming attacks

especially as it is viewed as a terror tactics. Dread is the extreme fear that is felt about a high-risk event (Fischhoff, 1978). Unfamiliar, potentially catastrophic and involuntary risk invokes outrage and extreme fear and are perceived as more serious risks (Sandman, 2001) while everyday familiar and voluntary risks like driving a car are perceived as low risks. Based on this risk model, VRAs characterized by extreme fear and unfamiliar hazard, are considered high dread and high outrage events and would therefore be located on the Unknown and Dread lower right quadrant of the risk matrix model. Studies show that there is a very high level of risk perception immediately after incidents like VRAs (Breakwell, 2014). While risk perception may increase, it may not be enough to cause the public to change their behavior.

Risk reduction, disaster preparedness and mitigation for this risk not only requires situation awareness it requires surveillance and monitoring and expensive physical mitigation measures. The frequency may require mitigation strategies that may alter existing urban landscape, change traffic regulations, and the installation of extensive monitoring systems that are costly, intrude on privacy, and their effectiveness are yet to be examined (CEP, 2019; Forman et al, 2019; TSA, 2017). Understanding the public's perception of these emerging risks will assist government and other key public safety professionals to develop mitigation measures that the public deems as acceptable. If the public's perception of the risks of vehicular attacks are low, they are fine with the status quo, and hostile vehicle-borne situation awareness and mitigation measures can be limited to inexpensive and less intrusive measures like public awareness campaigns to promote the public's awareness of their surroundings and how to observe suspicious behavior. A higher risk perception will result in the public calling for counter measures to be implemented and may

include physical measures which are quite costly and interferes with the public's enjoyment of public spaces.

2.4 Social Media

Social media has garnered increased interest since the popularity of platforms like Twitter, Facebook and Instagram. As its use is increasing, traditional media channels such as TV, radio and news print are declining. Studies show that an increasing number of people turn to social media for news and to provide commentary, updates and seek information, during emergencies (Anderson and Schram, 2011, Gray et al, 2017). In 2018, according to Statista, 77% of Canadians get their news online and 29% consider social media their trusted source of news. 40% and 11% used Facebook and Twitter respectively for their news. Most mainstream media have incorporated Twitter and other social media platforms into their news distribution using the platform to publish their headlines. As such social media platforms like Twitter increasingly complement mainstream media.

Social media has diversified the ways in which news is delivered. The news has now become an equal opportunity environment (Eriksson, 2016). People use Twitter to communicate personal feelings about an event, publicly react to an emergency, seek information about loved ones, and provide updates on their status. The public has the ability to embed video clips, photographs, links to media, and other multimedia (Murthy, 2018). The public are not just consumers of news, they have become news producers, provide eye witness accounts of events, updates and advisories about events, crowd sourcing, and have been great with addressing rumors (Houston et al, 2014).

The potential application of social media platforms like Twitter in disaster and emergency management (DEM), public health and other domains is evolving quite rapidly. A copious amount of data about an incident can be obtained from social media platforms like Facebook, Instagram, and Twitter. Examples of DEM, applications include incident detection, situation awareness, risk management and communications, incident monitoring, and public perception (response, crisis) (Sinnappan et al., 2010, Cameron et al). Within the disaster and emergency management context, Twitter is used to monitor trends or news about an event (Vis, 2013; Sinnappan et al, 2010; O'Connor et al, 2010). Twitter has been used to gather information about the spread of pandemics such as the 2014 Ebola outbreak. Odium and Yoon (2015) used Twitter to understand the distribution of Ebola related tweets, for surveillance and monitoring, and to understand the American public's concerns about the disease.

Twitter is a social media platform that allows users to post and share short messages usually of 280 characters (was 140 characters) privately or publicly (Murthy, 2018). A user has to register by creating an account with a profile, during which they can decide whether they want a private or public account. Private tweets are only available to those who follow a user and public tweets are publicly available. Twitter uses hashtags - a keyword(s) (no space) prefixed with the hash # symbol as a method to organize topics, stories, or events among a community of users (Bruns & Stieglitz, 2014). Hashtags allows users the opportunity to tag certain keywords that represents trending themes, topics, events, and conversations (Small, 2011). Its creation and use is spontaneous and during emergencies and disasters, hashtags can represent the location, name of the incident or the affected community (Burns et al, 2014). Some hashtags persist and are shared

many times over (Bruns & Stieglitz, 2013). Hashtags enable tracking of specific topics (topical hashtags) (Bruns & Stieglitz 2012; Bruns & Stieglitz, 2013).

Any person with an account can search the platform for public tweets about any subject. Twitter is particularly popular because it is easier to mine data than other social media platforms like Facebook and is very reactive to current events (Murthy, 2018). Its open access allows for both (mis)information and rumors to be circulated widely and may create issues for risk management. During emergencies, users propagate information by (re)tweeting, making it very easy for verifiable and unverifiable information to go viral possibly with serious implications for emergency response. Weller et al (2011) discuss various aspects of Twitter, but focus primarily on the function of Retweets. They explore how retweets serve as an attenuator or amplifier of a tweet. The advance of social media platforms like Twitter where information can be easily disseminated have made risk communications and management very challenging (Mendoza, Poblete and Castillo, 2010; Acar and Muraki, 2011). It is important therefore to explore how Twitter analysis can help understand public perception. Tweets over a period of time can show how public perceptions change as the event evolves.

Twitter's real time environment (users' ability to post tweets immediately) enables it to be responsive to breaking news. Sometimes, information about emergency events are reported on Twitter before mainstream media. Gabarain (2008) noted that reports that public tweeted about the Sichuan earthquake two minutes before the US Geological Survey. Twitter use increases exponentially during an event and the period immediately following the event (Sinnappan, Farrell & Stewart, 2010). This increase is driven by the information needs of all stakeholders. A

survey conducted by American Red Cross in the US showed that 60% of the general population get emergency related news online. A similar Canadian Red Cross study in 2012, showed that more than half of those surveyed used social media to communicate during an emergency. A study on Black Saturday, one of Australia's worst fire disasters, examined tweets posted about the fire to understand how people communicated during the course of the fire over Twitter and found that the information posted on Twitter can be invaluable for during crisis events (Sinnappan, Farrell & Stewart, 2010).

3 Methodology

This chapter describes the data and methodology used to address the research questions. First, I determined the keywords including hashtags to use to search and collect the 2018 Toronto VRA related tweets. Second, I examine who was tweeting about the incident - manually categorizing the users by type (eg. News media and emergency response) and noting the percentage of each type of user. Next, I look at the content to understand Twitter users' concerns and feelings about the incident - who and why. A content analysis of the tweet corpus was done to identify the key themes that dominated the discussion on Twitter. A coding schema was developed that was responsive to the specific context of this incident, drawing on the background literature of this study. The tweets were coded according to the coding schema. A combination of programmed data extraction in Microsoft Excel and manual content analysis, like Bruns et al (2012), and Chew and Eysenbach (2010) was used. I break down the dataset into the number of tweets and retweets, the number of unique users. I also examined the geotag fields of the data and mapped the geographic distribution of tweets. A combination of Microsoft Excel, NVIVO, and ArcGIS were used for this analysis.

3.1 Keyword and Hashtags

Twitter's advanced search function allows a person with a Twitter account to search all publicly available tweets. The search interface can be filtered by words, phrases, date, location and language. Twitter's Advanced Search function was used with the language option set to English only tweets. Non-English tweets were excluded because it would involve the extra step of using a translator. For the purposes of this study, no filters were placed on location. As VRAs had a global dimension, it was useful to see what the geo-distribution of tweets was. The Twitter

search can retrieve up to seven days of historical data, therefore the dates were set from April 23 to 29 inclusive.

A pilot search was done on April 24th and April 26th to explore the keywords that could produce a representative sample data for this incident. Studies use hashtags as a common approach to collect topic specific tweets (Brun et al, 2012; Bruns & Stieglitz, 2013; Vis, 2013; Sinnappan, Farrell & Stewart, 2010) but I used a combination of hashtags and phrases. For the initial pilot search, I used the hashtags #vanattack and #terrorattack which did not seem to yield a representative tweet dataset of the incident. I then used several combination of different keywords to help determine which search terms will yield relevant content. I finally decided on the following keyword combination: Toronto, #vanattack, #terrorattack “van attack” and ‘terror attack’. These search terms were chosen because when sampled together, they represented the ongoing Twitter conversation about the Toronto van attack. Figure 2 shows that the number of tweets under #vanattack and #terrorattack yielded quite fewer tweets than the text string “van attack” and “terror attack”. Keeping in mind Twitter’s one-week restriction on retrieval of archived tweets, I conducted a search of publicly available tweets about the April 23rd, 2018 Toronto Van attack on April 29th.

Twitter’s advanced search function was accessed on from <https://twitter.com/search-advanced?lang=en>. The following search string was used to mine tweets posted from April 23 to 29, 2018:

```
Toronto or "van attack" OR "terror attack" OR #vanattack OR #terrorattack  
lang:en since:2018-04-23 until:2018-04-29
```

Twitter’s search API only allows for one percent of tweets to be captured. After the search results are displayed on Twitter, the result was captured using NCapture, a web browser extension developed by QSR International.

Twitter’s algorithm for the language search filter is not publicly available it is therefore not possible to understand how some non-English tweets were part of the dataset. After removing a few non-English tweets that slipped through, a total of 22,095 remained, with the final sample consisting of 4,214 tweets and 17,881 retweets. Figure 2 shows that the phrase “van attack” resulted in a much higher dataset about 34.8% of the total tweets.

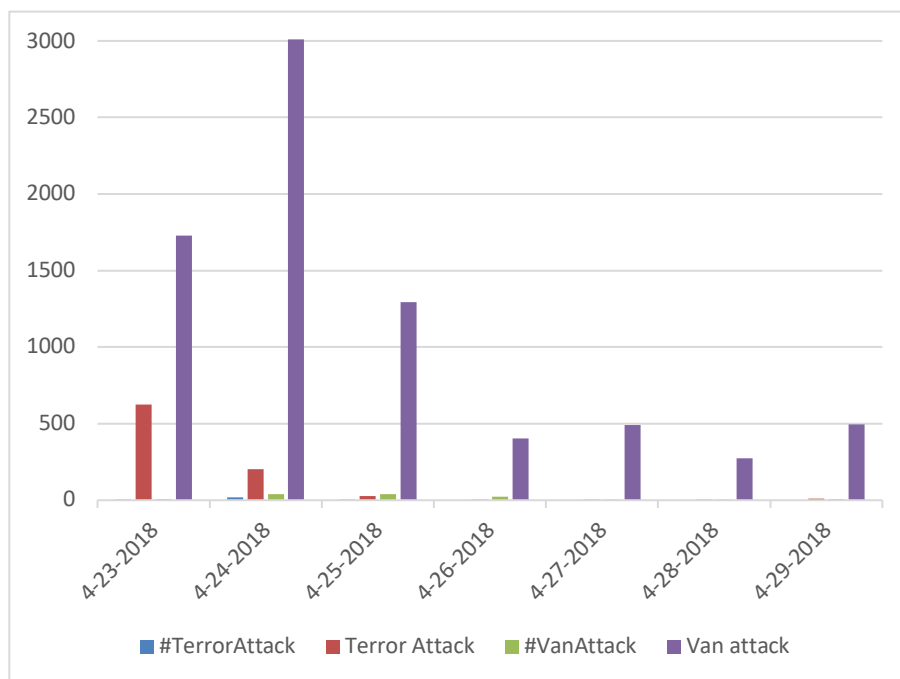


Figure 2. Tweets captured using study specific Hashtags and Keywords

3.2 User Types

The Twitter platform allows for a diversity of users in terms of their backgrounds – individuals, business or organization. To get a better understanding of who is tweeting, what they are

tweeting and their perception, I look at the diversity of users and manually classify them into user types based on the background information they provided in their Twitter user profile Bio field. Developing user type categories provides an understanding of the use and context of tweets by each user. The user type categories were classified based on the stakeholders they represent and their roles during an emergency event. For example, news media and individual accounts. Media related accounts report on news and provide updates about the incident and individual accounts are members of the general public with no stated affiliation to a business or organization, for example. The user type categories were based on both existing literature (Takahash, Tandoc Jr & Carmichael, 2010; Small, 2011; Vis, 2013) and evolved as each user profile was examined and categorized. When the category was ambiguous, a visit to their Twitter page often helped with resolving which category they belong to. User types helps us understand how they used Twitter. Additionally, a comparison of tweet activity between key user categories was done to understand how the different user types made sense of the incident.

3.3 Tweet Content

A combination of qualitative and quantitative methods was used to examine the tweet content and spatial-temporal distributions of the tweets. For quantitative analysis (descriptive), Microsoft Excel was used to analyse the whole corpus of tweets. For the qualitative analysis, In NVivo, a qualitative data analysis software by QSR International, the word frequency, hashtag and coding features was used for content analysis of the tweets.

NVivo's word frequency search function was used to get insight into the most frequently used terms in the tweets and to help familiarize and situate the content of the tweets based on the research question and literature. The resulting list of frequent words was studied and used to drill down into the tweet data to explore key themes. To get a sense of the public's perception of the

van attack, a code schema (themes) was developed for coding the tweet content, partly based on metrics suggested in previous studies (Bruns & Stieglitz, 2013) and on additional inductive code generation based on the research objective. Both tweets and retweets were coded for as many categories as was applicable. Categories coded included confirmed perpetrator’s identity, confirmed perpetrator’s motive, perceived perpetrator’s identity, etc.

The final coding schema included eight categories -past vehicle ramming or terrorist incidents (France, Spain, the UK, US Canada), perceived motive (terrorism), perceived identity (Muslim terrorist), confirmed motive (incel-inspired), confirmed identity (Alek Minassian/Armenian), community solidarity and support, VRA as risk (countermeasures and concerns for safety). Table 4 shows the Hashtags and frequent keywords used to guide the coding. Tweets with misspelled words were also coded. The resulting themes are shown in Table 4.

Table 1. Keywords Used for Thematic Coding

Theme	Keywords
Past VRA Incidents	Reference to past incidents at other locations. Eg., France, Germany, Barcelona, Spain, London, UK, Boston, Waffle house, James Shaw,
Canadian (CVI) and International (IVI)	WaffleHouse. Canada. This was further divided into two categories Canadian and International incidents
Perceived Perpetrator Identity (PI)	Reference to the identity and religion; suggestions about known terrorist groups. Words like muslim, moslem, #Muslim, Muslim, muslim, MOSLEM, Islam, #islam, mosque, #jihad, jihad, eastern, Middle eastern, ISIS, Al Qaeda, al-Qaeda,

Community and Solidarity (CAS)	Reference to solidarity, calls for donations, thoughts and prayers, etc. These keywords were used to code: TorontoStrong, #TorontoStrong, #canadastrong, #loveforallhatedformone, #torontostro, #torontostron, torontostronger, torontothegood, #prayersfortoronto, #prayfortoronto
Confirmed Perpetrator Motive (CM)	Reference to the official confirmed motive for the incident. Keywords used incel, involuntary celibacy, incels, #incel, celibate, misogyny, #misogyny
Perceived Perpetrator Motive (PM)	Perception of terrorism as motive even without confirmation from public officials. Some of the keywords coded include terrorism, terrorist, terror attack
Confirmed Perpetrator Identity (CI)	Tweets about the confirmed identity of the perpetrator. Armenian, Alek Minassian, Christian
Perceived Risk (PR)	Tweets that suggest VRA is an emerging risk in Canada, VRA countermeasures and express concerns for safety

The frequency of the dominant themes and hashtags were generated. Crossreferencing the dominant themes and users allows one to draw conclusions about the perception of the VRA incident. I developed a temporal distribution of tweets frequency by day and 6-hour time intervals. Retweets provide information about tweets that are viewed as important for sharing. I analyse retweets to identify what themes are being retweeted and determine influential user-types during the incident.

Spatial analysis for tweets with geolocation information was done using ArcGIS. The Twitter API includes coordinates of the tweets - longitude and latitude coordinates. The dataset for the

spatial analysis are all tweets with the geocode resulting in 12,465 tweets. The spatial analysis tracks the volume of the Toronto VRA related tweets generated across the globe. The dataset is imported into ESRI's Arcgis Online platform and mapped.

3.4 Limitations

Using Twitter to study an emergency event like the 2018 Toronto van incident is a challenge because first, tweets have a short time span in the public domain (Brun et al., 2012). Second, Twitter's search API returns a limited number (1%) of tweets, therefore, the dataset is not a comprehensive archive of past tweets about the incident and because the data is based on Twitter's algorithm, it becomes difficult to replicate the dataset. Third, there is a programmed limit on the number of keywords per user that can be queried within a given time period (Bruns & Stieglitz, 2012). This may result in the possibility that tweets sent immediately after the incident may not be captured depending on when the tweets are mined. Fourth, at the start of an incident or crisis, it is usually too early to tell which hashtags and keywords will gain traction and be representative of the incident being studied (Bruns & Stieglitz, 2012) As well it is sometimes difficult to predetermine what subject will be studied, as such the decision to collect tweets about the Toronto van incident was made without foreknowledge about its scope. The Twitter user's captured for this study do not represent the general population and therefore I cannot summarily apply the conclusions of this study to the general population. Finally, the dataset is not a representative sample of the general population, hence the findings cannot be treated as being a true reflection of public perception. A parallel study of offline users may provide a yardstick with which to compare the findings in this study.

4. Results

3,514 users posted 22,095 tweets that is 4,214 tweets and 17,881 retweets(19% and 81% respectively) from April 23 to April 29, 2018. The analysis produced an interesting set of results – expected and unexpected. The data was subject to descriptive statistical and qualitative analysis. The analysis focused on the two key user-types most relevant for this study – individuals and news media user types.

4.1 Hashtags

As the news spread widely, expressions of support and prayers for the victims poured in through Twitter by use of hashtags like: #TorontoStrong, #PrayforToronto and #CanadaStrong. The user @globalnews noted in a tweet that: the dominant Twitter hashtags to emerge during the 2018 Toronto VRA were #Torontostrong and #Torontoattack as Figure 3 illustrates. Both hashtags were established immediately after the Toronto VRA illustrating the spontaneous and organic way that hashtags are formed (Burns et al, 2014, Burns & Stieglitz, 2014). Several hashtags referred to the same sense of community and were included when calculating the frequency. Table 1 shows the list of keywords that were grouped together. The #Torontostrong hashtag is a combination of the following hashtags #TorontoStrong, #torontostrong, #canadastrong, #loveforallhatedfornone, #torontostro, #torontostron, torontostronger, torontothegood. Throughout the seven days that data was collected #TorontoStrong continued to be the most tweeted hashtag. Figure 4 shows a word cloud of hashtags that were part of the tweet content. Torontostrong has the most emphasis (Figure 4) and accounts for 30% of all the hashtags and Toronto 19.45% of the hashtags (See Figure 3), showing that even as a horrific and shocking incident, the public comes together as a community.

4.2 Twitter User Type Categories

The user types that contributed to the VRA tweets were wide-ranging. The public tweeted personal comments, personal accounts, news updates and other situational awareness information. Eight user type categories were manually coded based on Twitter user account profiles. The user type categories were business, news media, individual, organization, political, professional, emergency response and unknown. The description is as follows:

- *Business*: This category is used for all business or company accounts. Example Bio: @OakInfiniti: Oakville Infiniti seeks to provide you with an exceptional shopping and buying experience, we invite you to visit us at 2270 South Service Rd. W. O
- *Emergency Response*: This category includes any person or organization involved with emergency response including Police, Paramedics, Fire Fighters, Disaster and Emergency professionals. Example Bio: @EPIC__Podcast: Emergency Preparedness in Canada (EPIC) Podcast delivers Current, Relevant, Canadian content on disasters and their management. Proud partner of IAEM Canada.
- *News Media*: This category applied to all types of mainstream media, bloggers, journalists, radio, magazines accounts. Including online as well. Example bios: @Arabnews: The Middle East's Leading English Language Daily; @Globalnews: Breaking Canadian news with a fresh perspective on local & international headlines * On IG: <https://t.co/zVYsc0JhRharabnews>
- *Organization*: This category includes all private or government organization accounts. Includes NGOs, religious organizations. Example bio: @Ahmadiyyacanada: Official Twitter of the Ahmadiyya Muslim Jama`at Canada, Canada's largest national Muslim community. mediarelations@ahmadiyya.ca

- *Political*: This category includes elected government officials, political party members. Example bio: @Wutevuh: Official Twitter Account of the Scarborough Agincourt Federal Liberal Riding Association. Our MP is Jean YIp. Views are our own.
- *Individual*: This category represents individual accounts that are not linked to any of the above. Example bio: Blondie333. kind, curious, intuitive Piscean . Interested in ghosts and hauntings. Back at the gym, and it feels good. Was toooo long away!
- *Professional*: This category includes professionals from all backgrounds including lawyers, academics, professors, etc. Example bio: @ASemotiuk: US/Canadian immigration lawyer. Licensed in NY, Calif, ON, and BC. Forbes contributor. Writer and public speaker. See website for more.
- *Unknown*: This category includes all accounts that I am unable to classify based on their profile and tweets. Example bio: @23rd_AUGUST. I'm raising money for Toronto's Deadly Van Attack Funds. Click to Donate: <https://t.co/dvmj8FGyRN> via @gofundme #Toronto #Dead #Van #AlekMinassian #Canada #Terror #Donate

4.3 Twitter User Type Activity

The most salient user-type categories for this study are individual, emergency response and news media user types. Figure 5 depicts the number and pattern of tweets and RTs made by each user type category. Both individual and news media user-type categories made up 95% of active accounts tweeting about the VRA (Table 2). The individual user type category made up the majority of the VRA incident twitterers (persons who posts tweets), which was over half of the accounts 2,929 representing 82.65% of total users as depicted in Table 2. There were 469 users in the news media user type category representing 13.23% of all the accounts that tweeted about this incident. It is not surprising that the individual user type category ranked first and the news media user type category ranked second because of their presumed roles as news disseminator

and news seeker on social media during crisis events. There was a total of 9 users in the emergency response user type category making up .25% of users. Table 2 shows that individual user type had 14,322 tweets and news media 6,234 tweets that is 64.82% and 28.21% of all tweets respectively. The individual to news media tweet ratio of 1 to 43.5. Evidence that the individual user type was the most dominant and active user group. Figure 3 shows that news media type category tweeted 750 times and retweeted 5,484 times while the individual user type category tweeted 3,285 times and retweeted 11,037 times.

Table 2. Account User-Type Categories

User Type	Total	% Total Users
Business	48	1.35%
Emergency Response	9	0.25%
News Media	469	13.23%
Organization	48	1.35%
Political	6	0.17%
Individual	2,929	82.65%
Professional	26	0.73%
Unknown	9	0.25%
Total	3,544	

I look at which user type category dominated Twitter over the period of the week that data was collected. Figure 6 depicts the top 20 tweet/retweet generators. Ten of the top 20 were individual category, nine were news media accounts, and one was an organization category (See Figure). The overall tweet rate for the individual user type is 13.3 compared to 4.9 for the news media user type. This shows that individuals were more engaged and shared more information about the incident.

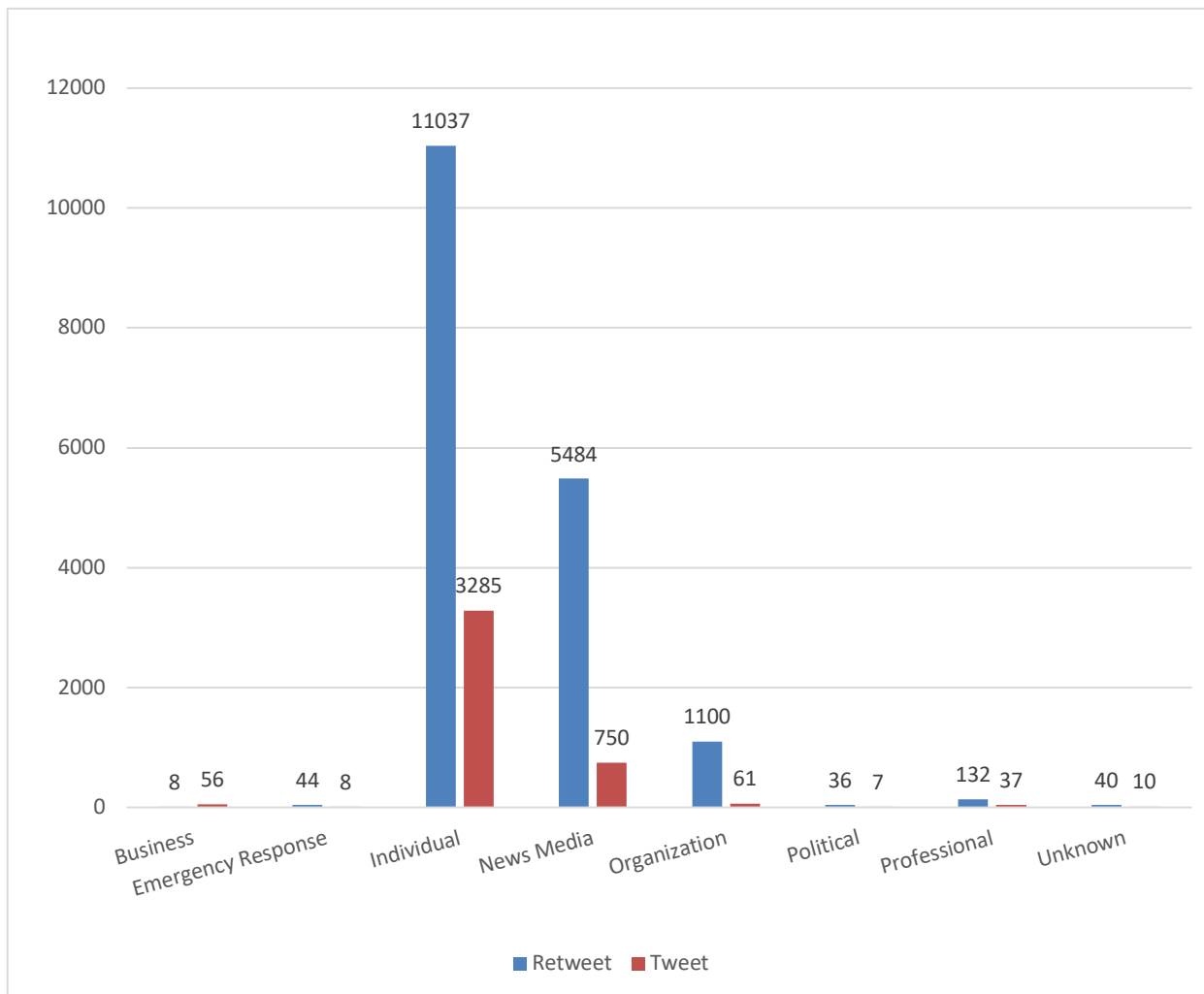


Figure 5. Twitter activity by user-type category

4.4 Overall Tweet Type Activity

Retweet analyses is used to identify influential user-type categories for this data set (Bruns & Stieglitz, 2014; Weller, Droge & Puschmann, 2011). This significantly high retweet rate suggests that the VRA twitterers engaged mainly in disseminating information which is consistent with crisis events (Bruns & Stieglitz, 2014).

Table 3. User-type Categories tweet activity

User Type Category	Total	% of Total		RT	
	Tweets	Tweets	Tweet	% Tweet	% RT
Business	64	0.29%	56	1.33%	0.04%
Emergency Response	52	0.24%	8	0.19%	0.25%
News Media	6234	28.21%	750	17.80%	30.67%
Organization	1161	5.25%	61	1.45%	6.15%
Political	43	0.19%	7	0.17%	0.20%
Individual	14322	64.82%	3,285	77.95%	61.72%
Professional	169	0.76%	37	0.88%	0.74%
Unknown	50	0.23%	10	0.24%	0.22%
Total	22095		4214		17,881

When analyzing the activity of the post-VRA twitterers, it was evident that some users retweeted only, essentially using Twitter to disseminate information (Bruns & Stieglitz, 2014; Weller et al, 2011). A small number of twitterers account for a disproportionate high number of retweets (see Figure 4). Twitter accounts @eugenegu, @globalnews, @ahmadiyyacanada, @MrFilmkritik and @Lrihendry focused mainly on retweeting, each posting over 500 retweets. They actively engage

in message propagation or amplification (Bruns & Stieglitz, 2012; Burns & Stieglitz, 2014).

Taking note of the tweet rate, two accounts stand out, one individual and one news media user type account with 3,205 and 1,559 RTs respectively. Three accounts (one organization and two individual) have over 500 RTs. The next 15 have over 500 retweets.

The individual account @eugenegu posted one tweet and two retweets about the incident 1,002 and 2,202 times. Users with many tweets sometimes skews the analysis because it can result in an overestimation of Twitter engagement about the incident.

@eugenegu Tweet:

My heart goes out to the victims of the van attack in Toronto. Whether inspired by ISIS, white supremacy, or any other ideology, terrorism is always abominable. Hoping for the best of care for the injured at the Sunnybrook Health Sciences Center. (@eugenegu, 2018)

@eugenegu Retweet:

RT @eugenegu: Wait. The Toronto terrorist wasn't inspired by ISIS. He was a sexually frustrated white guy who may have been so mad about being turned down by women that he went on a rampage. Toxic masculinity literally turned into terrorism. (@eugenegu, 2018)

The news media user type category user @globalnews, had the most posts with 20 tweets and 1,548 retweets (26 unique RT) in this category. It is not unexpected that a news media user type account would actively post updates frequently.

@globalnews Tweet:

#TorontoStrong and #CanadaStrong used to show solidarity after a van attack in Toronto left at least 9 dead, 16 injured. <https://t.co/s924iP9WD5>. (@globalnews, 2018)

@globalnews Retweet:

RT @globalnews: Toronto Mayor John Tory and deputy chief Peter Yuen will provide an update to the fatal incident in north Toronto where a van plowed into pedestrians on Yonge Street. #TorontoStrong. (@globalnews, 2018)

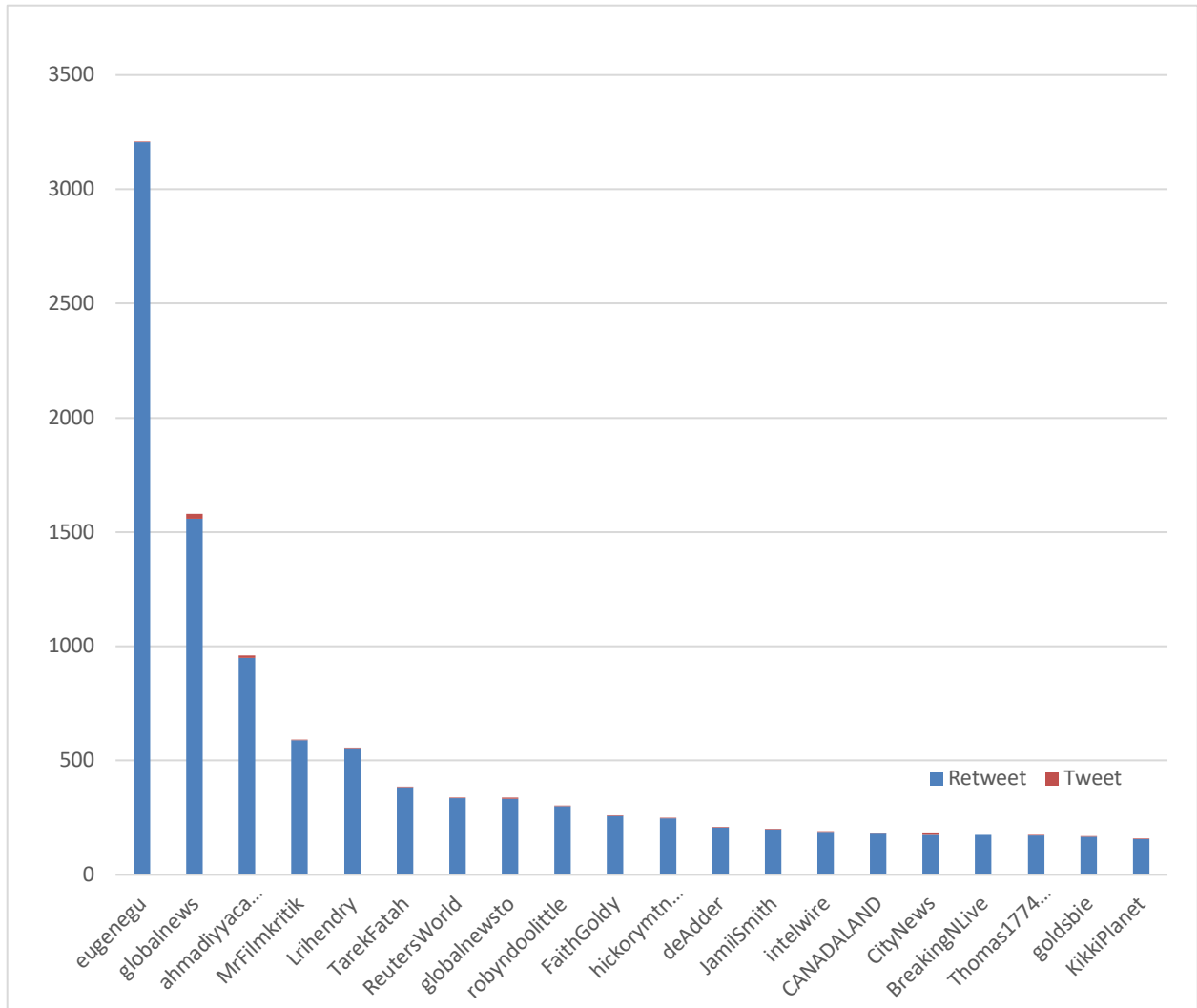


Figure 6. Most active users that tweeted after the 2018 Toronto VRA

Tracking the two main

types of tweets in the data - tweets (original tweets) and retweets (reposted tweets) will elucidate Twitter use during the study period. The majority of the tweets took place on the first and second day of the VRA representing 16% and 49% respectively of the total sample collected. This variance in tweet volume suggests tweets are posted closer to the incident date as was illustrated by a similar study that looked at Twitter responses to homicide incidents in the UK (Kounadi, Lampoltshammer, Groff, Sitko and Leitner, 2015). The overall tweet retweet ratio is 1 to 23.5 showing particularly high level of retweets over the 7-day period. Figure 7 shows the total number of tweets and retweets posted on each of the seven days. The highest number of tweets and retweets were posted on the second day, April 24th (Figure 7) with tweets at 2,065 (9.35%) and 9,130 retweets (41.32%), and a ratio of 1 tweet to almost 23 retweets, similar to the overall tweet ratio. This increased volume of retweets may be explained by the national and global attention the VRA incident was starting to receive and the public turning to Twitter to express support and condolences and retweet VRA related information (Eriksson, 2016).

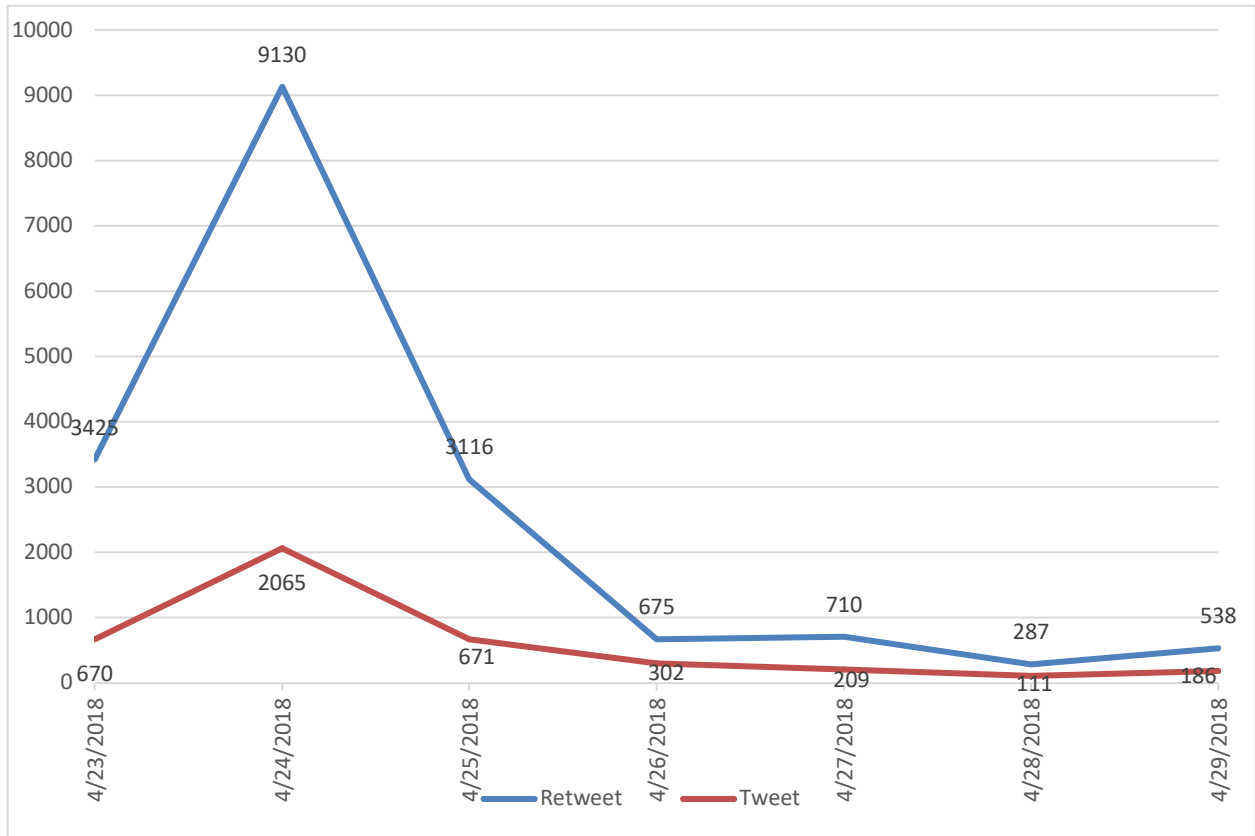


Figure 7. 2018 Toronto VRA Tweets and Retweets

A long tail distribution is observed for both tweets and retweets in Figures 7. This is consistent with previous studies that show that tweet activity about an event increases at the onset and immediate aftermath of the emergency incident and gradually decrease shortly after, except for prolonged disaster events. Retweets are considered a mechanism to propagate information on Twitter (Burns & Stieglitz, 2014). Several news media and individual user type categories had high retweet percentages of 28.21 and 64.82 respectively.

Figure 8 shows the number of unique users that tweeted each day. Tracking the number of unique users that tweeted each day gives a true picture of the daily active users (Bruns et al, 2012). The total number of tweets are 4,214 representing 19.07% of the total tweets collected

and posted by 3,399 unique users. Retweets account for 17, 881 (81%) of the total tweets and posted by 1,115 unique users. Table 4 shows that the number of active participants was highest on April 24. It is interesting to note that there were more people who tweeted original messages than retweeted, which means fewer users than those who tweeted were responsible for propagating information.

Figure 9 depicts a 6-hour interval of tweets/retweets and unique users. Using 6-hour intervals to drill down into the data, several peak volumes are observed between 6 pm on April 23rd and 6:00 am on April 24th - this means that there were 1,753 unique users that posted tweets.

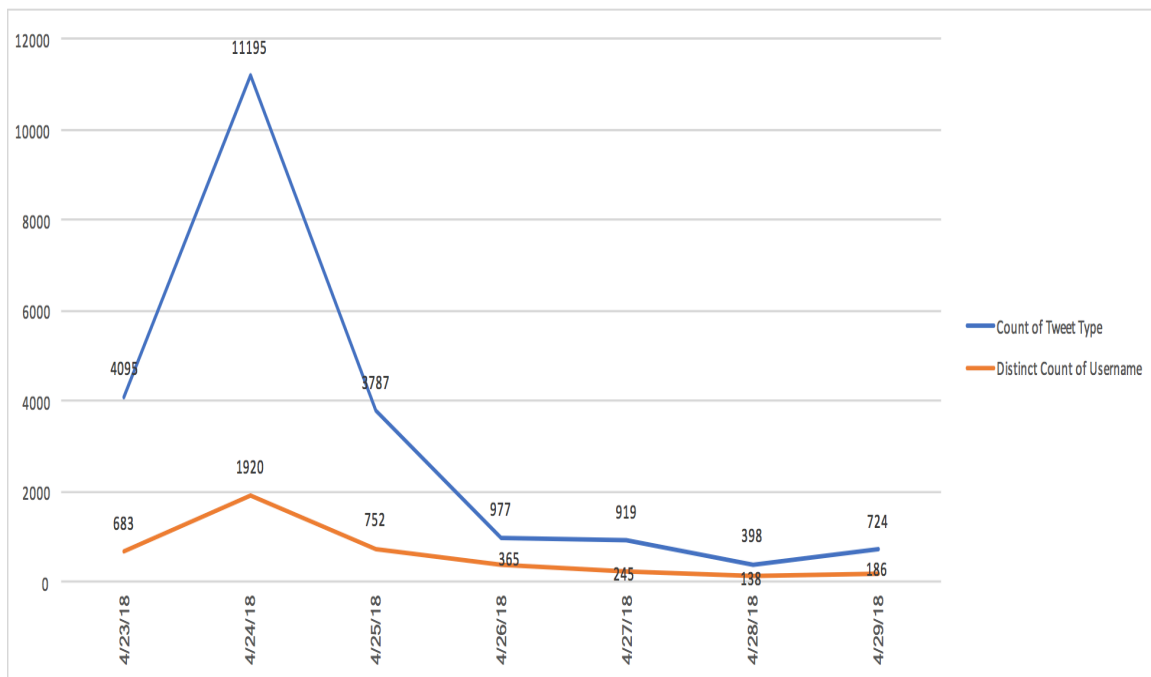


Figure 8. 2018 Toronto VRA tweets and unique users per day

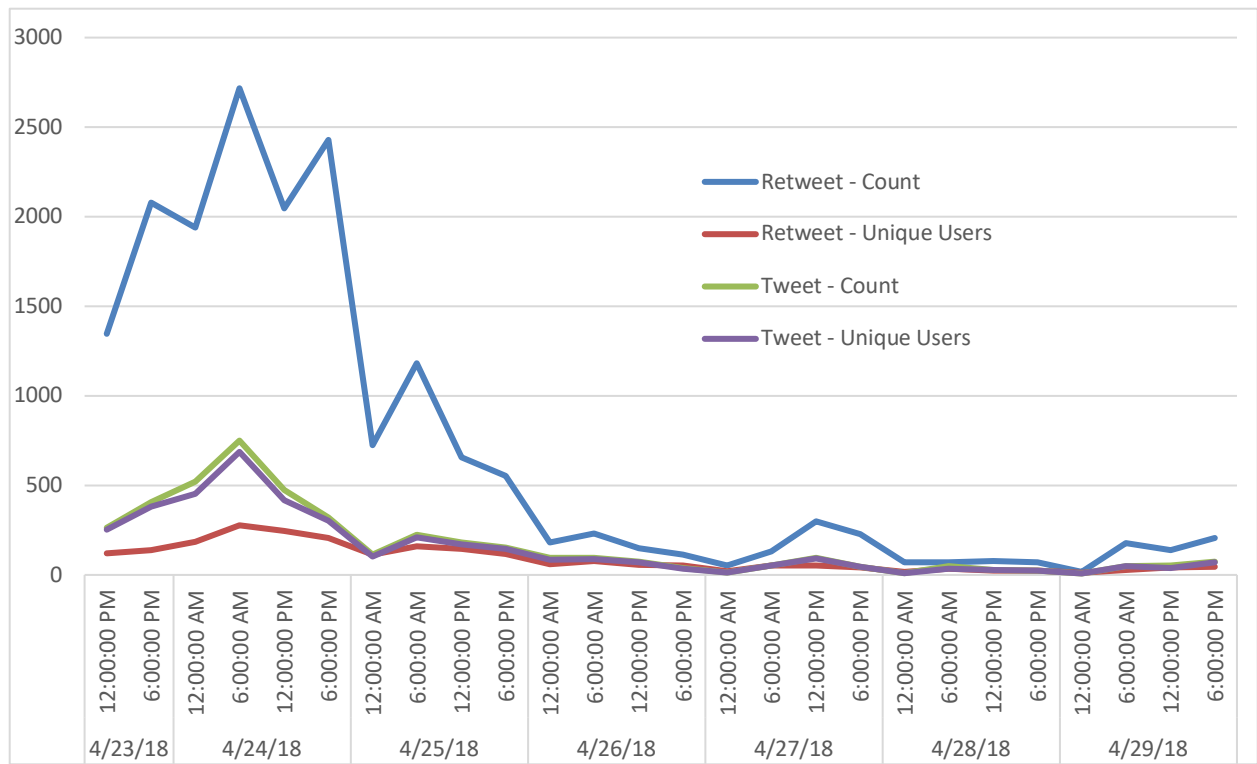


Figure 9. 2018 Toronto VRA tweets and unique users per every 6-hour Figure 9 shows that overall activity levels peaked before noon on April 24th. Significant drops in tweet activity are observed after midnight for April 23-25, tweet volumes were very high during these days as well particularly before noon each day. After the second day, tweets significantly decreased, tapering off after April 24, 2019.

Table 4. Tweet Activity by Unique Users April 23-29, 2018

Date	Retweet			Tweet		
	Total	% Total	Unique Users	Total	% Total	Unique Users
2018-04-23	3425	15.50%	214	670	3.03%	624
2018-04-24	9130	41.32%	615	2065	9.35%	1753
2018-04-25	3116	14.10%	340	671	3.04%	603

2018-04-26	675	3.05%	170	302	1.37%	275
2018-04-27	710	3.21%	115	209	0.95%	192
2018-04-28	287	1.30%	69	111	0.50%	91
2018-04-29	538	2.43%	90	186	0.84%	162
Total	17881	16.03%	1115	4214	1.24%	3399

Table 4 also shows that April 23 and 24 were the most active days in terms of volume of VRA tweets. The first day had the second highest number tweets/retweets about the incident. The two peaks on April 24th may reflect two events during this time period as stated earlier the suspects first court appearance and a police press conference. 1,753 unique users tweeted a total of 2,065 and 615 unique users posted 9,130 RTs on April 24.

4.5 6-Hour Temporal Analysis

A sharp, early spike in tweets took place in the evening of April 23rd, as the news of the VRA attack was shared on Twitter and coincided with the end of the working day when some of the public were just hearing the news about the day's events. Tweet activity levels peaked on April 24, 2018 between the hours of 6:00 AM and noon (Figure 10), at 562 tweets and 1,934 retweets. The VRA was a new and novel incident for Toronto and given recent global trends on terrorist related VRAs it was natural for the public to be anxious until the complete facts about the perpetrator and his motives were known. 6-hourly activity patterns show a diurnal pattern, with decreasing tweet activities after 6PM each day (Fig. 10). 51% of all tweets were made a day after the VRA incident on April 24. A single peak is observed for tweets on April 23 in contrast to three peak points on April 23 and 24 for retweets. Peaks coincide with news or other updates about the VRA incident from public officials. These three high data points correspond to several key events that took place including the breaking news of the incident, perpetrator's first court

appearance and the confirmation of the perpetrator’s motive. The events are mapped in Figure 10. The chart also depicts a consistent pattern that tweets posted decreased over time with a long tail.

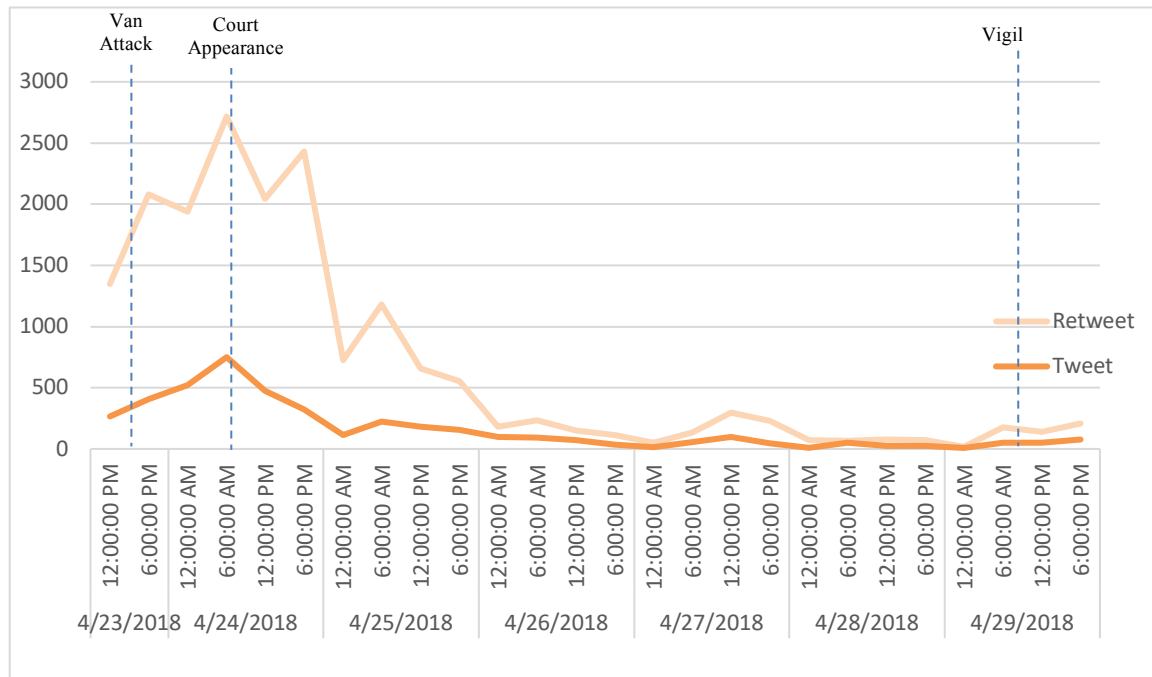


Figure 10. 2018 Toronto VRA 6-hour Interval per tweet type with key events mapped

4.6

Spatial Analysis of Tweets

Tweets with geolocation data points was mapped. 56.42% (12,465) tweets had geolocation coordinates and were used for spatial analysis. Geographical mapping of the geo-tagged tweets shows that most of the tweets were posted in North America, South America and Europe. This highlights the limitation of Twitter with regards to accessibility. The heat map depicted in Figure 11 shows that a substantial proportion of the tweets were posted in Canada. The US was second in the number of tweets posted followed by South America in third place. This may be due to the fact that the US is closer in proximity to Canada. It also shows that through social media, national events can have a global impact. The map in Figure 12 visualizes the global epicentres

of the tweets about the 2018 Toronto VRA incident. The major epicenter is Toronto, smaller epicenters are observed in Alberta, Canada, New York, US and Germany and UK in Europe. The map shows the spatial clusters over the study period.

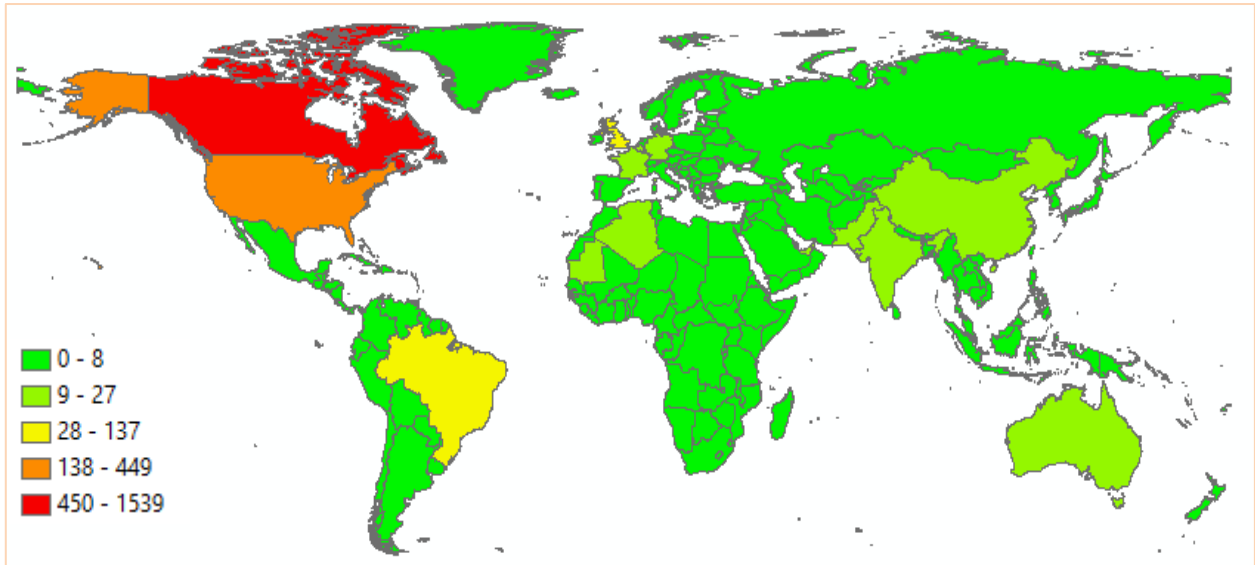
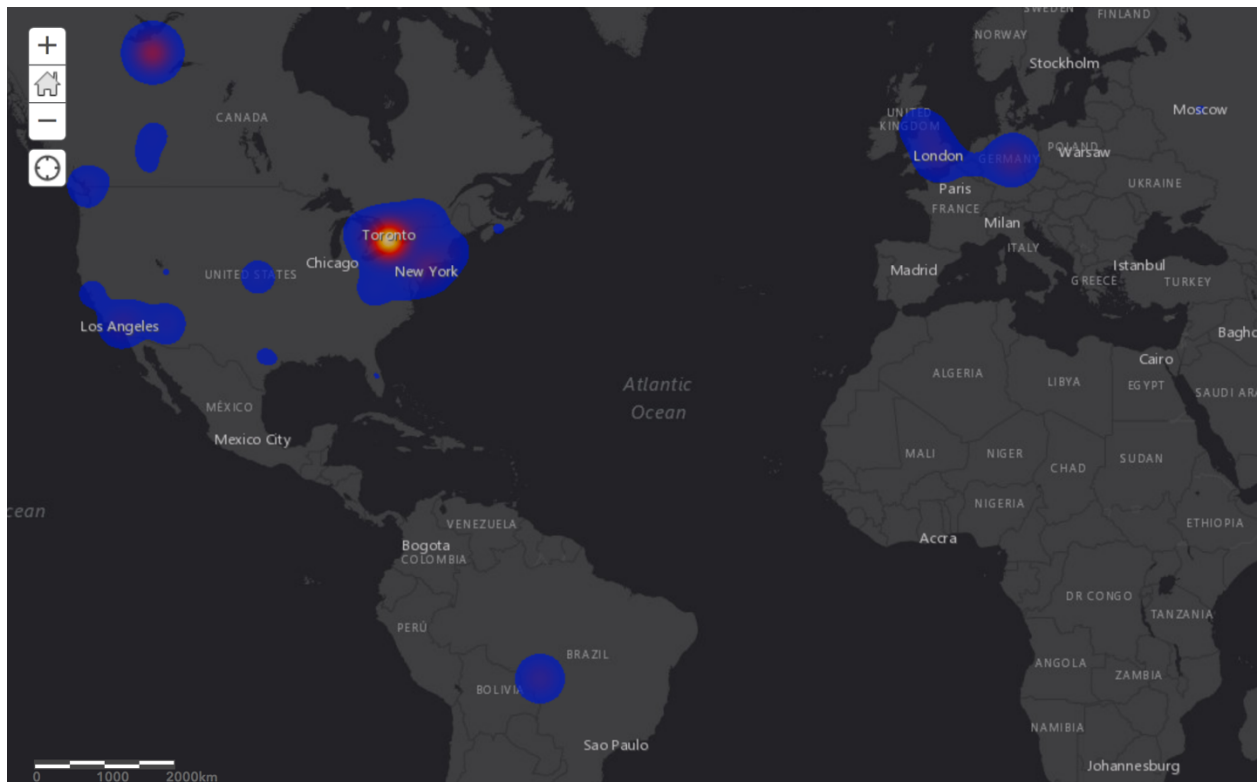


Figure 11. Spatial Distribution of 2018 Toronto VRA (Re)Tweets



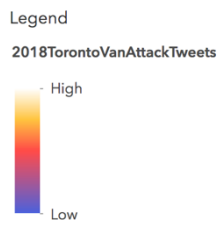


Figure 12. A point density analysis showing hotspots of geolocated tweets, generated using ArcGIS Online Spatial Analysis

4.7 Twitter Content Analysis

Past Events Canadian and/or International Incidents: Includes tweets that reference past VRA or violent incidents like the ones that took place in Canada for Canadian incidents and the US, France, or Spain for international incidents. Tracking both past international and domestic incidents helped determine which past incidents are being used to understand the current incident.

Canadian Incident

Could this Toronto tragedy today where a driver plowed through a crowd using rental van, similar to the Alberta tragedy last year been avoided with a simple real-time driver licence check? #carrentals #terrorism @verxdirect

International Incident

After Paris, New York, Barcelona, Madrid and London, let's embrace the new NORMAL in Toronto with lips sealed in fear, or should we do something else!!! Toronto van tragedy bonds city in blood. But no one will say the word 'terrorism' <https://t.co/XISQfZulUV> via @torontostar

Perceived Motive and Perceived Identity: These two themes include opinions and commentary labelling the incident terrorism. Tweets that opine about the motive of the perpetrator as terrorism and identity as Muslim. Tweets containing political, religious, ideological affiliation or ethnic keywords that have been used in past terrorism frames to reference the perpetrator's identity. References were made to Muslim, the Quran, ISIS and Al Qaeda. Given that VRAs are known terrorist tactics, it was not surprising that the suspect's identity was discussed in terms of religious identity and links to terrorist organizations. These discussions can be said to be influenced by terrorism frames. With no official reference or media headlines that suggested terrorism, it follows that the public was using past media frames to make sense of the incident. This became more salient as some of the tweets posted pointed out similarities between past VRA terrorist incidents and the Toronto VRA incident.

Perceived Motive

Another Act of Terrorism is occurring in Toronto. An individual in a rented van MOWED down multiple Pedestrians. Injuries Unknown. The driver has been arrested.

Perceived Identity

Canadian press can't say that van driver that hit pedestrians in #Toronto killing ten of them, is a muslim. Yes my friends, it was an act of terrorism performed by a islamic terrorist. Deal with it!

Confirmed Identity and Confirmed Motive: Tweets were coded based on whether they contain factual details about the perpetrator's identity (Armenian, Alex Minassian, religion) and motive (incel-inspired or misogyny). The police at different times within the seven days confirmed the identity of the suspect as Alek Minnassian of Armenian descent and his motive was the incel ideology.

Confirmed Identity

To those attempting to claim Muslim terrorism for today's van attack in Toronto, the suspects name is Alek Minassian, a name of Armenian descent, a country which was the first official Christian state, and is still predominantly Christian today.

Confirmed Motive

Incel terrorism: Alek Minassian, alleged killer of ten in Toronto van attack was inspired by Elliot Rodger [UPDATED] <https://t.co/oTKzgEK1Wr>

Community Solidarity: Tweets expressing support, solidarity for the victims, concerns about safety of others including calls to provide assistance and donations.

My thoughts are with families of victims, and those injured in today's North York, Toronto van incident. It will take time to investigate all the whys in the story and to heal, Torontonians take comfort in the safety of our home and the rarity of these incidents. #TorontoStrong

4.8 Overall Patterns

The high frequency of tweets for a theme suggests its prominence. For example, #TorontoStrong, was included in 17.59% of the tweets. It was not surprising as it was about solidarity and support

for the victims, their family, the city of Toronto and Canada. Tweet patterns for the themes in the time period collected were similar (Figure 13). Table 5 shows the theme trends. The most active days for all themes except for the confirmed motive theme was the day after the incident, April 24th ranging from a total of 3,095 to 11 tweets per theme. The confirmed motive was higher on April 25 coinciding with when more details about the incident was made public. The perceived identity which was the dominant theme trended higher than the confirmed identity for all seven days. It is evident that official confirmation of the identity of the perpetrator did not stave this perception of the incident from propagating on Twitter.

On April 23rd, CM was 0% because public officials had not yet determined the suspect's motive. Yet again, it is observed that PM trended higher than CM for all 7 days even after the motive was confirmed as incel-inspired. CM accounted for 2.32 % of the tweets compared to perceived motive at 24.49%. It was observed that on the third day, April 25, the perceived motive and identity, that is, the terrorism and Muslim related keywords, trended higher. This was two days after the perpetrator's incel-inspired motivation had been announced by the police. The themes perceived identity and motive were 24.5% and 24% respectively. Tweets about the confirmed facts on the other hand, were 5.38% and 2.32% respectively. Community and support accounted for 17.6% of the tweets. It shows the same trend peaking and decreasing after the third day. However, it peaked again, if not dramatically on the last day which is explained by the vigil that was held on 29th April to honour the VRA victims (Figure 9).

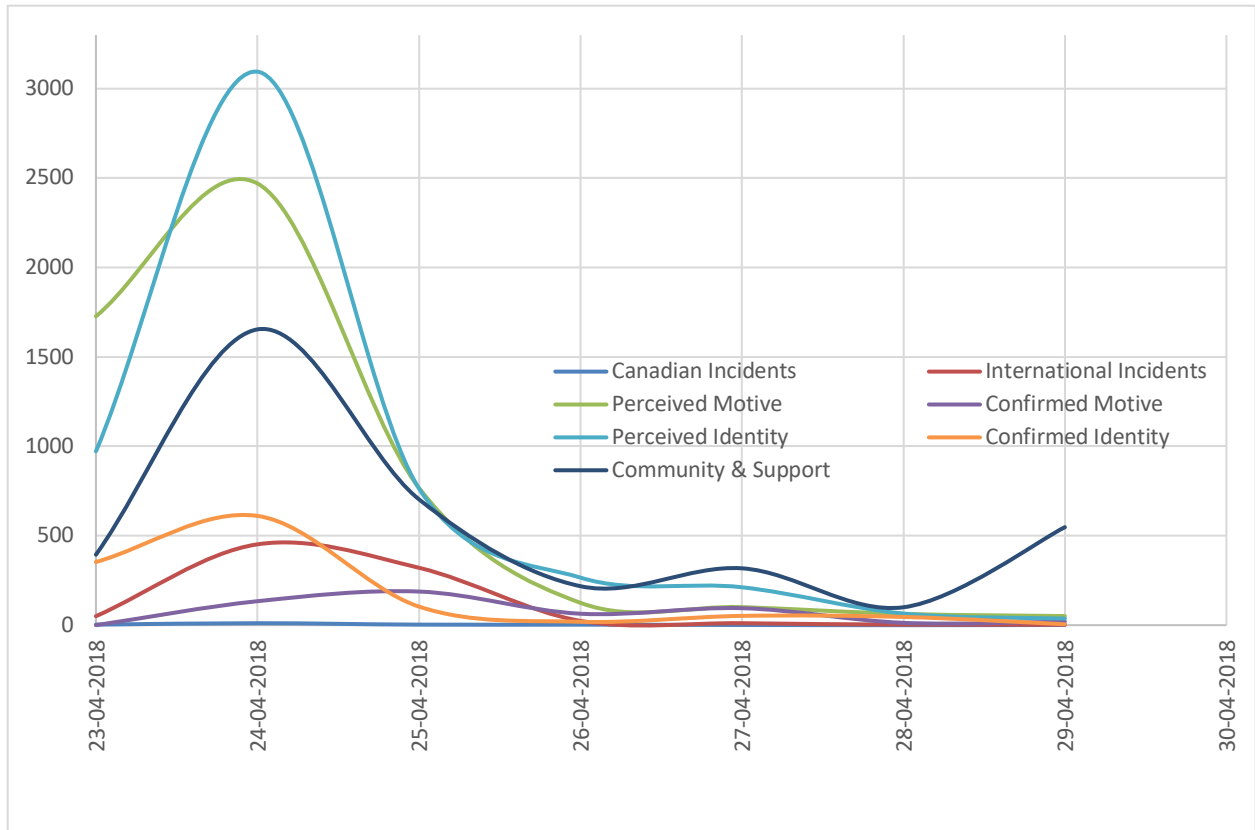


Figure 13. Popularity of 2018 Toronto VRA tweet themes over time

Table 5. 2018 Toronto VRA Themes

Date	Tweets	Cdn. Incident	Int. Incident	PM	CM	PI	CI	CS
04/23/2018 % Tweets	4,095 18.53%	3 13.64%	50 5.79%	1,727 32.55%	- 0.00%	972 17.96%	353 29.66%	394 10.14%
04/24/2018 % Tweets	11,195 50.67%	11 50.00%	452 52.31%	2,470 46.56%	134 26.07%	3,095 57.19%	611 51.34%	1654 10.14%
04/25/2018 % Tweets	3,787 17.14%	3 13.64%	321 37.15%	768 14.48%	188 36.58%	765 14.14%	104 8.74%	704 18.11%
04/26/2018 % Tweets	977 4.42%	3 13.64%	24 2.78%	125 2.36%	64 12.45%	266 4.92%	19 1.60%	218 5.61%
04/27/2018 % Tweets	919 4.16%	1 4.55%	11 1.27%	101 1.90%	95 18.48%	212 3.92%	52 4.37%	318 8.18%
04/28/2018 % Tweets	398 1.80%	- 0.00%	3 0.35%	63 1.19%	13 2.53%	65 1.20%	46 3.87%	100 2.57%
04/29/2018 % Tweets	724 3.28%	1 4.55%	3 0.35%	51 0.96%	20 3.89%	37 0.68%	5 0.42%	548 14.10%
Totals	22,095	22	864	5,305	514	5,412	1,190	3,887

5. Discussion and Analysis

5.1 Past Incidents

Recall of past VRA incidents and frames may have had an influence in shaping the public’s perception of the 2018 Toronto VRA incident. The number of terrorist inspired van attacks in Europe and in the US have increased in recent years, therefore it was perceived that the VRA was linked to Muslim or Islam sympathetic terrorists. International events figured more prominently in the tweets than the few events that had taken place in Canada. Most of them explicitly expressed that the event was similar to what took place in Europe. Reference to past events peaked on April 24 at 452 tweets representing 97%, this high percentage suggests that people used it as reference to make sense of the current event. If it is a van attack that was used to kill innocent people then it must be terrorism. Table 6 shows that individual accounts referenced past international events 440 times compared to the news media accounts at 12. Figure 14 shows that tweets about Canadian events was almost a flat line across while tweets about international events shows a sharp peak on the second day. The data suggests that knowledge of past events and media framing influenced the public’s perception about this incident.

Table 6. Tweets of Canadian and International VRA Incidents

Date	Canadian Incident		Internat. Incidents	
	News	Individual	News	Individual
	Media		Media	
4/23/2018		2	16	33
4/24/2018	2	9	12	440
4/25/2018	1	2	13	308
4/26/2018		3	1	22

4/27/2018		1	1	10
4/28/2018	1			3
4/29/2018				3
Total	4	17	43	819

Note: Internat. Incidents – International Incidents;

Over the course of the seven days, 22 tweets included a reference to past Canadian incidents compared to 864 that referenced international incidents, that is, .1% and 3.91 of the total tweets respectively. Individual user type category tweeted the most (819 tweets) about international incidents with the news media user type category at 43 tweets.

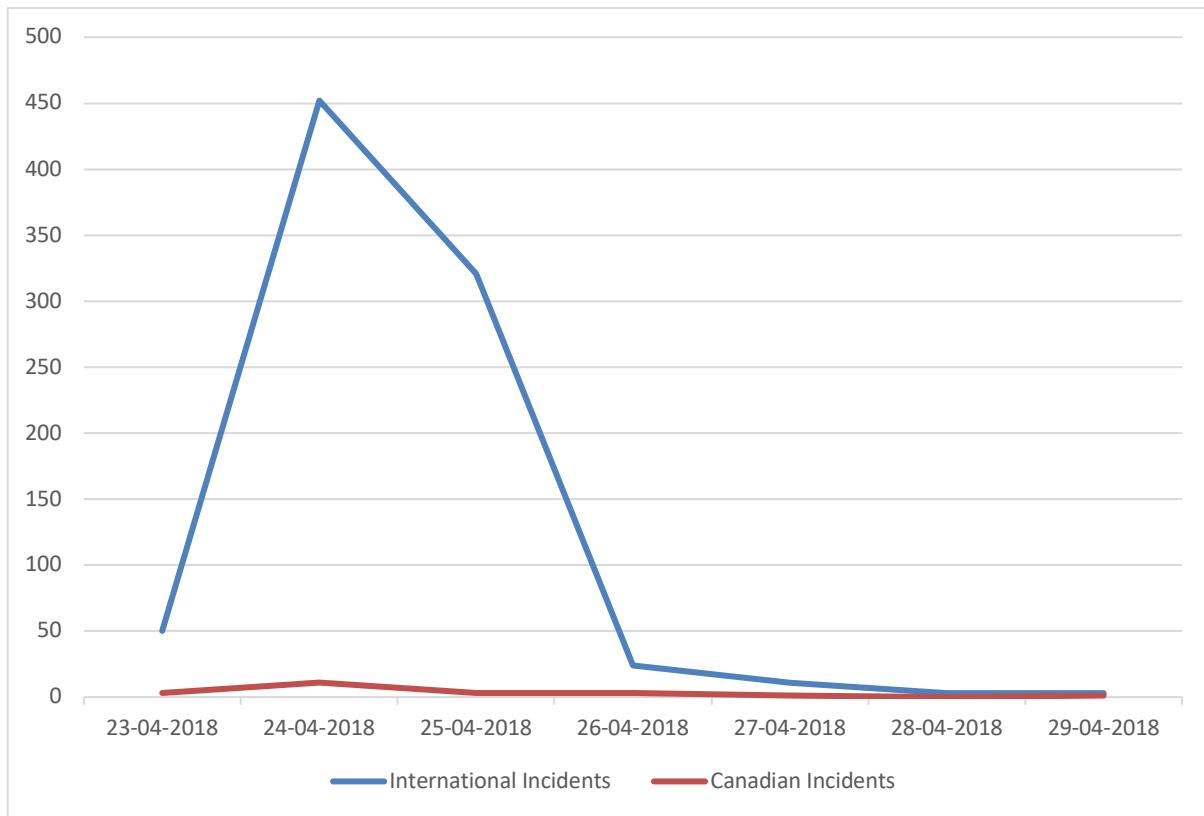


Figure 14. Past International and Canadian VRA incidents

5.2 Perceived and Confirmed Perpetrator Motivation

In the immediate aftermath of the Toronto VRA, public officials and the media were reticent to classify the van incident as terrorism. The Prime Minister of Canada, Justin Trudeau, the Public Safety Minister, Ralph Goodale and the Toronto Police were careful to state that there was no terrorist link to the incident (Zimmerman and Duriesmith, 2018). Yet, 24% (total of 5,305) of all tweets contained the label terrorism (Table 7). Some of the tweets suggested that the government was not forthcoming indicating a mistrust of the government like in previous studies (Lemyre et al, 2006).

Yesterday around 1.30 pm in the afternoon, a student from Seneca College, named Alek Minassian, took a van and deliberately drove it on pedestrians near Yonge Street. 10 killed and 16 were injured severely.
Minister @RalphGoodale denied it as TERRORISM but it seems as a TERRORIST ATTACK. <https://t.co/4c1onjW1zZ>

Notwithstanding the reticence by officials to not label the incident terrorism, references to van attack prompted a heated twitter debate about whether or not to call the incident a “van attack” vs terror attack. The volume of the tweets about the perceived motive was 24.49% compared to that of the confirmed motive at 2.32% implies that more people continued to believe that the incident motive was terrorism. Another narrative that surfaced on Twitter to support the perceived motive was to make public officials accountable by blaming them for opening Canadian borders to immigrants.

Goodale asked why Toronto van attack not dubbed terrorism
<https://t.co/Ddak8hhwNp>
Goodale is a loser like Trudeau with his intention of bringing boatloads more of immigrants to Canada

Table 7. Perceived and Confirmed Motivation for the Toronto VRA - News Media & Individual User Category

Date	Confirmed Motive		Perceived Motive	
	Individual	News Media	Individual	News Media
4/23/2018	-	-	733	352
4/24/2018	126	8	1416	764
4/25/2018	178	9	542	147
4/26/2018	39	24	108	6
4/27/2018	14	79	61	32
4/28/2018	8	5	29	31
4/29/2018	16	4	33	9
Total	381	129	2922	1341

Table 7 shows the total confirmed and perceived motive tweets posted by the individual and news media user type. Terrorism as the perceived motive trended for the first three days, peaking on April 24 with 2,180 tweets representing 9.8% of all tweets. It continued to trend high compared to the other themes until April 26th (Figure 11). Past terrorism frames used in coverage of similar incidents like the VRA incidents in Nice, London, and Madrid partly explains why this was a dominant trend. The speculation about the motive started the same day that the incident occurred. Figure 15 shows the temporal pattern of tweets for both the CM and PM showing several peaks within the first 72 hours. Both Figures 15 and 16 show that retweets were very high for the terrorism tweets indicating that individual user type category were primarily responsible for this framing on Twitter. 6% (1,341 tweets) of the news media user’s tweets were about the perceived motive compared to the individual users 13.23% (2,922 tweets) – a ratio of 1

to almost 46. Tweets for confirmed motive was quite low in comparison – news media and individual users at 129 tweets and 381 respectively.

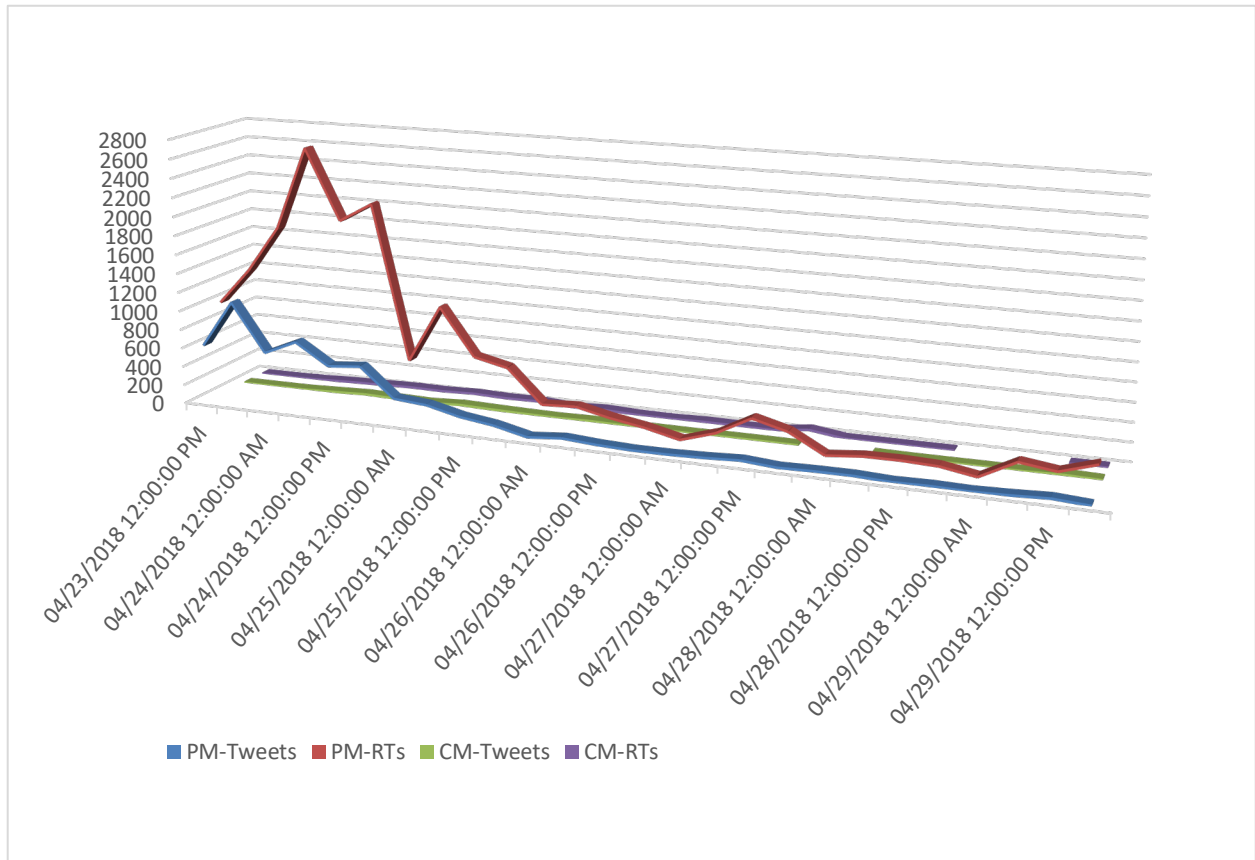


Figure 15. Toronto VRA Perceived and Confirmed motivation (re)tweets

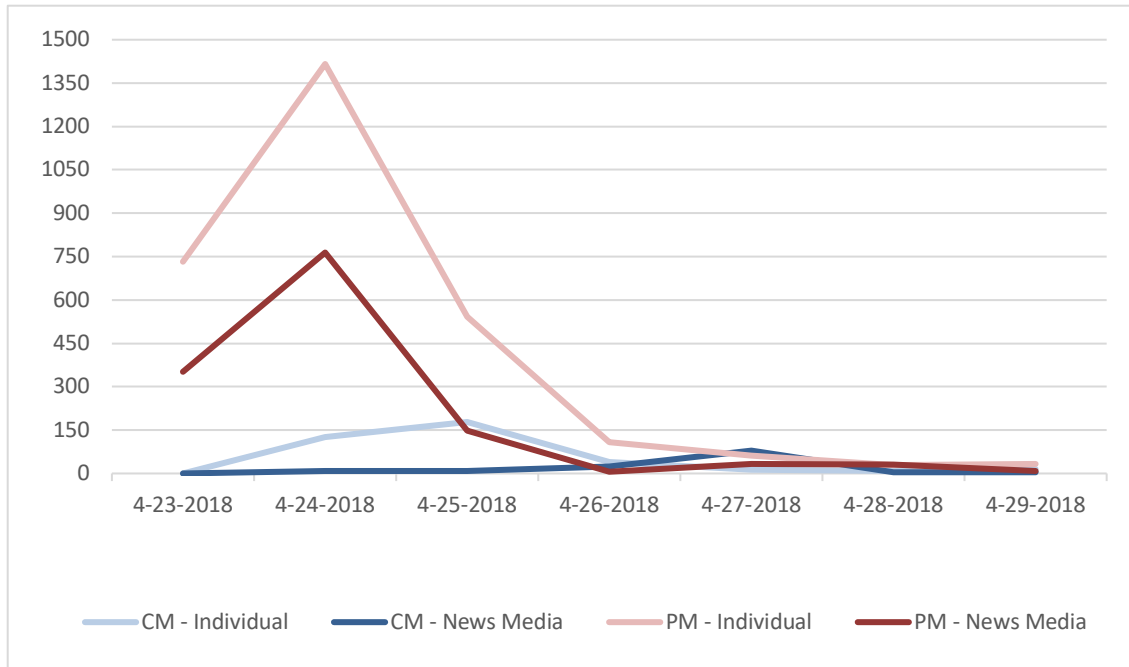


Figure 16. Confirmed and perceived motive themes by individual and news media user types

5.3 Perceived and Confirmed Perpetrator Identity

Human caused emergency incidents elicit a strong desire to identify the perpetrator and to make sure they are punished. Immediately after the van attack, the media and the public were seeking information about the perpetrator’s identity. The data shows that 24.5% of tweets (5,142 tweets) were about the public’s perceived identity and 5.4% (1,190 tweets) about the suspect’s confirmed identity. It takes longer for commentary and opinions online to dwindle than on mainstream media because of the platform’s open access. Some of the immediate eyewitness accounts reported that the perpetrator was of Middle Eastern descent. Suspicion was immediately cast that it was terrorism. Muslims along with terrorist organizations were on the list of suggested suspects.

Once again, individual user type accounts were prominent and the primary influence similar to the PI and CI trends. Individual user type category accounted for 19% of the tweets compared to

the news media’s 1% (Table 8). When it came to the CI theme, it seems that individual user types were less concerned about the perpetrator’s identity, contributing to 4% of the tweets with news media at 1%. Figure 17 shows the same trend with peaks on the second day with a sharp and steady decline thereafter. A similar high incidence pattern was observed with the PI theme which was much higher than the CI. On April 24th, the highest volume of tweets were observed for PI theme at 2,649 (Individual at 11.28% and news media at 0.75%) compared to the CI with 603 tweets (Individual at 2.42% and news media at 0.3%).

Table 8. Perceived and Confirmed Identity Theme

Date	Perceived Identity		Confirmed Identity	
	Individual	News Media	News Media	Individual
4/23/2018	966	3	114	236
4/24/2018	2482	167	64	539
4/25/2018	432	70	8	91
4/26/2018	217	3	1	18
4/27/2018	66	2	49	3
4/28/2018	20	1	27	19
4/29/2018	12		2	3
Total	4195	246	265	909

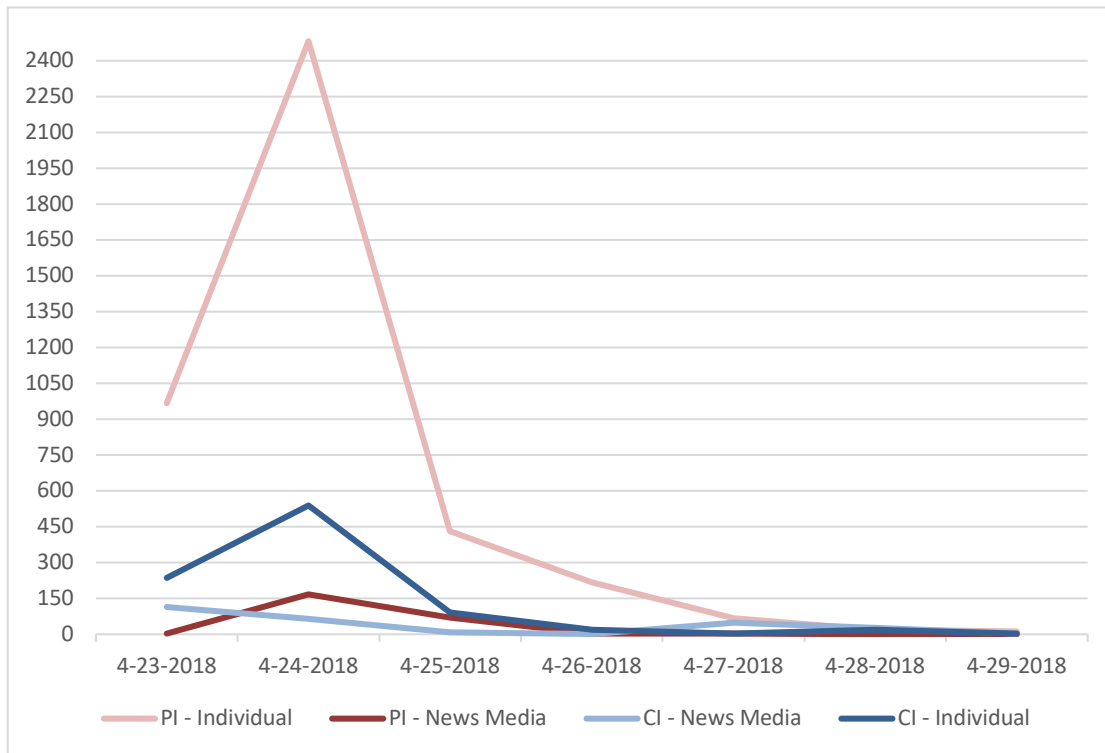


Figure 16. Confirmed Identity of Suspect by Individual and News Media User type category

5.4 Community & Support

#TorontoStrong and #CanadaStrong were prominent hashtags in the tweets. The data shows that the immediate response to the van attack resulted in an increase in patriotic expressions consisting mostly of reactions and expressions of horror and shock, sympathy and support for victims. This theme made up 17.59% of all the tweets. The emergence of such a strong sense of community is typical after events that invoke outrage and anger like this VRA incident. After September 11, citizens rallied behind the American flag (Norris et al, 2004). Table 9 shows that on April 24th, the tweets peaked at 1,632 (7.38% of all tweets). In Figure 18 two interesting patterns are observed. First, the CS tweet/retweet ratio is quite narrow compared to that of the tweets and retweets of xx to xx. Also included in this them were calls to donate and volunteer. The call to action using the hashtag #donate was quite popular. Calls for donations peaked by

April 25 and peaked even higher on April 27. Fundraising activities included setting up gofundme and other crowdsourcing accounts to help with the victims. The city setup a crowdsourcing account which spread quickly on Twitter. On April 29th, a second peak of 400 tweets is observed and coincides with the vigil that was held at Nathan Philips Square, Toronto to honour the victims. The theme had a similar pattern (Figure 18) like other themes except for the tail end where another peak was observed on the Sunday that the vigil was held for the VRA victims.

Table 9. Community and Solidarity

Date	Retweet	Tweet
4/23/2018	260	132
4/24/2018	907	725
4/25/2018	377	305
4/26/2018	114	101
4/27/2018	182	136
4/28/2018	33	67
4/29/2018	400	148
Total	2273	1614

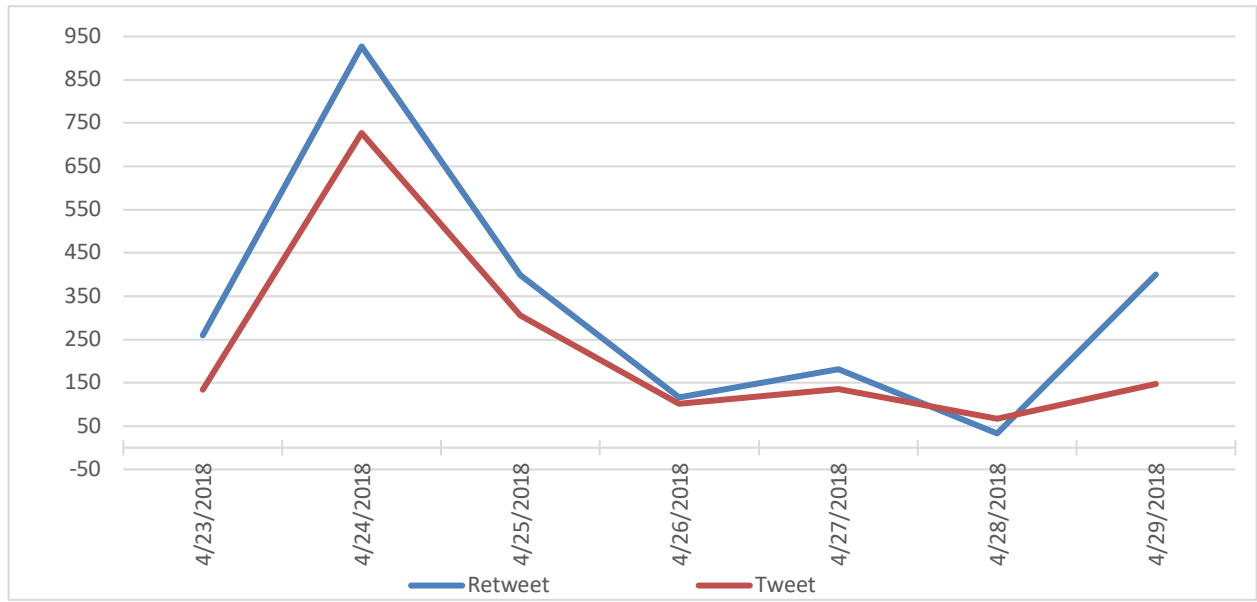


Figure 17. Community and Support

When the study began, I presumed a large number of emergency response and news media user-type categories will be tweeting about the VRA incident. It was unexpected that the number of emergency response user-type would be so low, given that they are significant stakeholders in the emergency management.

Main stream media did not frame the Toronto VRA as terrorism. It is interesting that the news media user-type (except for one journalist) tweets about the VRA incident did not use terrorism frames. Not surprising of course, studies (Kanji, 2018) have found that the media frames incidents by white Caucasian as extremists or mental illness related while incidents involving Muslim perpetrators are labeled as terrorism. This study found that individual user-types used terrorism frames to make sense of the incident. Publicly available information about the perpetrator’s real identity and motive did not change the public’s perception. The international

incident and perceived motive and identity themes shows that terrorism frames help shape the public's perception of violent incidents that have similar attributes as terrorism incidents.

It was unexpected that tweets about the VRA as an emerging risk were few and far between based on the findings of this study. This finding supports previous studies that found that Canadians feel safe and therefore did not feel they were at increased risk. However, it may also be because the suspect had been apprehended. The prevalence of terrorism frames represented with words such as terrorism, "terrorist attack", "terror attack" supports the impact of frames described by Entman (1999) and Norris et al (2004). Reference to past VRA incidents that took place in other countries like France supports the notion that media frames help shape public perception.

6. Conclusion

The findings of this study contribute to the now growing body of evidence about public perception of non-terror related incidents on social media platforms. Social media plays a significant role during and post disasters and emergencies. 22,029 tweets by 3,214 users between April 23-29, 2018 were collected for analysis. A thematic analysis of the tweets, in addition to an analysis of the Twitter user types during this period was conducted. The main discursive themes in the tweet corpus were expressions of past international and Canadian VRA and violent incidents, community and solidarity, and the perceived and confirmed motive and identity of the perpetrator. The data showed that the public's perception of the incident was much higher than the confirmed facts for the week of April 23-29, 2018. The confirmed facts of the incident did not alter the perception of the public much with regards to the perpetrator's motive and identity. The volume of tweets in the perceived motive and perceived identity themes was high throughout the seven days demonstrating that while facts matter, terror-like incidents are imbued with dis/misinformation and conspiracy which overwhelms the truth. This has implications for risk communications - DEMs must monitor all communications channels and actively engage with the public to keep these kinds of response at very low levels. The notion of the Moslem-inspired terror places these racialized communities at greater risk and continues to perpetuate racial tropes. The individual accounts are primarily responsible for this trend as they make up 82.65% of total users in this study. The individual and news media user type categories were the most engaged groups of users in the period studied.

Confirmed motive and identity accounted for 2.32% and 5.34% of the tweets in contrast perceived motive and identity accounted for 24.49% and 24% of the tweets showing a wide gap between reality and perception. These gaps are of particular concern to DEM and risk managers

that deal with crisis events and can be consequential for disaster response. The divergence between the public's perception of these arguably most horrific single VRA incident in recent Toronto history and the confirmed facts – incel-inspired Armenian descent perpetrator, indicates that 1) outrage and dread that these risk events engender– the public want to see the perpetrator being held accountable; 2) when the facts are not available the public will speculate answers to the who, what and why based on their experience and media cues; 3) it is difficult to take control of the messaging and misinformation online; and 4) terrorism frames with tweets about terrorism and Muslim identity resonated with Twitter users than the factual information because it made more sense to them.

To address the findings of low engagement of the emergency response user-type, DEM and government officials need to increase their presence on social media platforms in order to monitor dis/misinformation and provide counter information to reduce the gap between truth and reality. By understanding how the public and other stakeholders perceive VRAs, DEMs and policy makers can be better informed and positioned to develop and implement communication strategies that can bridge the gap between public perception and that of DEMs.

This study has shown that increased Twitter activity and volume coincides with newsworthy incidents. The accounts of news media and individuals were most actively engaged and it was surprising that the emergency response user-type engagement was very low. The results also showed that terrorism frames used in past events helped shape and factored quite heavily in the Twitter discussion. It is noteworthy as well that with references to past incidents, there were no tweets about the fear and concern about VRAs as a future risk. The absence of countermeasure

suggestions in tweets confirm the findings of a study by Lemyre et al (2006) that Canadians feel Canada is relatively safe from terrorism. Further study is needed to explore this further. Future study to look at associating themes with locations to determine whether there is some correlation with tweet content and location would be useful.

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