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“Follow Me So I Can DM You Back”: An Exploratory Analysis of a Female Pro- ISIS Twitter Network

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Graduate Program in Sociology
A thesis submitted in partial fulfillment of the requirements for the degree in Master of Arts
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Abstract

The purpose of this study is to explore a network of female pro-Islamic State of Syria and Iraq (ISIS) supporters on Twitter. To do so, I identified twenty Twitter accounts ($n=20$) through snowball sampling, and analyzed their network comprising 5,861 vertices and 12,034 edges. I studied the network using three social network analysis metrics—Freeman's normalized betweenness centrality, average geodesic distance, and tie strength. Females in the sample were more influential than males, and as a result, had a greater ability to radicalize other females within their network. Further, I observed that it took females longer than expected to send information within the network, according to the Three Degrees of Influence Theory. Finally, I found that most ties within the network were not reciprocated. In line with the Strength of Weak Ties Theory, Pro-ISIS females have a unique ability to radicalize others to support pro-jihadist terrorism on Twitter. I conclude that despite the long average geodesic distance, certain pro-ISIS females can successfully encourage other women to radicalize. Public safety officials, Twitter, and other researchers must respond to this phenomenon accordingly.

Keywords

Females, pro-jihadist terrorism, Islamic State of Syria and Iraq, radicalization, online radical milieus, social media, Twitter, Social Network Analysis

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Chapter 1

1 Introduction

In November 2014, a twenty-year old woman named Asqsa Mahmood was reported missing by her parents in Glasgow (Fantz & Shubert, 2015; Kenez, 2014). An investigation revealed she left on her own accord, travelling from the United Kingdom to live in Syria, within territory held by the Islamic State of Syria and Iraq (ISIS) (Vidino & Hughes, 2015). According to news outlets, Mahmood’s journey from being an average young woman to a staunch supporter of the Islamic State (IS) began online, when she started to visit extremist webpages—a similar path to other females who radicalized and supported pro-jihadist terrorism (Kenez, 2014; Pearson, 2015).¹ Mahmood resurfaced online, using a blog on Tumblr entitled *Diary of a Muhajirat* and a Twitter account, @ummlayth, to communicate (Kenez, 2014). Using these platforms she voiced her support for the IS ideology, including her desire to participate in combat (Peresin & Cervone, 2015).²

In February of 2015, Shamima Begum, a teenager from the Tower Hamlets Borough of London, tweeted at Aqsa: “Follow me so I can DM you back” (Begum as cited in Stone, 2015) Shortly thereafter, Begum and her two friends, Amira Abase and Khadiza Sultana, were reported missing by their families (Saltman & Smith, 2015).

¹ For example, Roshonara Choudhry radicalized by visiting webpages and viewing radical content on social media (Pearson, 2015).

² These accounts are suspended or have been deleted.

Officials quickly found that the teenagers (referred to in the UK and international media as the Bethnal Green Girls) left their homes to travel to Syria, with the intention of living under IS-held territory – similar to Mahmood (ibid). They settled in Raqqa, supposedly living within an IS-controlled compound (Sherlock, Daunt, & Tarling, 2015).³ Abase continued to use Twitter, posting content ranging from anti-Assad messages to seemingly benign tweets about enjoying ‘takeout’ food with another female IS supporter (Malm, 2015; Saltman & Smith, 2015).^{4,5}

The stories of Mahmood and the Bethnal Green Girls show how social media sites offer pro-jihadist terrorist supporters a unique opportunity to disseminate information and radicalize others through direct forms of communication. The utility of social media for these groups has been well documented by researchers, public safety organizations, and even infamous radical Islamic clerics (J. Berger & Morgan, 2015; Bjelopera, 2013; Helfstein, 2012; Huey, 2015; Institute for Strategic Dialogue, 2011; Klausen, 2014; Weimann, 2014). In fact, social media has become an integral component of IS’s strategy to claim victory in the Syrian Civil War (Farwell, 2014). These sites, such as Twitter, allow terrorists to appeal to a broader market of online sympathizers (Sageman 2008). Social media is also valuable for terrorist groups as it affords females unprecedented opportunities to support them (Hoyle, Bradford & Frenet, 2015; Huey & Peladeau, 2016;

³ Raqqa, or Al-Raqqah, was established capital of the Islamic-State in 2014 (J. Berger & Morgan, 2015; Farooq, 2015).

⁴ Recently, Sultana was killed after a Russian air strike hit the city (Dearden, 2016).

⁵ i.e. Amira Abase posted a picture on her twitter account, @*binttabbas*, of her and another woman enjoying take-out food (Sherlock et al., 2015). The account is currently suspended.

Lahoud, 2014; Saltman & Smith, 2015). Researchers have begun to observe what female supporters, like Mahmood, do on social media platforms—that is, what they tweet about and how they support terrorist organizations in their own rite. For example, Huey and Peladeau (2016), Saltman and Smith (2015), and Hoyle et al. (2015), have documented the fact that female supporters of pro-jihadist terrorist groups act in a variety of ways on social media, ranging from discussing topics central to the organization’s mandate or calling for direct acts of violence. Recently, scholars such as Klausen (2014) have also taken a network-based approach to study this phenomenon, providing a view on the structure of these pro-jihadist female social media networks.

1.1 The Current Study

The present study contributes to the existing literature through an exploration of female participation within the pro-ISIS Twitter network. It employs Social Network Analysis (SNA) to address three research questions:

1. How influential are pro-ISIS females, relative to their male counterparts (evaluated by betweenness centrality) on Twitter?
2. What is the average geodesic distance (the number of hops between two nodes) of the female pro-ISIS network?
3. How strong are the ties (the level of reciprocity) in the female pro-ISIS network on Twitter?

I collected a non-probabilistic snowball sample of twenty Twitter accounts owned by female users ($n=20$). The network within the sample comprised 5,861 accounts and 12,034 relationships amongst these accounts (i.e. retweets or follows between two individuals). From the sample, I calculated three SNA metrics – Freeman’s normalized betweenness centrality, average geodesic distance, and tie strength – in order to address the research questions.

This thesis consists of five chapters. Chapter Two reviews the current literature on the topics of social media, gender, and radicalization. The chapter begins with a discussion regarding the utility of social media for pro-jihadist terrorist groups – specifically ISIS. I move on to explain how these social media platforms act as online radical milieus (ORMs), in which individuals can become radicalized and made into supporters of extremist organizations through contact with other extremists. Next, I examine the work of other researchers on pro-IS males' and females' participation on Twitter. I explain how the current study will use SNA to explore the sample pro-IS female network. The chapter concludes with an explanation of the Three Degrees of Influence (TDI) and Strength of Weak Ties (SWT) Theories used in the analysis section (Chapter Five) of this thesis.

Chapter Three discusses the methodology used to analyze the sample pro-IS female Twitter network. It includes an overview of the data collection process, the different social network analysis metrics used, and the equations UCInet and NodeXL used to calculate the metrics. The chapter concludes with a review of the study's ethical considerations, as well as limitations identified that are unique to the social network analysis method.

Chapters Four and Five are the findings and discussions sections of the thesis respectively. In Chapter Four, I present my results in Tables 1 through 4. Chapter Five discusses the results of the study in accordance with the theories and literature explained in Chapter One. This chapter also explains the implications of the findings, addresses general limitations of the study, and identifies considerations for future studies on the topics.

Chapter 2

2 Literature Review

The purpose of this chapter is to examine the relevant literature on the topics of gender, radicalization, and Twitter. It begins with a discussion of why terrorist groups and their supporters use social media to communicate with each other. An examination follows of how social media platforms serve as online radical milieus (ORMs), or spaces in which pro-jihadist supporters radicalize others. Next, the chapter addresses research on Twitter as a radicalizing environment for pro-Islamic State of Syria and Iraq (ISIS) supporters. In particular, it discusses research on the ways in which female supporters use Twitter and facilitate the radicalization of others. The chapter concludes with a discussion of how this thesis contributes to the field of existing literature, as well as a review of the two theories employed in the study: Three Degrees of Influence and Strength of Weak Ties.

2.1 Social Media

With social media, terrorist organizations such as ISIS have an unprecedented opportunity to communicate with current and potential supporters (Conway, 2012; Klausen, 2014; Sageman, 2008; Smith, Burke, de Leiu, & Jackson, 2015; Weimann, 2010).⁶ Specifically, two factors have led to increased opportunities for supporters to connect. The first has been the internet's widespread accessibility. Since the beginning of

⁶ While there are many active terrorist organizations in the world, this thesis strictly focuses on ISIS.

the 21st Century, billions of individuals have been using mobile phones and computers to connect with one another in seconds, with little cost and effort required (Sageman, 2008; Stevens & Neumann, 2009). The second factor is the multitude of Web 2.0 platforms, such as forums, chatrooms, and social media sites, which promote user-generated content and interaction (Conway, 2016; Sageman, 2008; Homeland Security Institute, 2009; Weimann, 2010).⁷ Of these web 2.0 platforms, social media sites are the primary online environments for terrorist groups and their supporters (Berger & Morgan, 2015; Helfstein, 2012; Huey, 2015; Institute for strategic dialogue, 2011; Klausen, 2014; Weimann, 2014). Social media is defined as a set of tools or infrastructure that is “used to produce and distribute content” (Hogan & Quan-Haase, 2010; Howard & Parks, 2012, p. 362). Parks and Howard (2012, p.362) further explain that “the content [...] takes the digital form of personal messages, news, ideas, and cultural products” which may be consumed by “people, organizations, and industries.” Many popular platforms used today include Twitter, Facebook, YouTube, Instagram, and Tumblr.

Terrorists such as Anwar al-Awlaki have explicitly voiced their preference for communicating with others using these platforms, encouraging men and women to become *internet mujahedeen* (Bloom, 2013; Conway, 2012; Lahoud, 2014; von Behr,

⁷ *Web 2.0* is a term created by O’Reilly (2007) to describe websites created after 2001. These sites have different capabilities than their predecessors, such as enabling wikis or blog posts (ibid).

Reding, Edwards, & Gribbon, 2013).^{8,9} Awlaki pioneered the use of the internet in jihad by posting sophisticated versions of propaganda on social media, including videos inciting violence against the United States (Bjelopera, 2013; Weimann, 2014).¹⁰ Further, as Lahoud (2014, p.788) explains, “several jihadi activists who carried out operations in the United States credited their activism to their inspiration by his online writings and lectures.” For instance, an investigation into Roshonara Choudhry’s online activities revealed that she was an avid viewer of Awlaki’s YouTube sermons (Pearson, 2015).¹¹

There are a variety of reasons why jihadists such as Awlaki have preferred using social media. First of all, social media has increased the flow of propaganda for extremist groups such as ISIS (J. Berger & Morgan, 2015; Chatfield, Reddick, & Brajawidagda, 2015; Farwell, 2014; Homeland Security Institute, 2009; Institute for Strategic Dialogue, 2011; Hoyle et al., 2015; Klausen, 2014; Liang, 2015; Weimann, 2010). Terrorist groups that were active prior to the advent of social media had to rely on Web 1.0 platforms and a small number of traditional media sources to publish propaganda (Klausen, 2014). They used other mechanisms such as e-magazines to spread their message. For example, Al Qaeda’s *Inspire* magazine was created to discuss a variety of topics ranging from bomb-

⁸ Awlaki was killed by an American drone strike in 2011 (Lahoud, 2014).

⁹ *Mujahideen* is an Arabic term for “holy warrior” (Picart, 2015)

¹⁰ It is important to note that, in the context of this thesis, *jihad* refers to Salafist jihad in which “jihadi ideologues have molded [...] from a territorially oriented doctrine into a contemporary global military program” (Lahoud, 2014, p. 782).

¹¹ In 2010, Choudhry stabbed Stephen Timms, a British MP (Pearson, 2015).

making to praise for individuals for committing lone-wolf attacks (Conway, 2016; Helfstein, 2012; Holbrook, 2015; Lahoud, 2014; Picart, 2015). Today, groups such as ISIS still have formal media offices that disseminate propaganda, but efforts have been de-centralized and now members and supporters of these groups actively create their own propaganda (Gates & Podder, 2015; Huey & Peladeau, 2016; Klausen, 2014; Nissen, 2015).¹² Notably, the shift to social media platforms has given women opportunities to participate by sharing online content to influence other pro-jihadist supporters. In fact, as Picart (2015, p.5) explains, women are thought to be “well versed in the use of social media,” creating and posting content which frames jihad as “cool” (Ghajar-khosravi, Kwantes, Derbentseva, & Huey, 2016; Huey, 2015).

Pro-jihadist supporters use different social media platforms for different purposes. Sites such as YouTube are generally reserved for disseminating visual propaganda, such as videos from the frontlines, speeches, and sermons, as shown in the case of Awlaki (Klausen, Barbieri, Reichlin-Melnick, & Zelin, 2012; Klausen, 2014; Pearson, 2015; Weimann, 2014). Other social media sites such as Facebook and Twitter use Web 2.0 capabilities to the fullest, encouraging user interaction. In effect, propaganda on these sites becomes more engaging to potential and current supporters, making it much more effective at radicalizing other individuals (Helfstein, 2012; Klausen, 2014; Weimann, 2010). On Facebook, terrorists may have official accounts and communicate with followers and potential recruits through posts (Weimann, 2014). Weimann (2014)

¹² *Al-Hayat* is ISIS’s media outlet responsible for publishing the *Dabiq* Magazine (McCabe, 2016).

compares Facebook to an email marketing list, as supporters have a virtually infinite number of individuals they can connect with. Despite Facebook's popularity with pro-jihadist supporters, Twitter is considered to be the principal online radical milieu of (ORM) for male and female supporters of these groups (Altman, 2015; Klausen, 2014; Weimann, 2014).

2.2 Online Radical Milieus

Researchers consider social media sites, such as Twitter, as online environments or milieus for their users (Conway, 2012; Malthaner & Waldmann, 2014); however, platforms used by extremists and their supporters are considered to be online *radical* milieus (Conway, 2012; Malthaner & Lindekilde, 2010; Pearson, 2015). A milieu is radical in nature when the interactions within it are characterized by violent absolutist views towards a particular political conflict or issue (Conway, 2012; Malthaner & Waldmann, 2014). For supporters of IS, Twitter acts as an ORM in which they can voice support for IS ideologies and help accomplish their goals (Conway, 2012; Malthaner & Waldmann, 2014).¹³ Part of ISIS's mandate is to establish a Caliphate in the Middle East, and they have used the Syrian Civil War as a means of accomplishing this (Byman, 2015). As a result, many pro-IS Twitter accounts frequently discuss the necessity of establishing the caliphate (Huey & Peladeau, 2016). Perhaps because nearly all of these pro-IS supporters on Twitter share a common view of the conflict, Twitter acts as a milieu where they can share "experiences, symbols, narratives, and frameworks of

¹³There are a handful of groups fighting within the Syrian Civil War; however, for the purpose of this thesis, I focus strictly on ISIS.

interpretation” (Malthaner & Waldmann, 2014, p. 983). The *Tawheed* is one example of a common symbol for ISIS supporters and is frequently a subject of posts and online discussions (see Appendix 1) (Berger & Morgan, 2015). Supporters also share common extremist beliefs and values, such as the general view that violence is a reasonable means to an end (ibid). For instance, ISIS supporters may publicly call for acts of terrorism in order to spread their Salafist message (Dalgaard-Nielsen, 2010; Hoyle et al., 2015; Huey & Peladeau, 2016; Saltman & Smith, 2015).¹⁴

ORMs are a threat to public safety because they may radicalize individuals into committing acts of violence or adopting pro-violent attitudes and behaviors (Conway, 2012; Malthaner & Waldmann, 2014; McCauley & Moskalenko, 2014). For the purposes of this thesis, radicalization is defined as:

increased preparation for and commitment to intergroup conflict. Descriptively, radicalization means change in beliefs, feelings, and behaviors in directions that increasingly justify intergroup violence and demand sacrifice in defense of the in-group. (McCauley & Moskalenko, 2008, p. 416)

In this sense, radicalization is not an immediate occurrence, but a process marked by evolving changes in opinions and actions (McCauley & Moskalenko, 2014). Radicalized supporters may begin to adopt a violent rhetoric online, praising those involved in battles as “fighter-heroes” (McCauley & Moskalenko, 2014, p. 982). On the other end of the spectrum, participants in the ORM may engage in more radical acts, such as joining the terrorist organization they support or committing lone-wolf attacks in the West in order to

¹⁴Salafism is a fundamentalist view of Islam which promotes violence and strict interpretation of the Qur’an (Cottee, 2010; Pearson, 2015). As an example, both Al Qaeda and ISIS are considered to be Salafist organizations (Pearson, 2015).

show their support for the organization (McCauley & Moskalenko, 2014; Weimann, 2012). In the pro-IS ORM, outcomes may include making *hijra* to Syria in an attempt to become fighters themselves (Saltman & Smith, 2015).¹⁵

Social media sites are particularly impactful in the process of radicalization as they facilitate the formation of new online friendships (Bouchard & Nash, 2014; Conway, 2012; McCauley & Moskalenko, 2008). These new relationships can be understood as examples of *weak ties* because they form between two unfamiliar individuals who would be “otherwise unconnected” with each other (Ducol, Bouchard, Davies, Ouellet, & Neudecker, 2016, p. 106; Kennedy & Weimann, 2011) *Weak ties* serve as the basis for pro-jihadist terrorists and supporters to integrate an individual into a radical environment (Kennedy & Weimann, 2011). In this sense, platforms such as Twitter act as venues to normalize discourse on extremist views (Huey, 2015; Koehler, 2014; Torok, 2013).¹⁶

2.3 Twitter

Twitter is one of the largest social media platforms, with an estimated 310 million monthly users (Twitter, 2016a). The platform has innovated the process of radicalization, as users are now able to strategically communicate with others in an effort to gain online support in the Syrian Conflict (J. M. Berger & Strathearn, 2013; Carter, Maher, &

¹⁵To make *hijra* means to migrate (Saltman & Smith, 2015)

¹⁶ In this case, normalization refers to the act when “Practices become routinely embedded... in social contexts as the result of people working, individually and collectively, to enact them” (May, Mair, Finch, MacFarlane, Dowrick, Treweek, Rapley, Ballini, Ong, Murraray, Elwyn, Legare, Gunn, & Montori, 2009, p.2.)

Neumann, 2014; Chatfield et al., 2015; Klausen, 2014). Users influence others by communicating with tweets (posts consisting of a maximum of 140 characters), by retweeting others and using hashtags (Gruzd & Wellman, 2014). Additionally, account holders have the option of favouriting tweets (indicating they like the message), following other accounts, or direct messaging someone (direct messages are private and do not appear on profiles, unlike other features). Researchers have explained how the platform is extremely conducive to fostering weak ties – a key component in radicalization on social media, as previously established – because of the variety of ways in which users can connect with each other (Bouchard & Nash, 2014; Gladwell, 2010; Segerberg & Bennett, 2011; Takhteyev, Gruzd, & Wellman, 2012). Perhaps Twitter’s most important feature for ISIS supporters is the ability to hyper-link to other sites. Twitter acts as a “beacon for sharing short links to content dispersed across numerous digital platforms,” in effect uniting multiple sources of propaganda (Chatfield et al., 2015; Klausen, 2014; Prucha & Fisher, 2013). For example, a user can tweet a message with Pro-IS content, while at the same time linking to a YouTube video or Tumblr post with visuals, combining the power of multiple social media sources and, in effect, reaching out to more individuals (Carter et al., 2014). According to Twitter’s (2016) user statistics, this feature is extremely popular with all types of users, generating one billion visits to other sites on a monthly basis.

A significant portion of the research on pro-jihadist organizations’ online activities examines how men participate in these networks as jihadists and pro-jihadist supporters (Conway, 2016; Lahoud, 2014). Researchers have observed that among the pro-jihadist ORMs on Twitter, there are several groups of influential men. The first

group, fighters, or *mujahedeen*, make up a significant component of the milieu (Chatfield et al., 2015; Hoyle et al., 2015; Klausen, 2014; Vidino & Hughes, 2015). This group typically comprises Western Foreign Fighters, also known as Green Birds (Carter et al., 2015; Klausen, 2014).¹⁷ These individuals post a wide variety of content, but often use Twitter to discuss activities directly from the frontlines as they are occurring (Carter et al., 2015; Klausen, 2014). As Klausen (2014, p.8) explains, Green Birds play a critical role in influencing the pro-IS ORM, with at least three-quarters of foreign fighters' accounts having a "significant impact as proselytizers for violent jihad." Their influence derives from the fact that their posts allow members of the milieu to experience battles remotely, inspiring others to take on a more radical mindset and normalizing violence (Carter et al., 2015; Farwell, 2014).

The second group consists of *disseminators* or *supporters*. These users are critical in encouraging radicalization (Al-khateeb & Agarwal, 2015; Carter et al., 2014; Glavin, 2015; Klausen, 2014; Nissen, 2015; Prucha & Fisher, 2013). While they do not actively participate on the frontlines of the war, nor do they have an official affiliation with ISIS (Carter et al. 2014), disseminators are considered news-brokers – a collection of individuals who ensure information through their respective networks (Carter et al., 2015; Klausen, 2014). Disseminators are particularly influential because these users ensure they

¹⁷ Carter et al. (2015, p. 10) define a foreign fighter as "any person who has travelled to Syria to join any group opposed to the Syrian government; performs combat activities; and lacks Syrian citizenship (or, if ethnically Syrian, is ordinarily domiciled outside of the country);" however, in the context of this thesis, foreign fighters refer to those who join ISIS.

engage with other accounts, unlike other pro-IS tweeters (Carter et al., 2015; Glavin, 2015). For example, @shamiwitness is a known disseminator and one of the most influential pro-ISIS accounts on Twitter (Chatfield et al, 2015; al Khateeb & Agarwall, 2015; Klausen, 2014; Carter et al., 2015).¹⁸ His influence derives from his efforts in tweeting at other users in an attempt to radicalize them (Chatfield et al., 2015).

There are also official IS accounts that participate in the pro-IS milieu; however, these users abstain from interacting directly with other users through Twitter (Berger & Morgan, 2015; Carter et al. 2014; Chatfield et al. 2015; Klausen, 2014; Prucha & Fisher, 2015). Instead, they use Twitter strictly to post updates on conquests in battle or to disseminate propaganda (Carter et al. 2015). For this reason, users of these accounts often have a close relationship with those who are fighting on the frontlines (ibid).

2.3.1 The Umm Network

Recently, scholars have observed that female supporters act primarily as disseminators in the Twitter-verse (Klausen, 2014). This trend is worth noting as male and female networks have traditionally been separate online, which has led to the dominant view in research that women are not as influential in comparison to their male counterparts (Conway, 2016; Sageman, 2008); however, as Huey and Peladeau (2016, p.18) have found, women's activities on Twitter do in fact "create and sustain radicalizing milieus."

¹⁸ The handle @shamiwitness derives from the Arabic name for Syria (Liang, 2015).

The female population of pro-jihadist Twitter supporters is referred to as the *Umm Network* or *Umm Factor* (Liang, 2015; Klausen, 2014).¹⁹ Women within these networks support and sustain the ORM through tweets that provide emotional support or by posting more radical and menacing content (Huey & Peladeau, 2016). Notably, female ISIS supporters provide ideological support, highlighting *ummah* counter-narratives in an attempt to instill “ummah consciousness” – a perception that Muslims make up a single community that is constantly under attack by the West (Hoyle et al., 2015; Saltman & Smith, 2015, p. 21). Specifically, they discuss the *ummah* in the context of *baqiyah* – or an extended family. (Amarasingam, 2015; Huey & Peladeau, 2016; Huey & Witmer, 2016). Tweets by female pro-jihadists are often dichotomous, declaring that one either stands in solidarity with the *ummah* or stands against it (Saltman & Smith, 2010). This attitude is critical to fostering a-group mentality (McCauley et al., 2008). Group identification enhances the emotions one may feel towards a political issue and leads to a higher level of commitment to the in-group (Ellemers, Spears, & Doosje, 1997; van Stekelenburg, 2014).

In some cases, women do use Twitter in more explicit ways to support IS. Specifically, pro-IS women often tweet about making *hijra*, to IS-held territory, which is the main goal of the IS’s social media strategy (Hoyle et al., 2015; Huey & Peladeau, 2015; Peresin, 2015; Saltman & Smith, 2015). This phenomenon has garnered a

¹⁹ The *Umm Network* or *Umm Factor* title derives from the Arabic kunya, *umm*, an honorific title meaning mother (Klausen, 2014). Pro-IS females use this kunya in their Twitter handles to identify their gender (ibid). Females may also use the kunya *bint*, meaning ‘daughter’ (Berger & Morgan, 2015).

significant amount of attention in the media, with headlines focusing on jihadi brides, women who travel for the purpose of getting married (Bloom, 2011; Katherine Brown, 2014; Saltman & Smith, 2015). These *muhajirat* may also tweet about life within IS-held territory once they have arrived, providing advice for others who are considering making the journey (Hoyle et al., 2015; Peresin & Cervone, 2015; Saltman et al., 2015).²⁰

Further, they may also use Twitter to post images or tweets of different aspects their life in Syria, such as their family (Hoyle et al., 2015; Huey & Peladeau, 2016; Klausen, 2014; Liang, 2015).

Some female pro-jihadist supporters also encourage and attempt to justify violence on Twitter (Hoyle et al. 2015; Huey & Peladeau, 2016; Peresin, 2015; Smith as cited in Brown, 2014). However, this support falls on a spectrum, ranging from women who may voice their support in the form of prayers for fighters, to women who encourage others to commit lone-wolf attacks. Aqsa Mahmood, mentioned in the Introduction of this thesis, is an example of the latter. Mahmood has been observed by researchers to be an avid supporter and inciter of violence (Hoyle, et al. 2014; New York, 2014; Peresin, et al., 2014). (Hoyle et al., 2015; Peresin & Cervone, 2015; Zavadski, 2014). Mahmood frequently outlines the benefits of making *hijra* to IS-held territory, or for individuals who are not able to do so, she attempts to encourage them to commit acts of terrorism (Hoyle et al., 2016).

²⁰ *Muhajirah* or *muhajirat* is Arabic for “female migrant” (Peresin & Cervone, 2015).

2.4 The Current Study

The preceding literature review has explained how Pro-IS supporters have used Twitter to create an ORM, which normalizes pro-jihadist behaviors and facilitates the process of radicalization in two ways. First, by connecting with other individuals online and fostering weak ties, and second, by influencing followers with pro-IS propaganda. This chapter has also explained how female users play an integral role in this process by posting content that is intended to provide emotional support for ISIS, encourage violence and recruit others. Yet, traditionally females in pro-jihadist environments have not been viewed as influential. The current study contributes to recent literature by exploring how female actors participate in to the pro-IS ORM using Twitter.

2.4.1 Social Network Analysis: A Method to Study Gender, Radicalization, and Twitter

There are several reasons for using social network analysis (SNA) to examine female involvement in the pro-IS milieu. First, a review of the literature indicates SNA is particularly useful for studying radical networks online, with a variety of researchers having employed this method (J. M. Berger & Strathearn, 2013; J. Berger & Morgan, 2015; Carter et al., 2014; Klausen et al., 2012; Klausen, 2014; Magdy, Darwish, & Weber, 2016; Sageman, 2008). For example, Klausen (2014) used SNA to examine networks of male Western Foreign Fighters in Syria to provide an overview of their interactions. She also observed how women fit into this larger network (ibid). Second, SNA allows researchers to analyze the process of radicalization in these milieus, by way of examining the strength of social ties and exertion of influence (Bouchard & Nash, 2014). Finally, the Three Degrees of Influence and Strength of Weak Ties theories, which

can be applied to this thesis in order to develop a greater understanding of women's influence, are based on SNA.

2.4.2 Three Degrees of Influence Theory

Christakis and Fowler (2011) developed the Three Degrees of Influence (TDI) theory. The theory explains that an individual can be influenced to engage in an activity or behavior based on what people around them are doing.²¹ The foundation for this theory is Stanley Milgram's (1967) Small World Experiment, which found that every human is connected by six degrees of separation. Christakis and Fowler (2011) explain that while humans may be connected by six degrees, individuals that far in social space certainly cannot influence them. The TDI principle builds on Milgram's (1967) work by clarifying that one must be in close proximity to another human if they are to be influenced. In fact, the authors have observed that an individual must be within three "hops" of an influencer in order to alter their behavior or actions accordingly (see Figure 1). In SNA technical terms, this theory suggests that as long as the geodesic distance between two nodes (individuals) is relatively short and under three geodesics, one is able to feel the influence of the other. Outside of the three hops, influence seems to have little or no impact.²²

²¹ The theory came from the authors' studies in epidemiology, which examined behaviors that impact health. In a study on obesity, they explain how one's weight is influenced by those around them; specifically, if one's close friends were obese, they were 40% more likely to be obese themselves (Christakis & Fowler, 2007).

²² See Christakis and Fowler (2011, p. 28-29) for the three hypotheses (intrinsic-decay, network instability, and evolutionary purpose) as to why influence becomes ineffective.

The TDI principle can be employed to explore the topics of radicalization, gender, and Twitter as it “applies to a broad range of attitudes, feelings, and behaviors, and it applies to the spread of phenomena as diverse as political views” (Christakis & Fowler, 2011, p.28). First, it can provide insight into how influential a network based on female actors is through an analysis of the geodesic distances within that network. To illustrate, if the average distance between actors within the network is under three geodesics, this would indicate that female members of the milieu may be more successful in encouraging others to radicalize. Second, TDI provides the theoretical basis to comparatively examine which actors are more influential within the milieu, by evaluating centrality measures within the network.

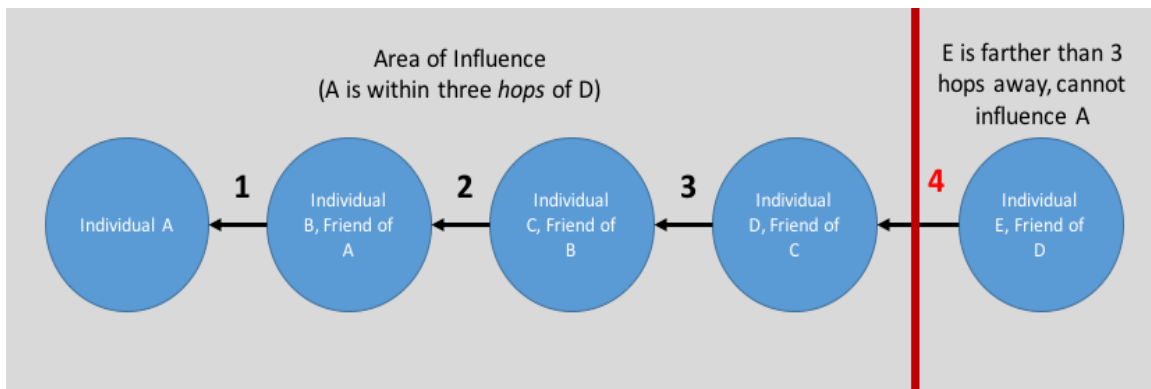


Figure 1 Three Degrees of Influence Theory (adapted from Christakis & Fowler, 2011)

2.4.3 Strength of Weak Ties Theory

The Strength of Weak Ties was developed by Mark Granovetter (1973). He contends that one’s social experiences are based on their relationships to the individuals that they frequently communicate with, which includes family, friends, and acquaintances. Friends and family are considered *strong ties*, whereas acquaintances are *weak ties*. When an individual interacts with their acquaintances, they are exposed to

their acquaintances' social networks (ibid) (see Figure 2). Acquaintances provide individuals with an opportunity to interact with others outside the handful of strong ties they have with friends and family and come into contact with new ways of thinking, beliefs, and ideologies. Removing these individuals from one's life would result in complete isolation outside of an immediate network of family and friends (ibid).

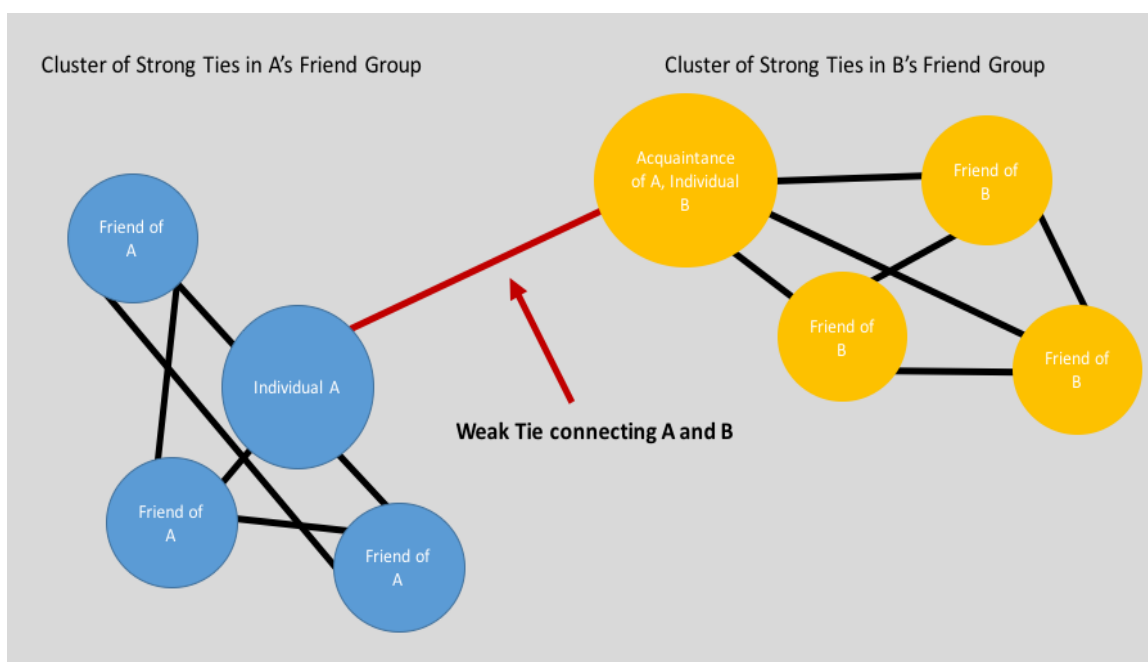


Figure 2: Strength of Weak Ties (Adapted from Granovetter, 1973)

Kennedy and Weimann (2011) posit that the Strength of Weak Ties theory is extremely important to the study of terrorism. The authors relate SWT to the decentralization of terrorist organizations, such as Al Qaeda, as there are more opportunities to foster weak ties with other groups of radical individuals (Kennedy & Weimann, 2011). Further, decentralization has coincided with the rise of the internet, causing a proliferation of these weak ties (ibid). Through weak ties, pro-jihadist supporters recruit others through processes of social bonding (ibid). Once a weak tie has

been established, the indoctrinated individual may adopt similar ideologies and behaviors, and the weak tie may develop into a stronger, more rigid tie (ibid).

Combined with Granovetter's (1973) initial theory, Kennedy and Weimann's (2011) logic provides a theoretical perspective for this study. SWT can be employed alongside SNA metrics such as reciprocity to determine the strength of ties within a given milieu. For the purposes of this thesis, if network analysis reveals that rates of reciprocity are relatively low among a network of female pro-IS supporters, it may indicate low tie strength in the network (Petroczi, Bazsó, & Nepusz, 2007). Considering Kennedy and Weimann's (2011) assertion, this would mean that pro-IS females have the potential to radicalize other individuals within a milieu. Conversely, if the group of female supporters has a high level of tie strength, this could indicate that members within the group have similar attitudes and behaviors, indicating that individuals' beliefs and opinions towards violence have been radicalized.

Chapter 3

3 Methodology

This chapter outlines the methods used in the analysis. It begins with a summary of the research questions, the sampling method, and the data collection process. Specifically, I review how influence, network distance, and tie strength were operationalized. I also outline the mathematical foundations for the corresponding SNA metrics and highlight some of the limitations of the SNA methodology. The chapter concludes with a summary of the ethical concerns that arose in the study, as well as an explanation of how I addressed them.

3.1 Research Questions

The goal of this study was to explore the network of pro-ISIS females on Twitter.

To do so, I addressed three research questions:

- R1.** How influential are pro-ISIS females, relative to their male counterparts (evaluated by betweenness centrality) on Twitter?
- R2.** What is the average geodesic distance (the number of hops between two nodes) of the female pro-ISIS network?
- R3.** How strong are the ties (the level of reciprocity) in the female pro-ISIS network on Twitter?

3.2 Sampling Method

To answer the three research questions, I collected a sample of twenty female pro-ISIS accounts ($n=20$) through purposive snowball sampling. I selected this sampling method because it has been shown to be a highly effective method for researching “hard-

to-reach” populations (Knoke & Yang, 2008, p. 18).²³ Perhaps for this reason, the snowball method is typically used to study radicalization on Twitter (Berger & Morgan, 2015; Berger & Perez, 2016; Berger & Strathearn, 2013; Carter et al, 2014; Huey & Peladeau, 2016; Klausen, 2014).²⁴ I determined that a sample of twenty accounts ($n=20$) would provide ample data to perform my analysis after two careful considerations. The first was that previous researchers – such as Berger and Strathearn (2013, p.3) – who studied the influence of online extremist networks have reported that only a relatively small number of accounts are influential and “highly engaged with extremist ideology” (Berger & Strathearn, 2013, p.3). In order to perform their analysis, Berger and Strathearn (2013) only used a sample of twelve seed accounts ($n=12$). By using a relatively similar sample size, I have ensured that this thesis aligns with commonly accepted methodological practices.²⁵ Second, through the use of data mining techniques

²³ Methodologically, pro-ISIS supporters are considered to be hard-to-reach as accounts are constantly suspended, deleted, and recreated (Wright, Denney, Pinkerton, Jansen, & Bryden, 2016).

²⁴ Within the literature, this method is referred to as selecting “seed accounts” (see Klausen, 2014)

²⁵ Berger and Strathearn’s (2013) study provided the basis for one of the most significant studies on ISIS: the ISIS Twitter Census (see Berger & Morgan, 2015). The methodology used in this paper was also based on the initial paper by Berger and Strathearn, as explained by the authors (Berger & Morgan, 2015). However, it is important to note that other studies do differ in terms of n size, as there is no consensus on what a reasonable sample size is when studying this type of population. For example, Klausen (2014) used a seed sample of 59 ($n=59$), while Carter et al. used a sample of 120 ($n=120$) accounts to study Western Foreign Fighters.

through NodeXL, a sample of twenty would import thousands of vertices and edges, providing a substantial amount of data points to address the three research questions.²⁶

3.2.1 Procedures for Data Collection

The purposive snowball sampling process included several six steps (See Figure 1). First, I used Twitter's search function to identify accounts that used hashtags or terms central to IS supporters. For example, I searched *#Baqiyah*, as the literature suggests this term is frequently used among this population to voice their support for ISIS (Amarasingham, 2015; Berger & Perez, 2016; Huey & Peladeau, 2016; Wright et al. 2016). Using the search function, I retrieved a list of accounts that discussed pro-IS topics. I selected *@Umm_GreenBird* as my starting point, as she appeared to be a central node within a pro-IS network, with several hundred followers and more than 1,000 tweets.²⁷ I then employed the snowball sampling method; I reviewed the account's follower and following lists and began to select users for the sample. I continued to review follower and following lists, selecting accounts until I had met my sample quota of twenty pro-IS female accounts.

²⁶ In fact, researchers have noted that one of the main issues in conducting SNA on data from social networking sites such as Twitter is that too much data exists for proper analysis (Ediger et al., 2010)

²⁷ *@Umm_GreenBird* is a pseudonym used in place of the actual account name. All account names mentioned in this thesis have been anonymized for ethical reasons outlined in section 3.6 of this chapter.

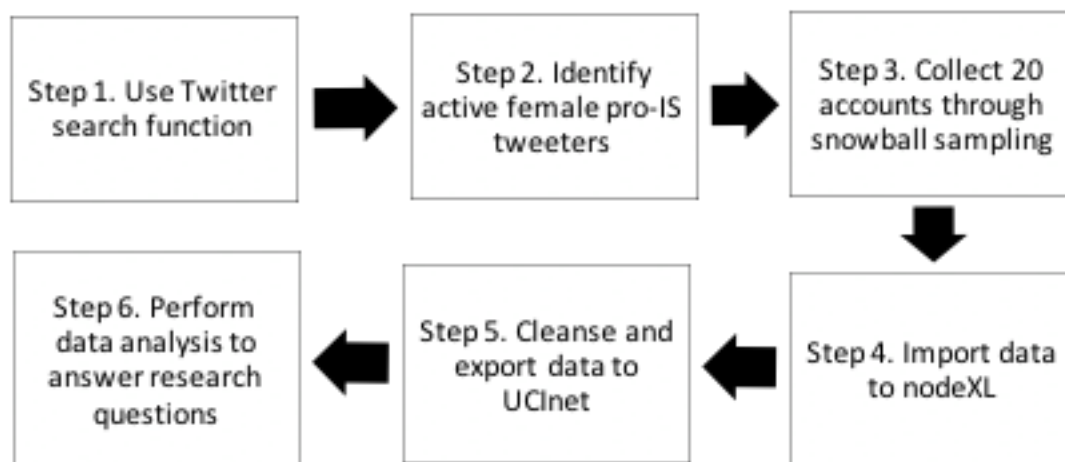


Figure 3. Procedures for Data Collection

To be considered eligible for inclusion in the sample, an account had to be unprotected and unsuspended as of August 9, 2016 (the date of data collection), post content indicating support for IS, have explicitly disclosed their gender on their profile, and predominantly tweet in English. Additionally, all members of the sample needed to have at least 61 followers and to have tweeted at least once since January 1, 2016.²⁸ These cut-off criteria were implemented to ensure that the sample reflected the active actors within pro-ISIS Twitter networks.

I employed coding practices based on existing literature in order to properly identify the gender and group supported by the user (see Appendix 2 for the coding guide). Coding for gender involved reviewing the Twitter account names or handles of

²⁸ 61 Twitter followers is the medium for active accounts (Bruner, 2013).

the sample. Gender was easily identifiable if an account included a *kunya* or *nasab* in the handle.²⁹ For example, as discussed in the literature review of this thesis, female accounts generally included honorific titles within their account names, such as *Umm* or *Bint* (Klausen 2015).³⁰ I also their profile pictures to discern gender. Female avatars also typically depicted women in burqas or kittens (see Appendix 3 for examples). To code for pro-IS support, I examined posting patterns and autobiographical descriptions (see Appendix 4-5 for examples). For example, supporters often posted pictures of the Tawheed, tweeted prayers for ISIS fighters or shout-outs to other IS supporters. They also frequently used ISIS-related hashtags, such as #IS, which were easily identifiable.

To verify my coding, I had a fellow graduate student who is familiar with online posting patterns of pro-ISIS females code the data. They made an independent decision as to whether the account holder fit the inclusion criteria for the study. As well, in certain occurrences where a ‘tweep’ used a language that was not English, I used Google Translate to translate the text into English, and instructed my research assistant to do so as well. In these cases, I coded based on the English version of the tweet.

3.3 Procedures for Analysis

The subsequent sections of this chapter detail the procedures I used to collect descriptive data and perform the analyses for the three research questions.

²⁹ The *kunya* and *nasab* are components of traditional Muslim names. Each term refers to whether the individual is a mother or father, and a son or daughter, respectively (Dawson, Amarasingam, & Bain, 2016).

³⁰ Mother or daughter (ibid).

3.3.1 Descriptive Data

The process of radicalization is based on one's relationships with other individuals within their ORM, so I explored the relationships and personal networks of the twenty female sample members ($n=20$). I used the NodeXL software to collect this data. I entered the list of sample accounts into the software and used the importer function to retrieve data on other accounts that engaged the users in the main sample, up to 2.0 levels away.³¹ I also restricted the import function to only retain the last 200 tweets of each user in the sample.³² In doing so, I accessed two types of information that would allow me to perform my analysis for my three research questions. First, the process returned a list of accounts (known as vertices), which have a relationship with an account in the main sample (that is, *who* interacted with a member of the sample). Second, I collected data on the relationships between these vertices, known as edges (specifically, whether someone in the sample was tweeted at, mentioned, replied to, followed someone else, or vice-versa). In order to analyze the data, I cleansed it set to ensure there were no duplicate edges or missing data. Finally, I used the visualization tool in NodeXL to create

³¹ This level imports an individual's immediate connections, or alters, and their subsequent alters and ties. By using the highest level possible on NodeXL, I ensure I capture a more accurate picture of the total breadth of the pro-IS network on Twitter.

³² Similar studies, such as Berger & Morgan's (2015) ISIS Twitter Census, typically analyze data only from a user's 200 most recent tweets. Twitter's Application Program Interface (API) is limited to 180 queries per fifteen minutes, making it difficult to extract over 200 tweets per user (Hansen, Schneiderman, & Smith, 2010).

a sociogram and used the Harel-Koren Fast Multiscale layout to present the relationships between the different nodes in the sample.³³

3.3.2 Research Question One

R1. How influential are pro-ISIS females relative to their male counterparts (evaluated by betweenness centrality) on Twitter?

The first step in addressing R1 was to identify the influencers in the female pro-ISIS network. Within the literature on social network analysis, Twitter and extremism, there is no agreement on how to measure influence. It is operationalized in a variety of ways, ranging from the amount of times an individual is mentioned or retweeted, to SNA centrality scores (Carter et al., 2014; Berger & Morgan, 2015; Berger & Strathearn, 2011; Klausen, 2014). For the purpose of this study, I operationalized influence as a node with a high normalized betweenness centrality score, relative to other nodes within the networks. Normalized betweenness centrality was the best metric to measure influence for this thesis for several reasons. First, this measure of centrality has been specifically identified as a means to identify influential actors that have many abilities, one of which is to control the movement of information within the network (Borgatti, 2004; Freeman, 1979, Gruzd, Wellman, & Takhteyev, 201; Newman, 2003). Evidently, this ability is critical in disseminating propaganda within the pro-ISIS milieu. Second, this measure bases influence on a calculation of the space between different actors within the network, complementing R2 (Wasserman & Faust, 1994).

³³ In studies that employ SNA, it is often up to the author to determine which layout to use as there is no precedent. I selected the Harel-Koren Layout as it is known to provide high quality visuals for large networks (Harel & Koren, 2001).

Within undirected networks, betweenness centrality is a measure of how often a certain node is on the shortest path between all vertices in a network (Wasserman & Faust, 1994).³⁴ Accounts which have a had a high centrality score are the nodes which information must pass through in order to reach other individuals (ibid). To calculate betweenness centralities, I first transformed the data into a nondirectional set using UCInet, as NodeXL imports directed data.³⁵ I then used Freeman’s (1978) model to calculate the betweenness centrality of each actor within UCInet:

$$C_B(n_i) = \sum_{j>k} g_{jk}(n_i) / g_{jk} \quad (1)$$

Freeman (1979) assumes that communication in the networks takes place over the shortest path between two actors, j and k , and all paths have an equal chance of being selected (Wasserman and Faust, 1994). Betweenness centrality calculates the sum of probabilities that actor i lies on the paths between actors j and k . Therefore, g_{jk} is the number of geodesics between the two actors, j and k . In turn, $g_{jk}(n_i)$ is “the number of geodesics lining the two actors that contain actor i ” (ibid, p.190). Finally, $g_{jk}(n_i) / g_{jk}$ is the probability that the path which contains i will be selected for communication. Equation 1 is normalized by dividing the centrality score by the number of vertices, excluding actor i :

³⁴ “Undirected” refers to data sets where the direction of ties is not relevant; rather, just the tie itself is important. Conversely, in directed networks much more attention is paid to the direction of ties. For example, if @janedoe follows @johndoe, or *vice-versa*.

³⁵ It is common to undirect data when analyzing centrality measures such as betweenness in directed networks (Ediger et al., 2010)

$$C'_B(n_i) = C_B(n_i)/[(g - 1)(g - 2)/2] \quad (2)$$

The normalized equation turns raw centrality scores into values that can only lie in the range of [0,1] (ibid).³⁶ If actor *i* had a high normalized betweenness centrality, they lay on more frequently travelled paths (ibid). Conversely, if actor *i* had a low score, they lay on paths that are less frequently travelled (ibid).

This research question also considered how influential female pro-IS Twitter users are in comparison with their male counterparts. To do so, I created a spreadsheet of all nodes and their corresponding normalized centralities after running the betweenness function in UCInet. I ranked the nodes from highest to lowest centralities. My analysis was performed on the top fifty accounts.³⁷ I reviewed each account individually in this list ensuring that I would be able to analyze specific variables including gender and posting patterns, as NodeXL does not import certain demographic information. If I could not obtain this information about an account by manually importing it, the account was dropped from the analytic sample for this question, and the account with the next lowest rank was moved up. Finally, I calculated the proportion of males and females among the fifty most influential accounts to determine who had more influence within the network.

³⁶ The definition of normalization, in the context of this chapter, differs from the definition of normalization explained in the literature review. Here, normalization strictly refers to the quantitative procedure which allows for comparing the betweenness centralities of different actors.

³⁷ In Berger & Strathearn's (2013) study on Twitter and extremism, they focused their analysis on the top ten and top fifty most popular accounts, as there are typically only a small handful of central actors within the networks. I opted to analyze the same number of actors to prevent observing Twitter users that were not influential and did not impact radicalization.

3.3.3 Research Question Two

R2. What is the average geodesic distance (the number of hops between two nodes) of the female pro-ISIS network?

This question complements R1, as network distance impacts the way influence is disseminated in social networks (Christakis & Fowler, 2011). Wasserman and Faust (1994) explained that the measure is useful when evaluating the transmission of messages. If the length of a geodesic (the shortest distance between two individuals in a network) is relatively short, information would travel through the network quickly, since messages usually take the shortest route in networks (ibid). For this study, network distance is a valuable insight, as it can indicate how quickly information can travel through the network, and also whether other members of the network are within three hops of influential female actors. I found the average network distances of all four networks at large by using running the overall metrics for the network in NodeXL. The equation to find these distances is (Oliveira & Gama, 2012):

$$l = \frac{1}{\frac{1}{2} n(n-1)} \sum_{i \geq j} d(i, j) \quad (3)$$

Equation 3 is the “[t]he average geodesic distance for all combinations of vertex pairs in a network” (ibid, N.p.). In the equation, $d(i, j)$ represents the geodesic distance between the two nodes, i and j (Wasserman & Faust, 1994). The denominator, $\frac{1}{2} n(n-1)$, is the maximum amount of edges in the network, which has n nodes (Oliveira & Gamma, 2012).

3.3.4 Research Question Three

R3. How strong are the ties (the level of reciprocity) in the female pro-ISIS network on Twitter?

Tie strength has proven to be one of the most popular and insightful metrics of network science, revealing whether a network's structure is composed of rigid relationships or weak acquaintances (Gilbert & Karahalios, 2009). As explained by Kennedy and Weimann (2011), tie strength is extremely useful for studying the recruitment and radicalization patterns of terrorist groups online because varying levels of strength correspond with different outcomes. For example, weak ties may indicate a group in which extremist ideologies are not as pronounced in their infancy, but there is room for radicalization to occur (ibid). Conversely, strong ties may indicate that a group is radicalized and shares extremist ideology (ibid). Evaluating the tie strength of a network will allow me to discern whether the pro-IS female Twitter network poses a threat for radicalizing others.

Theoretically, tie strength can be evaluated by analyzing the intensity, intimacy, and reciprocity of a relationship (Granovetter, 1973). On a practical level, it is impossible to evaluate all of these dimensions of strength on Twitter, as the platform is public, and therefore intimacy and intensity may be non-existent (Takhteyev, Gruzd, Wellman, 2012). Reciprocity proves to be an exception, as mutuality can be evaluated more easily by accounting for dyads (a couple of accounts) that either follow, retweet, reply to, or mention each other. Therefore, I operationalize tie strength as the reciprocity of a dyadic relationship (i.e. if one account has an outgoing relationship to another account, which has a returning connection), measured by NodeXL as the ratio of reciprocated ties within the network, as shown in Equation 4 (Oliveria & Gama, 2012):

$$r = \frac{\# mut}{\#mut + \#asym} \quad (4)$$

This proportional measure divides the number of mutual dyads (again, the number of vertices that have both an incoming and outgoing connection) over the number of all possible dyads, which accounts for asymmetric dyads, in which one account may not retweet, reply, follow, or mention accounts despite the other doing so (Wasserman & Faust, 1994).

3.4 Limitations of the Social Network Analysis Method

The SNA method has two important limitations. First, SNA focuses on the structure of networks and not the contextual factors that may impact actor agency within the network, such as specific drivers to radicalization (Borgatti, Brass, & Halgin, 2014; Scott, 2000). I addressed this limitation by accounting for specific demographic characteristics (gender and group support) in my sampling process. Further, I discuss my data in relation to two theories: Three Degrees of Influence (TDI) and Strength of Weak Ties (SWT). By incorporating these theories into the analysis, I attempt to account for external information and minimize the extent of the limitation (Wölfer, Faber, & Hewstone, 2015).

There are other possible solutions that can be employed in future studies to develop a greater understanding of context. For example, Scott (2010) explains that researchers can apply mixed-methods to observe social networks. For research on Twitter and radicalization, scholars may consider combining analyses of networks with an analysis of the content of tweets by using qualitative methods or sentiment analysis.

The second issue with SNA studies is related to boundary issues (Wolfer et al., 2015). As Wolfer et al. (2015, p. 57-58) explain:

In contrast to conventional sampling procedures, individuals in social networks are not sampled independently, but result from and are exposed to the interdependencies within a certain network boundary.

Therefore, researchers must pay particular attention to the boundaries they set at the onset of their studies (Laumann, Marsden, & Prensky, 1983). Specifically, researchers must decide how large or small of a network to sample. This issue is particularly prominent in SNA studies using Twitter data, as researchers are limited by the amount of relationships they can import; the Twitter Application Program Interface (API) restricts abilities to sample extensive networks easily³⁸. To address this limitation, I selected a network boundary definition (sampling the networks of twenty females, with the API import function limited to the 200 most recent tweets) that was based on existing standards.

3.5 Ethical Considerations

This study passed ethical approval by the Research Ethics Board (REB) at the University of Western Ontario on December 5, 2014 (see Appendix 6). Mining social networking sites is a relatively new way of studying social phenomena, and as a result, researchers have identified a number of issues regarding the appropriateness of using these sites' data for research. For example, a central question in the literature is whether or not data on social media is truly public (Boyd & Crawford, 2012; McCay-Peet & Quan-Haase, 2016). Quan-Haase and McCay-Peet (2016) also question the issue of

³⁸ The API has a 180 inquiry within fifteen-minute rating, meaning that there are technical limitations preventing one from reaching an extensive network boundary in a relatively short period of time (Hansen et al., 2010)

boundary specification in relation to ethics and address whether or not relational data (such as likes and follows) are fair play for data analysis within social media research.

Specific ethical procedures were taken to ensure this thesis addressed the ethical concerns mentioned. Names of account holders, Twitter handles, and time stamps were altered in this thesis, as this is considered an appropriate low-risk way to prevent ethical breaches (Sloan & Quan-Haase, 2016). I also ensured that all information and analysis on accounts was kept on a password-protected computer and encrypted hard drive. Finally, to be eligible for inclusion within the sample, accounts had to be unprotected. Twitter users have the opportunity to select certain privacy settings, and by opting to be unprotected, they acknowledge that any information they post on the website is visible to the world. As a result, there was no need to gain consent from these users to include their accounts as part of the sample.

Chapter 4

4 Results

This chapter reviews the results of the study. The first section details the descriptive data reported in Table 1 and presents an analysis of the sociogram depicting the female pro-IS network (Figure 1). The second section of this chapter addresses the three research questions. The findings for the first research question, presented in Table 2, indicate that females within the sample are more influential than males. Results for the second research question, which considers the average geodesic distance of the network, are presented in Table 3 and show that it takes a total of 3.6 hops for information to travel through the network. The chapter concludes with the findings of the third research question; an analysis of the sample network's reciprocity values, found in Table 4, shows that only 36.8 percent of ties between users reciprocated.

4.1 Descriptive Data

Table 1 reports descriptive data for the sample female pro-IS network. A total of 5,861 vertices, or Twitter accounts, were imported using NodeXL. Among these accounts, there were a total of 12,034 edges, which consist of a combined sum of 12,034 retweets, follows, mentions, and replies within the network. A unique edge is an instance where one user mentions another account only once. Of all edges in the network, 80.10% ($n=9,640$) were unique. Edges were duplicated, or considered not unique, in 19.90% ($n=2,394$) of the network. This value reports there was a repetition in an interaction between two nodes of the network in almost 20% of the sample. Using the example mentioned above, a duplicate edge is an instance where one user may have tweeted at another user within the network multiple times. Self-loops – where an edge from one

node leads back to itself, such as when a user tweets at him or herself – made up 11.44% ($n=1,377$) of the total 12,034 relationships in the sample.

Table 1. Descriptive Data

Graph Metric	Value
Vertices	
Total Vertices (n)	5,861
Edges	
Unique Edges (n)	9,640
Edges with Duplicates (n)	2,394
Total Edges (n)	12,034
Self-Loops (n)	1,377
Cohesion	
Connected Components (n)	1
Single-Vertex Connected Components (n)	0
Maximum Vertices in a Connected Component (n)	5,861
Maximum Edges in a Connected Component (n)	12,034
Density (p)	0.0003

Table 1 also shows data regarding the cohesion of the network. All nodes within this network are connected in some way, as there is only one connected component (comprising the 5,861 vertices and 12,034 edges) and zero single vertex components. This result was expected, as when using snowball or seed sampling, NodeXL only imports individuals that are connected to the starter nodes in some way. Density, or the proportion of actual relationships over all possible connections, is another metric reported in Table 1. Density is relatively low in the pro-IS female network, as only 0.0003% of the network comprises actual edges. Therefore, despite the fact that on an aggregate level, the network is completely connected, the users within the network do not all interact with each other.

Figure 3 displays the data presented in Table 1. Twitter logo icons within the figure represent the initial accounts used for snowball sampling. As shown by the

sociogram in Figure 3, the majority of accounts in the sample fall within the center of the graph among other nodes, as they are more central or influential, in the network. They interact with each other on a higher basis, meaning their number of retweets, mentions and follows are higher relative to others within the graph. However, there are hundreds of accounts that drift towards the peripheries of the sociogram. These accounts are less central and have a more distant connection to other members of the network. They may only mention or reply to one central node that is more connected to others within the network.

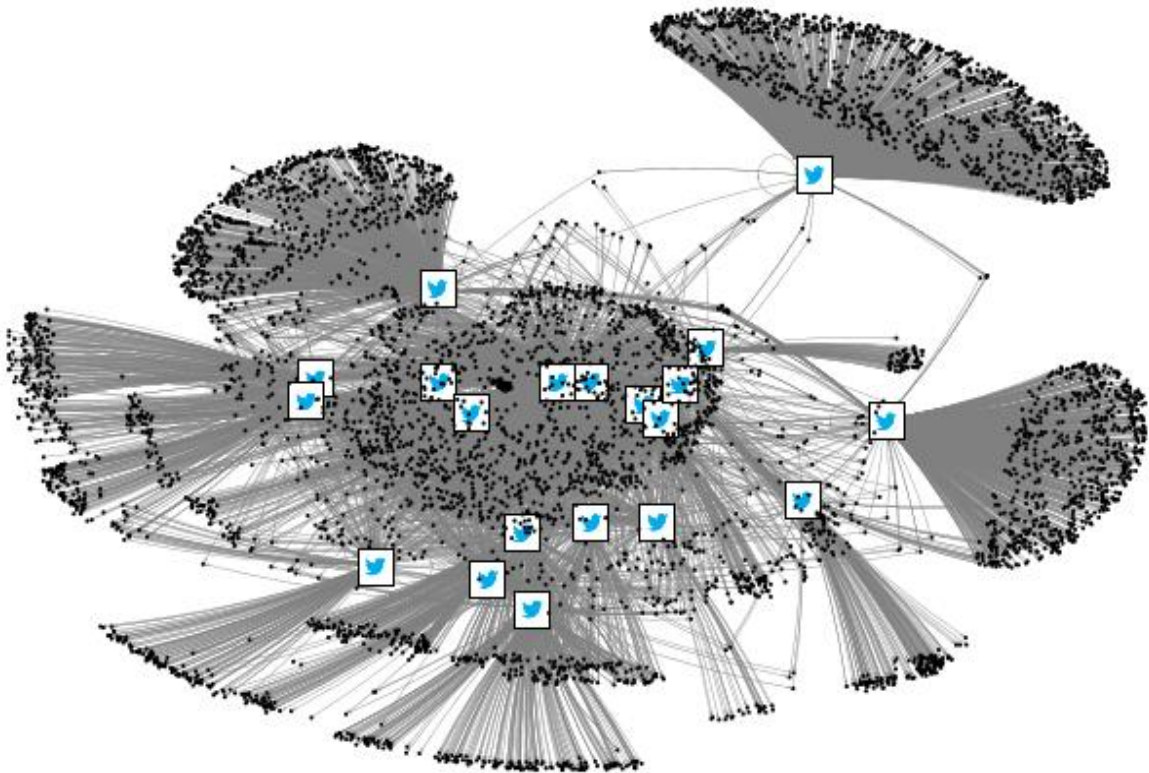


Figure 3. Harel-Koren Layout of the Sample Pro-IS Female Network

The sample includes a handful of hubs, which are “highly connected users” (Smith, Rainie, Shneiderman, Himelboim, 2014, N.p.) (see Appendix 7). These accounts represent individuals who are at the center of small communities within the network. The users around them are considered their spokes. There are a few different types of hub and spoke models. Broadcast networks occur when the spokes may retweet the main hub but do not tweet at each other (ibid). In this case, information flows towards the hub and away from the spokes. Conversely, in a support network, the hub directs ties towards its spokes, and as a result, ties are in the opposite direction of those in a broadcast network (ibid). It is important to note that within this pro-IS network, the hubs share qualities of both-inbound and outbound networks. For example, as with a broadcast hub, users in these hub and spoke communities do not necessarily communicate with each other. Rather, they seem to consume propaganda directly from the closest influential actor they are linked to, avoiding the other people in their community. However, in certain cases, the hub mimics support behaviors, as it may retweet or mention the spokes.

There are a significant number of bridges within the network (see Appendix 8). Bridges are accounts that do not necessarily have many connections within the female pro-IS network; they only retweet, follow, or mention a small number of other accounts. Yet, they play a critical role in disseminating propaganda within the network, as they connect “otherwise disconnected groups” (Smith et al., n.p.). These actors are especially important within this female pro-IS network, since density is low and connections are not as cohesive as they could be. As a result, these bridge actors have a higher centrality score relative to other members of the network.

4.2 Research Question Results

4.2.1 Research Question One

Table 2 shows the results for the proportion of males and females in the top fifty accounts with the highest influence, as ranked by the normalized betweenness centrality score ($n_{\text{Betweenness}}$). Within the top fifty most influential accounts within the pro-IS sample, it appears that females are represented more than their male counterparts, making up 62% of the list versus 38% for males. These proportions indicate that most accounts get their information primarily from female users. Thus, female users are more influential within the network. As the hubs and bridges that ensure the sub communities stay informed on topics by posting propaganda or other tweets on their profiles, it appears that female users are the knowledge brokers of the network. Without these 31 female accounts in the sample, the network would be largely disconnected, and information would not be able to effectively flow to other accounts. In other words, accounts have to receive tweets from female accounts to stay informed. Conversely, if a user wants to pass information on to others within the network, that user must go through a female actor who can broadcast it for them.

Table 2 also shows some critical information on the spread of the $n_{\text{Betweenness}}$ values. For the minority group, males, the mean was relatively similar to the standard deviation (1.75 and 1.73, respectively). The range of these values was 6.71, with a minimum of 0.41 and a maximum of 6.58. These values indicate that the males in the top fifty were consistently uninfluential. As a result, members of the sample network would not turn to these male users for information and would not tweet, mention, reply to, or follow them. Conversely, for the females represented in the top fifty, data was extremely

widespread. To illustrate, the 31 females had an average *nBetweenness* value of 6.62, with a standard deviation of 10.10. The range of values was 36.91, with a minimum of 40 and a maximum of 37.31. The large spread and high standard deviation, relative to the mean, shows that while females may be more represented within the upper echelon of the network, their values are not consistently high. Accordingly, while other individuals in the network may be more directly connected to these females, they are not necessarily following, retweeting, and mentioning them at a consistent rate. Rather, there are certain females that are constantly in communication with those around them and a high proportion of females that are not as communicative.

Table 2. Descriptive Table for Top 50 Accounts Ranked by *nBetweenness*.

Variable	Frequency (<i>n</i>)	Percentage (%)	Mean	Standard Deviation	Minimum Value	Maximum Value
Gender						
Male	19	38	1.75	1.73	.41	6.58
Female	31	62	6.62	10.10	.40	37.31
Total	50	100	4.77	8.32	.40	37.31

4.2.2 Research Question Two

Table 3 details the average and maximum geodesic distances for the sample network.³⁹ This table indicates that the average shortest distance between all accounts in the networks is 3.6 hops. Therefore, in order for users to share content with other users throughout the network, they must cross over a handful of other individuals to do so. This pattern indicates that nodes do not necessarily communicate directly with each other (if

³⁹ Additional analyses using the UCInet software, showed different results: The average geodesic distance was 4.4, with a standard deviation of 1.5. However, 48.80% of ties were excluded from the calculation. There is no way to check UCInet or nodeXL's backend codes to explain these differences.

this were the case, the average distance would be one geodesic). In addition to this lack of communication between nodes, there are several other factors restricting the channels of communication within the network, thus severely impacting average geodesic distance. First, users must frequently go through bridges or spokes to communicate with others. In addition, network density is relatively low, so members of the sample have to rely on communicating through the handful of individuals with a high proportion of betweenness centrality, which also impacts the average network distance.

Table 3 also shows that the maximum value for the shortest path length between two accounts within the network is 6 hops. For a user to pass information from one end of the network to the other, they must pass through 6 other users. Looking at the average in relation to this value provides an interesting picture of the female pro-IS network; the diameter is only 2.4 hops larger than the average distance. Thus, the nodes in the network are not situated close together relative to the total breadth of the network.

Table 3. Geodesic Distance Results

Metric	Average	Maximum
Geodesic Distance	3.6	6

4.2.3 Research Question Three

The results for tie strength are listed in Table 4. On Twitter, accounts can engage in reciprocal behaviors by following, tweeting, or re-tweeting one another. Within the network, 36.80% of ties (with the exception of self-loops and duplicated edges) were reciprocated. Complementing this percentage, 63.20% of ties (also with the exception of self-loops and duplicated edges) were not reciprocated. These percentages indicate that the network is not symmetric, or bi-directional; within the female pro-IS network, the

majority of users do not converse back-and-forth with each other. A user may tweet another user within the network, but the likelihood that they will receive a response from that user is small. In technical terms, the proportion of asymmetrical edges (one-way relationships), combined with the number of symmetrical edges (two-way relationships) outweigh the sum of the symmetrical edges. In this sense, most members of this sample are lone wolves and their online interactions are typically shaped by solitary experiences. This value can also be interpreted as the relationships being unequal, as on average, one individual is often reach out to others with no response. However, the fairly small percentage of reciprocity does suggest that in certain instances, accounts in the network are inclined to respond to those within their online community.

Table 4. Tie Strength Results

Metric	Frequency (<i>n</i>)	Percentage (%)
Reciprocity		
Reciprocated Edges	3041	36.80
Unreciprocated Edges	5222	63.20
Total Edges	8263	100.00

Note: Percentages were rounded to two decimal places.

Chapter 5

5 Discussion

The purpose of this chapter is to interpret the findings of the study. The first section explains how females within the sample were more influential, compared to their male counterparts. The second section examines the high average geodesic distance result. This result shows that, while certain users within the sample network acted as key influencers, the network was not influential on an aggregate level; however, I caution against ignoring the population because of this result. The third section explains that individuals within the female pro-ISIS sample network were susceptible to radicalization due to the low level of reciprocated ties between different users. The chapter concludes by discussing the study's implications for public safety officials, Twitter, and other scholars, as well as the study's limitations. I also present some considerations for future research.

5.1 Research Question One

R1. How influential are pro-ISIS females, relative to their male counterparts (evaluated by betweenness centrality) on Twitter?

This study found that among the top 50 most influential accounts (ranked by Freeman's normalized betweenness centrality scores), there were 31 accounts held by females and 19 accounts held by males. There are two main lessons from these results. First, females were more influential than males within the sample, since they were often at the center of the ties within the network and were the hubs and bridges holding the network together. This result aligns with previous studies that have found female accounts to be disseminators—users that position radical attitudes as normal— or even

‘cool’—by posting pro-IS propaganda (Huey, 2015; Klausen, 2014; Picart, 2015). Accordingly, female users within pro-jihadist social media networks have unique opportunities to determine what information other individuals in the ORM are exposed to, and help establish a strong in-group mentality or *ummah consciousness*. As a result, these influencers can radicalize other females within their respective social media networks.

Second, the results of R1 indicate that male and female networks are separate on Twitter. Female users control the information in the female pro-IS network. This finding supports existing literature, which observes that males and females are segregated in pro-jihadist terrorist networks, both on and offline (Sageman, 2008). For example, women such as Shamima Begum were active within their own communities, or *umm network*, tweeting at other popular “sisters,” like Aqsa Mahmood (Klausen, 2014; Liang, 2014). Conversely, in male Western Foreign Fighter networks on Twitter, male users, such as Anjem Choudhry or Ahmad Musa Jibril, were more popular (Klausen, 2014; Carter et al. 2015; Chatfield et al. 2014). Scholars point to Salafist principles as a contributing factor for the division, since women and men typically support terrorism differently within the pro-IS Twitter ORMs. To illustrate, women may provide emotional support by praying or making *duas* for males engaged in martyrdom operations on Twitter (Huey & Peladeau, 2016). Conversely, their male counterparts engage in overt calls for violence and tweet directly from the frontlines (Klausen, 2014).

5.2 Research Question Two

R2. What is the average geodesic distance (the number of hops between two nodes) of the female pro-ISIS network?

The average geodesic distance result for the sample female pro-IS network was 3.6 hops, whereas the diameter, or maximum, was 6. Revisiting the Three Degrees of Influence Theory (TDI) initially discussed in Chapter 2, an individual is only influential to those around them if they are within three hops of the influencer (see Figure 1). Considering this theory, the results of the social network analysis suggest that the female pro-IS network was not influential as a whole since, on average, individuals had to cross the three-hop threshold to transmit information or send propaganda to others in the network. However, it is important to keep in mind that within the network, females were more influential than males, as discussed in Section 5.1. Together, these two results show that within the female pro-IS Twitter network there were certain females who were highly influential despite the network not being influential as a whole. This finding is valuable because it suggests that the majority of females within these networks are not well-versed in the art of radicalizing other women on social media like Mahmood. Nonetheless, high geodesic distance does not warrant ignoring the female pro-IS population on Twitter or making claims they do not play a part in the process of radicalizing other women, for two reasons. First, women who tweet radical propaganda – regardless of how far apart they are in social space – still contribute to an in-group mentality that normalizes attitudes in favor of pro-jihadist terrorism; they may not be an overt threat, but do sustain their respective milieu (Huey & Peladeau, 2016). Despite the fact that many users within this network are not influential, closely examining the female pro-IS network can help investigators determine which key nodes have the potential to radicalize other users. Second, the network's high geodesic distance makes it relatively difficult to dismantle and unresponsive to attempts to take it off the web (Morselli,

Giguère, & Petit, 2007). Morselli et al. (2007) explain that within extremist networks (e.g. The group responsible for the September 11, 2001 attack on the World Trade Centre), greater geodesic distance is fairly common (ibid). In fact, a high average geodesic distance ensures a level of security and protection for network members, as the network is spread out and individuals are not in close reach of each other. As a result, it takes investigators a significant amount of time to identify each member of the network and determine how they all connect to one another. Other researchers have identified that, on Twitter, account suspensions are the method of choice to combat the pro-IS ORM; however, these attempts lead to a whack-a-mole problem, in which accounts continue to pop back up and gain more of a following (Berger & Perez, 2016; Wright et al., 2016). An echo chamber of pro-IS messages is created, as ‘tweeps’ feel they are being attacked, further reinforcing these users’ sense of in-group solidarity (Berger & Morgan, 2015). Thus, the high geodesic distance, may actually give female pro-IS networks an advantage in terms sustaining the milieu, since they are spread out. In this sense, the TDI theory may not be wholly applicable to networks of pro-ISIS supporters, since it does not account for the strategic purposes of being more distant in social space.

5.3 Research Question Three

R3. How strong are the ties (the level of reciprocity) in the female pro-ISIS network on Twitter?

The fact that 36.8% (a minority) of ties within the sample network were reciprocated signifies that accounts mainly tweeted, replied to or mentioned other accounts without receiving responses by the accounts with which they were attempting to make contact. Consequently, this network has a low level of tie strength. Kennedy and Weimann’s (2011) elaboration on Granovetter’s (1973) Strength of Weak Ties (SWT)

theory provides more context for this result. Weak ties are thought to increase the level of social solidarity or macro social integration (ibid). If the sample female pro-IS network had strong ties, there would be strongly connected components, indicating ideological similarity (ibid). The network's low tie strength, however, suggests that users in the network did not necessarily have total ideological similarity, or the same attitudes towards ISIS. Low tie strength could be attributed to the fact that Twitter networks of pro-IS users contain a variety of different groups of accounts (Chatfield et al., 2015). For example, a recruiter may follow a variety of IS supporters also in addition to news media or other individuals with varying levels of support for terrorism (ibid). Additionally, some Twitter supporters of IS have been known to alter their opinions or beliefs over the course of their involvement, thus showing a complex history and variety of content posts—so any given user may have a network comprising a variety of opinions and beliefs (Hoyle et al., 2015). The low level of tie strength also relates to the structure of the pro-IS ORM, as there are many bridges within weak-tie communities (Kennedy & Weimann, 2011). Bridge accounts, or accounts that connect two groups who might otherwise be unconnected, ensure that members of the network are still able to access information regarding ISIS even if they are not deeply entrenched within the network. As a result, key female IS players can strategically use their positions as influencers or bridges to entice other female users to support the Salafist ideology and encourage pro-jihadist terrorism through ensuring their online posts appeal to this group. Precisely for this reason—because it is held together by weak ties—the female pro-IS ORM still has room to grow and develop traction on Twitter.

5.4 Implications of the Study

The results of this thesis can contribute to discussions surrounding the need for policy changes to address female pro-jihadist radicalization.⁴⁰ Current counter-radicalization efforts have been largely focused on pro-jihadist men. In Canada, strategies to counter violent pro-jihadist extremism target male Western Foreign Fighters (Canadian Security Intelligence Service, 2016) . Public Safety Canada (2016) has only recently begun to view women within these groups as an “emerging threat” because several hundred have migrated to ISIS-held territory to marry (Canadian Security Intelligence Service, 2016; Public Safety Canada, 2016). In the UK, counter-radicalization efforts are also centered around males. For example, 90% of referrals for the Prevent Program were male (Vidino & Brandon, 2012).⁴¹ Evidently, a policy blind spot has developed around female contributors to pro-jihadist terrorism, and a better understanding of female posters within these networks has become necessary.

The findings of this thesis can contribute to an appropriate policy shift in two particular ways. First, the knowledge that pro-jihadist females do have the ability to

⁴⁰ It is important to note that the recommendations posed in the section are limited by the sampling methods used to execute this study (amongst other factors noted in the following section). Accordingly, these implications may not be generalized.

⁴¹ The Channel Programme is “a multi-agency approach to identify and provide support to individuals who are at risk of being drawn into terrorism” (HM Government, 2015, p. 3). It is part of the broader Prevent program, which is “the counter-terrorist programme which aims to stop people being drawn into terrorist-related activity” (HM Government, 2011, p. 11).

radicalize other females on Twitter could be used in building training sessions to equip public safety officials with a more nuanced understanding of the unique ways in which pro-jihadist females support terrorist groups, like ISIS, on social media. In fact, more rigorous training of public safety officials has been viewed as a critical element in furthering counter-radicalization efforts (Vidino & Brandon, 2012). With training that accounts for the theme of female pro-jihadist supporters, investigators could become more effective at identifying individuals—both male and female—who currently support ISIS or are in the process of radicalizing. This training must stress the need to understand topics discussed by female pro-IS supporters. For example, officials should be educated on Salafist-related propaganda or discussions of the ummah consciousness. As a result, they can effectively investigate individuals who are posting propaganda touching on these themes. The consequences of not incorporating these elements into training could lead to an increased policy blind spot and contribute to Islamophobia as individuals could be mischaracterized as being radical, or radicalizing others, when they are not.

Second, public safety officials can create programs specific to women and girls who may be on the fringes of radicalizing and expose them to counter-narratives to break away from ummah consciousness (Hoyle et al., 2015; Saltman & Smith, 2015). Again, these approaches should be tailored to females who have online connections (or weak ties) to other known pro-jihadist supporters or those female who are posting radical propaganda online. In doing so, it ensures that the programs specifically address the issue of pro-ISIS radicalization, and prevent mischaracterizing females who may be discussing their religion online. An example of such a program could be working with educators in

high schools and post-secondary educational institutions to help promote a critical awareness of online media (Neumann & Stevens, 2012; Saltman & Smith, 2015).

The second recommendation of this thesis is directed to social media companies such as Twitter. Currently, Twitter (2016b) does not hesitate to suspend pro-jihadist terrorist accounts, explaining that 360,000 accounts have been suspended since mid-2015 “for threatening or promoting terrorist acts, primarily related to ISIS.” Twitter’s strategy focuses on responding to reported accounts and “leverag[ing] proprietary spam-fighting tools to surface other potentially violating accounts for review by our agents” (Twitter, 2016b, N.p); however, as noted within previous sections of this thesis, this approach is not working, despite claims of efficacy (Berger & Perez, 2016; Wright et al., 2016; Twitter, 2016b). The reactive approach only works to fuel the *ummah* consciousness. Due to the relatively high geodesic distances found within networks of pro-IS females, Twitter must proactively target key accounts, such as females with high nBetweenness Scores, in order to effectively dismantle these networks. Further, in part due to the low level of tie strength, a more effective approach would be for officials to target bridge accounts and eliminate the networks’ primary information brokers. Twitter can achieve this result through several different ways. For example, data scientists can help build out Twitter’s spam-detecting algorithms to identify specific female pro-jihadist supporters, and act accordingly.⁴² Alternatively, as Hoyle et al (2015) suggest, targeted advertising of counter-narratives can be used online to discourage females from radicalizing. Twitter

⁴² Twitter (2016, N.p.) notes, “there is no one ‘magic algorithm’ for identifying terrorist content on the Internet.”

could use their spam algorithm to tailor home pages of potentially vulnerable females to stop them from following or messaging other radicalized females. It bears repeating that these efforts must be informed and ethical so they do not violate an individual's freedom to express themselves. In the same fashion as the implications for public safety officials, Twitter must take an educated approach to takedowns, ensuring that their suspensions are not purely based around labelling someone as a threat because of their social positioning. Rather, Twitter must account for the tweets posted when considering suspending a user, to ensure that they are in fact tweeting radical propaganda which can radicalize others.

The final recommendation is for public safety officials, social media organizations, and researchers alike. This study has shown that SNA can be used effectively to explore online pro-jihadist terrorist networks. These individuals should continue to examine the topics of gender, radicalization, and social media, using SNA so that scholarly work can inform policies and practices. To illustrate, scholars can help identify key indicators of radicalization for females, such as networks that include pro-jihadist females with low tie strength, to help Twitter—and potentially other social media sites—account for this in their spam-detecting algorithms. Similarly, public safety organizations can use this information to identify individuals that need to be de-radicalized; they can use this data to find these hard-to-reach individuals and direct informed offline investigations.

5.5 Limitations & Future Studies

There are several limitations to this study related to sampling design and data collection, which may have skewed the results of this study (see Section 3.4 for

limitations specific to the SNA method). Further, these limitations restrict the implications in this thesis, as the results cannot be generalized.

To start, the sample for this study was collected using snowball sampling during a relatively short period of time, so the results only pertain to a small amount of female pro-IS supporters who were active on August 9th, 2016. Future studies may examine alternative methods of data collection which could allow for stronger inferences. For example, a researcher can perform a longitudinal study in order to examine how the influence of females within the pro-IS network changes over time or in response to a particular event.

This study was also limited by the available data on gender and group support on Twitter, as there was no way to confirm whether a tweet had actually been generated by a single female account holder. Potentially multiple individuals or males posing as females could use fake female accounts to tweet propaganda. This issue is particularly relevant to supporters of ISIS, as the organization's mobile application, *The Dawn of Glad Tidings*, can post automatically for its subscribers (J. Berger & Morgan, 2015; Farwell, 2014; Glavin, 2015). It was also difficult to verify whether a user in the sample actually supported IS offline. For example, Huey and Kalyal (2015) explain that, in some instances, other researchers or public safety officials might be active on Twitter, posing as extremist supporters. Moving forward, researchers may turn to using sentiment analysis to detect patterns in tweets and parse out whether or not they are unique to the account holders, and make more informed decisions on coding group support (see Ghajar-Khosravi, Kwantes, Derbentseva & Huey, 2016). In turn, this method would help strengthen sample representativeness of the female pro-IS population on Twitter.

Language barriers also proved to be a limitation for this thesis during the coding process. Individuals who support IS frequently tweeted or retweeted their messages of support in Arabic. I am a native English speaker, so I had to rely on Google Translate to convert the tweets into English before coding them; however, I had no way of ensuring that the translations were accurate. This issue was particularly prevalent when tweeters used idioms or slang terms. As a result, I tended to select accounts that used more visual displays of support (e.g. posting images of the IS flag) or used English as their primary language to ensure I did not include a non-IS supporter in my sample. Researchers who continue to examine pro-IS supporters' activity on Twitter should employ translators or trained Arabic linguists in order to ensure they have an accurate understanding of a user's Arabic tweets.⁴³

A further consideration is expanding the metrics used to analyze female pro-IS supporters on Twitter. This study analyzed the sample network using three common SNA metrics; however, there are many other metrics that can be employed to explore Twitter networks. In subsequent studies, researchers could consider performing more work on the micro level to identify specific influential actors and their sub-communities. For example, Borgatti (2006) created an algorithm to detect "key players" in networks, which could be employed to provide a clearer view of influencers within the network. The information gained by using this algorithm could help researchers gain a more accurate understanding of key radicalizers within networks. Further, it could be used by investigators to

⁴³ Twitter (2016) has also noted that they have made investments into the language capabilities of the platform in order to more accurately detect pro-jihadist users.

determine which individuals they must intervene with to prevent the radicalization of other women.

5.6 Concluding Remarks

The purpose of this study was to explore the network of female pro-IS supporters on Twitter using social network analysis. To do so, the study analyzed the 5,861 vertices and 12,034 edges based on a sample of twenty accounts. The results of the study showed that within the pro-IS female network, female users were more influential and had a greater ability to radicalize other females. The study also showed that the social distance between accounts in the network was more than three geodesics, indicating that not all pro-IS females within the network were influential. Accordingly, researchers, social media organizations, and public safety officials must pay close attention to the relatively small amount of hyper-influential pro-IS females within networks. Finally, this study also identified that the female pro-IS network has a low level of tie strength and, as a result, there was a significant opportunity for key influential female ISIS supporters to encourage other females to radicalize.

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Appendices

Appendix 1. The Tawheed



Appendix 2. Coding Guide

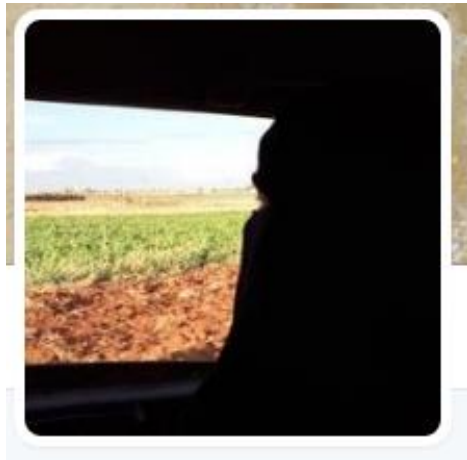
DEMOGRAPHIC INFORMATION	
USERNAME	
HANDLE	
FOLLOWERS	
FOLLOWING	
NUMBER OF TWEETS	
NUMBER OF RETWEETS	

GENDER CODING INFORMATION	
<p>PROFILE</p> <ul style="list-style-type: none"> -Handle/Account name includes female Kunya or Nasab (i.e. Umm or Bint) -cover picture/profile picture of female in burqa or niqab -self-disclose gender in autobiography 	
<p>TWEETS</p> <ul style="list-style-type: none"> -Use female pronouns (i.e. Mujahira) -Tweet at other 'Sisters' 	
<p>PICTURES</p> <ul style="list-style-type: none"> -Post pictures of themselves or other females 	

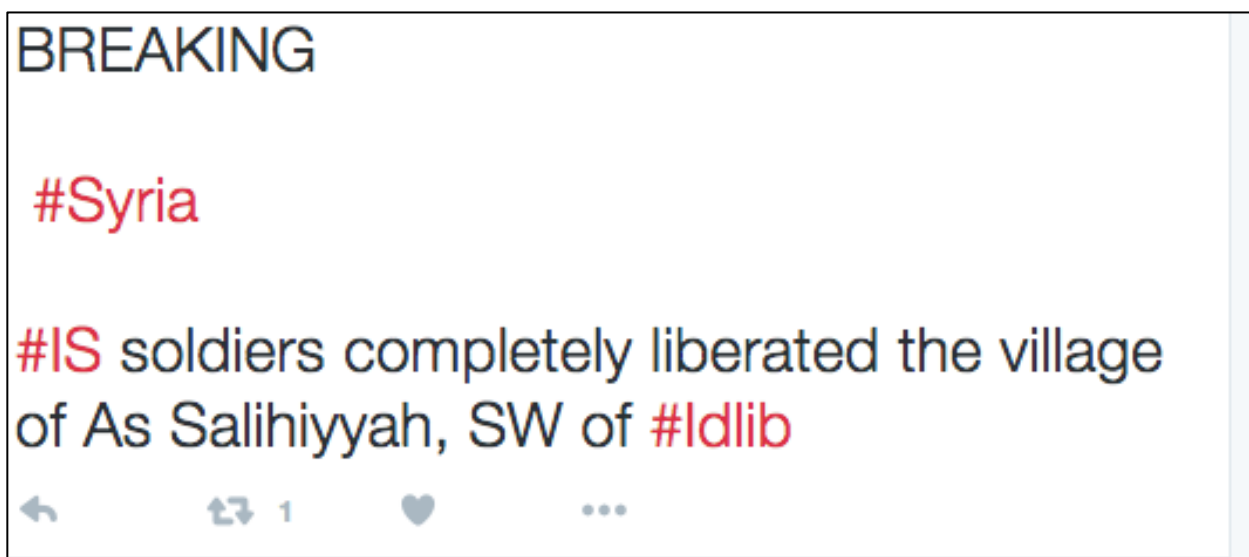
PRO-IS CODING INFORMATION	
<p>PROFILE</p> <ul style="list-style-type: none"> -Handle/Account name includes pro-IS term (i.e. Baqiyah, Greenbird) -IS mentioned in autobiography -cover picture/profile picture of IS image (i.e. Tawheed) 	

TWEETS -discuss ISIS-related content -Use ISIS hashtags (i.e. #IS, #ISIS)	
PICTURES -Propaganda (i.e. Meme's, pictures of IS controlled sites) -Screenshots of propaganda videos	
RETWEETS/FAVOURITES -supporting individuals from ISIS accounts (official news accounts, disseminators or fighters) - Baqiyah shout outs	

Appendix 3. Sample Profile Pictures



Appendix 4. Sample Tweets



May Allah empower our Mujahideen <3
اللهم قوي المجاهدين

RETWEET

1

LIKES

3



Imagine being a nurse at a hospital under Islamic state ❤️ bi itnillah ta ala

Is it true that it's harder to get into Islamic state now? What if you know sisters who are there ??



Appendix 5. Sample Autobiographies

if they ask about my freedom tell them it awaits me in the hearts of 2 green birds and a lingering diamond •• Neurological medic •• [REDACTED]

♥ Come for the NEWS, stay for the ηυτελλα ♥ Muslima tweep somewhere in this Dunya, relaying news on al-Sham+Iraq فاصبر صبيرا جميلا
 📅 Joined February 2015

Islam began as something strange and will revert to being strange as it began."
 📍 Kuffar's land
 📅 Joined February 2016

Appendix 6. Research Ethics Board Approval



Office of Research Ethics
Support Services Building, Western University
London, Ontario, Canada, N6A 3K7

RECOMMENDATIONS FORM NON-MEDICAL RESEARCH ETHICS BOARD Full Board Review

NM REB Chair: Dr. Riley Hinson

Ethics Officer: Mina Mekhail

Please note your study may not commence until you receive final notification of approval from the Office of Research Ethics (ORE).

PROTOCOL DETAILS

Review Date	December 5, 2014
Research Ethics Board ID*	106059
Study Title	Exploring Women's Participation in Online Radical Milieus
Principal Investigator	L. Huey

*This number must be quoted on all modifications, revisions and correspondence.

PROTOCOL STATUS

The proposed study submission has been reviewed and the following decision has been reached:

APPROVED - NO CHANGES REQUIRED

Please note that the submission has now been reviewed by the NMREB Full Board, and there are no recommendations at this time. Please note that this letter is being sent as acknowledgment that no changes are required. You **MUST NOT** begin any part of your research until you have received final notification of approval from our office.

REVIEWER RECOMMENDATIONS

N/A

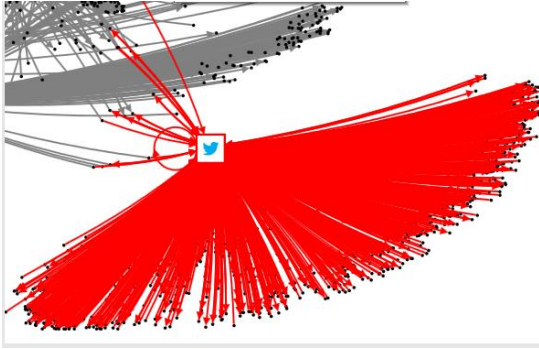
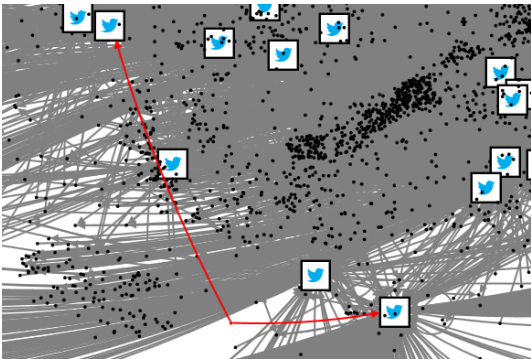
RESEARCHER REQUIREMENTS

Please log in to Romeo and make the required changes. Please also ensure to submit a separate response document addressing each recommendation.

1. *Amendments to the Western Protocol (application form)*: If changes are required for the Western Protocol, export a word copy of the protocol, make changes using track changes and re-upload in Romeo as an attachment. Please submit 2 copies: one tracked version (in word format) and one clean copy (as a pdf) of the entire revised Western Protocol.

PLEASE ENSURE TO INCLUDE A VERSION DATE (dd/mm/yy) WITHIN THE DOCUMENT AND IN ROMEO. Every time an amendment is made to this document, please remember to revise the version date to reflect the changes made and re-submit the entire document.

2. If a recommendation is not for a specific section number within the Western Protocol, please append a separate attachment in the 'Attachments Tab' indicating where changes have been made or indicating your response to the recommendation.

Appendix 7. Sample Hub and Spoke**Appendix 8. Sample Bridge**

Curriculum Vitae

JOSEPH VARANESE

EDUCATION

Master of Arts, Sociology, University of Western Ontario (Expected Fall 2016) Thesis: "Follow Me So I Can DM You Back": An Exploratory Analysis of a Female Pro- ISIS Twitter Network

Bachelor of Arts, Honors Specialization in Criminology, University of Western Ontario (2014)

RELATED WORK EXPERIENCE

CVE Lab Manager, University of Western Ontario (December 2014-December 2015)

Graduate Teaching Assistant, University of Western Ontario (September 2014-December 2015) Courses: Administration of Criminal Justice, Qualitative Research Methods.

Research Assistant, Dr. Laura Huey, University of Western Ontario (April 2013-December 2015)

PUBLICATIONS

Stoliker, B. E., & Varanese, J. A. (Forthcoming). "Spending the golden years behind bars: Predictors of mental health issues among geriatric prisoners." *Victims & Offenders*.

Huey, L., Varanese, J. and & Broll, L. 2015. "The Gray Cygnet Problem in Terrorism Research," in Martin Bouchard (ed.) *Radical and Connected: Social Networks, Terrorism, and Counter-Terrorism*. London: Routledge.

PRESENTATIONS

Stoliker, Bryce, and Varanese, Joseph. 2016. "Spending the Golden Years Behind Bars: Predictors of Mental Health Issues among Geriatric Prisoners." Presented at the Sociology Graduate Student Conference, The University of Western Ontario, London, Ontario, Canada. March 2016

Huey, Laura & Joseph Varanese. 2015. "Women in Jihad." Criminal Intelligence Service Ontario's Criminal Extremism Conference. Ontario Police College, Aylmer, Ontario, Canada. October 2015.

Varanese, Joseph. 2015. "Am I a Terrorist: Methodological Struggles in Terrorism Studies." Presented at the Sociology Graduate Student Conference, The University of Western Ontario, London, Ontario, Canada. March 2015

GUEST LECTURES

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