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Spiritual Polarisation on Social Media: The Case of Arab Atheists on Twitter

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Abstract

Social media platforms provide an unprecedented method of communication, and they are considered an integral part of people's lifestyles. Also, these platforms facilitate forming communities, groups and networks. Hence, it attracted researchers to study people's interactions and analyse the enormous human-generated data. In this thesis, I focus on studying the online Arab communities as a case study of online communities to understand online spiritual-based groups and the polarisation among them. This work combines multi-disciplinary approaches of natural language processing, information retrieval, data science and social and technological networks to understand better the online social behaviour of Arabs with different religious beliefs. I explore the discussion among Arab Twitter users from religious and atheistic groups. I identify four types of Twitter users based on how they describe themselves: Atheistic, Theistic, Tanweeri (reformers), and Rationalists. This study shows that Arabs from different religious spectrums get involved in online discussions on local and regional topics. I collected two datasets from Twitter for users who discussed religions and atheism, in which I considered about 434 accounts in the first dataset and 2,673 accounts in the second one. The analysis shows that, whatever their attitude towards religions, Arab Twitter users tend to use their accounts to promote their beliefs and to show their stances towards others. I showed that the data that was generated by these four groups illustrate the rich socio-cultural context in which discussions among believers, non-believers and religious reformers unfold. I showed that there is a clear online polarisation between atheists and theists, while Rationalist and Tanweeri accounts are spread among and between the two polarised groups. Arab atheists are separated into two groups in terms of engagement based on the accounts they prefer to interact-with. I found that Arab atheists and theists mention and reply-to users from any religious groups and vice versa, but they tend to retweet and follow accounts from their own group. The findings of this thesis provide insights for researchers to understand the case study of Arab online communities and the religious and non-religious online polarisation. Also, it shows the implications for the studies of spiritual discourse on social media and provides a better cross-cultural understanding of relevant aspects.

Declaration

I declare that this thesis was composed by myself, that the work contained herein is my own except where explicitly stated otherwise in the text, and that this work has not been submitted for any other degree or professional qualification except as specified. I confirm that the work submitted is my own, except where work that has formed part of jointly-authored publications has been included. My contribution and those of the other authors to this work have been explicitly indicated below.

The work presented in Chapter 3 was previously published in Social Informatics in the 11th International Conference, SocInfo 2019, Doha, Qatar 2019 Proceedings as “Arabs and Atheism: Religious Discussions in the Arab Twittershpere” by Youssef Al Hariri (student), Walid Magdy (primary supervisor) and Maria Wolters (co-supervisor). Chapter 4 was previously published in the 24th ACM Conference on Computer-Supported Cooperative Work and Social Computing (CSCW 2021) as “Atheists versus Theists: Religious Polarisation in Arab Online Communities” by Youssef Al Hariri (student), Walid Magdy (primary supervisor) and Maria Wolters (co-supervisor). Chapter 5 is under submission by Youssef Al Hariri (student), Walid Magdy (primary supervisor) and Maria Wolters (co-supervisor).

(Youssef Akram Y. Al Hariri)

In the name of God (Allah) the Most Gracious, the Most Merciful

...

It is with genuine gratitude and warm regard that we dedicate this work to Almighty Allah, my creator, my strong pillar, my source of inspiration, wisdom, knowledge and understanding.

My beloved family; father, Akram Al Hariri, mother, Yosra Al Masri, sisters, Huda, Nuha, Ola, Safaa and Sanaa, and brothers, Qutada, Obada, Mohammad and Musaab, beloved wife, Souzan Al Hariri, son, Akram, and daughters; Linda Lena and Leen.

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List of Abbreviations

ANT	Actor-Network-Theory
API	Application Programming Interface.
ArbAth	Arabic Atheists; Arab atheists and secularists strongly tied to non-Arab atheists
ArbInfl	Arab influential and Prominent Accounts; The most influential Arabs which do not discuss religions/atheism.
ArbSch	Arab & Islamic Scholars; Arab accounts that promote religion
AthPro	Arab accounts tied more to Atheist groups that criticise religions
CN	Connection Network.
CSCW	Computer Supported Cooperative Work.
FBI	Federal Bureau of Investigation.
GIA	Gallup International Association.
HCI	Human-Computer Interaction.
IN	Interaction Network.
Info	Infotainment; Regular non-influential Arabs and entertainment personalities
ISIS	Islamic State of Iraq and Syria. Also known as the Islamic State of Iraq and the Levant and Islamic State.
IVCC	Iterative Vertex Clustering and Classification
KSA	Kingdom of Saudi Arabia.
LDA	Latent Dirichlet Allocation.
NASA	The National Aeronautics and Space Administration.
News	News & Journalists; International public figures, politics, singers
NLP	Natural Language Processing.
NonArab	Non-Arabic & Western; Non-Arabic accounts that might criticise religions
OEC	Online Extremist Community
PN	Preference Network.
RelDis	Discussion theists and Religions; Arab accounts (mainly atheists and secularists) with strong ties with non-religious Arabs and tanweeri and rationalist Arabs.
TFIDF	(aka TF-IDF) Term Frequency-Inverse Document Frequency.
TheiPro	Theists and Muslim Scholars and influential Arabs.
UAE	United Arab Emirates.
URLs	Uniform Resource Locator.
US	United States of America.
WIN	Worldwide Independent Network.

Chapter 1

Introduction

1.1 Overview

Social media users use these platforms to discuss and share their personal life events, public issues and their positions towards various topics including beliefs, politics, economics, news and crises. Therefore, an enormous amount of data are generated within different platforms of social media, in which people produce content and interact with content produced by others. Hence, studies considered social media content as an unprecedented source of extremely massive data that helps to understand communities and people as individuals and groups (Bughin et al., 2013; Chebib and Sohail, 2011; Hill et al., 2012; Baumgartner and Morris, 2010). In addition, researchers investigate the role of social media to reinforce the social, political and socio-cultural polarisation within the online and offline communities and how the backgrounds of users lead to online segregation in which they are exposed to users with the same ideology or background, fostering echo-chambered communities.

Social polarisation is the state or phenomenon of increasing the size of divergent groups at the extreme ends of a social hierarchy with a parallel diminishing in the middle groups (Koch et al., 2021). The socially polarised community has a tiny group in the middle in comparison to the extremes in which the majority of community are segregated from each other into relatively smaller groups. Communities' polarisation is caused and influenced by different social-relevant factors, including politics, economics, science, healthcare, and religions; and researchers consider the partisan, ideological and issues-based extremity to study the social polarisation (Prior, 2013; Wojcieszak and Rojas, 2011; Weber et al., 2013). Economic polarisation could refer to the shrinking of middle-income group relative to the acute growth in low-income and high-

income groups within the community (Koch et al., 2021; Foster and Wolfson, 2009). Geographically, this can mean the segregation of social groups into different parts of a town. In relational terms, this could mean the segregation of social groups into parallel lives with limited connections or networks between them (Koch et al., 2021). Consequently, studying and understanding the social polarisation within societies attracted anthropologists and researchers to dive in and to understand the communities dynamics well before the existence of online social media (Koch et al., 2021).

The phenomenon of communities polarisation has moved to the online communities. Studies show that social media users tend to follow and interact with accounts that are in harmony with their opinions, ideologies and stances. Consequently, online polarisation is one of the topics widely discussed to understand communities and their dynamics. Studying the non-Western online communities such as the Arab world attracted the interest of researchers. However, the vast majority of these studies focus on analysing and understanding political, religious and ideological violence which are considered extreme or fundamental (Magdy et al., 2016b; Weber et al., 2013; Whitacker, 2014). Nevertheless, there is a lack of studies that investigate the religious and non-religious Arab accounts and the discussions among them over social media networks. Although the Arab region has a long history of political polarisation based on religious segregation and beliefs (Weber et al., 2013), spiritual polarisation has not been covered or investigated. Studying the virtual separation helps to understand how Arabs consider their spiritual affiliation and mainly the non-religiosity and atheism, in their online contribution. This is extremely important because atheism is generally criminalised legally and socially in the Arab world, which makes declaring or discussing atheism perilous (Nabeel, 2017; Benchemsi, 2015; Kingsley, 2014). Therefore, studying these aspects helps understand how these communities are really segregated online and offline. It also helps to understand how web 2.0 and mainly social media platforms contributed to reshaping the Arab communities virtually and in their real lives.

Our hypothesis is that the Arab theists and atheists are polarised in terms of the topics and the social networks (communities) they prefer to interact with in Twitter. Although we expect to find various discussions among them, we do not expect to see a wide discussions as Arab atheists may not be interested to get involved in such discussion either as a sign of cultural disengagement or to protect their online identity. We also expect that rationalists and tanweeri to be more attracted to support Arab atheists in their discussions as they might have the same concerns against religions.

Furthermore, the main contribution of this thesis is that we identify and observe how online Arab communities that interact with others on topics related to religions. It contributes to the literature of understanding online Arab communities, religious-based polarisation among Arabs and atheism among Arab communities. We also investigated how they are polarised in terms of network interaction and the topics they discuss online. This work aims to extend our understanding for the main features of online Arabs communities with beliefs and non-beliefs and their interactions. This is a vital topic in the Arab context as, in one hand, atheism is considered anti-social and sometimes illegal in the Arab societies, and, on the other hand, theism are linked to extremism. The study is an insight to identify and observe how online contrasted communities from societies similar to Arabs interact with each other and how do they are polarised in terms of the topics they discuss and their network interaction in such ‘controversial’ and ‘critical’ topics. In this study, online polarisation means that Arab Twitter users are distinguishable from each other based on their spiritual affiliations which can be extracted from their online activity and interactions without considering the contents of their accounts. This study is the first study that uses the positions that are declared by the accounts themselves within the religious context. We use the declared positions for two reasons: first, to minimise the human factor of bias or errors in the annotation process; and, second, to avoid a long, risky and ethically arguable process of annotating the accounts based on the content.

1.2 Important Concepts

Before the detailed explanation of the research questions and the objectives, below we explain the important concepts and terms we have in this thesis.

Online Polarisation: In the context of this study, online polarisation means having a separated online communities in which each sub-group within the communities have their own features in which the members of each group are distinguishable from others based only on these features. The network features we investigate include following the same set of accounts, tending to retweet and reply to similar accounts and discussing specific topics with a general stance towards these topics among the group members.

Spirituality: Spirituality has a wide range of definitions which are differ from being relative or connected to religious beliefs to the spiritual tendencies, including those mystical spirits (Harris et al., 2018; Burkhart and Solari-Twadell, 2001). The diverse concepts of spirituality inherited from cultures and the background. Hence, many

studies and communities consider spirituality connected to religions, metaphysical superpower, i.e. God. On contrary, increasing studies argue that the two concepts should be differentiated from each other. Based on the cultures and background, spirituality would be differentiated from religions in the West (Wixwat and Saucier, 2021). This is aligned with the findings that an increasing number of people define themselves as spiritual but not religious (Wixwat and Saucier, 2021; Saucier and Skrzypińska, 2006). In spite of that, in this thesis we use the term spiritual to refer to religions and religious beliefs.

Spiritual Polarisation means having divided communities or sub-communities based on religious beliefs in which the members of each community consider (us) as within group, and (them) for others. Several researchers and writers consider discussing such concept including (Sandage and Harden, 2011).

Atheist: In this thesis, we consider defining the atheist as the user who clearly declare that they do not believe-in nor practising any specific religion. This group also includes those who used to adhere to an organised religion, such as ex-Muslims and ex-Christians without showing any affiliation to another religion.

Theist: In this thesis theists are defined as the users who clearly state their religion in their Twitter account and promote their religious belief on Twitter in their accounts' bios and timelines and they mention the relevant topic in their account's meta data.

Arab: In the context of this study, Arab Twitter user includes any user that uses their Twitter account to tweet in Arabic language in some of their tweets without showing otherwise. By this definition, Arab theist means the Twitter user who use their Twitter to promote their religious belief by using Arabic language in at least some of their tweets. Arab atheist means the Twitter user who use their Twitter to promote their atheistic views by using Arabic language in at least some of their tweets. It is an arguable definition; however, identifying the race or origin for Twitter users is not an easy process and has ethical complication so we utilise this definition in our study.

1.3 Goals and Research Questions

This thesis aims to understand how online communities use social media platforms and their dynamics and how Arabs use social media to discuss topics related to religions and atheism. To the best of our knowledge, this study is the first study that traces the spiritual polarisation among Arab communities and the relationship between the atheists and theists from the Arab communities and Islamic backgrounds. Hence, this

this thesis addresses and answers the following research questions:

RQ1 Do Arab Atheists discuss their beliefs on Twitter? and How other accounts interact with them?

RQ2 Does polarisation exist among Arabs with different beliefs? What are the characteristics of the network interaction of Arabs from different religious spectrum?

RQ3 What are the main topics that attract Arab Atheists and Theists to discuss on Twitter and how do other relevant groups involved in such topics?

Answering these research questions contributes to understand the online Arab communities and how the members of these communities use Twitter to interact with each others. Also, this thesis reveals the effects of religions, non-religions and atheism on the online Arab societies and their networks' dynamics. It also helps to understand the impact of Twitter as a social media platform on such communities.

1.4 Contributions

This thesis contributes to the literature which focuses on studying the online Arab communities, understanding the online spiritual-based polarisation among Arabs, and the main topics that attract religious and non-religious Arabs to discuss online. The outcomes of this thesis can be summarised as follow:

- Our work combines multi-disciplinary approaches of natural language processing, information retrieval, data science and social and technological networks to understand better the online social behaviour of Arabs with different religious beliefs. Although our analysis in this thesis considers religious beliefs and atheism as a case study of segregated communities, it is relevant to understand the online communities and their dynamics. The findings of this thesis provide insights for researchers to understand the case study of Arab online communities and the religious and non-religious online polarisation.
- We explore atheistic discussion in the Arab Twittersphere. We identify four relevant categories of Twitter users according to the content they post and the way they identify their religious beliefs. These four groups are Atheistic, Theistic, Tanweeri (reformers), and Rationalists. (Chapters 3 and 4).

- Our analysis shows that Arabs from different religious spectrums have discussed online topics related to local and regional issues and mainly topics related to gender-based persecution. (Chapters 3 and 5).
- Our findings have implications for the study of religious and spiritual discourse on social media and provide a better cross-cultural understanding of relevant aspects. (Chapters 3, 4 and 5).
- Our study shows that Muslim Arabs from Saudi Arabia actively contribute to Twitter and they show solidarity with the government of the Kingdom of Saudi Arabia. On the other hand, Arab Christians are more likely to argue against Islam than to argue against Atheism. (Chapter 5)
- Our analysis shows that Arab Twitter users from both the religious and non-religious groups use their accounts to promote their beliefs and stances towards others. This finding is based on studying 2,673 active, public Arab Twitter accounts which clearly state their beliefs to be in one of the four groups. Our findings suggest that they can be distinguished into four-to-seven sub-communities that illustrate the rich socio-cultural context in which discussions among believers, non-believers and religious reformers unfold. (Chapter 5)
- Our study shows that there is a clear online polarisation between atheists and theists. However, Rationalist and Tanweeri accounts are spread among and between the two polarised groups. Arab atheists are separated into two groups in terms of engagement. The first group prefers to interact with Arab accounts promoting atheism and the other group primarily engages with Western accounts promoting atheism. (Chapter 4).
- Our study shows that retweeting and following interactions are mainly done for accounts within the same group, while replying and mentioning interactions are done with accounts from the opponent groups. The first two types show solidarity, endorsement and support while the last two tell that users discuss with or mention opponents to share tweets that prove a point or dispute it. In other words, we found that Arab atheists might mention and reply to users from religious groups and vice versa; but, they would retweet and follow accounts within their groups. (Chapter 4).

1.5 Thesis Organisation

This next chapters of this thesis are organised as follow:

1.5.1 Chapter 2 - *Background*

In this chapter we explore the background of the relevant studies including the literature review, the aim of studying these communities and the motivation for choosing the spiritual-based polarisation to represent the polarised online communities. We also explain the major religions in the world in term of the geographical distribution and the populations of its believers, and the non-religiosity in the world and within the Arab societies. We shed light on the importance of religions within the Arab communities and how atheism is considered critical in these communities.

1.5.2 Chapter 3 - *Religious Discussions in the Arab Twittersphere*

In this chapter, we discuss the initial motivations of this study and the experiments we conducted to answer the first research question. The main motivation of this chapter is that most previous research on online discussions of atheism has focused on atheism within a Christian context. In contrast, we find that there is a lack of studies that consider the discussions among atheists and theists from Islamic background or the Arabic context. We started the data collection by identifying a seed list of relevant Twitter users. The first list was provided by Bridge Foundation¹ in which we reviewed the accounts to consider the active accounts and the accounts that are used to promote or criticise atheism or religions. We then used Twitter streaming API to collect all the tweets that interact with these accounts for the period from February 2018 until May 2018. We collected the timelines and the network interactions for the 434 user accounts which interacted with our seed accounts more than 200 times. By network interaction we mean retweeting, replying, or mentioning any of our seed list accounts. In total, we collected a set of 1.3M tweets for these accounts. However, labelling the accounts based on their published content is 1) an arguable and critical step because that might breach their privacy; and, 2) a very long and subjective process that is time-consuming and vulnerable to human factors error. The work done in this chapter was accepted, published and presented in the SocInfo 2019 as shown in Section 1.6

¹<https://bridges-foundation.org/>

1.5.3 Chapter 4 - *Religious Polarisation in Arab Online Communities*

In this chapter we extend our work in Chapter 3 and we answer on the second research question.

To avoid the limitations of the work done in the previous chapter, we used a new method of utilising the labels as they are declared by the accounts themselves. Consequently, we collected the Arabic active accounts that declare their religious beliefs in their accounts name or descriptions and we investigate their following and retweeting interactions with others. Then, for the most influential accounts, we did an intensive qualitative analysis for the content they generated online over their social media account, TV shows and broadcast interviews, and over the written articles and books they published. This analysis helps to understand the main concepts, ideas and messages they promote to their audience personally and online and to what extent they use their Twitter accounts to actively reflect their belief.

In this chapter, we investigate the extent of polarisation among theists versus atheists within the online Arab Twitter users. Indeed, we were able to differentiate four self-identified groups of Arab users based on their religious affiliation. In addition to Atheists, Theists and Tanweeri, there are Rationalists, who promote rational thinking regardless of religious affiliation. Our analysis includes 2,673 active, public Arab Twitter accounts. These accounts clearly state their beliefs in one of the four groups, in which we analysed their online interactions. Our findings suggest that they can be distinguished into four-to-seven sub-communities that highlight the rich socio-cultural context in which discussions of religion, non-religion, and religious reform unfold. While there was clear online polarisation between atheists and theists, Rationalist and Tanweeri accounts are spread among the two polarised sides, acting as natural bridges. We also found a clear separation between Arab atheists who engage with Arab accounts promoting atheism and those who primarily engage with Western accounts promoting atheism. We discuss implications for the study of religious debate and religious polarisation on social media. The work done in this chapter was accepted, published and presented in the CSCW October 2021 as listed in Section 1.6.

1.5.4 Chapter 5 - *Polarised Networks Discuss the Same Topics*

In this chapter, we analyse and extract the topics discussed by the four self-identified Arab communities with different spiritual beliefs: atheists, theists, rationalists and

tanweeris. The main objective is to answer the third research question.

It extends the work we have done in chapter 4 in which we applied LDA topic modelling method to extract and understand the topics discussed by these four groups. The aim of this study is to investigate the polarisation level among these communities in terms of the topics they involved with in their discussions. Our analysis includes collecting the timelines of the 2,673 accounts. In total, we analysed about 2M Arabic tweets that were published by these account between January 2018 and June 2021. Although the main two -polarised- communities have different positions towards topics they discussed online, they are strongly concerned with local and regional and global issues and stories. In other words, We found that Arab atheists and theists are polarised in terms of the topics they discuss, and the motivations to response to debates. This chapter explains in detail the main results and the finding that we submitted for publication in which we are still waiting to hear from the conference committee as shown in Section 1.6.

1.5.5 Chapter 6 - Discussion and Conclusion

In this chapter, we provide the summary and the discussions of the main analysis and findings of the previous chapters. We discuss the social impacts of understanding the online communities and possible implications and limitation of such studies. We also provide the directions of future works of online polarisation, interactions and spiritual-discussions.

1.6 Publications

The outcomes and contributions of the experiments and analysis we conducted in this thesis are submitted and/or published as follow:

- Al Hariri Y., Magdy W., Wolters M. (2022) Do Polarised Networks Discuss the Same Topics? Analysing Arabs topics of Interest According to their Spirituality. (Under submission)
- Al Hariri Y., Magdy W., Wolters, M. K. (2021) Atheists versus Theists: Religious Polarisation in Arab Online Communities. Proceedings of the ACM on Human-Computer Interaction, 5(CSCW2), 1–28.

- Al Hariri Y., Magdy W., Wolters M. (2019) Arabs and Atheism: Religious Discussions in the Arab Twittersphere. In: Weber I. et al. (eds) Social Informatics. SocInfo 2019. Lecture Notes in Computer Science, vol 11864. Springer, Cham

Chapter 2

Background

2.1 Overview

This chapter presents the literature background and relevant studies of this thesis. This chapter has five main sections for each aspect we consider in the thesis in addition to the research gap. The first section explains the religious and non-religious beliefs in which we define the concept of religions and atheism and how researchers consider these concepts in the online context. It also reflects how we identify different types of non-religiosity and why we combine labels from a wide spectrum of non-religiosity into one group, i.e. combining atheism, agnosticism, scepticism etc. into atheism. We also explain the other three labels we used in our analysis theism, rationalism and tanweer. In the second section, we survey the studies that examine different communities that discuss religions and atheism and how the polarised and echo-chambered communities interacted with each other. It also elucidates how this topic was considered in other studies in general and in the Arab context, i.e. religions and atheism in the Arab world. In the third section, we review the studies that consider network interaction in the social media platforms, online communities within the social media and how beliefs have been reflected over social media. It also explains the religious context of the concept of spirituality as it has a wider scope than being limited to religious beliefs. Fourth, we survey the polarisation by investigating the online polarisation over social media, the online polarisation among Arabs, and the religious polarisation among online groups on social media. In the end, we discuss the research gaps in understanding the online polarisation among Arabs from different religious beliefs based on the features of their network interactions and the contents they publish or interact-with over their social media accounts.

2.1.1 Religions

Religion is one of the common acquired characteristics of humans. Both the supporters and opponents of religions coincide in that religion is one of the main acquired features of humankind, just as language. The concept of religion has been mentioned in all known languages and all societies (Bloom, 2007; Hopfe and Woodward, 2009). In his book, *The Essence of Christianity* (Feuerbach, 1854), Ludwig Feuerbach (1804-1872) considered religions as a result of the inclinations and needs of humankind to complement their weaknesses and to fulfil their needs from a perfect blessedness superpower. For believers, preachers, and even researchers, religion is widely considered the source of morals and beliefs espoused by people. The followers of any religion determine the righteousness and virtues, i.e. right acts and good deeds, and the vices, i.e. sins and wrong acts, from their religion and its teachings (Hopfe and Woodward, 2009).

Indeed, the term “religion” has a myriad number of definitions in which; some authors listed tens of definitions in one source, such as the fifty definitions that James Leuba lists in his book of 1912, (Leuba, 1912; Nongbri, 2013). Although scholars write what they consider comprehensive definitions, these definitions were affected by the authors’ backgrounds and the context of their studies (Nongbri, 2013). Consequently, in order to comprehensively define the term religion, we need to consider the background of the communities which practice it, the discipline and the context of the study and the surrounding conditions of its origins and growth (Rees, 2018; Croucher et al., 2017).

Nevertheless, the definition of religion would be simplified to be focused only on the relation with Deity as it was defined by (Croucher et al., 2017):

“The belief in or the worship of a god or gods”

This definition ignores the parts of religions that are relevant to humans as individuals and groups and the interactions among them and with others. Other definitions focus more on humans but have been influenced by the background and the context of that definition. For instance, a clear influence of patriarch societies can be found in the definition by (Geertz, 1993):

“a system which acts to establish powerful, pervasive, and long-lasting moods and motivations in men by formulating conceptions of a general order of existence and clothing these conceptions with such an aura of factuality that the moods and motivations seem uniquely realistic.” (Croucher et al., 2017).

Nevertheless, this thesis focuses on the communities of believers and non-believers; hence, the definition should consider social content to have it aligned with the context of this study. We found that Durkheim, (Durkheim, 1976), coined the most relevant definition to this study:

“a unified system of beliefs and practices relative to sacred things, that is to say, things which are set apart and forbidden—beliefs and practices which unite into one single moral community called a Church, all those who adhere to them.” (Durkheim, 1976; Croucher et al., 2017).

Indeed, some would argue that not all religions use the Christian term, Church, to define their worship places or community. Instead, it would be more precise rather use a common term such as a monastery. Religious communities differ from one religion to another, and it is based on the scope and level of the study. For instance, the community in the Christianity it is *Church*, in Islam it is the *Umma*, in Judaism it is *eretz Yisrael* and in Hindus, it is *sampradaya* (Ward, 1999; Campbell, 2005).

Such arguments are reasonable and prove the limitation of the attempts to define religions and how the background affects these attempts. Accordingly, religion constitutes a community of believers within a system of social culture to act together and worship their God together (Rees, 2018; Campbell, 2005). Such communities might become entirely separated from others, i.e. having us (the believers) and them (the non-believers) (Croucher et al., 2017). Indeed, the level of such constituencies of the unified community of believers varies between religions. However, almost all of them require their members to belong faithfully to the community of believers (Rees, 2018).

For the purpose of this thesis, we define religion as a “complex cultural and social framework” (Kohls and Walach, 2006)[p. 126] that is built around spiritual experiences. This definition highlights religions as social organisations and allows us to draw parallels with other forms of online polarisation by the organisation, such as political polarisation. Partially following Buie (Elizabeth Buie, 2018), we see spirituality as a person’s relationship with the transcendent, that which is larger than oneself, with basic values that give life meaning. The transcendent does not have to be linked to a deity; it is perfectly possible to be spiritual, but not religious, and without belief in any divine beings.

People’s attitudes to religion vary depending on their own spirituality, their experiences of living within a religion, and their views of people who follow other religions or accept different doctrines. Intolerance of different religions or variations in doctrine is a major source of armed conflict. For an overview of the major sects and divisions

in Islam, see (Shahrastani, 1984). Like Judaism and Christianity, Islam is a monotheist religion that postulates a single, supernatural deity with the power to intervene in the human realm. Traditionally, those who are not religious have been classified according to their views about the existence of such a deity.

2.1.2 Atheism versus Theism

The term **Theism** is derived from the Ancient Greek term (Theos), which means Deity or God (Diller and Kasher, 2013). The simple definition of theism is to believe in God. In general, Theists believe that God is a perfect, independent and inexhaustible being; and, without God, the universe would not exist (Diller and Kasher, 2013). The simplicity of this definition holds complexity regarding the application of such belief. For instance, some theistic groups believe that God is the creator of the world from nothing and that God is the providence who actively intervenes in the world directly, by metaphysical miracles, or indirectly through the matter, energy and natural laws (Diller and Kasher, 2013). Theistic groups differ in their distinctive understanding and relationships with God(s) and hold fundamental differences in practising their religions and their understanding of and interactions with God. *Monotheism*, which means to believe in one divine reality and is mainly reflected in Judaism, Christianity ¹ and Islam; *Polytheism*, to believe in the existence of more than one God, and *Panentheism*, which means to believe that all world is in God; and *Deism*, which is larger than the world, controls it inactively (Diller and Kasher, 2013; Clayton, 2011; Visala, 2011; alm, 1828).

Nevertheless, in this thesis, we do not perform a comprehensive study to cover different religions, doctrines and sects. Instead, we used the term theism as a synonym of religion in which theistic accounts are the accounts that reflect an affiliation to any religion.

On the contrary, **Atheism** is the rejection of the existence or even the whole concept of a deity or superpower entity, usually referred to as God or the creator that controls human life and natural phenomena (Geaves, 2006; Bullivant, 2013; Alexander, 2020). By analysing the philosophy of atheism and its definitions, studies show that there are two main types of atheism: *negative atheism* and *positive atheism* (Bul-

¹Christianity is a monotheistic religion with different views of the Deity. While Unitarian Christians believe in One God (alm, 1828), the vast majority of Christians believe in the Trinitarianism (alm, 1828; Diller and Kasher, 2013). Recently, some Christians promote the eschatological panentheism view within the Christianity (Diller and Kasher, 2013; Clayton, 2011).

livant, 2013). The first means disbelieving in the existence of God, while the latter means believing in the non-existence of God. However, non-belief in a deity is only one way to characterise the variety of non-religious experience (Blanes and Oustinova-Stjepanovic, 2017; Quack and Schuh, 2017). In 1874, Charles Bradlaugh (Bradlaugh, 2014) argued that atheism is “no mere disbelief”; instead, it is “a hearty, fruitful affirmation of all truth, and involves the positive assertion of action of highest humanity”. Bradlaugh posits that atheists cannot reject God’s existence because the concept of a God is not meaningful to them. In the context of this study, atheism/atheistic group includes all the groups that reject any religion without showing any affiliation to any other religion. Indeed, *Atheism* is distinguished from *Agnosticism* in which agnostics question whether there is a god or not, believing this question is unanswered or unanswerable (Alexander, 2020; Lightman, 2019, 2002). There also exist wide range of non-religiosity thoughts such as *Anti-religion*, *Areligion*; which denotes the absence of any attitude or meaningful relation toward religion, *Irreligion*, *Nonreligion*, *Non-theism*, *Indifferentism*; which means that all religions are equally valid or invalid, and *Naturalism* and *Secular Humanism*. Some of these categories might be controversial as they have been used in the sociological context. In addition, deists believe that there is God who created the universe, but that this creator does not influence its course or directly interfere in human affairs, including contacting humans or revealing holy doctrine (Stevenson, 2019). Deists may be part of a religion that worships the Creator. The non-religious share common ground with the religious in movements such as secularism, which emphasises the separation of religion and state and humanism, which emphasises human rights and asserts the value of all human beings. Other non-religious groups consider organised religion to be actively harmful and take a strong anti-religious stance. For the purpose of this thesis, we combine all accounts that affiliate with any of these categories into one group, atheism, and limit their concept to rejecting religions. *Atheist users* are those who describe themselves in their account biography as agnostics, atheists, non-believers, or Deist. Although it is more complicated to consider all of these as one group from anthropological and social prospects, we consider them as one group as they all share the same idea of doubting or rejecting religions that posit that there is a Creator who can connect with humans.

2.1.3 Tanweer

The term Tanweer is the transliteration of the Arabic term tanweer (تنوير), which means to enlighten, enlightenment, lightening and illumination (Manzur et al., 1997). Tanweeri (تنويري) is the person who follows or promotes tanweer. We use the transliteration instead of the English translation -enlightenment- to avoid the possible confusion with the enlightenment movement in the European renaissance (Sorkin, 2008).

Arab Tanweeris are usually referred to by using the Arabic term, and they might adhere to an organised religion such as Christianity, Jews and Islam or non-religious groups, i.e. atheism. With some exceptions, some Arab tanweeris demand or support religious reforms, others demand social, educational and political reforms, and others seek drastic changes in the Islamic legislation and education systems. Many Western, Arab and Islamic scholars consider Tanweer as a movement that started more than a century in Arab societies. Starting from the foremost religious reformer in Egypt, Rifa'a at-Tahtawi (1801-1873) -the pioneer of tanweer- and Muhammad Abdu (1845-1905), Jamal al-Din Afghani in several Islamic regions including Egypt, Syria and Iran (1838-1897), and Jamal al-Din al-Qasimi (1866-1914) in Damascus. These scholars insisted that Islam is a rational religion, and it encourages the use of reasoning (Hashmi, 2016; Najjar, 2004).

In this thesis, the Tanweer group includes the accounts that state their positions by using the term tanweer. Although this term is used by accounts from the theistic and atheistic groups, we preserve how these accounts describe themselves. However, we need to clarify that the Tanweeri in the Muslim Arab background usually referred to the social and religious reformists as well as non-religious, i.e. atheists.

2.1.4 Rationalism

Rationalism is the translation of the Arabic term (عقلانية), which is refereed somehow to mind or intellect or cognition. We say somehow due to the controversial discussions about the root of the term in Arabic and its derivations as discussed in (Jabri, 2011). In philosophy, rationalism means to realise the efficient and final reason for a phenomenon or knowledge (Jabri, 2011). In his book (Jabri, 2011), Aljabri (1935-2010) traversed the classical rationalists in Arab history, mainly thinkers such as al-Farabi (870-950), Avicenna -Ibn Sina- (980 – 1037), and Averroes -Ibn Rushd- (1126-1198); and explained how they developed and expanded the rationalism of the Greek philosophical traditions within the Arabic and Islamic cultures and traditions. He illustrated

the intellectual tool they got to find reasons to concern Deity, human beings and existence, independent of religious doctrines, mainly Islam. AlJabri was a contemporary thinker who contributed to Rationalism in the Arabic and Islamic tradition and coined the concept of 'Islamic-Arab Rationalism' (Jabri, 2011).

People from different religious spectrums use rationalism to describe themselves and justify and reason their beliefs as the most rational than other choices. Just as our choice in the Tanweer group, the Rationalist group includes the accounts that state their positions using the term Rationalist and its Arabic translations and derivations. We notice that these terms are used by accounts from the theistic and atheistic groups and not-relevant accounts. We preserve the way that these accounts describe themselves as it is without any modification. The accounts in the Rationalist group tend to take pride in their thoughts and beliefs, unlike Tanweeri groups who tend to demand reforming and promote their way of thinking or beliefs. Also, Rationalists emphasise rational and logical discussions relevant to social and religious points of view.

2.2 Communities from religious perspective

Studies suggest that communities formed based on religious perspectives differ from the social communities and should be treated differently (Campbell, 2005). As we introduced, the community of believers form a social and cultural group to act together and worship their God together, and it might become entirely separated from the non-believers. Also, the consideration of community differs from one faith to another based on the unique perspective of communities for each religion (Ward, 1999; Campbell, 2005). Also, forming and being committed to a religious-based community was affected by the different understandings and interpretations of how to form such communities and on which limits or bases. This is clear in Christianity from its early days and Islam mainly in the Sunni and Shia doctrines (Campbell, 2005; Nielson and E. Thomas Dowd, 2006). However, believers see that their group of believers is a special community that is ordained and gathered by God as the Christians see the Church. In her book, (Campbell, 2005), the author shows features of the church, including "church as sacrament" in which the church is a symbol for the community of the presence of grace coming to fulfilment; "Church as herald" in which the community is brought together; and, "church as servant" in which the individuals provide support to others providing that the support is by order, for the direct benefit of others and not self, and they lose their dignity to show respect to God and others. To make it clear,

religions might have a mystical community in which the interaction is not limited to be among humans but also includes the grouping between them and God. However, in this study, we focus on human interactions and communities. In the following subsections, we introduce religions, including atheism in the world and in the Arab world, mentioning the main motivations of this study.

2.2.1 Religions of the World

Recent studies and surveys reflect that religion is an integral part of life for the vast majority of humans (Berger, 1999; Leustean, 2022). Both religiosity and non-religiosity are highly complex and multifaceted. In general, religions consist of a community of believers who share tenets of faith and practices of worship, some of which may require separation from others (Croucher et al., 2017; Durkheim, 1976; Rees, 2018). Within a religion, there are often many branches which create separate groups of communities. These groups may or may not coexist peacefully, although they share the main religious belief. For example, Sunni and Shia are the two main denominations of Islam (Shahrestani, 1984), and the Christian denominations, Roman Catholics, Protestants, and Eastern Orthodox (Hayward, nd; Cadoux, 1928). Each denomination has split into many ‘branches’ and ‘sub-denominations’ (Shahrestani, 1984; Hayward, nd; Cadoux, 1928).

Some argue that religion is still a force to be reckoned with in today’s world and that the world now is fiercely more religious than in previous centuries (Berger, 1999). Since the beginning of this century, religions have been connected to major incidents or events that do impact people’s lives. Starting from the attack on the World Trade Towers on September 11th, 2001, followed by the ‘invasion’ of Afghanistan and Iraq in 2001 and 2003, respectively, as a result of the United State’s ‘crusade campaign’ and its ‘international coalition’ as a major response to that attack. These two incidents are considered part of religious war by both Osama bin Laden, Al-Qaida’s leader who was accused of the 9/11’s attack, and the US administrators at that time (Hegghammer, 2006). Bin Laden claimed that the attack was part of the religious war between the ‘East Muslim people’ and the ‘Western -Christian- Crusaders’:

“This war is fundamentally religious. The people of the East are Muslims. They sympathised with Muslims against the people of the West who are crusaders.” (Yelenskyj, 2011).

On the other side, US President George W. Bush also used religious language in his historical speeches and addresses to the nation. He mentioned religious concepts



Figure 2.1: An example of Stereotyping Both the Victims and Perpetrators, Selecting Pictures, Sentences and Words

such as God and faith more than presidents Roosevelt, Clinton and Ronald Reagan. He also quoted biblical quotes on several occasions to justify his administration's response to that attack by what is called the war against terrorism (Froese and Mencken, 2009; Hendrickson and Tucker, 2005; Ford, 2001). Other clear examples of the world's religiosity recently are religious-based hate speech and acts. For example, the Hindu-Muslim clashes in India, which are recorded to be escalated in the last three decades, the terrorist attack against Muslims in two Mosques in Zealand in 2019, and the radical religious militias such as ISIS and Boko Haram, which have extreme actions based on religious interpretations (Tomass, 2016; Gyang Mang, 2014; Campbell, 2019). However, measuring the crises and incidents which are connected to religious motivations is difficult due to biased and prejudiced views.

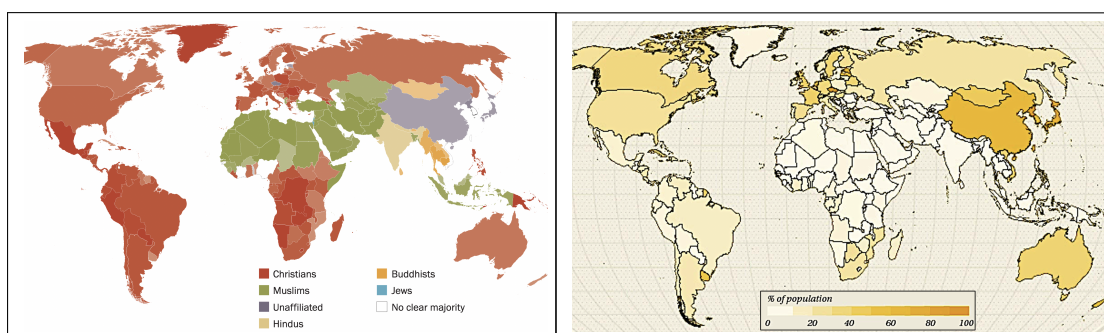
Unfortunately, the history and events of race and religious-based incidents are labelled as "act of terror" if the perpetrator's background is Muslim, and not such as an act of terror otherwise². For example, the perpetrator was declared a terrorist by New Zealand's government, and he conducted a terror attack based on the definitions of The Crown Prosecution Service³ and the FBI⁴. Still, news agencies usually called him

²<https://www.reuters.com/world/europe/four-critically-wounded-three-killed-danish-mall-shooting-sunday-police-says-2022-07-04/>

³<https://www.cps.gov.uk/crime-info/terrorism>

⁴<https://www.fbi.gov/investigate/terrorism>

a gunman or a suspect due to his background or motivations. Again, news agencies do not connect him with religious-based acts; instead, he was associated with white supremacy. Moreover, the news agencies usually select the pictures that stereotype the victims and the perpetrator, as Figure 2.1 suggests⁵. In addition, the Hindu-Muslim clash has also been affected by the biased coverage of different news agencies. This includes anonymising the victims' and the killers' identities when the victims are Muslims and clearly stating their identity otherwise. A clear example is how news agencies covered the story of the killing of two teenagers on June 11th, 2022, in India. The victims' identities had been concealed by most of the Indian and Western news agencies, while, on the other hand, the names and ages of the victims have been clearly stated by Arab-background news agencies such as Aljazeera channel^{6 7} which again add complication to the literature to identify relevant incidents and to avoid prejudice and biased outcomes. These findings suggest that covering the worldwide events and news might affect measuring the religiosity of the world, although reports and studies still suggest that the world is religious nowadays (Berger, 1999; *The Global Religious Landscape*, 2013).



(a) Distribution of main religions

(b) Distribution of Unaffiliated Population

Figure 2.2: Distribution of (a) the world's main religions and (b) the Unaffiliated population, coloured according to the majority religion. Colours' level represents the majority level. Sources: (Hackett et al., 2012; Deshmukh, 2022)

A worldwide poll which was conducted by Pew Research Center in 2012 shows that 80% of the people connect themselves to religious groups (*The Global Religious Landscape*, 2013). The report illustrates the global wide distribution of the major re-

⁵<https://www.nbcnews.com/news/world/new-zealand-mosque-shootings>,

⁶<https://www.aljazeera.com/news/2022/6/11/india-two-killed-during-protests-over-prophet-muhammad-remarks>

⁷<https://www.reuters.com/world/india/protests-flare-across-india-over-anti-muslim-comments-by-ruling-party-members-2022-06-10/>

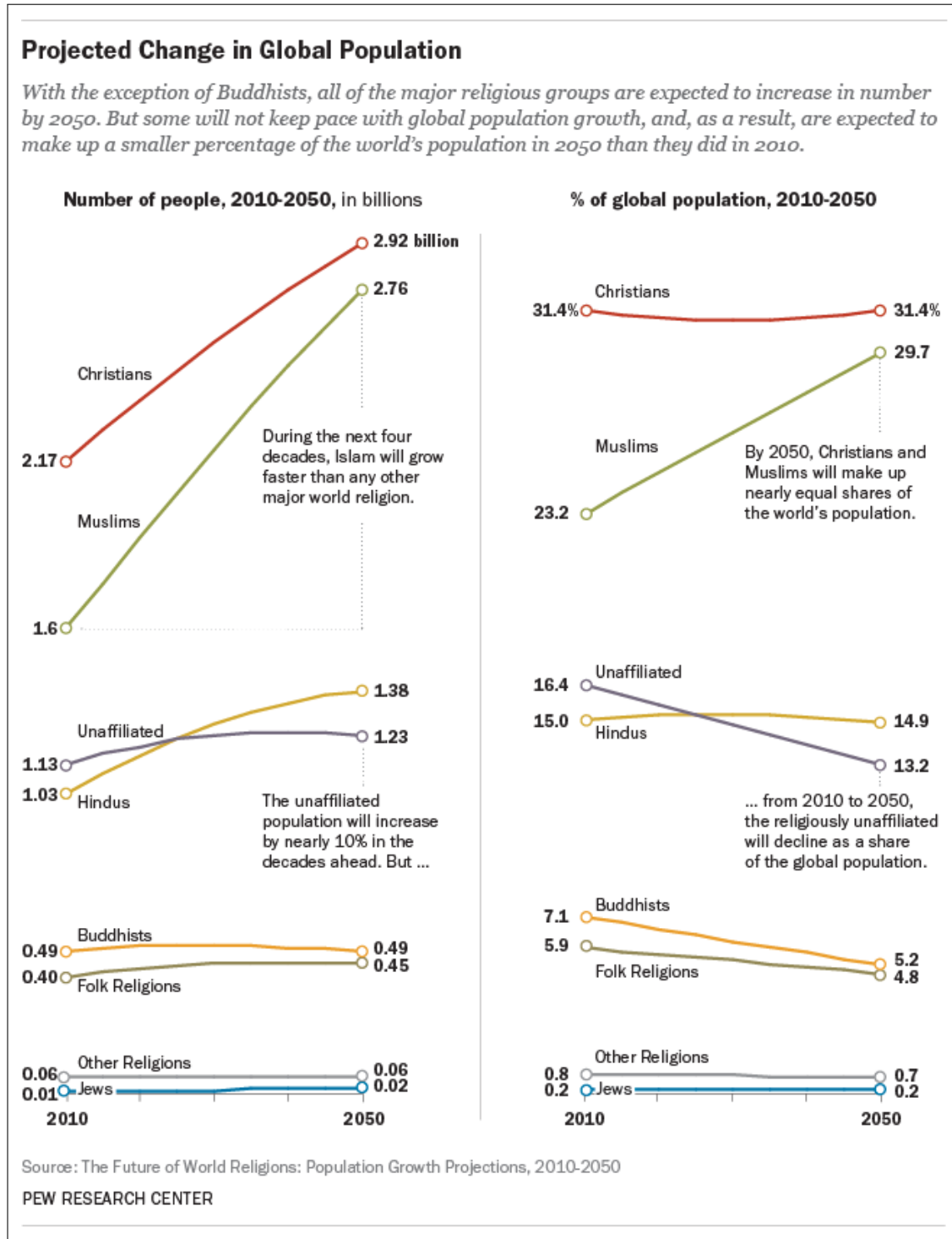


Figure 2.3: The Expected Projection of the World's main religions coloured according to the majority religion. Colours' level represents the majority level.

(Source: Pew Research Center)

ligions as Figures 2.2a and 2.2b show⁸. In addition, another recent report published by Pew Research Centre expects that the number of religious population will have a steady expansion as Figure 2.3 presents. Figure 2.2a illustrates that the dominant religion for the whole world is Christianity (in red), and the dominant religion in the Arab countries is Islam (in green). The report shows that 32% of the world's population are Christians, 23% are Muslims, 15% Hindus, 7% Buddhists, and 0.2% Jews (Religion & Public Life Project, 2014). The saturation of colours represents the percentage level of the majority. The darker level of each colour represents a higher level of that percentage.

Atheists are represented as an unaffiliated category in the report, and they are the third largest religious group, with more than 16% of the world's population. Religiously unaffiliated are distributed around the world, but they are the majority of the population in the Czech Republic, Korea, Estonia, Japan, Hong Kong, and China; and they are minorities in most of the other countries, with some exceptions in Europe (The Global Religious Landscape, 2013). Figure 2.4 shows the distribution of religiously unaffiliated people worldwide. Having about 900 million atheists, Asia-Pacific has the majority of atheists, while Arab countries have the lowest number of atheists, and it is expected to be about 2.1 million with no certain statistics.

2.2.2 Religions in the Arab World

As shown in section 2.2.1, the vast majority of the population in the Arab countries are Muslims, followed by Christians and then all other minorities (Banks, 2017; Religion & Public Life Project, 2014). The distribution of the Muslims, Christians and atheists in the Arab countries, are 94.8%, 3.6% and less than 0.6% respectively (Pew Research Center's Religion & Public Life Project, 2015). According to (Pew Research Center's Religion & Public Life Project, 2015), in 2010, the greatest number of Arab atheists was recorded in Syria, with about 2% of the Syrian population. Algeria, Bahrain and the United Arab Emirates come next with 1.86%, 1.59% and 1.2%, respectively. These numbers include the citizens and immigrants in these countries. In addition, different studies claim that the number of Arab atheists is increased noticeably recently despite the harsh penalties of declaring atheism (Stuart, 2016; Benchemsi, 2015; Pew Research Center's Religion & Public Life Project, 2015).

⁸<http://www.pewforum.org/2012/12/18/global-religious-landscape-exec/>

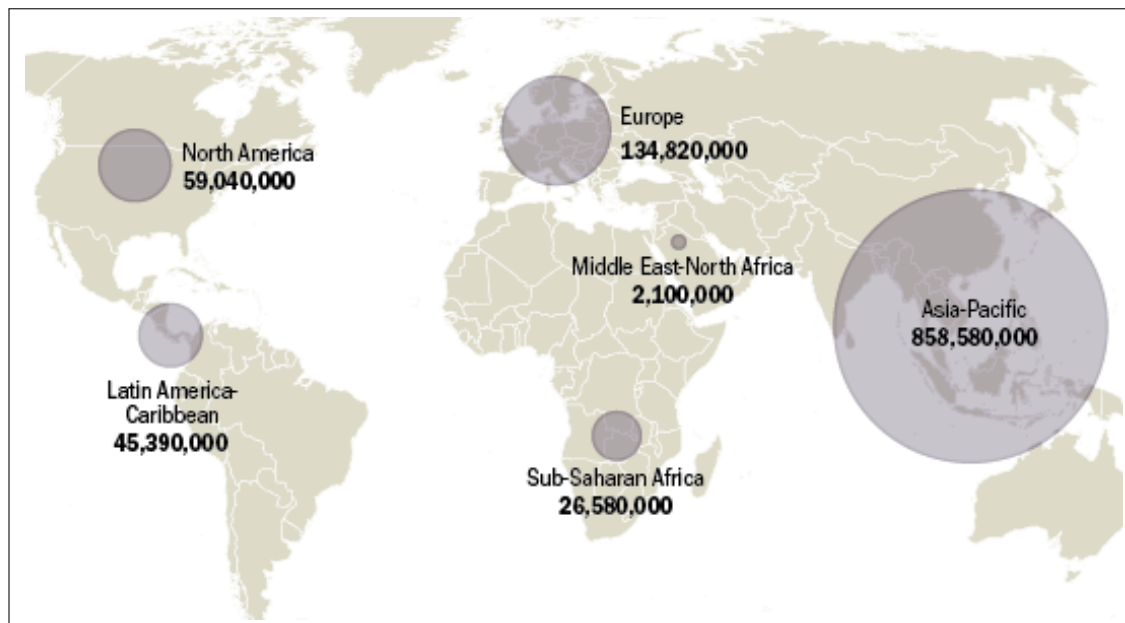


Figure 2.4: Distribution of the World's Unaffiliated. (Source: Pew Research Center (2015))

2.2.3 Atheism in the Arab World

While atheists are minority in Arab countries (Banks, 2017; Religion & Public Life Project, 2014; The Global Religious Landscape, 2013), the number of Arab atheists appears to have increased noticeably recently despite the harsh penalties for atheism in several Arab countries (Benchemsi, 2015; Pew Research Center's Religion & Public Life Project, 2015; Stuart, 2016). According to a wide range poll done by the Worldwide Independent Network/Gallup International Association (WIN/GIA) in 2012, an average of 22% of Arabs express atheist views or at least some measure of religious doubts by using their social media accounts (Benchemsi, 2015; Pew Research Center's Religion & Public Life Project, 2015). Also, it shows that 5% of Saudis described themselves as "convinced atheists" (Benchemsi, 2015). Another social survey is performed by Al Azhar University in Cairo. The results show that the expected number of atheists in the Arab countries is exactly 2,293 distributed in all Arab countries (Benchemsi, 2015). According to that study, the majority of atheists are located in Egypt, Morocco, Tunisia, Iraq, and Saudi Arabia.

However, atheists and secular activists claim that the exact number is much higher, but because of the lack of freedom of speech and freedom of conscience; people do not feel safe if they declare their actual beliefs in the Arab societies (Benchemsi, 2015). Indeed, measuring and understanding the existence of atheism and atheists in Arab countries require more investigation because there is a lack of studies in this regard.

We noticed that there is no formal study conducted about the exact number of atheists in the Arab world other than the social poll that is done by WIN/GIA in 2012 (Gilani et al., 2012) and the dataset published by Pew Research Centre (Hackett et al., 2012); Almost all of the other resources that talk about atheism in the Arab world are done either based on one of them or the work done in (Benchemsi, 2015).

Table 2.1 summarises the numbers of the atheists in each country as listed in both (Benchemsi, 2015) and (Pew Research Center's Religion & Public Life Project, 2015). The numbers of each study contradict the other. For example, in (Benchemsi, 2015), the author claimed that 5% of the Saudi citizens are convinced atheists, and Egypt has the largest number of Arab atheists; yet in (Pew Research Center's Religion & Public Life Project, 2015), about 0.6% of citizens and immigrants in Saudi Arabia are found to be atheists, and Egypt has one of the lowest portions of atheist people in the Arab countries. In other words, the expected number of atheists in Saudi Arabia in the first work is claimed to be 1 million; but in the second work, it is stated that the number is only 180,000 atheists. This may be due to the methods conducted in both studies and the clarity of standards applied. Another potential reason is the time of the study. We expect that the number of atheists is affected because of the dramatic failures of Arab spring⁹. The uncertainty and huge differences in the studies of atheism in the Arab religion motivated us to conduct this study. News agencies and reports claim that Arabs are turning their backs on religions.

The main motivation of this study is that, to the best of our knowledge, the previous studies that consider the discussions among Arab atheists and theists or the Arabs with religious doubts or questions about religions are affected by personality differences and the social background of the researcher. In other words, the researchers are usually from non-Arab and non-Muslim backgrounds, which affects their interpretation of discussions, answers or doubts. This affects these studies because of two main reasons:

- Misinterpretation of the social actions or social response to different events. This is not limited to the actions themselves but also to the motivations, reasons and consequences.
- Coining the questions to be clear enough to the Arab respondent and to have clear and accurate answers. This includes interpreting the answers to these questions in surveys or focus groups.

Indeed, these two points might not be the only reasons, as some might argue the

⁹<https://www.opendemocracy.net/tamer-fouad/arab-spring-and-coming-crisis-of-faith>

Country	(Benchemsi, 2015)	Pew Research Center (2015)
Egypt	888	<10,000
Morocco	325	<10,000
Tunisia	320	20000
Iraq	242	40000
Saudi Arabia	178	180000
Jordan	170	<10,000
Sudan	70	350000
Syria	56	420000
Libya	34	10000
Yemen	32	20000

Table 2.1: The Number of Atheists in Arab Countries in 2012 from two Different resources

biased interpretations and the intended and unintended stereotyping of such communities. For instance, as Figure 2.1 shows, Arabs and Muslims would see a clear stereotyping of the families and relatives of the Muslim victims as angry people, eager to attack and retaliate, and who tend to scream and talk loudly. While on the other hand, the terrorist who killed people in the mosques was represented as a peaceful man who was confused because of their screams! Unfortunately, we noticed such “misinterpretation” in all the reports about atheists and atheism in the Arab or Muslim communities. For instance, we noticed that most of the articles and reports are:

- Written based on interviewing extremely few people.
- Having a clear ignorance of the criticism from the political and social barriers and their intervention with the social disengagement with what is considered religious actions.
- They show a clear confusion and mislinking of the views of Muslim scholars (aka fatwa) and fundamental Islamic rules and doctrine.

We noticed that the fundamental reliance for these reports is based on such answers. The foremost motivation for this study is the mislinking between the concepts beyond the questions and the reality of the answers. This was clear when we reviewed the questions in the survey conducted by Arab Barometer. Interpreting questions is

Q1012 What is your religion?				
	Iraq	Tunisia	Lebanon	Algeria
Muslim	2450	2381	1270	2295
Christian	7	0	940	8
Jewish	0	0	0	3
No religion	2	7	0	12
Other	0	6	190	0
Refused to answer	0	6	0	14

Q609 In general, you would describe yourself as religious, somewhat religious, or not religious?				
	Iraq	Tunisia	Lebanon	Algeria
Religious	1179	728	581	633
Somewhat	1115	891	1458	1283
Not Religious	143	700	353	372
Don't know	9	70	4	34
No answer	13	11	4	10

Table 2.2: Sample of the Main Religious-related Questions. Source: Arab Barometer Wave V (2018-2019), <https://www.arabbarometer.org/survey-data/data-downloads/>

affected by the background of the reader. Although that might affect the outcomes of the study, it was ignored by all reports. Table 2.2 show a sample of two questions with their recorded answers. Interestingly, while we were writing this thesis, we read a report written by the same resource, i.e. Arab Barometer¹⁰, that the number of non-religious young Arabs is decreasing. However, at the same time, the reporter presented these details on the BBC with a clear bias. We claim that the report was a biased one as the report connects the spread of atheism with the raise of a sensation of freedom, while, according to the report, the spread of theism is connected with the raise of financial and social crises. The report claimed that the economic and social instability caused such shrink in the number of atheists in Tunisia. We see that this is a controversial point of view to claim the report is a biased one. However, as an independent audience who tries to be unbiased on a critical topic, we believe that there are other ways to deliver the results without showing a stance towards it. For instance,

¹⁰<https://www.arabbarometer.org> Source: <https://www.arabbarometer.org/ar/media-news/11685/>

the title of the video clip is **Why did most of the Arab youth return to religiosity?**; while, on contrast, in the previous reports that present the increased number of atheists, the authors used titles such as **Are Arabs turning their backs on religion?**¹¹ and **Lebanon's atheists rejecting their religion**¹². We believe that understanding Arab communities and societies requires unbiased researchers to collaborate and integrate with Arab researchers to have a clear and purified understanding of the people from that region.

2.3 Online Communities from a Religious Perspective

The online communities is described as a collective of users or individuals who aggregated to form a self-organised, informal and unified group through a web-based system to generate, share and exchange a general form of interests, knowledge and experience although they might be in dispersed locations (Mozaffar and Panteli, 2022; Rheingold, 2000). Studying online communities attracts attention to understand and predict trends, crises and conflicts from the network dynamics and online content (Georgiou et al., 2017; Li et al., 2016; Mark et al., 2009).

The earlier studies to understand the online religious communities is the work done by Heidi Campell (Campbell, 2005). In her book, she described the real and virtual religious communities paying attention to the communities from a Christian perspective. Studies show that people have used the internet as a communication tool to connect and reunite with others since the mid-nineties of the last century (Campbell, 2005). Nowadays, beyond being a communication tool, people use the internet as a relational social web (Haythornthwaite and Wellman, 2002; We Are Social, Hootsuite and DataReportal, 2019). Similar to other technologies, web 2.0 and social media networks are widely used by people to broadcast their messages, communicate with their followers and update the public with their projects, events and publications (Cheong, 2012; Burge and Williams, 2019; Bramlett and Burge, 2020). Muslim majority communities is also considered in studies to understand these communities and their core issues and concerns (Mustafa et al., 2020; Sultana et al., 2020; Alabdulqader et al., 2017; Benigni et al., 2017; Rifat et al., 2017; Wyche et al., 2008b). However, more efforts is required to have a better understanding of these communities (Mustafa et al., 2020)

¹¹<https://www.bbc.co.uk/news/world-middle-east-48703377>

¹²[urhttps://www.bbc.co.uk/news/av/world-middle-east-48729203](https://www.bbc.co.uk/news/av/world-middle-east-48729203)

2.3.1 Religious Beliefs on the Social Media Platforms

In addition to being used to connect with others and to form online social groups, internet and social media platforms have been used to send and share religious content and to communicate with others for religious objectives. For instance, religious preachers used to publish their lessons, thoughts and religious subjects and teachings by using letters and books in the past. In the last century, they used cassette recordings, magazines, leaflets, Radios, TV shows and the internet; and, in the last decade, they utilised social media platforms (Campbell, 2005; Hjarvard, 2011; Sule and Abdulkareem, 2020).

One of the main features of social communities is the homophily phenomenon. Homophily means that people tend more to interact with others who share similar attributes, features and opinions. Although several studies prove the homophily phenomenon in social media, religious online homophily is still questionable. The religious online homophily means that people tend to interact with and follow others who are similar in their religious group and with people from different affiliations based on the teachings of their religion (Hanusch and Nölleke, 2018; Bisgin et al., 2012; Garimella et al., 2017b).

2.3.2 Religious Discussions On Twitter

A Report shows that in 2019 Twitter had 336 million active users per month (We Are Social, Hootsuite and DataReportal, 2019) and its data has been used before to study religions on social media.

Social Media platforms have been considered to examine different contents published by religious and non-religious people platforms, such as tweets on Twitter and the sentiments they express online (Ritter et al., 2014; Chen and Huang, 2019). Using linguistic analysis tools, Ritter et al. (Ritter et al., 2014) showed that Christians on Twitter presented as happier, more socially connected, but less reflective.

Since influential accounts have an ever more noticeable impact on society (Buccoliero et al., 2020; Cheong, 2012; Burge and Williams, 2019; Bramlett and Burge, 2020), another line of research focuses on the way leaders and influences leverage religious discourse. (Burge and Williams, 2019) studied how U.S. evangelical leaders used Twitter by analysing more than 85,000 tweets published by 88 prominent American evangelical leaders. The authors found that these leaders use their accounts to communicate with their followers, disseminate sermons, and share their events and news.

Political parties also co-opt religious discourse. (Bramlett and Burge, 2020) investigated whether the members of American Congress use religious language in their tweets by analysing about 1.5 million tweets posted by them in April 2018. The authors found that members from both major political parties, i.e. Democratic and Republican, use religious language in their social media accounts.

(Ritter et al., 2014) analysed text data from about two million tweets published by about 16k users. The authors aimed to examine the differences between the linguistic content published by Christian and atheist users. They found that Christians tend to use positive emotional words and fewer negative emotional words than atheists. Their collection and labelling of the dataset are based on the ‘following interaction’. They considered the accounts that follow five prominent Christian accounts as Christians and, on the other side, the accounts that follow five well-known atheists as atheists. However, the following interaction might not represent the real belief or position towards religion and, more drastically, might not represent the Christian or atheist communities. The authors have already discussed these limitations in their collecting and labelling methods.

In (Chen et al., 2014) the authors analysed more than 250k Twitter accounts to understand the main features of religiosity on Twitter for users from the US. The work found a reasonable positive correlation between Twitter data, i.e. declared religions, and offline surveys data for the geographic distribution of religious people. The study includes analysing the tweets and networks of each user to identify discriminative features of each religious group and to study the linkage preference. It shows that the network dynamics, mainly followers, friends, retweets and mentions, tell more about the religious users and provide more effective features than the contents of the tweets. They also observe that Twitter users tend to interact more with users from the same religion.

2.3.3 Religious Discussions Among Arab Twitter Users

Arabs have positive views about social media and its influence on their societies. According to (Mourtada and Salem, 2012), Arabs interacted positively with other cultures, opinions, views and religions after their involvement in social media. Social media has many different functions. It facilitates the revolutions spread during the Arab Spring in 2011 (Mourtada and Salem, 2012), but it also serves as a propaganda and recruitment venue for extremist groups around the world (Awan, 2017; Fisher,

2015; Magdy et al., 2016b; Richey and Binz, 2015). It also serves as a platform for underrepresented groups, such as Arab atheists, to communicate and show their existence.

There is surprisingly little work on online atheist communities within Arab or Muslim societies. A notable exception is the study of (Schäfer, 2016) which considers atheist communities from Muslim (non-Arab) backgrounds. In her study of Indonesian atheists, the author found that social media helped atheist activists to safely highlight their existence in a religious country, Indonesia, show their positive side, and build a thriving community. However, they risked exposure through contact with human rights activists around the world through social media.

Studies considered social media contents and networks to study *extremism* (Benigni et al., 2017; Awan, 2017; Richey and Binz, 2015; Magdy et al., 2016a,b; Ammar and Xu, 2018; Guiora, 2014; Hegghammer, 2006; Gyang Mang, 2014; Ahmad et al., 2019), *wars and conflicts* (Froese and Mencken, 2009; Denton-Borhaug, 2012; Hendrickson and Tucker, 2005; Hegghammer, 2006; Gyang Mang, 2014; Kwan and Yu, 2019), *hate speech and abusive languages* (Mubarak et al., 2017; Zhang and Luo, 2018), *religious topics and content* (Abokhodair et al., 2020; Gillespie et al., 2013), *privacy and safety online* (Keküllüoglu et al., 2020; Aldayel and Magdy, 2019), *misinformation, disinformation and fake news* (Allcott and Gentzkow, 2017; Babcock et al., 2019), *political and social engagement* (Baumgartner and Morris, 2010; Twenge et al., 2019; Lee, 2013; Hetherington, 2008; Buccoliero et al., 2020), *health* (Abi-Jaoude et al., 2020), *social and political polarisation and echo chambers* (Alsinet et al., 2021; Barberá et al., 2015; Foster and Wolfson, 2009; Lee et al., 2018; Magdy et al., 2016b; Borge-Holthoefler et al., 2015; Duca and Saving, 2022; Darwish et al., 2017; Chebib and Sohail, 2011; Weber et al., 2013; Cross and Sorens, 2016; Boxell et al., 2017; Lee, 2013; Garimella et al., 2017a,c; Garimella and Weber, 2017) and *religious polarisation* in Western European countries (Ribberink et al., 2018), in India (Migheli, 2019) and in Christian communities (Campbell, 2005). However, to the best of our knowledge, no study explores the religious-based polarisation among online Arab communities, online discussions among Arab atheists, and online discussions about atheism among Arabs.

(Benigni et al., 2017) studies extremism on Twitter by analysing the Arab Twitter content of a large community that supports the diffusion of ISIS propaganda and the type of Twitter users in that community. (Awan, 2017) considers extremism among the Arab social media users by investigating 100 Facebook pages and 50 Twitter user

accounts and reports that online hate is used by extremists (ISIS) for reasons including recruitment and propaganda. (Richey and Binz, 2015) focuses on extremism in South East Asia by applying human geographic, network, content, and authorship analysis. Proposes an Intelligence Collection Pathway to identify extremists based on integrating three components of organisational or regional analysis. Magdy et al. (2016a) analysed the hate speech and political polarisation and homophily towards Islam and Muslims among Twitter users from USA. The study explores how online social media interactions would play a role in users' future attitudes and positions even with topics they never mentioned in their accounts. The authors proposed a method to predict the future stances of the users based on their online content and network dynamics. The case study of their work is the Twitter accounts located in the United States (US). The objective is to predict the stances of these accounts toward Islam and Muslims after the terrorist attack on November 2015 in Paris. Magdy et al. (2016b) studies the extremism, religious extremism, and political polarisation among Arab Twitter users by analysing Twitter content. The authors investigate the methodology of using social media content to predict the stance of users towards possible supporters and opponents of the ISIS extremist group. Evolvi (2018) investigates the Islamophobic content, as hate speech content, in tweets relevant to Brexit. The author performed a qualitative analysis on 1329 tweets published between 23 and 30 June 2016 and labelled Islamophobic. Senbel et al. (2022) studies religious violence and Hateful speech on Non-Arabic content. The study proposed a method based on actor-network-theory (ANT) and content analysis. They compare the online reactions, i.e. on Twitter, to three religious-related violence. The analysis considered over 900,000 tweets related to three different shooting incidents: the shooting at AME church in the US in 2015, the shooting at the Tree of Life synagogue in the US in 2018, and the two shootings in the Christchurch mosques in New Zealand in 2019. The shootings targeted religious gatherings in which the first shooting was in an African church, the second was in a Jewish synagogue, and the latter was in Muslim mosques.

A particular facet of religious discussion on Arab social media is hate speech about religion and atheism (Albadi et al., 2018; Albadi et al., 2019a,b). The studies by Albadi et al. show that 42% of the studied tweets ($n=6000$) that cross-reference religions contain hate speech.

(Albadi et al., 2018) studies six categories of Arab Twitter users who can be identified as Muslims, Jews, Christians, Atheists, Sunnis, and Shia. The findings suggest that hateful language was very common in the sample of Arab tweets with religious

content. The most targeted groups are found to be Jews, Atheists and Shia. In their next study, (Albadi et al., 2019b), Albadi et al. extended their analysis by using the dataset from their previous study. They contribute to the literature on hate speech in the Arab Twittersphere as they published the first publicly available annotated Arabic tweets dataset and relevant lexicon of terms for hate speech. To label the dataset, they used Figure Eight crowdsourcing platform (now known as Appen) with some quality measures, including employing annotators from the Arab IP addresses and 70% accuracy limits in quiz mode questions. They also presented their insight analysis for the dataset, including the lexicons of terms used, the targeted groups and the location of the accounts that generated the hateful content. The location analysis has been limited to the country's level based on two features: the time zone and the location parameter in the tweets' metadata. The analysis also illustrates the top relevant hashtags in the hateful and non-hateful contexts. Then, they compare several classification models to use lexicon, n-gram and deep learning-based modules to label the tweets. The Gated Recurrent Units (GRU) model with pre-trained word embeddings performs the best precision and F1 score and well with the unseen test dataset. Their analysis used feature selection methods, including point-wise mutual information, chi-square, and Bi-normal separation. For hateful content analysis, they used temporal features (time-related parameters from the tweets meta-data), user features (including the number of followers, friends, lists and tweets), and content features (contents of tweets). For future work, the authors mentioned the importance of investigating the contribution of social bots in the religious-based hate speech in the Arab Twitter networks, predicting the users' demographics in relevant networks, and the character-level models in classifying Arab tweets.

In (Albadi et al., 2019a), the authors investigate how the automated Twitter accounts (bots) contributed to the hate speech on Arabic Twitter. The authors found that bots participated in slightly more than 10% of the total tweets in the dataset they used. They also used various features from about 86k tweets published by 450 accounts to develop a bot detection model by using the random forest regression model. The authors used the dataset they collected in their previous work (Albadi et al., 2018). The features they used to consider the contents and interactions of the tweets include the sentiments, replies to, retweeted, and textual features, accounts' metadata, and networks' interactions. These accounts are labelled manually by two annotators. They also investigate the features that would be used to distinguish Arabic bots from both human and English bots. The study includes reporting topic modelling (LDA) results

and source and network analysis. The main finding is that humans participated in about 90% of the hate-speech interactions on the Arabic Twittersphere.

Social media is an important forum for discussions for Muslims who wish to talk about aspects of faith and practice. As Echchaibi (Echchaibi, 2013) notes in her study of blogs, it can be a form of constructive dissent, where writers develop nuanced positions that promote reform. It can also be a safe space for Muslims to reflect on their own practice in predominantly non-Muslim contexts. An example is the online reaction to the French ban on Burkinis, a swimsuit for Muslim women that incorporates the hijab (Evolvi, 2019). In their online spaces, Muslim women develop and elaborate on the meaning of the religious practice of wearing hijab as part of their own identity (Kavakci and Kraeplin, 2017).

Another aspect of discussing religious content on Twitter that should be highlighted here is citing the Quran. A recent study by (Abokhodair et al., 2020) analysed mentions of the Quran verses in about 2.6 million Arabic tweets. The study shows that users extend their real-life religious practices and worship acts by sharing Quran verses as a form of religious expression. Another context of studying the Arab-Muslim communities and their interactions over social media is the privacy aspect.

(Abokhodair and Vieweg, 2016) studies how the citizens of two Arab countries, Saudi Arabia and Qatar. Both countries are from the Gulf Cooperation Council (GCC). The authors illustrate how these communities interpret privacy and how do they control their online privacy. The authors focused on understanding the role of the Islamic teachings, traditions and societal norms on understanding, interpretations and practices to preserve online privacy in these communities. Some participants stated that they have two accounts on social media, one for their families, relatives and friends, and the other, a fake one, to interact freely with 'open-minded' online friends without reflecting on their real identities. In (Abokhodair et al., 2017), Abokhodair et al. investigated how people from the same two Arab countries adhere to the traditions and cultural norms while they share their photos online. Although these two studies are far from the main topic we discuss in this thesis, i.e. online polarisation, they are the main available works to understand the Arab communities online. In fact, the findings of both works (Abokhodair et al., 2017; Abokhodair and Vieweg, 2016) show how complicated it is to understand or study the religious and cultural disengagements among Arabs online.

Far more attention has been paid to radical theists in the Arab world. Magdy et al. (Magdy et al., 2016b) sought to understand the origins and motivations of ISIS Arab supporters by comparing data for about 57,000 Arab Twitter accounts before and after

the emergence of ISIS. They find that historical data can be used to train a classifier to predict a user's future position on ISIS with an average F1 score of 87%.

There are also clear differences in the topics discussed. ISIS opponents are linked to the position of Arab regimes, rebel groups, and Shia sects, while ISIS supporters talk more about the failed Arab Spring. (Magdy et al., 2016b). Interestingly, the most widely-used and distinctive hashtag used by ISIS supporters was “#Million_Atheist_Arab” which was part of a campaign by Arab atheists. This indicates that the topic of atheism is well known and discussed in the Arab world, despite the lack of studies.

Nevertheless, compared with the different studies that focus on online Arab content and networks, there are relatively few studies of religious discussions between Arabs on social media that do not focus on hate speech or political extremism. Also, there is a lack of studies that consider online discussions among religious and non-religious groups.

To the best of our knowledge, no study considers understanding the Arab communities from different religious beliefs and backgrounds by studying the religious discussion among Arab-Muslim background users.

Reference	Extremism	Hate speech	Political polarisation	Religious violence	Religious Polarisation	Region/Language	Analysis	Event/Story	Data Type/size
Allcott and Gentzkow (2017)						Non-Arabic	misinformation and fake news	2016 US election	browsing, fact-checking, online survey
Alsinet et al. (2021)						Non-Arabic		social polarisation	Reddit
Awan (2017)	X					Arabic	Content & qualitative	ISIS	100 FB pages & 50 Twitter accounts
Babcock et al. (2019)						Non-Arabic	disinformation and fake news	Black Panther	Twitter
Barberá et al. (2015)			X			Non-Arabic			Twitter
Benigni et al. (2017)	X					Arabic	OEC / IVCC	ISIS	2-d follow & mention, 22k Twitter acc
Borge-Holthoefer et al. (2015)			X			Arabic		Egypt	Twitter
Evolvi (2018)		X				Non-Arabic	Qualitative analysis	2016 UK referendum	1329 tweets
Ribberink et al. (2018)					X	Non-Arabic		Western EU	Twitter
Migheli (2019)					X	Non-Arabic		India	Twitter
Lee et al. (2018)			X			Non-Arabic		South Korea	Social Media (N=6411)
Magdy et al. (2016a)		X	X			USA English	stance & location	US election	Twitter
Magdy et al. (2016b)	X		X			Arabic	Content, temporal & prediction		Twitter data
Senbel et al. (2022)		X		X		Non-Arabic	Actor-Network-Theory	Shooting incidents	900k tweets
Richey and Binz (2015)	X					Southeast Asia	Human geographic, network, content, & authorship	ISIS	

Table 2.3: Sample of the Literature's Cover the Online Discussions

2.4 Online Polarisation

Studying societies to instantiate development plans and tackle social polarisation attracts researchers. Studies show that polarisation within communities would be beneficial and offer opportunities to develop it, but it also has drastic consequences that affect the relevant communities and the whole world (Lee, 2013; Fiorina et al., 2008). For instance, studies show that partisan polarisation increases in the US among the supporters of the two main parties, Democrats and Republicans (Hetherington, 2009; Lee, 2013; Fiorina et al., 2008).

The evidence of polarisation within communities shows how important is to tackle it, understand its reasons and minimise its effects on the community. Studies showed that there are five types of evidence for polarisation (Fiorina et al., 2008): 1) Differences in Sociocultural Characteristics, 2) Differing World Views or Moral Visions, 3) Opposing Positions, 4) Polarised Choices, and 5) Differences in Where We Live. Polarisation would affect the communities in different aspects, including (Fiorina et al., 2008; Hetherington, 2009, 2008):

- Higher political awareness, although it might limit their engagement in the political elections.
- Polarisation might impair economic performance.
- Extremism and Terrorism have a complex relationship with polarisation. Studies suggest that although they are not connected directly, polarisation would escalate extremism, and the latter would fuel polarisation (Bu Khuraysah, 2018; Hiebert, 2022).
- Polarisation would be escalated by media and the accessibility to information such as the internet. Media fragmentation would also reflect the polarisation within the communities; studies suggest (Duca and Saving, 2022; Kutlu et al., 2018)
- Echo chambers would escalate the polarisation within the community. This is due to exposure to people or ideas aligned with the person's stance towards the topic (Garimella et al., 2017b, 2018a). This is important as studies suggest that the informational bubble is one of the characteristics of communities that is amplified by social media. In other words, social media users usually being exposed

to content and users that are similar to their viewpoints, i.e. homophily phenomena (Garimella et al., 2017d, 2018a).

2.4.1 Online Polarisation over the Social Media

Online polarisation over social media networks has attracted much attention in the computational social science community to understand and predict people's behaviour and opinions. A form of online polarisation that has received higher attention is hate speech from religious and political perspectives. For example, the study by Weber et al.'s (Weber et al., 2013) is to understand the polarisation among secularists and religious Twitter users in Egypt. The authors conduct a quantitative analysis of the polarisation between secular and Islamist Twitter users in Egypt. The authors expanded an initial manually labelled seed list of 22 politicians and prominent users from both groups by using *retweeting interaction* to have about 7,000 accounts. Then they studied the top topics discussed by the two groups and measured how they are polarised by computing the valence of hashtags used in tweets published by their members. They found that hashtags published by both political sides could be used as a polarisation barometer as they coincided with periods of violent events. They showed that followers of accounts on the Islamist side are more likely to use Islamic and charitable terms and are less likely to use derogatory terms and hate speech when talking about followers of other religions.

A long-term analysis of Twitter content regarding polarisation is conducted by Garimella and Weber, (Garimella and Weber, 2017), to study whether social media increases political polarisation in the US. The period of study was 2009-to-2016 and covers two presidential elections and two mid-term elections. The authors analyse a large Twitter dataset published by 679k users from both partisan. The authors investigated the following interaction, retweet interactions and the hashtags used by users from both sides, the Republican and Democrat parties. The data collection started by identifying the seed lists of Political accounts and Media outlets that mostly represent both sides for the period of study. Next, for the following users, the authors consider the accounts that follow any account from the seed list accounts back-to January 2009. For the retweeting users, the authors consider the 50% random sample of the accounts that retweeted these accounts up to 100 times. Then, they collected their timelines considering the tweets from September 2009 onward. Another study of the political conversations on Twitter was conducted by Recuero et al. (Recuero et al., 2020) to

understand how pro and anti-Bolsonaro behave online. The authors studied the polarisation, hyperpartisanship and disinformation among Twitter users in tweets relevant to the two rounds of the 2018 Brazilian presidential election. The authors showed that although there was an interaction between users from both clusters, more interactions were among users within each group. The findings suggest that each group has its own features, for example, the higher visibility of Bolsonaro narratives in the Bolsonaro supporters group and the more extreme and highly polarised discussions among them.

In the context of this study, the concept polarisation among Arabs from these four groups (i.e. atheists, theists, rationalists and tanweeris) means that these communities are separated, segregated and differentiable from each other based on the network of users they tend to interact with and the topics they discuss online. It does not indicate in any mean the state of polarisation that is accompanied with congestion, hostility and tension. We believe that our study provides an important step towards identifying the main characteristics and features of these communities for further understanding of these communities and their interaction not only in Twitter, but even in other social media networks and other interaction methods.

(Alsinet et al., 2021) proposes a quantitative method that precisely measures the polarisation level presented in online Reddit discussions. This is because, by its design, Reddit supports discussions, as stated by the authors. The authors used different datasets from Reddit to practically evaluate their method. The proposed method uses the greedy local search optimisation algorithm to compute the homogeneity of each partition and the negative interactions between both partitions. Another way to consider studying polarisation and polarised communities is by understanding the users within a bubble and balancing their exposure to different viewpoints. Several studies proposed methods to identify, quantify, and reduce such bubbles by exposing users to balanced views from different campaigns (Garimella et al., 2017a,c,d).

In another study by Garimella et al. (Garimella et al., 2018b), the authors proposed, illustrated and evaluated methods used to measure the degree of polarisation, or as they describe controversy, of a topic regardless of the topic's domain. The authors used different interaction features, i.e. follow and retweet, and contents, i.e. bag-of-words and sentiment analysis, to perform their study. For instance, they used 'Retweet graph', 'Follow graph', 'Content graph', and 'Hybrid content and retweet graph'. Each of these graphs considers relevant features such as a minimum threshold of two retweets as an endorsement interaction in the retweet graph. Next, they used methods to measure the controversial topics using 'Random Walk', Betweenness, Embedding, Bound-

ary Connectivity and Dipole Moment. They also proposed two measures based on the random walk algorithm for user controversy scores. Finally, using the BiasWatch method as a baseline, the evaluation shows that random walk methods using sentiment analysis have better results.

2.5 Research Gaps

Previous work in HCI and CSCW on technology, religion, and spirituality has focused on three main aspects, leveraging technology for worship and adherence to religious practices (Akama and Light, 2015; Wyche et al., 2007, 2008b; Woodruff et al., 2007; Derthick, 2014), using technology to mediate transcendent experiences (Elizabeth Buie, 2018), and supporting social action that is linked to religion (Rifat et al., 2017). This study provides important background for the first aspect, technology for supporting religious practices.

Studying the Arabic contents and the online Arab interactions over social media, and mainly on Twitter, only consider the religious discussions within the political perspectives, hate speech, and extremism context. Although many works consider these topics, there is no study that considers the religious-based arguments, i.e. religiosity and non-religiosity perspectives, among Arabs from Muslim-Arab backgrounds and how they are polarised in such topics. Particularly studying how Arabs from different beliefs are polarised and how do they interact with other users on Twitter.

In comparison with previous literature, particularly (Albadi et al., 2018; Albadi et al., 2019a,b), and (Weber et al., 2013), our study provides an in-depth analysis of network polarisation on Arab Twitter as it relates to religion. While (Weber et al., 2013) also studied network polarisation between secular and non-secular groups, they did not expand their analysis to non-political contexts and restricted their study to Egyptian accounts. We conclude that there is a clear gap in our knowledge of religious discourse and dialogue between atheists and theists on Arab social media. We propose to address this gap by applying quantitative analysis to characterise the Arab online theist and atheist communities. Hence, we find that our study will provide an initial step to consider Arab Twitter in general as they discuss topics relevant to their own beliefs, whatever their political positions. We consider accounts that clearly declare their positions and study their interactions, paying more attention to influential accounts and those that have been verified by Twitter. We formally analyse the following, retweeting, and mentioning interactions to understand the polarisation between

these communities and sample a wider collection of accounts which give more relevant information about such communities.

Chapter 3

Religious Discussions in the Arab Twittersphere

3.1 Overview

According to several studies and reports, the number of Arab atheists is growing¹ in a region that is often intolerant to atheists (Benchemsi, 2015; Kingsley, 2014; Nabeel, 2017; Stuart, 2016). However, the studies that consider and analyse online discussions about atheism, such as (Chen et al., 2014; Ritter et al., 2014) focus on Christian-background communities and Western societies.

In this chapter, we investigate how atheists in the Arab societies leverage Twitter to discuss their disengagement from religion, mainly Islam, the dominant religion in the Arabic region, and the interactions by different users around this topic. We characterise relevant types of user accounts by distinguishing between four main groups: Arab atheists, who do not believe in a deity; Arab theists, who believe in a religion; Arab Tanweeris, who believe in Islam but also accept other beliefs and promote religious reform; and Other, who do not openly discuss their religious views.

We focus on the main topics discussed online by each of these user groups and the way in which their opponents engage with them through replies and retweets. For our analysis, we collected and analysed the tweet timelines of around 450 user accounts that were heavily involved in discussions concerning atheism. We use this dataset to answer the first research question:

¹Sources: <https://newhumanist.org.uk/articles/4898/the-rise-of-arab-atheism>
<https://www.washingtontimes.com/news/2017/aug/1/atheists-in-muslim-world-growing-silent-minority/>

RQ1 Do Arab Atheists discuss their beliefs on Twitter? and How other accounts interact with them?

However, to answer this question, we investigate the following two sub-questions:

RQ1.1: What are the common topics and features that Arab Atheists share that distinguish them from Theists, Tanweeris, and Others?

RQ1.2: How do Arab Atheists interact with the other three groups?

Our analysis shows that there are active online discussions between Arabs from across the religious spectrum. Most of the discussions are related to local and regional topics and, mainly, the oppression of women. The vast majority of Arabs who believe in a deity are from Saudi Arabia and show solidarity with their government. Arab Christians are more likely to argue against Islam than to argue against Atheism. Our findings should promote research in this direction to further analysis and in-depth studies of atheism and religion in the Arab world.

3.2 Research Methodology

3.2.1 Data Collection

To identify and retrieve the relevant accounts, we received a list of 200 Arabic Twitter accounts from Bridge Foundation², a non-profit organisation based in London that aims to build bridges between Islam and other religions. Volunteers from Bridge Foundation labelled these accounts as promoting atheism and atheistic content. We manually reviewed these accounts by inspecting their description and shared content. We only kept those that 1) explicitly mention that they are atheists and 2) promote atheism or clearly criticise religions in the majority of their tweets. Thus, we ended up with only 80 accounts that met our criteria. We used these 80 accounts as our seeding accounts. Next, we used the Twitter streaming API to collect all the tweets that interacted with these accounts for four months between Feb and May 2018. We collected over 100K tweets during that period and limited our analysis to those 434 user accounts that interacted with the seed accounts over 200 times, either by retweeting, replying, or mentioning them. We consider these to be the most active users on the topic of atheism on Arab social media at that time. Although it might look promising

²<https://bridges-foundation.org/>

to consider the whole network of accounts that interacted at least one time with our seedlist, identifying the threshold (of 200 interaction times) helped us to consider the most relevant accounts so we can consider them online communities with potential interactions among them. Having lower threshold will increase the size of the network, but further resources are required to clean and analyse the considered accounts. This would be reasonably handled with quantitative analysis, but would be costly with the qualitative analysis in terms of understanding the accounts, and their timelines. For these 434 accounts, we collected their entire Twitter timeline to study their network interactions and the content they discuss in their tweets. At the end of this step, we collected a set of 1.3M tweets for these accounts.

Although the data collection method we followed here is arguable due to the ignorance of the relevant accounts which discuss the topics but are not covered by the Bridges Foundation list of accounts, it gives us a starting point to answer the questions about the existence of the relevant groups and how do they interact over Twitter. Also, as we discussed in the limitations section of this study, having better method for data collection gives a better understanding of the communities and their network interactions, and hence better conclusions.

Finally, we need to mention that the selected users are not mandatory representative of other Twitter users nor the people in the real life -i.e. general population-. This includes considering that the active Twitter users are not representative of the passive users. In addition, as studies show, the users of a platform are not representative of the users of other online social media platforms (Wellman and Gulia, 1999; Driskell and Lyon, 2002).

3.2.2 Data Annotation

After a careful inspection of the data, we labelled the accounts based on the contents of their tweets and the beliefs they promote in their timelines. A detailed revision of the tweets published by each account for the dataset was conducted to label these accounts. The four labels we devised according to the content are:

- **Atheistic** content that promotes content denying the existence of God (or gods) or explicitly rejects a religion (or religions) without any sign of religious affiliation.
- **Theistic** content that shows belief in God or discloses a religious affiliation and defends it.

- **Tanweeri** content that shows affiliation to Islam (or another religion) but promotes religious reform and accepts other beliefs.
- **Other** none of the above.

Three native Arabic speakers from three different Arab countries received a training workshop to learn the accounts' labelling requirements. The main purpose of the training was to ensure a clear understanding of the annotation guidelines and to isolate any personal beliefs while annotating the data. Each annotator was instructed to inspect most of the collected tweets for each account before making a judgement. They also had access to the user description and link to their online profile to assist them in making decisions if needed. Judgements were based both on the tweets published by the users and their frequent retweeting of a particular stance.

Initially, 50 accounts were labelled by all three annotators. Cohen's Kappa values between each annotator pair were 0.732, 0.592, and 0.634, which reflects the subjective nature of interpreting statements of belief. The main confusion was distinguishing the 'Atheistic' from the 'Tanweeri' accounts. We discussed the possible sources of disagreement among the annotators; then, they proceeded to label the remaining 383 accounts. The average time for labelling one account ranged from 15 to 30 minutes.

In addition, the annotators tried to identify if the account belongs to a person or a formal entity that promotes certain stances. For individual accounts, we also recorded gender if it was identifiable.

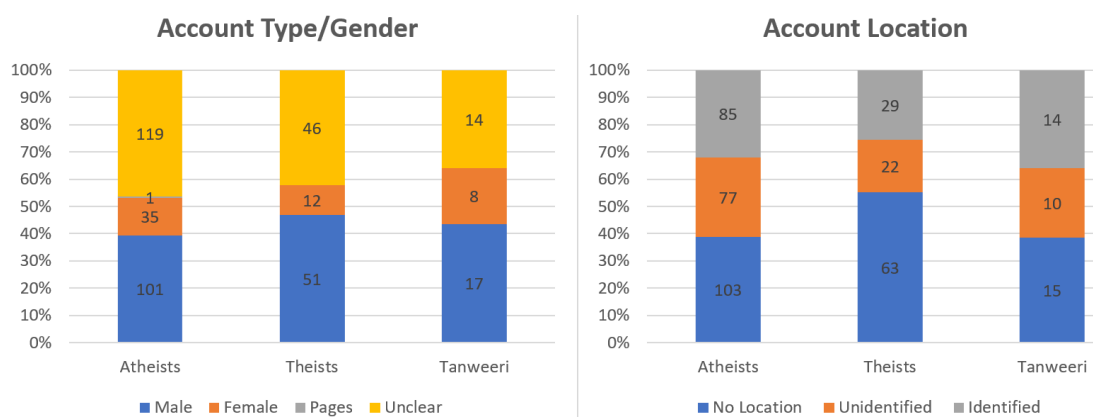


Figure 3.1: Type, Gender, and Location of Accounts

3.2.3 Data Statistics

Since the seed list consisted of atheist accounts, it is unsurprising that most of the accounts we labelled belong to the atheistic class ($N = 256, 59\%$). One hundred nine accounts (25%) are labelled as theistic, 39 (9%) as tanweeri, and 30 (7%) as Other.

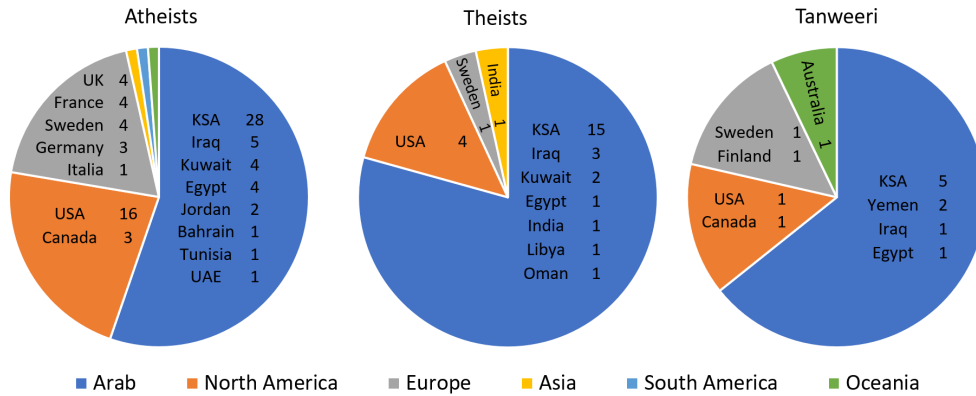


Figure 3.2: Identified Locations for Atheist Group

Regarding the type of accounts, only one atheist account is a page, while all the others are personal accounts for Twitter users. Figure 3.1 shows the distribution of accounts' gender from each category. In addition, it shows which of these accounts has an identifiable location listed in their profile. As shown, there are more males than females in the collected accounts, while for around 40% of the accounts, gender is not identifiable. Tanweeri users have the largest percentage of females among other groups and tend to declare their gender more than other groups. For the location analysis, theistic users have more identifiable locations than atheists and tanweeris. This might be for security reasons of atheists to protect themselves against laws in some Arab countries. The most identifiable locations are from Saudi Arabia for all accounts, followed by the USA for atheist and theist accounts. The identified users' location in each group is shown Figure 3.2.

3.3 Analysis of Atheism Discussions on Twitter

For each account, we apply our analysis to both the content of their tweets and network interactions. This includes the accounts they retweet their tweets (**retweets**), the accounts they reply to (**replies**), the accounts they mention in their tweets (**mentions**), the hashtags used by the account (**hashtags**), and the Web domains linked in their tweets (**domains**). In the following discussion, all tweets are rephrased to protect the

Table 3.1: The highest occurrence of hashtags used by all groups

Hashtag (Translation)	Atheistic	Theistic	Tanweeri
عقلانيون (Rationalists)	28048	16743	2377
السعوديه (Saudi Arabia)	2274	1018	453
داعش (ISIS)	972	2001	86
صناعه المحاور (Creating Almohawer (interlocutor))	938	1159	123
الاسلام (Islam)	888	716	75
ايران (Iran)	514	648	96
سوريا (Syria)	543	611	67
مصر (Egypt)	663	464	81
اليمن (Yemen)	690	347	71
توير (Tanweer)	836	50	117

original posters. Our study in this chapter considers the accounts position and their tweets are considered based on the general position of their publishers. We also consider counting the tweets, i.e. frequencies, although other studies such as normalised counting would reflect better intuition and understanding for different communities.

3.3.1 Top Discussed Topics

In this section, we analyse the frequently discussed topics within the 1.3M tweets in the timelines of all the 434 accounts. This should highlight the discussion topics by the most active Arab users on atheism. We used hashtags to describe the topics that users talked about. Tweets will not be quoted, so they cannot be traced back to their authors. However, we provide example English translations of those tweets.

As shown in Table 3.1 (an extended list is in the Appendix Table 7.1), and Table 3.2, almost all classes talk about similar topics such as rationalists, Middle-East countries, ISIS, women's oppression, Saudi women's rights, regional conflicts, and topics related to atheism and reformation, such as tanweer, ex-Muslims, atheists and atheism. Table 3.3 gives a few example tweets of the usage of these hashtags in context.

The hashtag `CreatingAlmohawer` (training the interlocutor) refers to an online program designed to prepare Muslims to rebut unfounded claims about Islam. Most Arab atheists do not only argue against Islam but against all religions, specifically the Abrahamic religions (Judaism, Christianity and Islam). However, Islam is the most discussed religion as most of them are Muslims. Relevant hashtags include `Abrahamic dice` and `Former_scriptures`; relevant tweets argue that since archaeology provides counterevidence to the Jewish Bible, which, according to the tweets, invalidates all Abrahamic religions. Other tweets questioned the existence of Moses, a prophet

in Abrahamic religions, and claimed that there is no archaeological evidence to prove his existence. Interestingly, the hashtag `Former_scripts` is also used by some non-Muslim theists to argue against Islam.

<p>All: Rationalists, SaudiArabia, CreatingAlmohawer (interlocutor training), ISIS, Islam, StephenHawking, Israel, Egypt, Iran, Truth, Yemen, Syria, Friday, CEDAWSaudi, SaudiWomenDemandDroppingGuardianship, Qatar, Kuwait, DroppingGuardianship, AForgottenWomenPrisoners</p>
<p>Atheistic: DelusionTrade, ExMuslim, Atheism*, EvolutionFact, Atheist*, Tunisie, SaveDinaAli, TweetAPicture, Raif-Badawy, Science, BlessedFriday, QuranInPictures, Trump, YouthTalk, Sweden, WomenCarDriving, FreeSherifGaber, Woman, ALogicalQuestion, DontSayIamDisbeliever, WhereIsAminah, OsamaAljamaa, UnveilingIsNotMoralBreakdown, WomenInternationalDay, ViolenceAgainstSaudiWomen</p>
<p>Theistic: Atheist, Atheism, ChildrensMassacreInAfghanistan, Pray, SpreadOfIslam, ChristianityFact, Jesus, Palestine, Bible, AlAzharIsComing, Quran, Atheists, LegalizationOfZionization, Urgent, Continued, DefenceQuranAndSunnahByProofs, AssadBombardDomaChemicalWeapons, Christianity, MesharyAlAradah, Jesus, NaizakTranslation, Gaza, Aleppo, Turkey, Iran-Protests</p>
<p>Tanweeri HashemiteOccupation, OayedDoNotSteal, WeakHadithEmployedBySahwa, CleaningSchoolsFromSururi-Women, FlutesRevelation, CrownPrince, Al-NassrFc, CrownPrinceOnCBC, SlaveryAllowanceForSaudiWomen, HowISurvive-FromSahwa, RefusedToReleaseHisDaughter, IDecidedToWearItOnMyHead, AlmutlaqAbayaIsNotObligatory, Brothers, Yemen, SaudiWomenProudOfGuardianship, SaveMeFromViolence, CompassWithIslamBahiri, NoClouserShopsDuringPrayTime, My-FaceVeilIsHonor, SaudiCinema, MajidaElRoumi, CinemaInSaudiArabia, OffendedWomenOnly-GymClosed, MBSInterview-sTheAtlantic</p>

Table 3.2: Top 25 hashtags from each class translated into English. Full details of hashtags are shown in Appendix

1	A	Religious drugs generate huge profits for delusion traders and dealers and more poverty for the people #Rationalist.
2	A	#Delusion.traders successfully make simple minds fools, mindless and inhuman.
3	A	I am going to publish a simple introduction to Palaeontology Which is overwhelming proof to the #EvolutionFact; Follow me.
4	A	Anyone benefited from the diffusion would promote myths and delusions #DelusionTrade.
5	A	@user: #ViolenceAgainstSaudiWomen #SaveDinaAli where is Dina Ali? she was disappeared since a year.
6	A	@hrw_ar you need to prove credibility to protect that girl from being killed by her family.
7	A	@user: #ViolenceAgainstSaudiWomen Religions shouldn't be a law ..
8	A	We are living in 2018 and still there are people being arrested for expressing their political views and religious beliefs. We should have legal codes to protect the freedom of speech. #freeSherifGaber #FreeSherifGaber
9	A	#ViolenceAgainstSaudiWomen #SaudiWomenDemandDropGuardian640 #StopEnslavingSaudiWomen We demand justice for female victims of domestic violence.
10	T	A A Darwinian Atheist says please help Dina. Why don't we consider her story as a natural selection or an evolutionary development? #SaveDinaAli
11	T	Atheists did not support Muslims in liberating lands or defending themselves. Still, they believed that they had the right to live between them. #rationalists
12	T	The Gravity theory Scientist believes in God and says atheists are the most stupid.
13	T	Some atheists talk about the capital punishments for atheists in Islam; However, they ignore that it is applied through a justice body. #rationalists
14	T	#FreeSherifGaber This is the penalty for any beggar who trades in atheism and asks for funding to produce rotten mould.
15	T	#FreeSherifGaber he worked for months to prepare storytelling full of lies, ignorance and fabrication, but the response is quickly found.
16	T	RT @user Anyone who claims that violence against women and children is allowed in Islam is a liar. #Al-AzharIsComing
17	T	@hrw_ar We will stay protected by our families, and you should stop attacking our religious and cultural heritages. It is a crime against us.
18	T	#ChildrensMassacreInAfghanistan USA has problem with the Holy Quran not with Muslims. #Rationalists
19	W	Yes, the cost is prohibitive; there will be mass destruction, killing and displacement. But it is less costly than governing the Iranian criminal gangs #HashemiteOccupation
20	W	#OayedDoNotSteal, what are we did not discover yet from the Sahwa era?.
21	W	Lots of Hadiths were fabricated by Sahwa scholars and it is time to execute them. WeakHadithEmployedBySahwa
22	W	#WeakHadithEmployedBySahwa Assassinating #Sahwa is a national duty.
23	W	#CleaningSchoolsFromSururiWomen The school is an educational body. It shouldn't be part of a religious party, and it is unacceptable to be used for the interests of some!
24	W	Schools are the most places to spread Sahwa thoughts, specifically women teachers of schools in Riyadh. #CleaningSchools-FromSururiWomen
25	W	#CleaningSchoolsFromSururiWomen Obligating students to wear veil with the face cover enforces them to follow a certain jurisprudential.
26	W	Soon women will travel and enjoy their full rights the same as men. May Allah prolong the life of this leader. #CrownPrinceOn-CBC
27	W	Soon, there will be Shia members in the Council of Ministers and in the government. Also, the president of the most important university in KSA is Shiite. We have a mix of Islamic schools and sects #MBSInterviewsTheAtlantic

Figure 3.3: Sample (translated) tweets with Significant Hashtags. A: Atheistic, T: Theistic, and W: Tanweeri Timelines

Topics related to the oppression of women attract users from all groups. The hashtags ‘SaudiWomenDemandDroppingGuardianship’ and ‘StopEnslavingSaudiWomen’ come from a long-term online campaign led by Saudi women who want freedom from social restrictions and supported by feminists from the region and around the world. Atheist users claim that Saudi women must have their freedom of choice without the guardian system. For example, they will explicitly demand dropping restrictions on travelling, obtaining a passport, and driving. While some theist users show sympathy with the cause, most reject it. For example, one tweet claims that travelling on a passport is possible with the guardian’s electronic permission, and another claims that men manage the dropping guardianship campaign. Similar polarisation is found around the hashtags that talk about different cases of oppression against women, such as WhereIsAmna, AbusedWomanInAbha, SaveDinaAli, RefusedToReleaseHisDaughter and MajedManaOmairOppresseHisWife. All of these hashtags are related to cases of women in Saudi Arabia. Tweets number 5, 7, 9 and 10 in Table 3.3 shows some tweets related to these hashtags. Some theists support the victim, but others try to find excuses for the case. For instance, some theists in the latter hashtag claim that the wife benefits from the accusations and accuses her of treason.

All groups intensively discussed terrorism and terrorist groups. While atheists blame Islam for terrorist groups, such as ISIS, theists claim that Islamophobes use ISIS to equate Islam with terror. It is noticeable to see that Atheists prefer to mention ISIS by using its English acronym, Arabic name (The Islamic State *الدولة الإسلامية*), or the acronym Da’esh (داعش) within hashtags such as Da’esh_is_an_Islamic_Product. On the other hand, theists prefer to mention ISIS by its Arabic acronym. While some Tanweeris argue that ISIS is not real Islam, others blame religion, mainly Islam, for spreading terrorist groups.

In addition, the data set shows interactions with international organisations conducted by both atheists and theists. Atheists are willing to contact international organisations to seek protection or to promote their opinions (example: Tweet 6, Table 3.3), while theists also actively discuss their point of view on similar topics.

For instance, in Spring 2017, Human Rights Watch (HRW) tweeted that “An emergency case resulted from guardianship law in KSA #SaveDinaAli”. A theistic account denied that and argued that she might have escaped after committing a crime or that there is a missing piece of information in the story. Another tweet published by HRW argues that while allowing women to drive is a step forward, the guardianship law in Saudi should be abolished. A female theist replied with tweet number 17 in Table 3.3.

Another theist wrote: “@hrw_ar it is not your business”. In another tweet, HRW quoted a claim of prisoner abuse in Saudi Arabia published by the New York Times. A theist account denied that news and wrote: “You should have the truth, most of these news topics are fabricated”. These samples show that Arab theist society actively engages with reports by other organisations.

Theists are more likely to talk about Arab countries and Middle East countries, such as Iran and Turkey, than atheists and tanweeris. In contrast, the latter two groups are more interested in topics relating to Saudi Arabia. All classes are divided in their opinion about conflict regions in the Middle East. For example, most atheists look forward to dramatic changes in the relationships between Arab countries and Israel, while some refuse any rapprochement. However, most theists claim that news of such changes, especially regarding the relationship between Israel and Saudi Arabia, is fabricated.

3.3.2 Distinctive Topic Discussion by Groups

Table 3.3: The four most frequent hashtags used by each group compared with other groups Total Tweets Counts from Each Group Accounts

Hashtag (Translation)	Atheistic	Theistic	Tanweeri
تجاره الوهم (Trades of illusion)	859	5	40
ExMuslim	719	60	51
Atheism	614	72	27
التطور حقيقه (Evolution is a fact)	609	8	29
ملحد (Atheist)	166	1214	6
الالحاد (atheism)	129	473	6
مذبحة الاطفال في افغانستان (Afgan children's massacre)	16	449	9
دعاء (Pray)	2	403	0
الاحتلال الهاشمي (Hashemite occupation -over Yemen-)	1	0	236
لا تسرق يا عايش (O Ayed, Do not steal)	43	3	140
احاديث ضعيفه استغلها الصحوه (Weak Hadith employed by sahwa)	142	32	85
تنظيف المدارس من السروريات (Cleaning schools from Sururi women)	64	33	84

To have a clear understanding of the trends that are mostly used, we ran a logistic regression analysis for each of the three main groups (Atheist, Theist, Tanweeri) with the top 50 hashtags as features. The hashtags with the highest weight are considered to be particularly distinctive. In addition to the top 25 hashtags from each group and the combined among the three groups, which is shown in Table 3.2, a sample of the top 4 hashtags used by Atheists, Theists and Tanweer groups is demonstrated in Table 3.3.

The extended list of the top 15 hashtags with their frequencies from all groups is shown in the Appendix, Table 7.2. Both tables show the frequencies of each hashtag from the three groups.

The most frequent hashtags mentioned by atheists related to evolution theory, delusion trade, atheism and leaving Islam. The dataset shows that Arab atheists strongly support evolution theory and provide evidence to convince others. Most theists are not interested in discussing the theory, while others respond with the hashtag (خرافة_التطور) - “Evolution myth”). Atheists also show solidarity with other atheists or activists. That is clear from hashtags such as FreeSherifGaber, RaifBadawy, AbdullahAlQasimi (one of the most controversial Saudi writers according to several reports³), and OsamaAljamaa (Saudi Psychologist), which are cited and retweeted by atheists. Abdullah Al Qasimi, as described in tweets, changed his position from being an Islamic Salafi scholar to defending atheism and tanweer. At the same time, Aljamaa has written about personal development and self-awareness, and his works are cited widely by Arab atheists. Finally, atheists talk more about atheism and leaving Islam. Relevant hashtags include ExMuslim, Atheism, Atheist, TheReasonWhyILeftIslam, and Ex-MuslimBecause.

Most of the accounts in the theistic and tanweeri groups are located, or at least interested in topics related to, Saudi Arabia, which can be inferred from country-specific hashtags such as SaudiArabia, CrownPrince, MohammadBinSalman, CleaningSchoolsFromSururiWomen and TurkiAlSheikhThePrideOfPeople. Arab theists widely discuss atheism and atheist by using their Arabic names (إلحاد - atheism) and (ملحد - atheist). Theists discuss pan-Islam topics, which is clear from hashtags including ChildrensMassacreInAfghanistan, SpreadOfIslam, Palestine, AlAzharIsComing, AssadBombardDomaChemicalWeapons, Gaza, Aleppo, Turkey, and IranProtests. The first hashtag talks about the US-backed Afghan air raid, which killed around 150 people, including religious scholars, civilians, and children celebrating their memorisation of the Quran. The latter talks about the instability and protests in Iran.

Also, it is clear that most of the theistic content either discusses or criticises Christianity. This is shown by hashtags such as Truth about Christianity, Jesus, Christianity, Contradictions of the Bible, and Books about Christianity. In addition, hashtags relevant to terrorism are specifically used by this group. Theists talked about ISIS by

³<https://english.alarabiya.net/variety/2016/10/22/Meet-the-Arab-agnostic-who-went-his-own-way-in-the-1940s>
<https://www.alriyadh.com/513289> (Arabic)

using its short Arabic name *الدولة* (the state) and its leader (Al-Baghdadi). Theists also talk about Al-Qaeda, its Syrian branch (Al Nosra front and Hayat Tahrir Al-Sham), and their leaders -Algolani (Al Nosra) and Al-Zawahiri (Al-Qaeda)-, as well as conflict regions such as Al-Raqqah, Afghanistan, Syria, Palestine, Gaza, Aleppo, Iran and Yemen. One of the most significant hashtags used by theists is #Al-AzharIsComing. A famous Egyptian Islamic scholar publishes it. Theists widely retweet his tweets, and as described in his tweets, Al-Azhar is one of the oldest academic bodies in Islamic countries.

The typical hashtags used by Tanweeris are a mix of different cultures and opinions. One of the most discussed topics among tanweeris is the Hashemite Occupation, which talks about Islam and specifically about Houthis as an Islamic sect that took control over Yemen. Some of the tweets show the refusal of the existence of Islam as a religion in Yemen, but most of them talk about the conflict in Yemen and the rejection of Houthis. Also, Tanweeris discussed a wider spectrum of Islamic parties and movements. However, most of their discussions show solidarity with their governments against different Islamic parties and scholars. In addition, they show a clear rejection of the opinions of scholars and sheikhs. These tweets are also evidence of their solidarity with the government in KSA. This is reflected in tweets related to the Crown Prince of KSA Mohammad bin Salman interviews, as shown in tweets 26 and 27 from Table 3.3.

Interestingly, the most frequent hashtags are related to Saudi football, particularly a club from the capital of 'Riyadh'. Most of the accounts with tanweeri content are fans of this club. The hashtag Urawaian Proverbs is used by Al-Nassr FC fans to mock another team from the same city after being defeated by Urawa Reds FC.

3.3.3 Network Interactions around Atheism

Analysing the social network is an important step toward understanding the motivation of Arab atheists to declare their beliefs online. Here, three types of interaction networks are analysed, user mentions in self-written tweets, mentions in replies, and accounts that they retweet. Due to potential repercussions for the Twitter users mentioned, especially since some Arab countries criminalise atheism, we will not list the names of the accounts unless they are official news sources but instead characterise their content. Account names are available upon request from the authors after signing a confidentiality agreement.

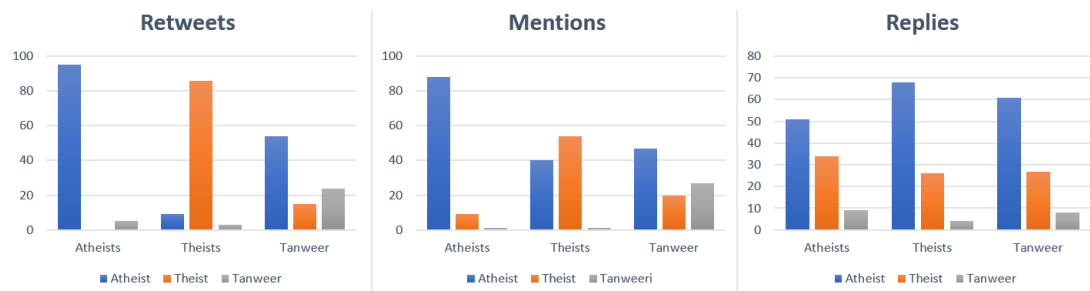


Figure 3.4: Interaction Network of Each Group

Interestingly, as shown in Figure 3.4, Atheists are more likely to mention, reply-to and retweet-to members of their groups. This Figure shows the number of accounts that each group interacted with. Also, they are the most mentioned accounts by users of different beliefs. This is aligned with the previous findings that Arab societies openly discuss their beliefs online. It might be good to investigate more the tweets that both Atheists and Tanweeris reacted to, especially given that Tanweeris are less likely to be mentioned by atheists. Atheists are also very active in publishing replies to members from all groups. A sample of these tweets shows that they support each other, defend their opinions, convince others, and discuss others' beliefs. Arab Theists are more likely to retweet each other than to retweet other groups. They amplify significant tweets, such as tweets published to explain a phenomenon and link it to religious belief or to support their opinions.

Even though many of the accounts mentioned in Atheist tweets are self-described atheists, the most frequently mentioned account belongs to a well-known supporter of the measures taken by the new Saudi leadership. The accounts with theistic content frequently mention accounts that belong to a famous religious figure or an active theist who defends Islam. Most Muslim believers argue against atheism and promote Islam in their timelines. Some Christian believers in the theistic group criticise Islam and argue against it without discussing atheism.

3.3.4 Domains Analysis

Web domains might give information about the source of information each group prefer. Hence, we analyse the most frequent domains used by each class. The top 5 domains of each group are listed in Table 3.4. The full list is shown in the Appendix Table 7.3.

The most frequent websites used in tweets by atheists are related to social media

Table 3.4: The five most frequent Domains used by Each class. Full list in the appendix

Atheists		Theists		Tanweer	
Domain	Freq.	Domain	Freq.	Domain	Freq.
ask.fm	901	du3a.org	11768	flwrs.com	323
wearesaudis.net	596	d3waapp.org	2807	crowdfireapp.com	134
goodreads.com	439	alathkar.org	1402	eremnews.com	63
ibelieveinsci.com	273	kaheel7.com	375	alqabas.com	59
dw.com	213	almohawer.com	327	thenewkhalij.news	57

platforms such as [instagram.com](https://www.instagram.com), [facebook.com](https://www.facebook.com), [pscp.tv](https://www.pscp.tv), [curiouscat.me](https://www.curiouscat.me) and [ask.fm](https://www.ask.fm). This might be because these websites help them to stay connected and reachable to other atheists in their societies and help them to share posts with atheism-relevant groups and users. The domain “wearesaudis.net”, also frequently mentioned by atheists, is an online forum that provides suggestions and guidance on how to seek asylum in different countries, including Israel. Atheists are also more interested in online resources about science, such as [ibelieveinsci](https://www.ibelieveinsci.com), and they often interact with non-Arabic news websites such as [dw.com](https://www.dw.com), [bbc.com](https://www.bbc.com), [arabic.rt.com](https://www.arabic.rt.com), [theguardian.com](https://www.theguardian.com), [independent.co.uk](https://www.independent.co.uk), [f24.com](https://www.f24.com), [dailymail.co.uk](https://www.dailymail.co.uk), and [nytimes.com](https://www.nytimes.com). Atheists also widely share online campaign posts from [change.org](https://www.change.org), which hosts many human rights petitions, and the domain of the organisation Human Rights Watch, [hrw.org](https://www.hrw.org). This organisation covers human rights in the Middle East, especially in the Arab Spring countries and Saudi Arabia.

On the other hand, the most frequent domains used by the theists are [du3a.org](https://www.du3a.org), [d3waapp.org](https://www.d3waapp.org), [alathkar.org](https://www.alathkar.org) and [7asnat.com](https://www.7asnat.com). These sites are auto-post services for Islamic supplications, aka duas, and notifications.

In addition, [qurani.tv](https://www.qurani.tv) and [quran.ksu.edu.sa](https://www.quran.ksu.edu.sa) are frequently used, but there was no way to determine if they are used as auto-post services or cited actively. The news sources preferred by believers are those written in Arabic, such as the Arabic service of Russia Today ([arabic.rt.com](https://www.arabic.rt.com)), Saudi Press Agency ([spa.gov.sa](https://www.spa.gov.sa)) and Sabq News ([sabq.org](https://www.sabq.org)). The most referenced non-Arabic news source by Arab theists is [cnsnews.com](https://www.cnsnews.com). However, most theists believe it is not a trusted source; it is regarded as a “liar” and “a conservative and right-wing American source”.

Like Atheists, Tanweers often share content from other social media platforms on Twitter. Relevant URLs include [curiouscat.me](https://www.curiouscat.me), [instagram.com](https://www.instagram.com), [facebook.com](https://www.facebook.com), and [pscp.tv](https://www.pscp.tv). They also use the tools to track and report the changes to their followers.

Similar to atheists, they are interested in scientific sources such as n-scientific.org. Tanweeris prefer to access and interact with a mix of official and non-official, Arabic and non-Arabic news sources. However, they prefer sources related to traditional newspapers such as alqabas.com, thenewkhalij.news, alghadeer.tv, aljarida.com and alhudood.net. Also, they use Iranian news sources such as mojahedin.org, Iraqi news sources such as alsumaria.tv and alghadeer.tv, and one non-Arabic source ansa.it. This supports our observation that Tanweeris are interested in challenging cultural restrictions in Arab societies and interacting with other cultures as inspiration for reform.

3.4 Summary

In this chapter, we investigated the first research question, RQ1:

- **RQ1** Do Arab Atheists discuss their beliefs on Twitter? and How other accounts interact with them?

and its two sub-RQs:

- RQ1.1: What are the common topics and features that Arab Atheists share that distinguish them from Theists, Tanweeris, and Others?
- RQ1.2: How do Arab Atheists interact with the other three groups?

We shed some light on a neglected but important topic, online discussion of Atheism in the Arab world. While our analysis is mostly descriptive and quantitative, we believe that it provides valuable insights into the atheist community in the Arab world and how they interact with other online users, which should provide a solid baseline for future work. Our analysis of the most active 434 Arab users on Twitter discussing atheism shows that there is a large discussion of the topic online between the three groups: 1) users promoting atheism and arguing against religion; 2) users who are refuting atheism and its arguments, and 3) users who do not explicitly deny religions but asking for reform of them.

Our findings show that much of the discussions about atheism in the Arab world include the situation in the Middle East. Atheists focus more on the rights of some groups in the Arab world, such as violence against women. Theists discuss more the national challenges facing society. Tanweeris were found to show more solidarity with their governments while criticising Islamic groups and their interpretation of Islam. We observed that Arab atheists are willing to communicate with foreign cultures, such

as Western news sources, TV shows, and worldwide organisations. Tanweeris interact more with traditional news sources such as newspapers and discuss non-religious content. Theists were found to reference much Islamic content in their tweets.

In the next chapter, we replicate this study with a better method to identify relevant Theist, Tanweeri, and Atheist users. The main motivation for the next chapter is to avoid the limitations we face in our analysis in this chapter. Limitations include noticing that labelling the content of the accounts would be considered breaching accounts' privacy. This is vital because, as we showed in this chapter, atheism is considered critical in Arab societies. Another limitation is that labelling the contents of accounts is a subjective process. This was clear from the accounts with Tanweeri-content and the accounts that publish tweets with different religious stances. We also noticed that our work in this chapter ignores many users engaged in religious and atheistic discussions. These users describe themselves as rationalists, and we will cover their group in the next chapter.

The next chapter will give us a more rounded picture of Arab religious discourse online. We investigate the network dynamics and the directions of interaction and links in more depth. We will also find how to consider the potential ethical implications, given that atheism is critical and illegal in Arab countries.

Chapter 4

Religious Polarisation in Arab Online Communities

4.1 Overview

In the previous chapter, we started our analysis of the online discussions of Atheism and religions among Arabs. It includes analysing the contents of the most active 434 Arab users on Twitter who discuss atheism and religions. However, our work has some limitations, such as the controversial labelling process for the content of the accounts. The labelling process is controversial because of its subjectivity and the possible ethical interceptions. The analysis of the previous chapter misses a group of users that is considered relevant to the religious and atheistic contents. So, we cover this group in this chapter to have a wider range of the religious spectrum.

Arabs actively discuss religious beliefs and political views over social networks (Weber et al., 2013; Whitacker, 2014; Abokhodair et al., 2020). In the last decade, Arabs have become increasingly polarised along a spectrum ranging from actively promoting non-belief (atheism) to promoting religious beliefs, including those are considered extreme or fundamentalist in the Arab world (Magdy et al., 2016b). The reasons behind the claimed rise of active atheists in Arab social media are unclear. Some researchers have suggested that this is due to the combined reasons of 1) the enormous spread of social media in the last decade and 2) the catastrophes that followed the failed Arab spring (Magdy et al., 2016b; Whitacker, 2014), which may encourage atheists to speak out more.

While there is a substantial body of work on political polarisation in the online Arab world (Weber et al., 2013; Borge-Holthoefer et al., 2015), relatively little is known

about how religious polarisation manifests itself in networks of social media users.

In this chapter, we aim to empirically investigate the social dynamics in online Arab communities that adhere to various levels of religiosity and non-religiosity. While there is obviously a political dimension to these religious issues as well, we believe that it is useful and necessary to fully focus on religious views to reveal the rich tapestry of online Arab belief and non-belief. We use Twitter because there is a rich literature on the expression of religious and political views on this platform, especially in the Arab world (Weber et al., 2013; Albadi et al., 2018; Abokhodair et al., 2020).

Our main research goal is to establish whether there is a polarisation between Arab Twitter users on different ends of the religiosity spectrum and to characterise the extent of this polarisation. Specifically, we answered the second research question:

RQ2 Does polarisation exist among Arabs with different beliefs? What are the characteristics of the network interaction of Arabs from the different religious spectrums?

To have a comprehensive answer, we investigated and answered the following three sub-research questions:

RQ2.1 What are the relevant communities of Twitter users, and where do they fall on the spectrum of religiosity?

RQ2.2 Do these communities form echo chambers, or do they have bridges between them?

RQ2.3 What is the nature of the networks that each of these religion-related communities interacts with?

To the best of our knowledge, this is the first study that investigates religious polarisation between theists and atheists on Arab Twitter without limiting itself to a particular region or country and without focusing on hate speech or specific sub-communities. We perform a comprehensive search of Twitter biographies to identify Arab users who actively talk about matters of belief and non-belief and use network analysis to show how these users engage with each other and with their communities. While most previous work on polarisation focused on analysing the retweet network among users, in our study, we investigate three types of networks for our studied communities: follow network (the accounts they follow), retweet network (the accounts they retweet), and mention network (the accounts they reply and mention in their tweets). This network

analysis adds an important sociocultural dimension to the study. It situates those accounts in the wider context of Arab and Western social media and allows us to surface relevant political discussions that go beyond advocating for religious fundamentalism.

As our starting point, we distinguish four categories of users based on their self-identification in their Twitter biography. Three of those categories are derived from Chapter 3, while the fourth emerged from the analysis of Twitter biographies.

Atheists: This category includes users who clearly show that they do not practice any specific religion. This group also includes those who used to adhere to an organised religion, such as ex-Muslims and ex-Christians, without showing another religious affiliation.

Theists: This category includes users who clearly state that they belong to an organised religion and promote that religion. Unlike Tanweeri, they are not reformists.

Tanweeris: This category, as introduced in Chapter 3 includes the accounts that described themselves by using the Arabic term *tanweeri* (تنويري). Tanweeri might adhere to an organised religion but demand or support reforms or changes.

Rationalists: This category consists of theist and atheist users who clearly label themselves as Rationalists (عقلانيون) in their Twitter biography. They emphasise rational and logical discussion of diverging points of view.

Our analysis of the networks of 2,673 users and the accounts they follow, mention and retweet shows that there are 4–7 more or less clearly delineated sub-communities of users, depending on the type of interaction that is used to build the networks. All analyses show that the large two groups, theists and atheists, are indeed polarised and echo chambers. Across networks, we also find that the Arab atheist community on Twitter are not one coherent body. A portion of this community is connected more to the western world and has most interactions with non-Arab users, creating a clear echo chamber that is isolated from all the Arab communities online, including other Arab atheists.

Our findings also indicate that while polarisation based on religion does exist on Twitter, there are natural bridges between the two opposite echo chambers, allowing for fruitful interactions and clear discussions on certain topics regarding religion. Tanweeri and Rationalists act as bridges between those communities, stoking the debates and facilitating interaction between diverging points of view. Thus, to understand the complex online dynamics of religious discussion on Arab Twitter, it is important to

acknowledge the role of the comparatively small Tanweeri and Rationalist communities who reflect the rich diversity of thought in the Arab world in general; and Islam in particular.

4.2 Background and Related Work

4.2.1 Influential Users Among Twitter

The importance of influential users in the social media context is understood from their roles to generate and diffuse ideas, promote knowledge, and attract users' attention and interactions from different backgrounds to engage in discussions (Riquelme and González-Cantergiani, 2016; Bakshy et al., 2011; Bodrunova et al., 2016; Abidin and Ots, 2016; Abidin, 2016). Hence, identifying the influencers and understanding their influence on others helps to understand the online behaviours of individuals and communities and how information spreads within them.

For example, the work by (Abidin and Ots, 2016) analyses social media influencers who joined campaigns aiming to discredit telecommunications providers in Singapore. They see how influencers can lead to trends that might be unethical or deceiving. They highlight that influencers and their followers are sensitive to what they experience as deceptive and unethical behaviours that put normative pressures on the influencers to conform to certain ethical standards. This even extends to affect the brand clients they talk about.

In our study, we study the accounts that are followed, mentioned and retweeted the most by the different religious groups. We notice that some of these accounts are influencers in different areas, such as politics or culture.

4.2.2 Religious Polarisation in Arab Twitter

Religious hate speech is a form of religious polarisation that has received much attention. (Albadi et al., 2018) studied six categories of Arab Twitter users who can be identified as Muslims, Jews, Christians, Atheists, Sunnis, and Shia. The authors found that hateful language was very common in their sample of Arab tweets with religious content. The most targeted groups are found to be Jews, Atheists and Shia.

The study which is perhaps closest to ours is Weber et al.'s (Weber et al., 2013) quantitative analysis of the polarisation between secular and Islamist Twitter users in Egypt. The authors expanded an initial manually labelled seed list of 22 politicians and

prominent users from both groups by using retweeting interaction to have about 7,000 accounts. Then they studied the top topics discussed by the two groups and measured how they are polarised by computing the valence of hashtags used in tweets published by their members. They found that hashtags used by both political sides could be used as a polarisation barometer as they coincided with periods of violent events. They showed that followers of accounts on the Islamist side are more likely to use Islamic and charitable terms and are less likely to use derogatory terms and hate speech when talking about followers of other religions.

4.2.3 Contribution of Present Study

Compared to the previous chapter, and the work performed by (Weber et al., 2013), this chapter provides an in-depth analysis of network polarisation on Arab Twitter as it relates to religion. While Weber et al. (Weber et al., 2013) also studied network polarisation between secular and non-secular groups, they did not expand their analysis to non-political contexts, and they restricted themselves to Egypt. In our study, we consider Arab Twitter in general as they discuss topics relevant to their own beliefs, whatever their political positions.

Furthermore, this chapter extends our work in Chapter 3. Here we consider accounts that clearly state their positions to study their interactions, paying more attention to influential accounts and those that Twitter has verified. We formally analyse the following, retweeting, and mentioning interactions to understand the polarisation between these communities and sample a wider collection of accounts which give more relevant information about such communities.

4.3 Data Collection and Method

Identifying the non-religious community in the Arab countries is difficult because atheism is either illegal or heavily socially sanctioned in the Arab World. Therefore, it is almost impossible to find representative organisations. However, as we have seen, non-religious Arabs are active on social media, such as Twitter (Weber et al., 2013). Therefore, following earlier work, we used seed accounts to identify relevant religious and non-religious communities on Twitter. While Facebook might be more popular in some Arabic countries (especially north Africa), we conducted our study on Twitter since it is a more open platform where data collection of public posts could be

easily collected using their API, unlike Facebook, which is highly restricted and data collection is not allowed. In addition, as shown in the previous section, most of the literature works applied to Arabic social media were on Twitter data. Thus, our study here continues in the same direction.

Data collection was performed over two stages. Initially, we identified the relevant accounts that disclose their position towards religion. Then, we expanded the data set by adding the accounts they follow or interact with.

4.3.1 Ethical Issues

Discussing non-religion is sensitive, especially in the Arab and Muslim communities. During this study, we took several measures to protect Twitter users' identities. First, we focused on users who clearly stated their religious orientation in their Twitter biographies at the time of data collection. Secondly, we do not perform any statistical analysis to infer information about these accounts, such as gender, that they do not wish to disclose. When we talk about people behind individual accounts, these are either verified by Twitter or well-known figures with a public and social media profile across several platforms. Finally, most sample tweets we provided are either slightly rephrased (for English tweets) or translated (for Arab tweets). We only provide original tweets where the user tweeted a headline together with a link to a web page. We also note that individuals' religious beliefs change - accounts may be deleted, Tweets may be deleted, and authors may modify their biographies to highlight changes in belief or loss of faith.

4.3.2 Collecting the Seed-list Data Set

To answer RQ2.1 (identifying relevant communities of Twitter users), we searched for users who explicitly state their position toward religions in the screen names, user names or descriptions (bios) of their Twitter accounts. To do so, we compiled a list of Arabic terms that can be used to reflect a relevant position towards religions and refuting or challenging others' beliefs. We considered all the different morphological forms that can be derived from these terms because Arabic is one of the most inflected languages, and one word can have many morphological variations (Darwish and Magdy, 2014). In addition, we used terms inspired and accumulated in the iterations of analysis and data collection, such as hashtags عقلايين (Rationalists) and صناعة_المحاور (Creating_the_interlocutor), which are both used in atheism/religion de-

bates. When choosing keywords for theist accounts, we found that using generic terms such as Muslim, Christian, or believer yielded a large number of irrelevant accounts, since many Arab Twitter users add their religion in their account descriptions even though they don't discuss their beliefs in their timelines. In total we compiled a set of 118 terms and listed in Table 4.1. Table 4.2 shows a few examples of the Arabic terms used along with their English translations.

Group Label	Term
Atheist	ملحدة سابقة , ملحدون , ملحدين , مليون-ملحد-عربي , نقد الإسلام , مستلحدين , ملاحدة , ملاحده , ملحد , ملحدات , ملحدة , لادينيون , مستلحد , مستلحدات , مستلحدة , مستلحده , مستلحدون , لا دينيون , لا دينيين , لا ديني , لاديني , لادينيات , لادينية , لادينية , لادينيون , ربوبيون , ربوبيين , صلعم , لا ديني , لا دينيات , لا دينية , لا دينيه , إلحادية , إلحاديون , إلحاديين , ربوبي , ربوبيات , ربوبية , ربويه , الملحدات , الملحدة , الملحدون , الملحدين , إلحاد , إلحادي , إلحاديات , المستلحده , المستلحدون , المستلحدين , الملاحدة , الملاحده , الملحد , اللادينية , اللادينيون , اللادينيين , المستلحد , المستلحدات , المستلحدة , اللا دينيه , اللا دينيون , اللا دينيين , اللاديني , اللادينيات , اللادينية , الربويه , الربوبيون , الربوبيين , اللا ديني , اللا دينيات , اللا دينية , إلحاديون , إلحاديين , إلحاديه , الربوبي , الربوبيات , الربوبية , el7ad, Atheist Arab, Arab atheist
Theist	ملحد سابق , صناعة-المحاور , صناعة-المحاور , صناعة المحاور
Ex-Theist (Relevant to Theist)	مسلمة سابقة , مسيحي سابق , مسيحية سابقا , Ex-Muslim , مسلم سابق , مسلمة سابقا
Rationalist	عقلاني , عقلانيات , عقلانية , عقلانيه , عقلانيون , عقلانيين , العقلانيات , العقلانية , العقلانيه , العقلانيون , العقلانيين , العقلاني
Tanweer	تنويرات , تنويرية , تنويره , تنويريون , تنويريين , التنويرية , التنويره , التنويريون , التنويريين , التنويري , التنويريات

Table 4.1: Terms Used to Identify the Initial List of Accounts in Each Group

Search term	Translation	Search term	Translation	Search term	Translation
ملحد	Atheist	مسلم سابق	Ex-Muslim	ملاحدة	Atheists
لا ديني	No-religion	تنويري	Tanweeri	مستلحد	Extreme-atheist
ربوبي	Deist	عقلاني	Rationalist	الحاد	Atheism

Table 4.2: Sample of the core terms used to search for profiles with their translations. All variations are used for each term, including the singular/plural and masculine/feminine versions. The list on the right references atheists as usually used by those refuting atheism.

This set of 118 terms was then used to search for user profiles that have any of them in the profile name or description. We used Followerwonk¹, an online tool that allows searching user profiles and screen names, as this functionality is unavailable through the Twitter API.

Our search process was done in January 2020, and we successfully retrieved a set of 5,010 Twitter accounts that use at least one of the selected terms in their profile.

We manually analysed profile names and descriptions to exclude irrelevant accounts and assign relevant accounts to one of four categories: Atheist, Theist, Tanweeri, and Rationalist. Unrelated accounts were retrieved for several reasons. Most of the Arabic tokens in the extracted list have homonyms. The same token might give different meanings depending on the context or their diacritics, which is rarely used in Arabic social media text (Darwish et al., 2012). For example, the Arabic word عقلاني (rationalist) is used in different contexts such as personal names (mainly surnames), sports and football clubs, social relations in addition to the religious context.

More drastically, some accounts used the term atheism in the sport context. For example, some accounts' descriptions state that "Atheism in football is to deny the historical leadership of a specific football club".

After this process, a set of 2,356 (47.02%) accounts remained relevant. We then collected the *Networks* of the 2,356 accounts. These networks are all accounts that these users followed and interacted with by retweeting, replying, or mentioning. We then searched the profiles of those accounts for any of our 118 terms to be sure that FollowerWonk might have missed nothing. We retrieved 520 accounts which belonged to one of the four categories. Next, we collected their timeline data from January 2020, in which we collected their timelines tweets up to the Twitter API limit of 3200 tweets;

¹<https://followerwonk.com>

and we kept collecting their new tweets until the end of June 2021. We limited the study to be for the period January 2018 to June 2021 inclusive.

Next, from this set of 2876 accounts, we removed those with no tweets in their timelines or who have not interacted with other accounts on Twitter. Our final set of accounts included a total of 2,673 (92.95%) Twitter accounts. We call this set of accounts our *seed list*.

4.3.3 Network Analysis Methodology

In this section, we present our methodology for constructing and analysing the social media networks of Arab Twitter users from different religious affiliations. To answer RQ2.2 and RQ2.3, we examined how the four religious communities interact with each other; and the nature of the network of influential users located within each of them.

Constructing the Follow, Retweet, and Mention Networks

According to (Aldayel and Magdy, 2019), there are three types of networks for each social media user:

1. the connection network (CN), which represents the network of accounts the user is connected to;
2. the interaction network (IN), which represents the network of accounts the user interacts with through retweeting and replying;
3. the preference network (PN), which are the accounts mentioned in the posts (tweets) the user likes.

It was shown that these networks could be enough to predict the users' views and beliefs (Aldayel and Magdy, 2019). Thus, in our study, we decided to analyse the CN and IN networks from our dataset. Particularly, we are interested in investigating the accounts that our groups follow (the *follow network*), those they retweet their posts (the *retweet network*), and those they mention/reply to in their tweets (the *mention network*). The follow network is part of CN, while the retweet and mention networks are part of IN.

For each of the 2,673 seed list accounts, we collected the list of accounts they follow and their timelines, which contain all the accounts they have retweeted and mentioned/replied to. The seed list accounts follow 550,238 Twitter accounts, retweet

142,880 accounts at least once, and mention or reply to 142,472 accounts at least once. We call these accounts *network accounts*.

The majority of these network accounts are followed, retweeted, or mentioned by only one of the seed list accounts, which means that the network will be highly sparse if plotted. In addition, an account that only a few of our seed accounts interact with may not be relevant. Finally, very large, sparse networks can be difficult to interpret. Thus, we used thresholds to ensure that the accounts in our follow, retweet and mention networks are relevant to several of the users in our seed list. For the **follow network**, we included accounts that were *followed* by at least 20 seed list accounts; for the **retweet network**, we included accounts that were *retweeted* at least once from at least 10 seed list accounts; and for the **mention network**, we chose accounts that were *mentioned* or *replied to* by at least 20 seed list accounts.

After applying these restrictions led to filtering out the majority of the accounts in the network; the size of the follow network is 5,150 accounts, the size of the retweet network is 5,404 accounts, and the size of the mention network is 7,707 accounts.

To ensure that the resulting network analysis was not unduly skewed by these thresholds, we performed all analyses, both with and without thresholding. Since the clusters generated in both instances were very similar, we report only the findings generated with thresholding, as they are easier to visualise and interpret.

4.3.4 Analysing the Follow, Retweet, and Mention Networks

In our analysis, we focus on the nature, influence, and positions of our seed accounts among the follow, the retweet and the mention networks.

We apply a graphical network visualisation to our seed accounts and their follow, retweet, and mention networks. We use Gephi², which is an open-source software for network analysis and statistical measurements for graphs with visualisation capabilities (Bastian et al., 2009). To generate the network graphs, we use the default values of most of the parameters of Gephi. The layout algorithm we use is ForceAtlas 2 (Jacomy et al., 2014), by setting the scaling and gravity as 10 and 1, respectively. To identify the sub-communities within the follow and retweet networks, we used the modularity algorithm (Blondel et al., 2008). We conducted several experiments to select the settings that produce reasonable and harmonious communities. To perform that, we manually investigate the resulting sub-communities for each experiment. With harmonious

²<https://gephi.org/>

communities, we mean maximising the number of nodes in each cluster, minimising the number of clusters, and grouping the majority of public and well-known accounts within a similar featured group with the least modifications for the default parameters of Gephi's functions.

For the *follow network*, we computed the modularity by using different values within the suggested range by its authors, i.e. [0.1 - 2], and studied the resulting communities from these values. We found that a resolution of 0.75 gives us reasonable communities in which most of the large component nodes, i.e. the well-connected accounts, in each community share similar characteristics.

For the *retweet and mention networks*, we used the default value for the modularity resolution, which is 1. Experiments showed no substantial differences in the results when we used different values to cluster the communities.

The final follow network graph has 0.063, 0.435 and 11 for average clustering coefficient, modularity and diameter, respectively. The mention network graph has 0.058, 0.692 and 14 for average clustering coefficient, modularity and diameter, respectively. Finally, the retweet network graph has 0.035, 0.485 and 19 for average clustering coefficient, modularity and diameter, respectively.

For the three networks, we plot the network graph twice, once including our seed accounts only to measure the connection among them, and another one with their follow, retweet, or mention networks to visualise the distribution of the different clusters of accounts in these networks, as shown in the next section in Figures 4.2, 4.3, and 4.4.

Network Interpretation

We manually interpreted the resulting clusters using a combination of qualitative and quantitative approaches. For the follower and retweet network, we manually collected the publicly available information about accounts' owners, including checking their official web-page and watching a few of their online videos/lectures (where applicable). These systematic observations were distilled into an overall theme for each cluster.

For the mention network, we were interested in the topics of the tweets where the accounts were mentioned or replied to. The quantitative and qualitative analysis methodology differs from the previous two networks. Here we inspect the tweets that have the mentions and replies to extract the main topic of discussion and name the cluster accordingly in Table 4.9. Since there are a large number of tweets in each cluster, we applied a topic extraction using LDA (Blei et al., 2003). First, we extracted all tweets by the seed list accounts that mention or reply to a member of the mention

network. Tweet texts were pre-processed by removing special characters (except the At-sign and the hashtag sign) and URLs and converted into input for LDA using a TFIDF vectorizer. LDA was performed using the implementation in the Python package GenSim ³ to extract the top five topics for each cluster. Topics were named based on the representative words.

4.3.5 Considered Limitations

This study provides deep insights to explain the general theme with a detailed analysis of the network dynamics and content generated by the covered Twitter Arab users. This study explains the network interactions and data generated by the considered accounts that share a set of opinions and religious-based features over Twitter during this study. It is important to mention that the resulted network of users from the four groups is not representative of the active users on Twitter who are not covered in this analysis nor the users of other social media platforms. On the other hand, studies argue that online communities over a social media platform is not representative for the communities with same perspectives over other social media platforms, other users within the same social media tool, and the relative communities in the real life. In other words, to consider the outcomes of this study generalizable, it is important to consider that online social media users are not representative of the population in real life, nor the Twitter users are representative of other social media tools such as Facebook and TikTok, and other users on Twitter such as the silent and non covered active users (Wellman and Gulia, 1999; Driskell and Lyon, 2002; Kaplan and Haenlein, 2010; Fardouly and Holland, 2018).

4.4 Communities of Twitter Users that Debate Religion

This section is an attempt to answer the first sub-section, RQ2.1. The 2,673 accounts in our seed list data set are distributed among the four religious groups, as shown in Table 4.3. Almost half of the accounts belong to the atheist group, while 26% and 21% belong to the theist and the Rationalist groups, respectively. The Tanweeri group has the smallest number of accounts, where only 5% of the accounts belong to it. This biased distribution towards atheist accounts could be expected since most of the search terms we used for collection have focused on the atheism topic. Thus, the theist

³<https://pypi.org/project/gensim/>

accounts in our collection are those that mention they refute atheism in specific in their profile.

We further manually labelled the theist accounts to classify their religion. Annotation was based on what users explicitly mention in their profile or what we can infer from what they share on their timeline (such as verses from Quran or Bible). As shown in Table 4.3, the vast majority of the theist group belongs to Islam, with two out of them mentioned in their profiles that they are Jihadi; 32 accounts are Christians, three Hindus and one Jewish.

The most frequently mentioned terms in the biographies of the atheist group include atheism, non-religious, humanist, rationalist, secularist, ex-Muslim, and Liberal. The rationalist group use both terms that are relevant to their belief about rationalism in general, such as thoughts, thinker, and logic, as well as more passionate and emotional terms such as lover, love, hate, and poet. A few members of this group also show their support of certain Arabic football clubs. Tanweeri accounts use more terms relevant to enlightenment (as a verb and a noun form). They often use the terms liberal, society, world, educated, Saudi, parody, religion, and peace. The most frequent terms used by Theist accounts are atheists (plural form in specific, especially the version الملاحدة, which is a sarcastic plural version of atheists in Arabic, unlike the normal version الملحدون), atheism, Islam, صناعة_المحاور (Creating_the_interlocutor, an online academy that teaches how to refute atheism and non-religiosity), Christian, Jesus and conservative.

Table 4.4 shows a sample of the bios (translated to English) of the accounts in our seed list dataset with their corresponding category.

Demographics

We extracted information about account type, gender, and location from the account descriptions. We used gender and location information specified by the Twitter users themselves, even though we are aware that they may be misleading since giving a false gender or location might be a conscious, privacy-preserving choice. The type of the account is either a person or a page. Page accounts include those that represent companies, organisations, campaigns or groups of interest, such as accounts for groups promoting or refuting religion/atheism. When the account shows that it belongs to a person, we label the gender of the person if it is clearly stated in the account's description and name as male, female or transgender; otherwise, it will be labelled as unclear, such as accounts using nicknames.

Belief	N	%	Religion	N	%
Atheist	1304	48.8%	Muslim	644	94.43%
Theist	682	25.5%	Christian	32	4.70%
Rationalist	549	20.5%	Hindu	3	0.45%
Tanweeri	138	5.2%	Jihadi	2	0.30%
Total	2673	100%	Jewish	1	0.15%
			Total	682	100%

Table 4.3: Distribution of categories (left) and religions represented in the theist group (right) in our seed list dataset.

Group	Bio (Translated)
Atheist	Before #Atheism, I was a miserable, disobedient, passive person with goal-less life, and I am eventually going to hell... #Now I am a new person, optimistic #lover_of_life... I will leave my mark and #go_away. #Agnostic
Atheist	I try not to think, but I find myself thinking; how do I stop thinking? I insult religion twice and atheism once; I belong to humanity, not religion, not belief nor theory.
Theist	I seek refuge in God from every atheist, and I seek refuge in God from anyone who follows other than Islam .. (Guide us to the straight path). Yes, really, it is my religion, the religion of truth.
Theist	Atheism is a void that must be filled with a religion someday! ... Religion is a human need... there are cities without education, but there are no cities without temples!
Rationalist	A rationalist interested in science and philosophy, interested in freedom and equality, human rights activist, and freelance writer.
Rationalist	Rational, taciturn, music-loving, sportive.
Tanweeri	Tanweeri religious researcher (masculine). Columnist, I wait for the mind's winning day.
Tanweeri	Tanweeri (feminine)... Before you argue, test your axioms by looking impartially at the opinions of its dissenters.

Table 4.4: Samples of biography description of the Twitter accounts from the four groups in our dataset

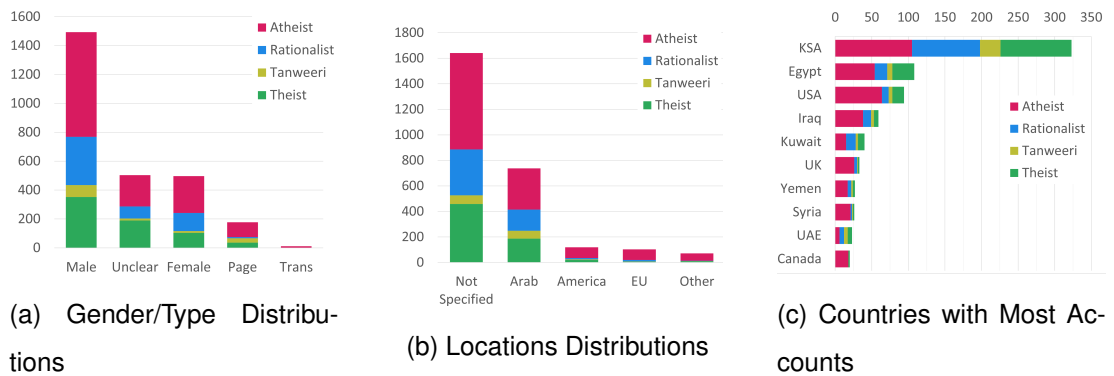
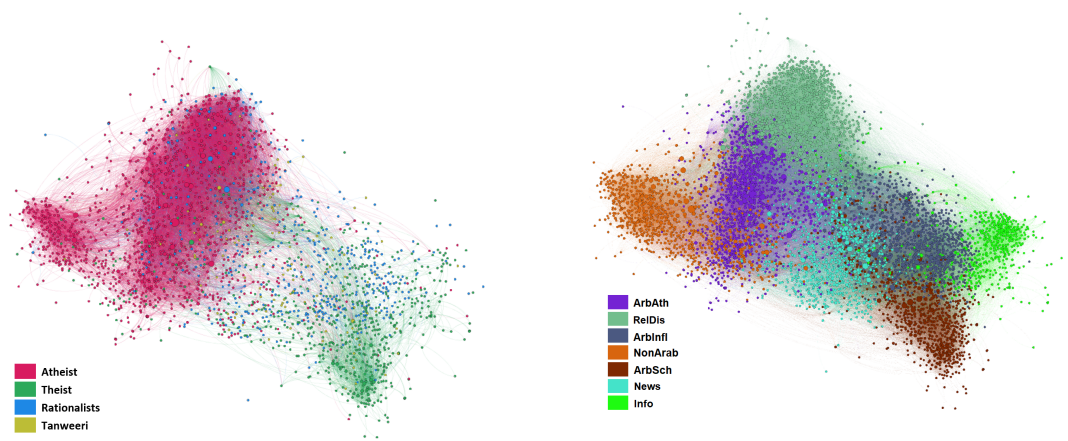


Figure 4.1: Distributions for Dataset Accounts

Location is identified by using the location field of the account profile if it exists and indicates a meaningful location. Many accounts have empty location fields or meaningless locations (e.g. "hellfire") (Hecht et al., 2011). When the account mentions multiple locations in their profile (e.g. "Saudi Arabia and the USA"), we consider the Arab country or the first mentioned one.

Figure 4.1 summarises the demographics of our seed list. As shown in Figure 4.1a, the majority of the accounts holders in our collection are male (55%), while less than 20% are female. This ratio is almost consistent across all account groups. Three of the atheist accounts mentioned they are transgender in their profiles. The remaining accounts (around 20%) do not provide clear gender information in their profile. Around 200 of the accounts are pages, mainly promoting atheism, while a small percentage of those are refuting atheism or representing rational and Tanweeri groups.

As shown in Figure 4.1b, most accounts (over 60%) do not share their location. Most of those who have stated a meaningful location that they live in Arabic countries, which is expected since we focused on Arabic terms when searching for those accounts. A small percentage were found to be living in North America and Europe. Figure 4.1c lists the top 10 countries identified for the accounts. Saudi Arabia (KSA) has the largest number of accounts, followed by Egypt, the USA, Iraq, and Kuwait. It can be noticed that the atheist accounts have a lower percentage in KSA, Egypt, and UAE, unlike the general distribution of those accounts in other locations. This might be due to several factors, such as the restrictive laws and stigma against atheism in these countries. It is also possible that atheists in these countries prefer not to share their location.



(a) The follow connections among our seed accounts. Node colours represent each group in our dataset.

(b) The follow connections among the seed accounts and their Follow network. Nodes colours represent different clusters obtained based on modularity

Figure 4.2: Visualisation of the follow connections among our data set and their network, including only accounts followed by 20 or more of the seed list. Description of cluster names is provided in Table 4.5

4.5 Echo Chambers, Bridges, and Network Structures

In this section, we introduce the experiments and analysis we followed to answer the two sub-questions, RQ2.2 and RQ2.3. We describe the network analysis results for the follow, retweet, and mention networks. For each network, we portray the nature of the network's clusters and identify echo chambers and bridges. We conclude by discussing the intersection between all three networks.

4.5.1 The Follow Network

Figure 4.2 shows the network representation of the follow network among our seed list (4.2a), and among our seed list and their follow network (4.2b).

Network Clusters

Seven clusters emerged from the analysis. The characterisation of each cluster is summarised in Table 4.5. Below, we describe each cluster in more detail.

ArbAth: Arab Atheists. Most of the seed list accounts in this group are Arab atheists. Overall, the accounts in this group promote atheism, view religions as irrational,

Cluster	Theme (name)	Description
ArbAth	Arabic Atheists	Arab atheists and secularists tied more strongly to non-Arab atheists
RelDis	Discussion of Religion	Arab atheists and secularists group, linked more strongly to non-religious Arabs
ArbInfl	Prominent Arabic Accounts	Most influential Arabs
NonArab	Non-Arabic & Western	Non-Arabic accounts that are critical of religion
ArbSch	Arab & Islamic Scholars	Arab accounts that promote religion
News	News & Journalists	International public figures, politics, singers
Info	Infotainment	Regular non-influential Arabs and entertainment personalities

Table 4.5: Cluster Themes for the Seven Groups in the Follow Network

Cluster	Total Size	Seed list				Non-Seed list
		Atheist	Rationalist	Tanweeri	Theist	
ArbAth	941	447 (47.5%)	29 (3.1%)	15 (1.6%)	59 (6.3%)	391 (41.6%)
RelDis	910	299 (32.9%)	9 (1.0%)	11 (1.2%)	68 (7.5%)	523 (57.5%)
ArbInfl	850	17 (2.0%)	92 (10.8%)	26 (3.1%)	182 (21.4%)	533 (62.7%)
NonArab	733	316 (43.1%)	25 (3.4%)	3 (0.4%)	10 (1.4%)	379 (51.7%)
ArbSch	649	8 (1.2%)	269 (41.4%)	25 (3.9%)	25 (3.9%)	322 (49.6%)
News	634	116 (18.3%)	55 (8.7%)	21 (3.3%)	84 (13.2%)	358 (56.5%)
Info	433	15 (3.5%)	96 (22.2%)	7 (1.6%)	39 (9.0%)	276 (63.7%)

Table 4.6: Distribution of Accounts Followed by dataset Accounts

and criticise the traditions and cultural values of Arab religious communities. They tend to follow Arab and non-Arab atheists from RelDis and NonArab groups. The personal accounts in this group tend to use names that show their origins or affiliations, such as mol7d_Arabi⁴ (meaning: An Arab atheist), _PROMETHEUS_1⁵, ArabIrreligious, and so on. Also, the screen names of non-seed list accounts tend to reflect atheist affiliations and stances, such as CurseOfIslam, AngryEgyptian1 and BigLieReligion. Some accounts criticise religions and promote secularism without reflecting their affiliation, such as aba_akrama, or declaring their position as Liberal_Infidel.

This cluster also tends to follow accounts which tweet about science, knowledge and exploration without mentioning any affiliation in their timeline, such as yousefalbanay from Kuwait and ScientificSaudi from Saudi Arabia. There are some non-popular theist users that follow atheist accounts, whether to criticise atheism or to criticise other religions, such as SaudiChrstian93 and SaudiChristian, who describe themselves as ex-Muslim Christians and denounce Islam. This cluster also contains some personal accounts that belong to well known Arab people due to their relationships, roles in their societies and their religious and political stances, such as MaysAlsuwaidan, HsnFrhanALmalki, TurkiHALhamad1 and MadawiDr. These accounts usually discuss sensitive topics related to secularism that grab public attention and create online debates. While all these accounts demand secular communities, some strongly support their governments, such as TurkiHALhamad1; others criticise it and demand political reforms, such as MadawiDr.

RelDis: Discussion of Religion. As for ArbAth, atheists are the majority in RelDis, and theists are a minority. The majority of this group tend to actively promote atheism and criticise religions such as DrTalebJawad, SherifGaber and hamed_samad. Also, in this cluster, we found some Israeli accounts that tweet in Arabic, such as IsraelArabic and EdyCohen. This group also actively campaigns for secular societies founded on rationalist principles. Some accounts do not declare their affiliations. Some of these accounts show they belong to or solidarity with the LGBTQ community, such as LGBTQarabic.

A good example of a RelDis account is Na9eR_Dashti, which is the account of Naser Dashti, a well-known Kuwaiti secular activist who actively discusses his point

⁴This name written by using Arabizi which is a form of writing Arabic in Latin letters, numbers and punctuation rather than Arabic letters

⁵Prometheus is the name of one of Titans which is believed to be one of the supreme tricksters in Greek religion, and a god of fire (of Encyclopaedia Britannica, 2020).

of view with others with respecting their rights to practice whatever they want as that does not harm others. In an interview⁶, Dashti states that he is a secularist and that he believes in the logic of reasoning and science in the areas of science, culture and even politics; but, according to him, faith is a spiritual experience for the individual. While this group has well-known accounts discussing religions and atheism, such as jaafarAbdulKari, hamed_samad and DrTalebJawad, it includes some satirical accounts that mock principles of religions, mainly Islam, such as OwaisMaqdesi, TwiceThinker, Suhaibfather, and shikh_elroibda.

Like ArbAth, RelDis includes science accounts by known scientists such as NidhalGuessoum, a verified account of an ex-researcher in NASA and tweets a lot about science and astronomy; and other unknown such as SciTalk2U, IBelieveInSci, NasaInArabic and Arabic_Nasa. The latter two accounts tweet in Arabic about exploration news from NASA. They both are not verified by Twitter nor officially linked to NASA.

ArbInfl: Influential Arabic Accounts. The third group, ArbInfl, contains accounts of non-popular seed list accounts, and the majority are rationalists; atheist accounts are the minority. In addition to theist members, there are Tanweeri of two spectrums, religious and social reformers. These seed list accounts tend to follow well-known figures in the Arab communities, mainly from the Arabian peninsula (i.e. Arab Gulf countries, Yemen) and Iraq. This group includes several accounts that belong to members of royal families such as KingSalman, MohamedBinZayed and abdullahthanii, popular individuals such as ministers from Saudi Arabia (AdelAljubeir) and Emirates (AnwarGargash), journalists, writers, actors, and shows presenters such as OlaAlfares and OthmanAlomeir; the Saudi TV presenter nadinealbdear, which is one of the first Saudi women TV presenters who demanded liberal society; poets (yasseraltwajri), and singers (AhlamAlShamsi).

The cluster also contains official news sources such as spagov and AlArabiya_KSA; unofficial news sources (ajlnews and AjelNews24), magazines (Saco_KSA), and well-known Saudi football clubs exist in this group, such as Alhilal_FC and AlNassrFC.

The scholars in this group are Islamic scholars or figures mainly from KSA and UAE such as SalehAlmoghamsy and Waseem_Yousef, who are known for their support to Arabic governments; academic members such as HatoonALFASSI and Abdulkhaleq_UAE; and some controversial tanweeri accounts such as Dr_Mhd_Shahrou,

⁶<https://www.youtube.com/watch?v=63wURurp3hI>

DrAdnanIbrahim and salrashed. While the first two provide new readings of the Quran, according to them, and Islamic principles, the latter discuss social reforms and personal development topics.

NonArab: Non-Arabic and Western. Almost 75% of our seed list accounts in the NonArab group are atheist accounts such as CEMB_forum, ExmuslimsOrg and Bas-samius. This group consists mainly of Arabs and non-Arab ex-Muslims who live in the West, establish or join organisations that support their stances, or tweet about religions in Arab countries, Iran, Pakistan and India. Oprah, and BillGates, in addition to many others, and some non-Arabic media sources such as AJEnglish and Reuters.

The accounts in this cluster include non-Arabic atheists/agnostics speakers and show presenters (e.g. SamHarrisOrg), Western atheists or agnostics scientists (e.g. RichardDawkins), Arab immigrants residing in the West (e.g. Ayaan), non-Arab Ex-Muslim immigrants who live in the West (e.g. MaryamNamazie), non-Arab secular Muslim immigrants (e.g. MaajidNawaz), former presidents of the United States (e.g. BarackObama and realDonaldTrump), non-Arabic religious people such as DalaiLama (The highest spiritual leader of Tibetan Buddhism) and benshapiro, official international organisations (hrw) and non-official organisations (HumanistsInt), Western popular figures such as (JustinTrudeau); Israeli politics (netanyahu and IsraeliPM); US organisations (NASA and FBI); Technology companies (Microsoft and Facebook); and entertainment series such as GameOfThrones.

ArbSch: Arab and Islamic Scholars. The general theme of the cluster ArbSch is promoting religion and refuting atheism. Interestingly it does not include many of the theist accounts in our seed list. It contains verified accounts for famous Muslim scholars such as MohamadAlarefe; women academics and Islamic scholars such as rokaya_mohareb_; Quran reciters such as Alafasy, poets such as Dr_Ashmawi, Muslim academics, intellectuals, and thinkers of different topics such as LoveLiberty (a specialist in political communication), Talhabeeb (consultant in psychiatry), MidoAlhajji (social and behavioural science), TareqAlSuwaidan, (historian and specialist in management), drjasem (social, educational and behavioural patterns specialist), mshinqiti (specialist in Islamic political thought and ethics); and DrAlnefisi (Political thinker); political and social activists, members of parliaments, and whistleblowers from different backgrounds and different Arab countries that demand political and social reforms such as saadalfagih, nasser.duwailah and mujtahidd; Islamic studies centres,

institutions, and programs that promote Islam and discuss or criticise atheism, such as takweencenter, Almohawer_T, and Wesal_TV. Also, this group contain some official Arabic news source (AJABreaking), non-official news source (3ajel_ksa), infotainment accounts (naizaktv), and Arab journalists and TV presenters such as Jkhashoggi and MousaAlomar.

In addition, there are personal accounts that impugn atheism and promote religious views, including popular Arab scholars (Dr_EyadQun, FadelSoliman, abosaleh95, and AhmadyuAlsayed), or some pseudonymous accounts (Ex_AtheistGirL); We noticed some accounts that belong to Arab political writers and activists (YZaatreh and EHSAN-FAKEEH) and specialists in technology who use their social media to raise technological awareness among Arab users (CyberkovCEO and Abdulaziz_Hmadi). The most interesting religious account in this cluster is PvGovSa, the verified account of the Committee for the Promotion of Virtue and the Prevention of Vice in Saudi Arabia.

News: News and Journalists. The majority of seed list accounts in the News group are atheists, while both theists and tanweeri accounts are minorities. However, there are some noticeable theist and rationalist accounts, such as BrotherRasheed, an Ex-Muslim Christian who criticises Islam, and hanyfreedom, who defines himself as an atheist from a Christian background. BrotherRasheed is well known for his TV show: Let's Be Clear and Daring Questions.

Where ArbInfl consisted of Arab influential figures and public accounts that are mostly followed by theists, the News sub-group represents those influential figures and public accounts that are mostly followed by atheists. Specifically, the group consists of Arabic news sources and TV channels (AJArabic and AlArabiya) and non-Arabic media (CGTNOfficial). It also includes some Muslim scholars (alqaradawy and DrAliGomaa), presidents and royal family members (TamimBinHamad, KingAbdullahII, AlsisiOfficial, MuhammadMorsi and Israelipm_ar), Arabic political thinkers (abdelbariatwan and AzmiBishara), public Arab figures (walidjoumblatt, and ElBaradei), journalists, writers and TV presenters (kasimf and FatimaNaoot), and symbolic accounts for writers and poets (Mh_Darwish, Wam_Shakespeare).

It also includes some Western and international organisations that tweet in the Arabic language, such as (USAbilAraby and hrw_ar) famous international professional football players, singers or show presenters (MoSalah, Rihanna, Oprah and elissakh), Arab and international football clubs such as (realmadrid and AlAhly), international football organisations (fifacom_ar), and Israeli accounts (Israelipm_ar and

AvichayAdraee).

Info: Infotainment. The last group, Info, has the majority from rationalist seed list accounts, while atheist accounts are the minority. Some of the theist accounts in this group criticise non-religiosity and organise an ‘electronic attack’ against the atheistic contents and accounts on Twitter such as (Anti_Godlessnes and SalwaSsee). It seems that they work in groups as most of them share the same hashtags *#جيش_السنه* (Sunna’s Army) and *#جيش_عمر* (Omar’s Army). Some theist accounts only show their affiliation without showing any stance towards others, such as *saudi_raiq*.

The accounts in this group tend to follow infotainment accounts such as *AQWAL_MATHORA*; personal accounts with no direct stances towards affiliation from different Arab countries such as Palestine (*MustafAbuZir*), Emirates (*EMARATI...1*), Saudi Arabia (*adelmz44*), Kuwait (*AhmedAbdullahQ8*), Yemen (*7oppp*); and non-official news sources such as (*aljadidnews*). We noticed that many accounts in this group were suspended or deleted during the study, and we found some bots that broadcast Islamic supplications (*TasbehEstigfar*).

Echo Chambers and Bridges

The general observation from Figure 4.2a is that the atheist group (in pink) and the theist group (in green) are well separated into echo chambers. In contrast, the Tanweeri (yellow) and Rationalist (blue) groups are spread between them, acting as a bridge. A small portion of the atheist group is somewhat isolated from the majority, seen in the left part of the graph). Similarly, a small number of users from the theist group seem closer to the atheist group. This would be better understood by analysing the communities’ clusters obtained with the follow network.

When we look at the distribution of our seed list among the seven clusters (c.f. Table 4.6), a more complex picture emerges. The majority of the Atheist group has been divided among three main clusters: *ArbAth*, *RelDis*, and *NonArab*. However, most of the Theist group users are located in one cluster (*ArbInfl*), and the remaining was split among the other clusters. Similarly, the vast majority of the rationalist group belongs to one cluster, *ArbSch*. Only the Tanweeri group was spread among all clusters.

In addition to the Tanweeri and Rationalist bridge accounts, there are also Atheist and Theist bridge accounts. For instance, *AtheistGhost* follows and retweets tweets posted by accounts from groups holding different beliefs. Analysing the timeline content and following relationships for this account shows tweets about supporting Pales-

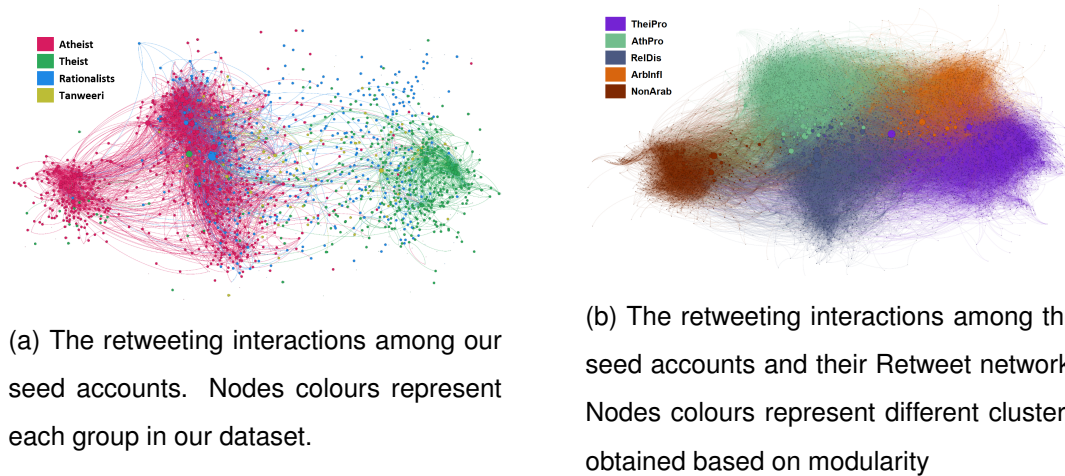


Figure 4.3: Visualisation of the retweet network among our data set and their network, including only accounts retweeted by ten or more of the seed list. Description of cluster names is provided in Table 4.7

tine, opposing internal policies and regional relations for some Arab countries, and discussing regional conflicts. Discussing these topics causes huge interactions between supporters and opponents of each topic.

Other accounts that play a bridge role between religious and non-religious groups such as z3bdal515, arabs_exmus and Fawazintheflesh. The first account claims that it belongs to an ex-Atheist, and the latter two are atheists who argue against religions; and mainly criticise the three main monotheistic religions Islam, Christianity and Judaism. In addition, the theist group contains some accounts that criticise other beliefs, which again causes intensive interaction among atheists and rationalists with theists.

4.5.2 The Retweet Network

Here we discuss the retweet network, which includes the accounts that our seed list has retweeted.

Figure 4.3 shows the network representation of the retweet network among our seed accounts themselves (4.3a), and among our seed list and their retweet network (4.3b). The codes used in Figure 4.3b are explained in detail in Table 4.7, where each cluster is described by the main theme characterising the accounts in it. Table 4.8 shows the distribution of our seed list among the five clusters obtained in Figure 4.3b.

TheiPro: Theism promoting accounts. The first cluster group, TheiPro, includes cross Arabs and international Islamic scholars and academics (e.g. alqaradawy, abdu-

Cluster	Theme	Description
TheiPro	Theists and Muslim Scholars	Islamic Scholars and influential Arabs
AthPro	Atheists & Discussion of Religion	Arab accounts with ties to groups that are critical of religion
RelDis	Discussing theists	Prominent Arabs discussing theists and demanding secular communities
ArbInfl	Arab influential accounts	Arab influential users which do not discuss religions/atheism
NonArab	Non-Arabic accounts	Groups with ties to Non-Arabic accounts

Table 4.7: Maps From Clusters Codes to The Corresponding Theme of Retweeting Community

Cluster	Total size	Seed list				Non-Seed list
		Atheist	Rationalist	Tanweeri	Theist	
TheiPro	1034	5 (0.5%)	320 (30.9%)	16 (1.5%)	64 (6.2%)	629 (60.8%)
AthPro	963	213 (22.1%)	4 (0.4%)	16 (1.7%)	67 (7.0%)	663 (68.8%)
RelDis	989	276 (27.9%)	15 (1.5%)	16 (1.6%)	81 (8.2%)	601 (60.8%)
ArbInfl	844	20 (2.4%)	67 (7.9%)	23 (2.7%)	99 (11.7%)	635 (75.2%)
NonArab	649	218 (37.1%)	18 (3.1%)	0 (0.0%)	5 (0.9%)	347 (59.0%)

Table 4.8: Distribution of Accounts Retweeted by dataset Accounts

lazizarefe, Dr.alqarnee, and salman_alodah), Muslim priests/activists (e.g. shugairi, AbdullahElshrif, and amrkhaled), political specialists and academics with Islamic backgrounds (e.g. DrAlnefisi, LoveLiberty), Arabic activists (e.g. TawakkolKarman), Islamic institutions that promote Islam and oppose atheism (takweencenter, braheen_center and islam_atheism). Interestingly, this group, while containing many popular Arabic Islamic scholars/activists, does not have many of our Theist seed list while having the majority of the Rationalist accounts. This shows that Rationalists still retweet a lot of theistic (Islamic in specific) content. Despite the emphasis on religious content, the cluster also includes accounts of a more general theme, such as Arabic infotainment accounts (e.g. TheArabHash), Arabic news sources (AJABreaking, AJArabic, ajmubasher, RassdNewsN, aa_arabic), Arabic journalists and TV presenters (kasimf and Omar_Almulhem), Academic figures, mainly from Saudi, and Some governmental bodies, such as SaudiMOH and Saudi_FDA.

AthPro: Atheism promoting accounts. AthPro includes a large portion of the atheist accounts in our seed list and contains other external accounts that promote atheism and criticise religions (mainly Islam) whether they are popular (e.g. hamed_samad); not widely popular individuals (e.g. DrTalebJawad), pages (e.g. AtheismAcademy), and public figures who actively criticise religions without a clear position towards atheism (e.g. NawalElSaadawi⁷). Also, we find infotainment and news source (e.g. aj-plusarabi), Scientific accounts (SciTalk2U, IBelieveInSci), Arab journalists and TV show presenters (jaafarAbdulKari), international news sources in Arabic (AlarabyTV and BBCArabic), international organisations in Arabic (Unarabic), and a few Israeli accounts (e.g. EdyCohen, Israelipm_ar and IsraelArabic).

RelDis: Discussion of Religion. RelDis group also includes a large portion of the atheist accounts in our seed list, but external accounts criticise Islam and Muslim communities in particular. It contains Symbolic accounts for historical sceptical people (e.g. abn_alrawndi), Non-public Atheist users, Saudi feminist accounts (hw_saudiwomen), public figures demand atheist community and criticise revealed religions (squemny), public figures demand secular societies (e.g. Azizalqenaei and ElBaradei (Weber et al., 2013)), writers and journalists from different Arab countries such as abdelbariatwan (Palestine), FatimaNaoot (Egypt), AhlamMostghanmi (Alge-

⁷It worth mentioning that the holder of this account is a popular Egyptian feminist and has passed away in Match 2021 (Sly, 2021). Most Atheist accounts and some of the Rationalist and Tanweeri accounts in our seed list have changed their profile picture to her photo in condolences of her death.

ria), Egyptian news sources (Shorouk_News, youm7 and AlMasryAlYoum), international news sources broadcast in Arabic (dw_arabic, cnnarabic, France24_ar and Rtarabic), international organisations (hrw_ar), and Israeli accounts (AvichayAdraee).

ArbInfl: Influential Arabic Accounts. The ArbInfl group includes many Arab influencer accounts with no specific stance towards religion. It includes royal family members from Saudi and Emirate (KingSalman and MohamedBinZayed), Arab government bodies and personnel mainly from Saudi and UAE, such as MOISaudiArabia, AdelAljubeir and Dhahi_Khalfan. football clubs (realmadridarab, Alhilal_FC), current and former cross-Arabs football players (MohammedAlDeaye and MoSalah) and accounts from different backgrounds such as Arabic official news sources (spagov and AlArabiya), Non-official Saudi news sources (sabqorg, and News_Brk24), infotainment (TheTopVideo and I_9mile). Interestingly, this cluster has the largest number of Theists accounts from our seed list.

NonArab: Non-Arabic and Western NonArab group is very similar to the nonArab group from the follow network, where a large portion of the atheist accounts in our seed list are in this cluster. It contains mainly popular Western politicians (realDonaldTrump, BarackObama, JustinTrudeau and Nigel_Farage) and persons (BillGates), Arab immigrants to the west (Ayaan), Non-Arab atheist immigrants to the west (Yas-Mohammedxx and MaryamNamazie), Western atheists (BillNye, SamHarrisOrg), Western organisations and scientific (hrw), Western news sources (dwnews), non-Arab journalists (nailainayat), non-Arabs immigrants to the West (TarekFatah, MaajidNawaz), news sources broadcast in non-Arabic language (AJEnglish, AlArabiya_Eng), and Israeli politicians (netanyahu).

Echo Chambers and Bridges

The general observation from Figure 4.3a is very similar to the follow network graph, where the atheist group and the theist group are quite apart from each other. In contrast, the Tanweeri and Rationalist groups are spread between them. However, atheists are clearly split into two retweeting groups, each retweet almost exclusively to themselves. In addition, it can be noticed that some rationalist accounts retweet more for the atheist group.

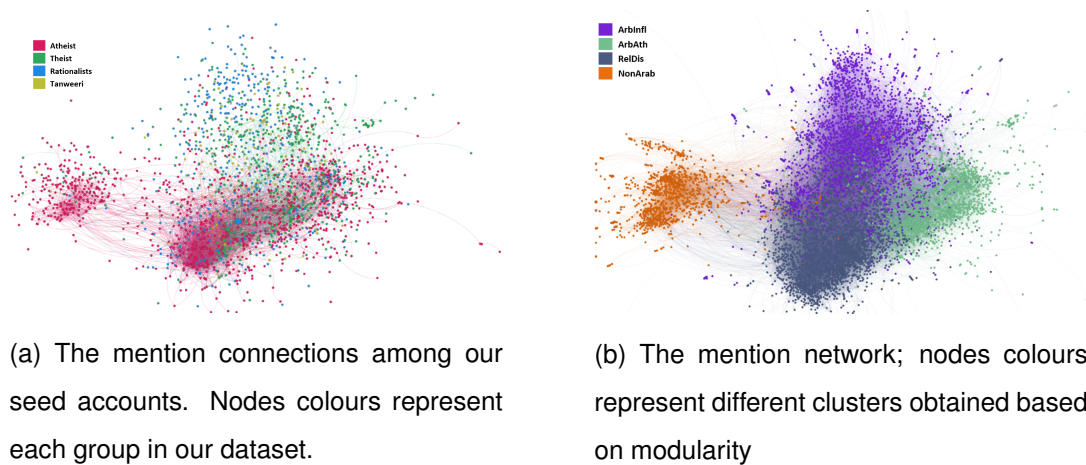


Figure 4.4: Visualisation of the mention connections among our data set and their network, including only accounts mentioned by 20 or more of the seed list. Description of cluster names is provided in Table 4.9

4.5.3 The Mention Network

Finally, in this part, we analyse the mention network, which includes the accounts that are mentioned the most by our seed list accounts. The mention interaction means that the account's screen name is included in a tweet, whether as a reply to or mention. This network reflects the discussion within and among groups. Unlike follow and retweet networks, which might indicate agreements between connected nodes, mention network can show links between opposing views.

Figure 4.4 shows the network representation of the mention network among our seed accounts (4.4a), and among our seed list and their mention network (4.4b). The colour codes used in Figure 4.4b are explained in detail in Table 4.9, where each cluster is described by the main theme characterising the accounts in it. Table 4.10 shows the distribution of our seed list among the four clusters obtained in Figure 4.4b.

Table 4.11 shows the top five discussion topics in each cluster, derived using LDA. In addition, we show samples of tweets from each cluster in Table 4.12.

RelDis: Discussion of Religion. The group RelDis includes mainly personal accounts that question religious actions. An account published a tweet 'I will not name my baby an Islamic name such as Muhammad, Omar or Ali, nor a Christian name such as George or David. I want him to know God without endorsing any religion'. The main topics discussed with this group are Metaphysics, religious legislation and rationalism, social relationships, and religions and atheism. Some of these topics are

Cluster	Theme (name)	Description
RelDis	Discussion group	Arab theists, atheists and secularists groups, linked more strongly to tanweeri and rationalist Arabs
ArbInfl	Arab influential users	Group includes Arab influential accounts, theist promoters (mainly Muslims) and Islamic scholars.
ArbAth	Arabic Atheists	Arab atheists and secularists that interact more with Arab theists
NonArab	Non-Arabic & Western	Non-Arabic accounts in which the majority criticise religions

Table 4.9: Cluster Themes for the Four Major Groups in the Mention Network

Cluster	Total Size	Seed list				Non-Seed list
		Atheist	Rationalist	Tanweeri	Theist	
RelDis	2291	243 (10.6%)	83 (3.6%)	24 (1.0%)	98 (4.3%)	1843 (80.4%)
ArbInfl	2059	106 (5.1%)	152 (7.4%)	40 (1.9%)	178 (8.6%)	1583 (76.9%)
ArbAth	1327	224 (16.9%)	59 (4.4%)	8 (0.6%)	123 (9.2%)	913 (68.8%)
NonArab	1057	199 (18.8%)	1 (0.1%)	0 (0.0%)	19 (1.8%)	838 (79.3%)

Table 4.10: Distribution of Accounts Mentioned by dataset Accounts

illustrated in tweets 13 and 14, which show rejection of religions; 12, which discuss the freedom of choice in Islam; and 15, which is a sample of tweets that discuss legislation.

ArbInfl: Influential Arab users. The ArbInfl cluster includes accounts of famous Arab influential users from different backgrounds. This includes professionals and academics, Islamic scholars, journalists, government and key government officials and football players, trainers and clubs. By considering the topics extracted with the LDA model, as shown in Table 4.11, we notice that ArbInfl accounts are usually mentioned in the context of ideas and interactions, as in tweets 1 and 3 from Table 4.12, wars and conflicts within countries and mainly in the middle east as shown in tweet 4, social interactions, and women’s rights as shown in tweet 3. Tweet 3 might not be clear, but it is a harsh reply to a tweet that complains about a fatwa that allows women to visit graves, which is not permissible in Islam. The complaint to the fatwa, which some say it eases the restrictions of women’s freedom, was written by a female account, while the reply, tweet 3, endorses the fatwa and is written by a male account as they both describe themselves.

ArbAth: Arabic Atheists. The vast majority of ArbAth cluster accounts are non-public and personal accounts from different beliefs. The main topics discussed within the tweets that mention accounts from these groups are religions and religious conflicts, Islam and Islamic law, personal freedom, religions in the Middle East and the development of societies. We can see such topics in the sample tweets in Table 4.12 in addition to other tweets that discuss freedom and development of societies, such as: ‘They used to forbid music and photography, and now they both are permissible. They said women would never drive a car, and now women can drive. Now they say secularism is a disbelief, but it is rooted in the culture!’. Another tweet talks about the conflict in the Middle East. The tweet ‘I never authorise anyone to concede or even to negotiate on behalf of me, my rights and the right of my offspring in this country’ shows a position towards the Arab-Israel conflict.

NonArab: Non-Arabic and Western. The main topics of discussion in this cluster are relevant to bigotry and prejudice, the prophet of Islam, Jesus Christ and Christianity, ex-Muslims, rationalism and secularism within the communities, evolution, and women’s rights. Tweets in the Non-Arab group are generally part of long threads that discuss these topics, and some of them mention widely known atheists from the West.

Tweet 13 in Table 4.12 is taken from a discussion of evolution and Islam between two non-Arab accounts, both of which accuse each other of irrationality. The topic related to Ex-Muslims is widely discussed within the non-Arab group, including tweets 14 and 15. Tweet 14 is part of a thread that claims that it is vital to have more Ex-Muslim atheists, which was instigated by a tweet from Richard Dawkins, the UK biologist and atheist, about ex-Muslim atheists.

Echo Chambers and Bridges While the mention network shown in Figure 4.4a has the fewest clusters (4), it clearly highlights an additional echo chamber that was not as clearly visible in the follow and retweet networks. There is a clear divide between a small portion of the Atheist group, which corresponds to the mention cluster NonArab, and the other three mention clusters, RelDis, ArbInfl, and ArbAth. Indeed, NonArab is almost isolated from any discussion with other Arab groups, including vocal atheists. Within the other three clusters, the atheist and theist echo chambers we saw in the follow and retweet networks become a lot more porous in the mention network. This means that within the Arab world, all four groups interact with and react to each other.

Topic	ArbInfl	ArbAth	RelDis	NonArab
1	Ideas and interactions	Religions and conflicts	Metaphysics	Bigotry and prejudice
2	Wars and nations	Islam and Islamic rules	Legislation and rationalism	Muhammad and Jesus Christ
3	social life	Freedom	Relationships	Ex-Muslims
4	Middle East and religions	Middle East and religions	Religions ⁸ and atheism	Rational and secular communities
5	Women's rights	Development of societies	Personal interests	Women's rights

Table 4.11: The Topics discussed in tweets with the top mentioned members as extracted with LDA

4.5.4 Summary of observations and intersections among networks

In this part, we present a summary of the connections between our seed list and the clusters of users they connect to for the three networks we discussed earlier. In addition, we examine the mapping between the different obtained clusters in each of the networks. We check the common accounts among these networks to see how each cluster in each of the interaction networks might map to the other clusters in the other ones.

Figure 4.5 shows the summary of interactions between our seed list and the cluster communities obtained from each network: follow (Figure 4.5a), retweet (Figure 4.5b), and mention (Figure 4.5c). In addition, we show the common accounts between the obtained clusters in each network in Figure 4.5d. These figures show the number of accounts from each communities and their belonging groups. This is based on counting these accounts within each group. This might affect the participation of smaller groups, mainly tanweeris and rationalists, in which further normalisation or applying threshold for larger groups would give better understanding for the interactions among them. However, in this we utilise and use the counting as a method to understand the interactions as an initial study to understand these communities.

As could be noticed, especially from Figure 4.5d, the religion discussion cluster in the mention network maps mainly to the religion discussion in the follow network with some members of the other clusters as well. Also, it maps mainly to the AthPro cluster in the retweet network and still connects to most of the other clusters. This also

Group	#	src	Tweet
ArbInfl	1	T	@MohamadAlarefe I believe in Allah as I believe a polar bear lives in the desert. I am an atheist, and I want to discuss it with you.
	2	T	@user Here are ten facts about the universe mentioned in the Qur'an; How did Muhammad know about it?
	3	T	@user @user @SaudiNews50 Hey you! go and bury yourself, the lives of others are not your business.
	4	T	@user @AJArabic Your dream has finished (ISIS), terrorism is in constant loss, now Mosul; and Raqqa in the future.
ArbAth	5	T	@user I am a Saudi, Sunni and Muslim girl from Makkah (Saudi Arabia). My ancestry returns to the cousin of Islam prophet Muhammad. I left Islam because of the discrimination against women in Islam.
	6	T	@user women are the ones who suffer from this religion (Islam).
	7	T	@user @user @user What is the evidence that there is a day of the Resurrection?
	8	T	@user Leaving Islam is an act of sense.
RelDis	9	T	@user @user What a mind? She got out of the rubbish of Islam to enter the garbage of Christianity. It is better for her to become an atheist.
	10	T	@user It is just nonsense that intimidates naive people to increase the followers of their religion.
	11	T	@user The first step to evolving your family and country is removing Islam from the legislative process. The legislative process must be based on rational and ethical thoughts, not on a book that was found 1400 years ago.
	12	T	@user @user Music to stay and grow. (criticising ISIS supporters claim 'Here to stay and grow').
NonArab	13	P	@user @user @user I have noticed that when you get stuck, you turn around by claiming that you hate Ahmadiyya. Please leave feelings out of our discussion.
	14	P	@user @RichardDawkins Here I am, an Ex-Muslims
	15	P	@user @user @user @realDonaldTrump Read the book "Why I am not Muslim" by a fellow ex-Muslim.
	16	O	An atheist Muslim on what the left and right get wrong about Islam @aliamjadrizvi

Table 4.12: Samples of the discussion tweets in each cluster, including some of the top mentioned accounts. "T" indicates the tweet is translated from Arabic, "P" indicates the tweet is in English but has been paraphrased to protect the user's privacy, and "O" indicates the original English tweet is shown

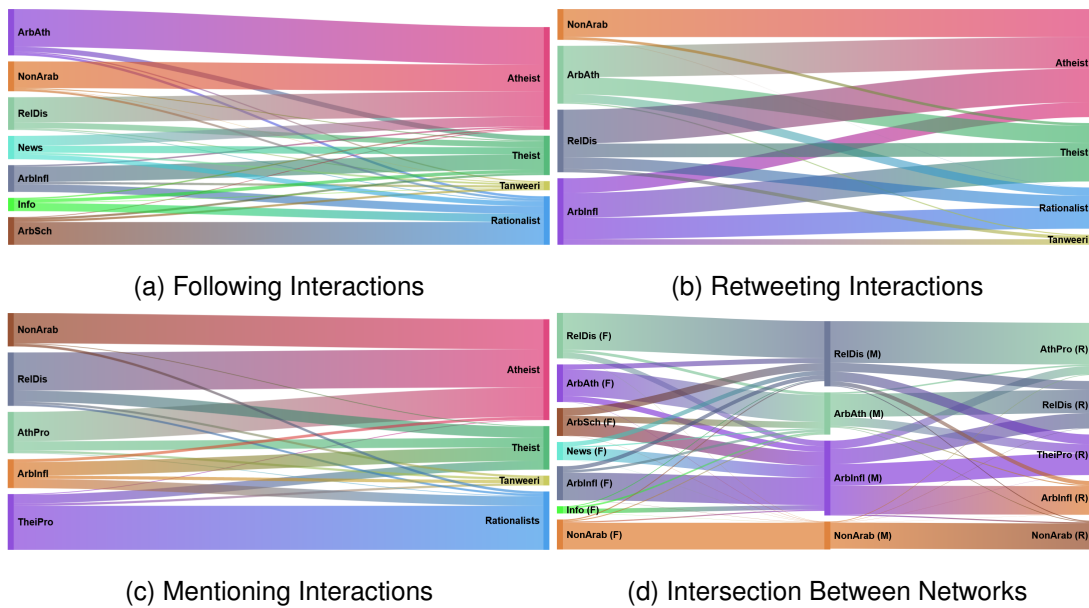


Figure 4.5: Summary of network interactions

applies to the ArbInfl cluster in the discussion that maps to most of the other clusters in the other networks. The general finding here is that while there are echo chambers in the follow and retweet networks, especially between atheists and theists, the mention network shows that these different echo chambers connect over discussions through mentioning and replying to each other.

The very obvious echo chamber from Figure 4.5d is in the nonArab cluster in all the three networks that almost fully map each other. This shows that the Arab atheists that connect to the non-Arab and western accounts follow, retweet, and reply to accounts from outside the Arab world and almost have no interaction with the Arab users, including the other Arab atheists.

In the following section, we discuss these findings from the network analysis and link them back to the RQs of our study.

4.6 Discussion

In this chapter, we investigated the second research question, RQ2 with its sub-RQs:

1. What are the relevant communities of Twitter users, and where do they fall on the spectrum of religiosity?
2. Do these communities form echo chambers, or do they have bridges between them?

3. What is the nature of the networks that each of these religion-related communities interact with?

To answer the first question, we investigate how Arabs from different religious backgrounds use Twitter to reflect their beliefs, promote it or criticise other beliefs, and if they participate in religious discussions. To this end, we created a list of seed accounts that openly mention their belief or non-belief in their account name or Twitter bio. We used four categories to describe user groups, Theist (regardless of religious affiliation), Atheist (including agnostics and Deists), rationalists (both religious and non-religious) and Tanweeri. These groups differ not only by their attitude to organised religion but also by their epistemological positions. While most users are committed to either atheism or theism, overall, we observe the full spectrum of religiosity and non-religiosity that the literature would lead us to expect.

To answer the second and third questions, we investigated the follow network (i.e., the network of accounts followed by the seed accounts), the retweet network (i.e., the network of accounts retweeted by the seed accounts), and the mention network (i.e., the network of accounts mentioned by the seed accounts). Surprisingly, the clearest divide across all three networks is not between theists and atheists but between atheist Twitter users who mainly interact with Western accounts and Twitter users of all four groups that have strong links to Arab Twitter in general. When looking at the follow and retweet networks, we find additional clear evidence for polarisation along the expected religious lines. Atheists and theists tend to follow and retweet accounts that have similar attitudes to religion.

In the follow and retweet networks, atheists split into three groups. In addition to those that mainly engage with Western accounts (NonArab), some atheists engage in active debate with theists and argue for secularisation (RelDis), and atheists who mainly engage with atheists in their own community (AthPro, ArbAth). Theists tend to follow, retweet, and mention well-known and influential accounts in the Arab world, including government, news sources, and popular figures.

The atheist-dominated clusters that focus on the Arab community include public figures, news sources, sports clubs, international organisations, and accounts that talk about science. In the Follow network, atheist, theist and rationalist accounts are connected almost equally to ArbInfl and News.

In all three networks, Rationalists and Tanweeri act as a bridge. These accounts are distributed between the main two communities, with more accounts on the atheist end of the spectrum. Notably, rationalists are the group that is most likely to engage with

Islamic scholarship.

4.6.1 Implication for HCI and CSCW

The social and cultural norms and practices of religions are often deeply embedded in the lives of those that practice them and affect every part of life, from wellbeing (Yeary et al., 2020) to engagement with technology (Sultana et al., 2020; Wyche et al., 2008a). They will also affect those that live in areas where these religions are dominant. Indeed, the lens of religious practice and discourse has been used to critique dominant discourses in HCI (Ames et al., 2015).

Our findings illustrate that the study of religious polarisation cannot be separated from culture. Regardless of their attitude to religion, Rationalist, Tanweeri, Theist, and many Atheist users are deeply rooted in their communities. They pay attention to (follow network), amplify (retweet network) and interact with (mention network) local news, journalists, political figures, sports clubs (in particular football) and other public figures. This is also reflected in the topics extracted using LDA. The three groups rooted in the Arab world, ArbInfl, ArbAth, and RelDis, feature at least one topic relevant to society and life in general. In contrast, the discussion topics of NonArab (including bigotry and prejudice) are focused clearly on religion-related issues.

The interactions between theist accounts and those whom they follow and retweet indicate a space where Muslims can safely discuss issues linked to practising their religion in the context of the modern world (Kavakci and Kraeplin, 2017; Vieweg and Hodges, 2016; Abokhodair et al., 2017). Non-religious Arab accounts indicate a space where those practices are critiqued, and reforms can be pushed and argued for. We suggest that analyses of online discussions of contentious topics, such as women's rights, might benefit from a nuanced classification of the religious stance of the accounts involved. We hypothesise that rationalist accounts, which, as we have shown, engage deeply with relevant scholarship, might play an important role in making such discussions productive. Openly Tanweeri accounts may indicate which relevant religious and secular reforms are currently being discussed in the Arab world.

Online polarisation in Arab communities has previously mostly been studied in the context of politics and radicalisation (e.g. (Weber et al., 2013)). While there is often an overlap between political stances and attitudes toward religion (Bramlett and Burge, 2020), it is counterproductive to reduce religious affiliation to political stance and vice versa. The Rationalist and Tanweeri groups on Arab Twitter provide important bridges

between the theist and atheist communities that might link discussions of reform in the atheist context to communities that might be open to adopting such reformed practices. When considering existing work on political polarisation, the role of these two groups highlights the importance of designing techniques to bridge echo chambers between (Garimella et al., 2017b, 2018b).

Since religion is so intimately tied to people's values and practices that it can affect uptake of, e.g. health interventions (Yeary et al., 2020), the detailed network analysis performed here can be helpful when researchers seek to leverage social media data to understand how people react to technology-mediated services and products. The study may also be informative for those who seek to design for user groups that differ in religious belief.

Finally, our analysis is strongly contextualised within Arab culture. In this chapter, we follow recent calls for HCI that acknowledges and incorporates cultural differences (Alabdulqader et al., 2017; Mustafa et al., 2020). The cultural knowledge contributed by the Arab author of this thesis allows us to characterise the position of prominent figures in the community, interpret the tweets within the discourse conventions of the Arab world, and acknowledge the varied strands of thought that are often not seen from a Western perspective which focuses on conflict and radical Islam.

In fact, our results show why cultural contextualisation is important. We identified an entire subset of atheist discourse within Arab Twitter that is almost unmoored from the debates that are going on in the rest of the Arab world. By interacting with Western atheist accounts, those Arab atheists position themselves within the wider debate between Muslim theists and atheists that goes beyond the Arab world itself. In order to understand this wider debate, however, we argue that we need more studies focusing on specific Muslim majority and minority countries and regions. The political and social situations in Turkey, India, Pakistan, Bangladesh, Nigeria, and Indonesia, to mention only a few countries with large Muslim populations, are quite different from each other. Our study shows that the online debate of religion versus non-religion benefits from the same in-depth analysis that we afforded to the Arab world here. It would be interesting to see whether there are similar differences between an atheist group that mainly interacts with the Western world and atheist groups that interact with local communities and whether there is evidence of theist and atheist groups in dialogue across national and regional boundaries in the Muslim world.

4.6.2 Limitations

In this chapter, we introduce a new dataset of Arab accounts that discuss religious topics. The chapter includes an extended analysis that avoids and solves the limitations we faced in the previous chapter. We successfully avoided the ethical complications of labelling people based on the content and interaction they have on their Social media accounts. However, the work in this chapter has new limitations. Below, we are introducing these limitations.

For reasons of protecting people with atheist leanings that are not public about it, our initial sample was based only on public information that people publish online, i.e. the biography. However, some of this information may be false. There are also parody accounts which have a huge volume of interactions. We also followed people's self-description even in cases where their timeline might have led us to a different judgement.

Most accounts have removed content, whether by the account holder or by Twitter. Studying the discussions, timelines contents, and network interaction in real-time would be richer and more informative. Still, it would not respect the Twitter users' right to control which parts of their timelines are accessible to the public or preserved as part of a putative research record. Removed content and suspended and protected accounts caused a lot of incomplete discussions. Investigating those requires a sensitive, qualitative approach because account holders may have deleted this information due to potential negative consequences for themselves.

Due to available resources, we limited the network analysis to accounts with more than a set number of followers or retweets. While this produces a cleaner data set that is easier to interpret, it is possible that there are smaller sub-structures which we failed to detect due to the lack of data.

We acknowledge that due to our focus on atheism, the sample of Theist accounts is comparatively small. We also did not divide Theist accounts according to the branch of Islam to which they belong. We acknowledge that polarisation between Theists and Atheists on Arab Twitter needs to be carefully contextualised within the general religious discussion on Arab Twitter. However, performing such an analysis is unfortunately outside the scope of this study and remains a potential future work.

Finally, we focused on people's attitudes towards religion, but we did not classify them according to their spirituality and spiritual practices. In other words, we did not accurately represent Twitter users who are spiritual but not religious; such people

might fall into the Atheist and Rationalist categories in this study.

4.7 Summary

In this chapter, we have shown how the network analysis can be used to develop a nuanced understanding of religious polarisation between atheists and theists on Arab Twitter. We have highlighted both religious and cultural divides and shown the importance of reformist (Tanweeri) and Rationalist users in fostering productive discussion despite strong polarisation. In addition, we have shown that analysing the mention/reply to networks of users might give additional insights about interactions between polarised online communities that might not be captured in their retweet and follow networks.

While we have started to examine the content of discussions between people with different attitudes towards religion using LDA, the logical next step is to perform detailed content analysis. This might ascribe to what extent these debates address current political and social issues in the Arab world. It would also allow us to surface humour and satire, which clearly play a part in the discussion. We believe that analysing the topic modelling outcomes helps to better understand the proven polarisation among the main two groups and how the tanweeris and rationalists are involved in the discussions among these polarised groups. Hence, in the next chapter, we will introduce and explain the LDA topic modelling method and the findings we have from the experiments and the qualitative analysis we applied to the outcomes of these experiments.

Chapter 5

Polarised Networks Discuss the Same Topics

5.1 Overview

In the previous chapter, Chapter 4, we identified four main user groups across the religious spectrum among Arab Twitter users, Atheists, Theists, Rationalists, and Tanweeri. While our work in the previous chapter examines the degree of polarisation between these groups as determined by the network analysis of the follow, retweet and mention networks on Twitter, here we focus on studying the differences in the topics discussed by these groups. Studying the topics discussed might strengthen the evidence for polarisation among the four groups, which we highlighted by the network analysis performed in the previous chapter. This chapter extends our investigation in the earlier chapters and, consequently, enriches this thesis as a multidisciplinary work. It contributes to understanding how Arabs engage in religious discussions, how these discussions reflect their stances, what topics are related to religious Arab communities, and how they are related to local, regional and global events.

The analysis goes over time from January 2018 until June 2021 inclusive. We aim to understand their response to religious and non-religious events and news and to find whether the content suggests any polarisation among these groups and gives a comprehension of what groups talk about and their interactions and responses to the local, regional and global events and actions. Hence, we try to answer the third research question mentioned in section 1.3:

RQ3 What are the main topics that attract Arab Atheists and Theists to discuss on Twitter, and how do other relevant groups involved in such topics?

To have a clear answer to this question, we answer the following two sub-questions:

RQ3.1: To what extent do the four user groups differ in the topics they discuss?

RQ3.2: To what extent do the differences between groups change over time?

To answer these research questions, we used a mixed methods approach. First, we applied LDA topic modelling (Blei et al., 2003) on the Arabic tweets belonging to the whole network, i.e. the accounts from all four groups. Then, for each group, we extracted the top topics that the LDA model identified to investigate the similarities and differences in the topics discussed by each group. Next, we applied qualitative analysis to:

- Label the topics based on the words with the highest scores and the connected tweets.
- Identify the top topics discussed by each group independently from other groups.

After extracting the top 8 topics of each group, we find that there is a perfect overlapping among the topics discussed by these groups in which we got 9 topics across them all. Next, we analysed the groups' tweets on each topic. This gives us a better understanding and more knowledge of the topics they discussed and how they are connected with local, regional, or global events.

5.1.1 Research objectives and contributions

In this chapter, we analyse a relatively large number of tweets published by accounts that used their Twitter accounts to reflect and discuss their thoughts and beliefs about religions. We applied the LDA topic modelling algorithm followed by manual topics labelling and finally, we applied a qualitative analysis of the tweets of the identified topics. We aim to find whether the topics discussed by the four groups suggest a polarisation that the network analysis performed in Chapter 4 of this thesis. This chapter has the following contributions:

- We study the behaviour of accounts from each group based on the topics they discussed and their reaction to different events and incidents. The main observation is that the interactions of these groups differ based on their affiliations and the events themselves. Our qualitative analysis shows that the responses and motivations of the accounts for the same event differ even though they are from

the same group. For example, we noticed that all groups talked about the Saudi women's car driving topic, but they all had different views or stances. The vast majority of theistic accounts mentioned that to show their rejection, while, on the contrary, atheists and tanweeri show their support. However, some atheists used that topic to criticise celebrating that and consider this as backwardness among the Arab-Muslim communities caused by Islam.

- Our results confirm the results of the previous chapter that the four groups participated differently in the topics and discussions, which supports the suggested polarisation from the network analysis we have done in the previous chapter. Although there are some identical trends among the four groups for global updates, such as the COVID-19 pandemic and the worldwide closer in March 2020, most events motivate the groups to engage in the topics differently and sometimes in opposite directions.

5.2 Background and Related Work

Mining the topics discussed online by different groups gives a better understanding of the nature of interactions and clarifies the polarisation level among these groups. This is useful as studies show that topic modelling is a good representation of user-level interests and interactions (de Melo and Figueiredo, 2021; Alam et al., 2018; Magdy et al., 2016a). Also, analysing the online discussions makes it easier to understand the general stance or position and the backgrounds of the participating groups towards local, regional and international events (Kutlu et al., 2018).

5.2.1 Online Discussions

Research studies consider social media documents (such as tweets on Twitter, posts on Facebook and discussions on Reddit...etc.) and interactions and analyse the linguistic features of these documents. Studies aim to understand the online communities, to detect and overcome false information such as fake news; and to improve the diffusion of trustworthy information (Babcock et al., 2019; Li et al., 2021; Alam et al., 2018; Georgiou et al., 2017).

(Kutlu et al., 2018) investigated about 108M tweets posted between the end of April 2018 and the end of June 2018 by Turkish users to understand the groups who show solidarity (i.e. support) and antagonism (i.e. oppose) with the Turkish president

Erdogan. The authors use the most distinguishing hashtags and retweeted accounts in the collected data. Data collection started with identifying the most used terms in the tweets relevant to the Turkish election in 2018, including the candidates' names, political figures, parties' names and abbreviations, and widely used hashtags such as #tamam and #devam. The authors used these terms to manually label 3866 accounts that use these terms to show their stances as pro-Erdogan and anti-Erdogan. Next, they use label propagation (Magdy et al., 2016a) to automatically label 652k accounts based on their retweet behaviours. Finally, they analysed the contents of timelines of these accounts, including extracting the most retweeted accounts, and most tweeted hashtags from both 'groups'. The results suggest that there is a strong polarisation not only in the ideology and stances toward Turkish elections but in their lifestyles, such as the preferred TV shows, and news sources that they tend to follow.

In (Li et al., 2021), the authors use Twitter data to understand the factors that affect the likelihood of getting responses from authoritative accounts for tweets published by Twitter regular users. The study aims to understand how to expand the access of authoritative users to information published by regular users during crises. The author aims to facilitate the connectivity between the affected people with the authoritative account to get a response from them in order to have access to trustworthy information. In other words, the authors try to facilitate the accessibility of Twitter users in charge with authoritative organisations to provide the people with updated and trusted information in crisis events.

The authors apply topics modelling and sentiment analysis to extract the linguistic features and understand these factors. The authors found that the authoritative sources are accessible and not being affected by their busyness or popularity. However, the content of the tweets, i.e. the topics covered and their sentiments, show significant impacts on the number of responses received. For example, the tweets that mentioned crises such as hurricanes, power outages, and timelines got higher replies and interactions. Also, they found that content used usually to show curiosity, reasoning, uncertainty, or to talk about movement, got significant attention and responses. They show that their findings are aligned with other studies. They also found that Spanish tweets got much lower responses than English tweets, and they claimed that it is likely due to the over-demand. Hence, they suggest having an improvement to offer the users' feeds to have higher responses and interactions with Spanish users.

(Babcock et al., 2019) perform an in-depth study on Twitter discussions about the Black Panther movie to identify the false information and how Twitter users respond to

it. The authors compared the tweets, users, and hashtags related to the #BlackPanther discussion. They identified four narratives of false information and studied how they spread over Twitter and how Twitter communities responded to it.

In (Darwish et al., 2017), the authors collected the 50 most retweeted tweets that mention the US election each day. The study considers the tweets between 1st September 2016 and 8th November 2016. In total, the study considers 26.6 million retweets of 3450 original tweets published in that period. The authors used three labels to annotate tweets based on their contents: attack, support, and neutral and also consider their relevant presidential candidates; Trump and Clinton. As shown in the literature, the 50 top retweeted tweets reflect 40% of the total number of retweets for the whole period and their retweeting volume correlates with the retweeting volume of the whole data. The authors consider analysing the discussions in the tweets intensively by analysing the most frequent hashtags, frequent terms, retweeted accounts, retweeted tweets, and most shared URLs.

Our study is an additional effort to the studies in HCI and CSCW in the areas of technology, religion, and spirituality, as it provides important background for technology supporting religious practices.

5.2.2 Religious online Discussions

Studying online religious discussions has been performed by researchers to understand the main features and the contents considered in such communities' debates (Rautela and Sharma, 2019; Ritter et al., 2014). Online religious debates attract multidisciplinary researchers to investigate psychological, linguistic and societal features, including hate speech, extremism, trolls (i.e. bot army), online debates and responses. However, no study considers the online discussion among Arab groups to understand how they reflect their beliefs and how they interact with others except in the hate-speech and extremism context. Hence, in this study, we provide an unprecedented attempt to understand the online polarisation among Arab religious and non-religious groups based on the topics they engaged with on Twitter.

5.3 Research Methodology

5.3.1 Data Collection

For the sake of this study, we used the dataset we collected in the previous chapter. As described in Chapter 4, the dataset includes the timelines of the set of 2,673 Arab Twitter accounts that tweeted and retweeted a total of 2,805,977 unique tweets. We used the tweets published in the timelines of these accounts and performed the following reprocessing steps. First, we removed the non-Arabic and non-textual tweets, such as tweets with only images, emojis, special characters and numbers with no Arabic text. At the end of this step, we got 1,976,156 tweets. Next, we stemmed the tokens using Farasa stemmer (Abdelali et al., 2016) to stem all tokens except hashtags and mentions. Finally, we ignored the too-short tweets by removing the tweets with less than three tokens. At the end of this step, we got 1,945,085 tweets. Then, we employed the LDA algorithm by using LdaMulticore from Gensim library (Řehůřek and Sojka, 2010) as a topic extraction method. We set the passes to 20 with eight workers and kept default values for other parameters. To build the bag-of-words, we removed the tokens that appeared in less than five tweets and eliminated the tweets that appeared in more than 2% and 10% of the tweets.

5.3.2 Topic Modelling

Topic modelling is a form of unsupervised machine learning that is widely employed to preserve the statistical relationships in the large collection of data while processing it. Researchers applied the Latent Dirichlet Allocation (LDA) as an algorithm of Machine Learning methods by (Blei et al., 2003).

We run several experiments to tune the LDA parameters and applied them to extract the topics by setting the number of topics to 10, 20, 25, 40, 50, 75, 100 and 120. At the end of each experiment, we analysed the coherence values and the extracted tokens for each topic to identify the most relevant co-occurring words within each topic or theme, taking into consideration the lack of accuracy with this method of labelling the topics described by (Chang et al., 2009). The values of the number of topics that lead to meaningful results are 50 and 100. Hence, we used 50 topics as the resulting clusters are more relevant to each other, and there are fewer fragmented clusters.

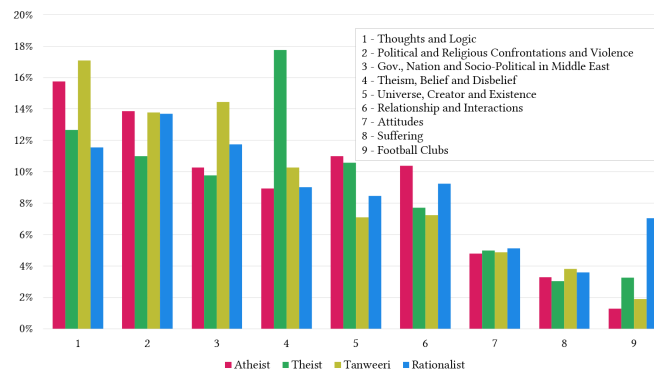


Figure 5.1: Average Distribution of Top 9 Topics among the Four Groups

5.3.3 Qualitative Analysis

Clusters Labelling (Topics)

At the end of applying the LDA, we got 50 clusters. Each cluster suggests a topic based on the most co-occurred words and the relevant tweets. Next, we labelled these clusters and considered them to understand the topics that have been discussed by the four groups. This is done by a manual labelling process for each cluster based on the top-scored words and the documents (i.e. tweets) from each cluster. To perform the tweets analysis, we identify the top tweets from each cluster for our qualitative analysis to decide the title of the topics.

Moreover, LDA combines the statistically relevant terms from the documents into one cluster (we call it topic). Each cluster has its own index. For simplicity, we keep these indices as the main reference for each cluster. However, more than one cluster (i.e. indices) might refer to one topic (same label). Below we explain the topics from the clusters based on our analysis. Further explanations of these topics with detailed descriptions are included in the appendix. Table 5.1 briefly lists the suggested topics and their corresponding clusters.

Temporal Analysis of the Topics

The study is performed in two steps. First, we extracted the topics of the four groups for the whole period. Figure 5.1 shows the average distribution of the top 9 topics discussed by each group by considering the whole period. Then, to obtain a clear idea of the topics discussed by the accounts from the four groups, we extracted the chronological frequencies for the top nine topics discussed by the four groups over time. Figure 5.2 shows the illustration of the top 9 topics discussed for the period from Jan-

No	Topic Title
1	Arguing and Discussing Metaphysics
2	Attitudes
3	Business
4	Events Relevant to Time and History
5	Football Clubs
6	Freedom
7	Gov., Nation and Socio-Political in Middle East
8	Health And Well-being
9	Marriage and Women
10	Multimedia
11	News and Events
12	Others
13	Political and Religious Confrontations and Violence
14	Relationship and Interactions
15	Religious Legislation
16	Suffering
17	Theism, Belief and Disbelief
18	Thoughts and Logic
19	Universe, Creator and Existence

Table 5.1: List of Topics Extracted. A detailed description of these topics are shown in Appendix A

uary 2018 until June 2021 by the four groups. Figures 5.2-A, 5.2-B, 5.2-C and 5.2-D show the temporal distribution over time for the percentage of top topics discussed by atheists, theists, rationalists and tanweeri groups respectively. To understand the discussed topics in detail, we investigate each peak in these frequencies from our dataset and compared/connect it with the events and trending news at that time.

The four groups have been involved in the online discussion relevant to the Covid-19 pandemic, as the topic suffering shown for the period between February 2020 and June 2020, with its peak in March. However, atheists and theists contributed less than the rationalists and tanweeri groups. At its peak in March 2020, the first two groups mentioned the suffering topic at about 10% each, while the latter two groups contributed to that topic by slightly above 15%.

Furthermore, as Figure 5.2 shows, it is clear that the top three topics discussed by

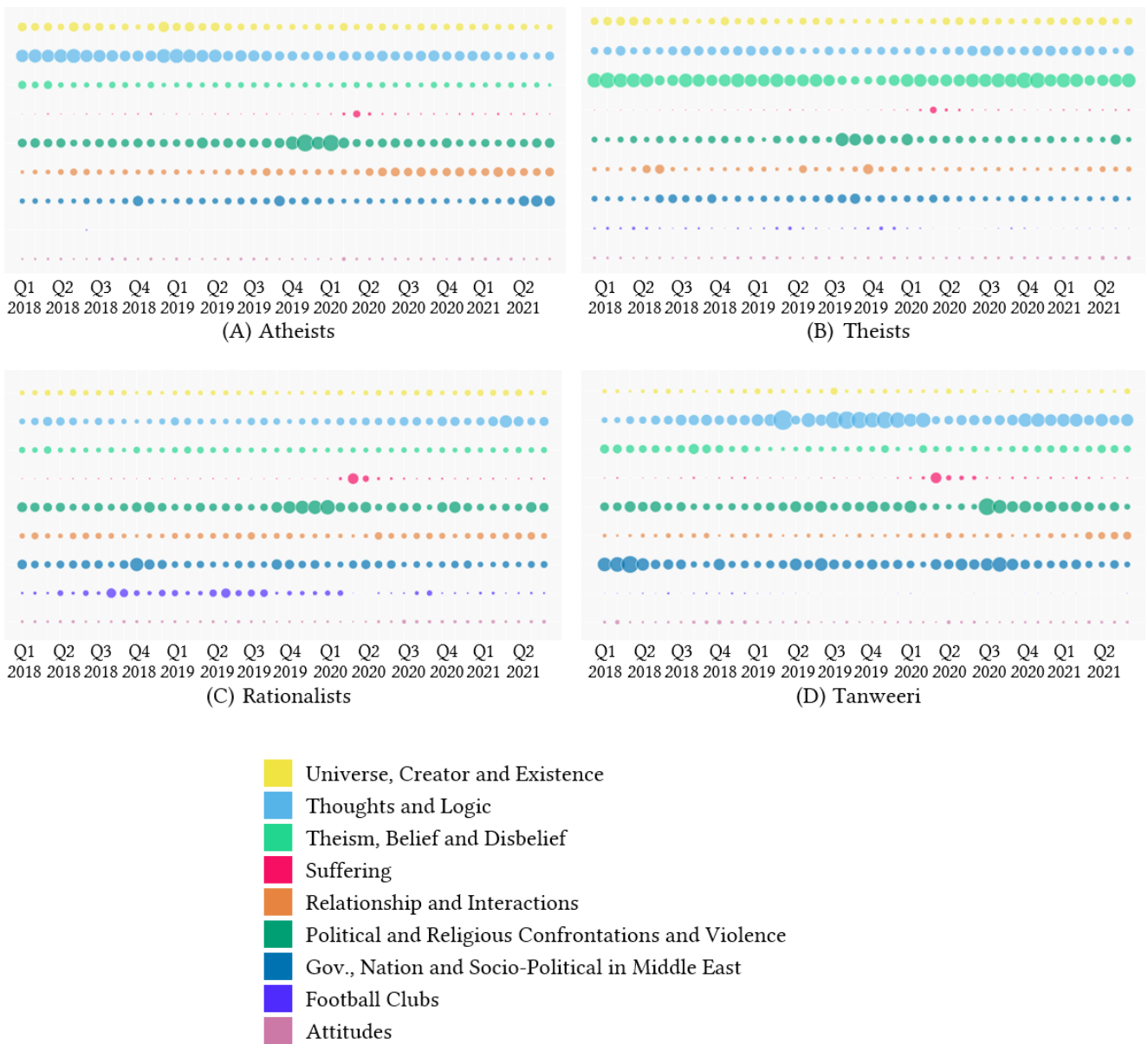


Figure 5.2: Topics Discussed by each Group

the four groups for almost the whole period of study are Thoughts and logic; Theism, belief and disbelief; and Political and Religious confrontations and violence. We notice that the first topic, Thoughts and logic, has the largest proportion of discussions of all time except between October 2019 and January 2020, where Political and Religious confrontations and violence become the most dominant topic among all groups during that period. From the graph of each group, we can find that atheists and rationalist accounts contribute the most to this dramatic increase in the discussions about confrontations and violence.

We also noticed a clear peak in March 2018 for the Thoughts and logic topic.

By investigating the relevant tweets, we found that there are two major events which are coincided with that month. These events are the death of Stephen Hawking, the English theoretical physicist, cosmologist, and author who was an atheist¹, and Riyadh International Book Fair 2018 (Carr et al., 2019). Both events caused lengthy debates among the four groups. In general, all groups acknowledged Hawking's scientific achievements, despite his health conditions and consider his death a loss. Atheists showed their sympathy and respect toward Hawking in their condolence tweets, quoted some of his opinions, and criticised theism and believers as miserable in comparison with him. While on the other side, theists discussed his life and death, considering it as a kind of lesson to learn, discuss whether they can pray for him, and, according to their tweets, consider that lack of faith is the real loss after death. Interestingly, the tanweeri group does not engage in the discussion as the other groups do, as Figure 5.2 suggests. Moreover, these discussions raised the proportion of this topic in March 2018. These, of course, are added to the regular discussions about thoughts and logic in regard to atheism, non-religious and religions, mainly Islam and Christianity, as the tweets suggest. Another topic that had a peak in March 2018 is the universe, creator and existence. The tweets relevant to this topic include discussions among the four groups about the Big Bang Theory, the contribution of Stephen Hawking and his death, evolution theory and intelligent design.

A third major event, or in fact series of events, in Yemen which attracted a significant response from the Tanweeri group in March 2018. Yemen is one of the Arab countries that are affected by the 'Arab spring revolutions' and the counter-revolution waves. In March 2018, Yemen was mentioned in the dataset by the four groups, but mainly by the Tanweeris, because of the fierce clashes in Aden and the Houthi strikes from Yemen towards Saudi Arabia in March 2018. The clashes in Aden were between the forces of the Saudi-backed Yemen's president Abdrabbuh Mansour Hadi and the southern separatists whose reports claimed that the United Arab Emirates backed them. The clashes were to gain control over the city of Aden, in the southern region of Yemen². The 2018 Riyadh missile strike was when the 'Shiite' Houthi rebels launched a series of seven missiles into different sites in the capital of Saudi Arabia on 26 March 2018, which followed another attack against the Saudi city in Jizan the Houthis claimed³.

¹<https://www.nbcnews.com/science/space/im-atheist-stephen-hawking-god-space-travel-n210076>

²<https://www.cfr.org/background/yemen-crisis>
<https://www.youtube.com/watch?v=0PbH56JpgGY>

³<https://edition.cnn.com/2018/03/25/middleeast/saudi-arabia-intercepts-missile/index.html>,
<https://www.wsj.com/articles/iran-backed-houthi-rebels-say-they-targeted-saudi-oil-port-11615157185>

The main response by tanweeris to these events shows sympathy for Saudi Arabia and thanks and supports to its leaders.

Also, there are lengthy discussions among atheists and theists on topics related to the universe, creator and existence. We observe that both groups have different argument points of view and motivations to discuss the topic. While theists argue that the nature of the universe and its complexity are evidence of the non-existence of a creator, religions consider these as central evidence of the necessity of the existence of God. Different hashtags support this finding, including The mindset of evolution denier (#عقلية_رافض_التطور), Evolution is true (#التطور_حقيقة) and sacred ignorance (#جهل_مقدس).

Furthermore, Figure 5.2 shows peaks in June 2018, October 2018 and May 2021 for the topic of government, nation and socio-political in the Middle East. In June 2018, Saudi women started getting their driving licenses as Saudi Arabia granted women the right to drive cars; the event that Saudi women and their supporters have been waiting for decades⁴. This event causes a very long debate among the four groups on Twitter. In the study groups, atheists supported the women's right to drive cars in Saudi, while theists used hashtags that support and criticise that topic as Table 5.2. In addition, we can find discussions about the political situation in Egypt. Although some tweets criticise his rule, the vast majority of tweets support the Egyptian president, Abdul Fattah Alsisi. This is clear from hashtags such as release Egypt (#افرجوا_عن_مصر), and Alsisi is not leaving (#السيدي_مش_هيرحل). These discussions as Egypt's Sisi swore as present of Egypt for his second term on June 2018. The most retweeted tweets relevant to this topic in June 2018 show sympathy with the governments.

By investigating the events that occurred in October 2018 and the contents of tweets, we find that it is coincident with several relevant events, including an event that had an enormous and wide impact on geopolitical relations in the Middle East and around the world. The murder of Jamal Khashoggi, the Saudi journalist and Washington Post contributor that cause shock waves across the world⁵. Almost all the theists retweeted and posted tweets showing sympathy with Saudi Arabia and support for its leaders, and, at the same time, sympathy with the victim, Khashoggi. In contrast, atheists, in general, show sympathy with the victim only and criticise the Saudi government and blame Islam for this crime.

⁴<https://ara.tv/6dzjd>

⁵<https://www.washingtonpost.com/news/global-opinions/wp/2018/10/06/read-jamal-khashoggis-columns-for-the-washington-post/>

N	Hashtag	P	Atheist	Theist	Rationalist	Tanweeri
1	You will drive, and people support you	S	2	6	1	2
2	Saudi woman drives	N	4	20	5	4
3	Saudi woman drives the car	N	5	11		1
4	Woman's car driving	N	5	5		2
5	Saudi woman's car driving	N	2	9	2	1
6	First Driving Licence to Women	N	1	5		1
7	SaudiWomenDriving	N	3	2	1	
8	Naked woman drives in Riyadh	A	1	16	4	1
9	You lie; people against women's driving	A		14		
10	You will not drive	A		6	1	
11	Does your wife drive a car or does not she	A		6	1	
12	We refuse to drive and travel with no mahram ⁶	A		6		
13	You will not drive, You will not drive	A		6		
14	Saudi women ignoring car driving	A		4		2

Table 5.2: Matrix of Hashtags that Discuss Saudi Women Driving in June 2018 from the Dataset. (S: Support, N: Neutral, A: Against)

In November 2019 and January 2020, there were two peaks for the political and religious confrontations and violence across all four groups. For example, we can see from 5.1 that atheists talked about this topic in about 25% of their tweets; while the rationalists talked in about 21% and theists and tanweeri in about 18% each. Tweets from the four groups in this period show discussions about the situation in Iraq as Iraq protests spread over the capital Baghdad which faced bloody responses from the government forces. Although both atheists and theists show sympathy for the Iraqi people, they have different stories about the situation. On one side, theists criticise Iran and its allies in Iraq for the unrest in Iraq, while on the other side, atheists criticise religions and religious power in Iraq and the region.

The Rationalist group shows strong engagement in the football clubs' results. Figure 5.2-C shows that in August 2018, there exists a peak, which is aligned with the winning of Alhilal FC in the 2018 Saudi Super Cup. Accordingly, the peak in May 2019 is synchronised with the winning of Alnasur FC in the 2018–19 Saudi Professional League. Lastly, we noticed a peak in September 2020, which was caused by the tweets about the results of the AFC Champions League 2020. During September, Alnasur FC played two games in which it won the first and lost the second one. Also,

Alhilal FC was kicked out of the Asian Champions League on Wednesday, September 23rd, 2020. This also gives an indication of the topics discussed during that noticed peak.

5.4 Discussion

In this chapter, we investigate two research questions to understand how Arabs from different religious backgrounds behave on Twitter. The groups are atheists, theists, rationalists and tanweeris. The two sub-research questions are:

RQ3.1: To what extent do the four user groups differ in the topics they discuss?

RQ3.2: To what extent do the differences between groups change over time?

To answer the first question, we intensively analysed the topics discussed by Arabs from the four religious groups. We used the labels as described in Chapter 4 analysis. From the Twitter timelines of these accounts, we applied the LDA topic modelling technique to automatically cluster the tokens; then, we manually investigated the extracted cluster (topics) and the relevant tweets to label these topics. We found that the accounts discuss 18 topics, of which nine are common and considered mostly by accounts from the four groups. The results show that these four groups have different motivations, stances and responses to the same events, and they are strongly affected by their epistemological background. The results indicate that accounts with different religious beliefs have different interests and interpretations of events and issues. Also, the accounts from these four groups have different volumes of responses to regional and global stories, such as the death of a scientist or celebrity or a global campaign or action.

We noticed that rationalists tend more to talk more about topics that favour the public, such as relationships and interactions, political and religious confrontations and violence, and football events. The latter includes local and regional football champions, such as Saudi and Asian champions. In fact, their interaction with football events continues for almost the whole period of study, with some peaks in months when the final matches have occurred. This finding supports that their interest in football is overwhelmingly greater than other groups. While theists show solidarity with the Arab governments and societies, atheists criticise authorities and societies. Atheists tend to connect the attitudes of the Arab societies towards the characters and events with

the religious background and the culture and traditions of Arabs. Arab theists, mainly Muslims, defend their religious principles and debate that it does not contradict science and knowledge, while atheists argue that it does. This is clear from their discussions in events, including book fairs relevant events and allowing women to drive cars. Rationalists and tanweeri have less degree of polarisation as they contributed on both sides. These findings answer the second research question in which it show a clear division between these groups in the temporal data in term of the topics they discuss and their motivation to respond to the same topic.

5.4.1 Implications

This chapter is a continuous effort to our study as we discussed in Chapters 3 and 4; as well as the other limited works to understand the Arab online communities from religious and non-religious backgrounds and their contribution and interaction with different topics (Abokhodair et al., 2020). The results of our study show that religion, tradition and culture are integral parts of the Arab online communities which supports our claim in Chapter 4. Theists, rationalists, tanweeris and atheists discuss religion, tradition and culture and how they affect the formation and the stances of Arab societies. While theists defend their religions that religious teachings protect and modernise societies, atheists consider that discouraging factors for the renaissance of the Arabs and humanity. Our study is an additional effort to the studies in HCI and CSCW in the areas of technology, religion, and spirituality, as it provides important background for technology supporting religious practices.

5.4.2 Limitations

Our study in this chapter depends on the communities that we defined in Chapter 4, which already has some limitations that we described there. As we discussed in the previous chapters, the main limitation in terms of online communities understanding is the generalisability of our study due to the fact the communities have different characteristics in different social media platforms and they are not reflecting the communities in the real life. This is important to consider especially that we are trying to understand such critical topic in the online Arabic context. Moreover, identifying the Arab atheist communities is practically difficult due to several reasons. For instance, as we have introduced in chapter 3, atheists and activists claim that the lack of freedom of speech and freedom of conscience minimises the number of Arabs who discuss their

religious doubts and non-religiosity in public. They consider that the reason for such lack of freedom of speech and belief due to political, judicial and societal reasons (Benchemsi, 2015). In consequence, our analysis is done based on a small size of communities which might be representative to some extent, but undoubtedly, it affects the generalisability. It also considers the labels as the accounts described themselves, which is not always trustworthy according to (Abbasi and Liu, 2013). This is also proved by our qualitative analysis of the accounts.

Our analysis lacks investigating relevant tweets and the replies on those tweets in which we can measure the level of discussions among these accounts and the time they consider to respond. Such content analysis might help to improve our analysis by adding a measure for quantifying polarisation. We aim to do so in the soon future to have an improved contribution to measuring polarisation in online debates.

Finally, we focused on the peaks in the temporal analysis of the topics. This might prevent us from having deep and vital topics these groups discussed among other communities or with less number of interactions within the communities we studied. This means we were unable to accurately cover all the topics discussed by these communities, which is why we covered the peak points. However, further investigation might lead to further nuanced understanding among these communities.

5.5 Summary

This chapter presents an analysis of the topics discussed by four Arabs communities with different religious beliefs: atheists, theists, rationalists and tanweeris. We collected the timelines of 2,673 accounts in which we analysed about 2M Arabic tweets. We analysed the online content published and interacted with these groups by using the LDA topic modelling method. The aim is to understand to what extent these groups are polarised in terms of the topics they discuss and interact with and their points of view on different subjects. Our analysis shows that atheists and theists are divided not just in their interests in different issues and topics but also in their motivations and responses to the same topics and stories. We extracted 18 topics that were discussed by these communities in which we intensively investigated the top 9 topics. We found that rationalists are the only group that is interested in football events; theists show solidarity with the governments and are motivated by religious occasions. The topics discussed online by these groups are strongly connected with local, regional and global events; however, they show different points of view on these topics. This work

extends the works of other researchers to understand the spiritual Arab online communities by seeing their debates towards political, spiritual and social issues. Future work might consider analysing the threads that consist of tweets with different responses, i.e. replies. This would support understanding the dynamic of interactions among groups with spiritual interests.

Chapter 6

Discussion and Conclusion

6.1 Scope of Study

In this thesis, we shed light on the online polarisation among Arab Twitter users from different religious and atheistic beliefs by studying their comporment on Twitter. We successfully identified four groups to consider, atheists, theists, tanweeris and rationalists. We investigated how the users from these groups interacted with each other and how they use Twitter to promote their opinions or discuss other beliefs. This thesis aims to understand how online communities reflect their beliefs on social media platforms and how their positions from religion affect their online interactions. Hence, this thesis addresses and answers the following three research questions:

RQ1 Do Arab Atheists discuss their beliefs on Twitter? How do other accounts interact with them?

RQ2 Does polarisation exist among Arabs with different beliefs? What are the characteristics of the network interaction of Arabs from the different religious spectrum?

RQ3 What are the main topics that attract Arab Atheists and Theists to discuss on Twitter and how do other relevant groups involved in such topics?

We applied two different methods of data collection to collect two different datasets. The first dataset contains 434 Arab Twitter accounts that interacted with the seed list accounts at least 200 times between February and May 2018. Our analysis included investigating the content and network interactions from 1.3M tweets published by these

accounts. The second dataset includes 2,673 Arab accounts that clearly state their belief in their Twitter account's metadata. We studied the network interactions among them and with the accounts they follow, mention and retweet, and we performed a temporal analysis for the topics they express in their tweets. The latter was performed by combining several experiments of LDA topic modelling with qualitative analysis for the outcomes. Each dataset has its own procedures of data collection, data cleaning and labelling. The methodology is improved in the second data set to avoid the limitation of the first one; i.e. to reduce human error and to minimise breaching the users' privacy as we discussed in Chapter 4. While we use the first dataset to answer the first research question RQ1, and its sub-questions, we use the second dataset to extend our analysis and to answer the latter two questions, RQ2 and RQ3 and their sub-questions. We applied an intensive content and network analysis on the tweets we collected from both datasets and a detailed network analysis on the second dataset as we presented in Chapters 4 and 5. The next sections summarise the research questions and their corresponding answers based on our findings from each related chapter. We also include the main findings, limitations, and possible directions for future works.

6.2 Thesis Contributions and Findings

Below we will discuss the covered questions, their answers and the main findings that are included in each chapter.

In Chapter 3, we performed the first study that focuses on the online discussion of Atheism in the Arab world. The work in Chapter 3 has been published in Socinfo 2019 (Al Hariri et al., 2019).

Our study includes applying natural language processing methods and social computing techniques combined with qualitative analysis, which provide valuable insights into the theistic and atheistic online Arab communities and how they interact with other online users. It also provides a baseline for future work. In this chapter, we manually labelled the contents of 434 Arab users' accounts who discuss atheism on Twitter. We classified the accounts based on the content without making explicit inferences about the world view of the person behind the account. So, within this chapter by atheist group we mean the accounts that promote atheistic content, by theist group we mean the accounts that promote theistic content, and by tanweeri group we mean the accounts that promote tanweeri content including reforming the religious teachings.

We investigated the demographics of the accounts, and we found that it is not rep-

representative of the communities as most of the relevant accounts hide their information or use non-informative details. However, for the identified accounts, we find that the vast majority of the three groups are male and live in Arab countries. We used hashtags to describe the topics that users mentioned in their tweets. We find that all groups discussed topics including terrorism and extremism, women's rights, human rights, Hijab, and the instability in the Middle East. Also, there was a long discussion among atheists and theists about the evolution theory. The network analysis shows that atheists tend to retweet, mention, and reply to accounts from within their group, with a significant increase in the number of accounts they reply-to from the theist group. Theists tend more to retweet and mention accounts from their group, while they tend more to reply to accounts from atheistic content groups. We also applied domain analysis by retrieving the domains from the URLs included in tweets. Atheists use non-Arabic domains and interact with foreign cultures, mainly news sources, organisations, and petition campaign websites. While theists use Arabic news sources and religious supplications, tanweeris interact with traditional and local news sources such as newspapers and discuss non-religious content. For example, tanweeris engaged more with local topics such as football clubs, schools, cinema in Saudi and the war in Yemen.

The findings suggest that Arab atheists and theists discuss their beliefs and opinion on Twitter, and there is a clear polarisation between them. Both groups amplify their point of view through retweeting and mentioning interactions. They also tend to mention accounts from other groups in which we find that they look for further discussions, call for attention or to prove their beliefs by referencing supportive tweets. Tanweeri group has significant similarities to atheists in the network interaction as they tend to retweet, mention and reply-to accounts from the atheistic group. We also noticed that there is a discussion among the theistic group users in which Muslims and Christians discuss their own religion and argue against the other religion. The significance is that Arab Christians argue against Islam and try to refute it, but they do not argue against atheism. Therefore, we find that this answers RQ1 and its sub-questions. Our findings promote research in this direction to further analysis and in-depth studies of atheism and religion in the Arab world.

In Chapter 4, we extend our efforts in the previous chapter by considering the relevant group (rationalists) and avoiding the limitations of the relatively small data size, and the controversial accounts labelling process. Therefore, we applied a new method of labelling the accounts based on how the users describe their beliefs on their accounts' metadata. Also, we collected a wider network by considering more rele-

vant tokens to identify a larger dataset of theists (regardless of religious affiliation), atheists (including agnostics and Deists), tanweeri and rationalist (both religious and non-religious) in which their size become relatively large enough to represent these communities. The work in this chapter was published and presented at the CSCW conference in October 2021 (Al Hariri et al., 2021).

The aim of this study is to answer the second research question RQ2 and its three sub-questions by investigating the polarisation level among these communities in terms of the topics they are involved in their discussions and the detailed network analysis. In this chapter, our analysis includes collecting about 2M Arabic tweets that have been published by 2,673 accounts. These tweets were published between January 2018 and June 2021. We performed a demographic analysis based on the metadata of these accounts, and we reported the available location, gender and affiliations of each account. We noticed that the four groups differ in their attitude to religions and their epistemological positions. The vast majority of these users belong to one of the two main groups, atheists and theists. This finding answers the first sub-question in which we observe the full spectrum of religiosity and non-religiosity among Arab Twitter users.

Next, we performed an intensive analysis of three networks of interactions by using the Gephi network analysis tool. We built the mention, retweet, and follow networks, and then we applied a detailed qualitative analysis to the sample of these networks. To detect communities, we applied the modularity algorithm (Blondel et al., 2008) to unfold the clearly separated theists and atheists communities. Our analysis shows that the polarisation among these communities is clear without considering their labels.

The outcomes of this analysis confirm the findings of the previous chapter as it shows a clear dissociation in the three networks between the atheists and theists. It also presents a clear separation between the Arab atheists who intensively interact with Western accounts and Arab Twitter users from the whole network, including the atheists who tend to interact with Arab accounts. Both follow, and retweet networks show that Arab atheists and theists tend to follow and retweet accounts that have similar attitudes to religion; suggesting that these two interactions are used for endorsement.

We also noticed that atheists have different aspects of discussions based on their networks. While some of them engaged with Western accounts, some engaged in active debate with theists about secularisation, and others engaged with users within their own community, i.e. with atheists. Theists tend to follow, retweet, and mention accounts from the Arab world, including government, news sources, and influential and public users; while, in the follow network, all groups tend to have the same feature

of following the influential and public Arab accounts and Arab news sources. Mention and reply network suggest that atheists and theists groups are close to each other, which supports the findings of the previous chapter too. We noticed that rationalists and tanweeri are not clearly separated from the four groups in the three networks. Although rationalists and tanweeris are distributed between the atheists and theists, there are more rationalist and tanweeri accounts positioned near the atheists; and rationalists engage more with Islamic scholars. Nevertheless, these findings suggest that rationalist and tanweeri accounts tend to act as bridges and breaking points of the echo-chambered groups, promote discussions among them, or some accounts belong to the atheist or theist groups but they label themselves as rationalists or tanweeri. This requires further investigation to understand these two groups. These findings answer RQ2 and its sub-questions.

In Chapter 5, we extend the work we have done in chapter 4 in which we applied the LDA topic modelling method to facilitate extracting the topics discussed by the four groups in order to understand the discussions conducted by them. The outcome of the work in this chapter is being revised as (Al Hariri et al., nd); it has not been published yet.

Analysing the topics is a way to clarify how the accounts from each group are involved in these discussions, which elucidates how each group differs from others. We use this as a method to measure the polarisation among these four groups.

The aim of this study is to answer the third research question RQ3 and its sub-questions by investigating the polarisation level among these communities in terms of the topics they are involved in online. It also contributes to understanding how Arabs engage in religious discussions, how these discussions reflect their stances, what topics are related to religious Arab communities, and how they are related to local, regional and global events.

The main finding is that there is a high overlapping among the topics discussed by the four groups. Our analysis shows that nine main topics are considered by the four groups. These nine topics cover the top eight topics from each group. However, the analysis also indicates that their positions, stances and responses to these topics differ based on their affiliations. This finding suggests that their motivations differ from one account to another among the four groups, with a general stream in each group. They also participated differently in the topics and discussions. A salient example is a response to the recent legalisation that allows Saudi women to drive cars. This topic attracted responses from four groups with different views or stances. While theists show

solidarity with the society's attitudes before the new legalisation, atheists criticise the 'backward' Arab societies and claim the religions cause that. After the new legalisation, theists endorsed it, although some rejected it within their families; in contrast, the atheists scoffed at that. This supports the suggested polarisation, which confirms the previous chapter's results.

Although the two main polarised communities have different positions on topics they discussed online, they are strongly concerned with local and regional and global issues and stories. In other words, we found that Arab atheists and theists are polarised in terms of the topics they discuss and in their motivations to respond to these topics. These findings answer RQ3 and its sub-questions.

6.3 Limitations and Future works

Studying Arab online communities with religious and atheistic backgrounds from the Muslim majority communities has a substantial role in understanding these communities from their online contributions, network dynamics and the attention they acquired online. This work provides an intensive analysis of Arab Twitter users who are involved in religious and atheistic discussions. However, as expected from such studies, it suffers from different limitations. While we were able to overcome some limitations that we encountered and identified in Chapters 3 and 4, below, we list the most important remaining issues and suggest possible methods to address them, which would be considered for future works.

The major limitation of this study is identifying the relevant communities and collecting their data. This limitation affects not just the under-represented communities such as atheists, tanweeris, rationalists and the spiritual but not religious groups, but even the larger group, the theists. Community detection is an expensive process in terms of time and resources. Identifying a seed list of users or using a list of terms to identify these communities led to small, noisy and non-representative communities. Communities detection algorithms have been widely investigated and would help to improve the process. We argue that implementing a set of iterations between the community detection methods, such as fast modularity or fast greedy modularity algorithm (Naik et al., 2022), and network and content analysis would help to build a larger network of relevant communities with a better understanding of their features.

Another limitation is identifying the non-relevant accounts, such as parody accounts and manipulators, including the automated accounts (bots) and troll army ac-

counts. We noticed that parody accounts gain a large number of interactions, which looks attractive to study and understand, but they do not provide useful topics of discussion and are not representative of their communities. Automated accounts might be considered to understand the objectives of campaigns' organisers and their motivations. However, their online contents are usually disinformative and deceptive and, consequently, lead to wrong conclusions (cdi, 2020). Although that would be handled by employing the recent Twitter feature of identifying automated accounts¹; still, studying online contributions requires considering such issues.

Furthermore, we notice that people sometimes provide false information in their Twitter metadata, such as the satirical locations and non-alignments between the account's description and the content of their tweets. Although this is unavoidable, studies must consider that and take a decision from the early stage to handle this 'phenomenon'. This requires further analysis of the context of religious interactions and their connection with the real societies within the Muslim and Arab communities.

Another limitation is the multimedia content of tweets. We noticed that some accounts from both theists and atheists tend to use pictures or videos in their tweets to explain their ideas or to recall evidence. Both network and text-based content analysis we conducted in this thesis ignore the rich data from multimedia content. Future work might involve analysing multimedia content from tweets which provide another dimension of understanding the context and the messages these communities share online.

Finally, our analysis of the topics and their temporal frequencies depends on the outcomes of the LDA model and on the crests in the topics within a period of time (monthly). This led to losing the important topics discussed by these groups but with smaller numbers of users or interactions. Specifically, some related small topics that LDA model and our clusters' labelling process failed to connect might be combined to give new peaks to consider. Also, we used the LDA topic modelling with manual justification for the parameters. Such a method is time-consuming and is heavily affected by human error. Employing Topic modelling with BERT models, such as BERTopic (Grootendorst, 2022), would simplify the analysis and improve the results. We consider that in the soon future work to enhance our results. Hence, we suggest that studying the topics with Arab focus groups would provide a better understanding of these communities and their interactions. Our suggestion might attract multidisciplinary researchers from social science and computer science to different routes of

¹<https://help.twitter.com/en/using-twitter/automated-account-labels>

study. Considering a survey or focus groups for these communities would provide a better understanding and fill the gap in connecting the virtual communities with the concrete communities. Computer science would utilise the topic modelling algorithm with multilingual BERT models to test the improvements in topic extractions from Arab Twitter content.

This requires further consideration to identify references to spirituality or personal religion and its relationship to the organised religions among Arabs and in the Arab Twitter-sphere. would require further collaboration with sociologists and theologists to have findings from the wider possible context of adherence to religion and spiritual beliefs and practices. Also, considering Muslims from different nations, such as Malaysian, Indonesian, and Turkish Twitter users are possible directions for further studies to understand how communities from different religious spectrums would be affected by their cultural backgrounds and how atheists interact with others in these communities.

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Chapter 7

Supplementary Material

7.1 Dataset Analysis - Chapter 3

Table 7.1: The highest occurrence of hashtags used by all groups

Hashtag (Translation)	Atheistic	Theistic	Tanweeri
عقلانيون (Rationalists)	28048	16743	2377
السعوديه (Saudi Arabia)	2274	1018	453
داعش (ISIS)	972	2001	86
صناعه المحاور (Creating Almohawer (interlocutor))	938	1159	123
الاسلام (Islam)	888	716	75
ايران (Iran)	514	648	96
سوريا (Syria)	543	611	67
مصر (Egypt)	663	464	81
اليمن (Yemen)	690	347	71
تتوير (Tanweer)	836	50	117
قطر (Qatar)	351	362	103
عقلانيون جديد (New rationalists)	437	678	19
نظريه التطور (The theory of evolution)	613	454	41
ستيفن هوكينج (Stephen Hawking)	625	194	94
ماجد مانع عمير معنف زوجته (Majed Mana' Omair oppresse his wife)	606	69	123
اسرائيل (Israel)	552	191	99
العراق (Iraq)	460	446	47
حقيقه (Truth)	527	382	52
محمد بن سلمان (MBS)	264	88	129
CEDAWSaudi	251	105	122
الصحوه (Sahwa)	293	47	114
الترد الابراهيمي (Abrahamic dice)	319	3	120
الكويت (Kuwait)	271	197	80
FreeRaif	427	49	84
القدس (Jerusalem)	279	358	28
نقد الموروث (Criticise ancestral)	418	58	72
رمضان (Ramadan)	471	128	47
القدس عاصمه فلسطين الابديه (Jerusalem is the eternal capital of Palestine)	226	352	23
Free Sherif Gaber	529	10	54
سعوديات نطلب اسقاط الولايه (Saudi women demand dropping of guardianship)	258	83	66
الرياض (Riyadh)	206	112	64
اسقاط الولايه (Dropping of guardianship)	235	149	51

Table 7.2: The 15 most frequent hashtags used by each group compared with other groups

Hashtag (Translation)	Atheistic	Theistic	Tanweeri
تجاره الوهم (Trades of illusion)	859	5	40
ExMuslim	719	60	51
Atheism	614	72	27
حقيقه التطور (Evolution is a fact)	609	8	29
الحرية لشريف جابر (Free Sharif Jaber)	533	66	88
Atheist	481	23	29
Tunisie	474	5	0
SaveDinaAli	430	5	18
غرد بصورة (Tweet a picture)	369	46	29
نطالب بحرية الاعتقاد (We demand freedom of belief)	369	0	112
رائف بدوي (Raif Badawy)	361	16	8
علوم (Science)	316	19	30
جمعه مباركه (Blessed Friday)	313	106	43
القران بالصور (Quran in pictures)	293	1	3
ترامب (Trump)	281	103	12
ملحد (Atheist)	166	1214	6
الالحاد (atheism)	129	473	6
مذبحة الاطفال في افغانستان (Afgan children's massacre)	16	449	9
دعاء (Pray)	2	403	0
انتشار الاسلام (Spread of Islam)	0	348	0
حقيقه النصرانية (The fact of Christianity)	7	345	0
يسوع (Jesus)	30	316	1
فلسطين (Palestine)	165	312	35
الكتاب المقدس (Bible)	10	297	0
الازهر قادم (Al-Azhar is coming)	11	280	1
Quran	42	266	2
الملاحده (Atheists)	10	262	0
شرعنة التصهين (Legalization of zionization)	0	230	0
حساب الدفاع عن الوحيين بالحجج والبراهين (Defence of Quran and Sunnah by arguments and proofs)	0	201	0
الاحتلال الهاشمي (Hashemite occupation -over Yemen-)	1	0	236
لا تسرق يا عايش (O Ayed, Do not steal)	43	3	140
احاديث ضعيفه استعملتها الصحوه (Weak Hadith employed by sahwa)	142	32	85
تنظيف المدارس من السورريات (Cleaning schools from Sururi women)	64	33	84
بوح ناي (Flute's revelation)	13	1	78
ولي العهد (Crown prince)	103	35	75
النصر (Al-Nassr FC)	18	21	65
ولي العهد علي قناة CBS (Crown prince on CBS)	110	29	64
بدل عبودية للمراه السعوديه (Slavery allowance for Saudi women)	26	8	63
كيف نجوت من الصحوه (How I survive from Sahwa)	122	35	59
اب يرفض خروج ابنته من السجن (Refused to release his daughter)	114	66	54
قررت البس عبايه علي الراس (I decided to wear it on my head)	85	40	54
المطلق العبايه غير الزاميه (Almutlaq Abaya is not obligatory)	137	48	52
الاخوان (Brothers)	57	21	49
اليمن (Yemen)	136	40	47

Table 7.3: The 20 most frequent Domains that are used by Each class.

Atheists		Theists		Tanweer	
Domain	Freq.	Domain	Freq.	Domain	Freq.
ask.fm	901	du3a.org	11768	flwrs.com	323
wearesaudis.net	596	d3waapp.org	2807	crowdfireapp.com	134
goodreads.com	439	alathkar.org	1402	eremnews.com	63
ibelieveinsci.com	273	kaheel7.com	375	alqabas.com	59
dw.com	213	almohawer.com	327	thenewkhalij.news	57
al-eman.com	198	sabq.org	175	8bp.co	43
atheistrepublic.com	170	unfollowspy.com	151	n-scientific.org	35
ahewar.org	163	bayanelislam.net	139	alghadeer.tv	21
atheistdoctor.com	154	antishobhat.blogspot	129	maktaba-	21
dorar.net	135	kutub-pdf.net	122	amma.com	
imdb.com	86	spa.gov.sa	109	alarab.co.uk	15
libral.org	62	i.imgur.com	108	telegra.ph	12
linkis.com	61	ncbi.nlm.nih.gov	97	aljarida.com	12
arabatheistbroadcasting	59	justpaste.it	96	alhood.net	11
dkhlak.com	58	7asnat.com	90	dr-alawni.com	9
iqtp.org	57	quran.to	82	alsumaria.tv	9
syr-res.com	50	survey-	82	ansa.it	8
bassam.nu	45	smiles.com		arabic.mojahedin.org	6
friendlyatheist.patheos	33	cnsnews.com	75	arabketab4u.blogspot	6
mustafaris.com	28	alkulify.blogspot	68	marebpress.net	5
		estigfar.co	56	emaratalyoum.com	5

7.2 Network Analysis Data

7.2.1 Friends (Accounts Followed by dataset) - Chapter 4

Cluster	Feature	Examples
ArbAth	Names reflect positions	mol7d_Arabi, _PROMETHEUS_1, ArabIrreligious, MindisReligion, among_religions, OmaniAtheist, kurdman444, atheistskurds, IraqiAtheist, Kuwaity_Atheist, CurseOfIslam, AngryEgyptian1, BigLieReligion, Liberal_Infidel, anawint2, GulfAtheist and saudi_agnostic.
	Criticising religions & promoting secularism scientific accounts	Without reflecting their affiliation: aba_akrama; or, with declaring it: Liberal_Infidel and Al_Qosaimi. youssefalbanay (Kuwait), ScientificSaudi (Saudi), iSciencesi (Saudi), Astro_Phys (Saudi), SpaceARAB, and NatureArabicEd.
	ex-Muslim Christians	SaudiChrstian93 and SaudiChristian.
	Controversial personal accounts	Demanding secular communities such as MaysAl-suwaidan, HsnFrhanALmalki, IbrahimAlbleahy, LoujainHathloul, SouadALshammary and Ayadjamaladdin. Some strongly support their governments (TurkiHALhamad1), others criticise it (MadawiDr).
RelDis	Actively Promote atheism and criticise religions	secularistegypt, SaudiExMuslims, DrTalebJawad, SherifGaber, NawalElSaadawi1, hamed_samad, AtheismAcademy, Omar_exmuslim, Kareemontah, coolevian10, mqasem, Quantum_Atheist, arabs_exmus, OpenMinded81, YemAtheist and Mol7id_IRAQI.
	Israeli accounts	IsraelArabic and EdyCohen.
	Rationalists	spideraustr, Na9eR_Dashti, Raseef22.
	LGBTQ community	LGBTQarabic, lgbtARABS and LGBTArSc.

Cluster	Feature	Examples
ArbInfl	Members of Royal families	KingSalman, TalalAbdulaziz, M_Naif_Alsaud, nawafbinfaisal, Alwaleed_Talal, Saudi49er, MohamedBinZayed, HamdanMohammed, SaifBZayed, and abduallahthanii.
	Ministers from Saudi Arabia & United Arab Emirates	AdelAljubeir, tfrabiah, TurkiAldakhil, Turki_alalshikh and aleissaahmed; and, AnwarGargash and Dhahi_Khalfan
	Football clubs	Alhilal_FC AINassrFC, ALAHLI_FC and ittihad from Saudi; and, fcbaselona_ara.
	Saudi football players	SamiAlJaber, altemyat, Fahadalhurifi and MohammedAlDeaye
	Muslim scholars	SalehAlmoghamsy and abuabdelelah from KSA and waseem_yousef from UAE.
	Tanweer scholars	Dr_Mhd_Shahrour, DrAdnanIbrahim.
	Arab academics	HatoonALFASSI, Abdulkhaleq_UAE and Walidfitaihi.
Arab journalists, writers, actors and shows presenters	OlaAlfares, BidzSaleh, shugairi, Adelaltwajri, waleedalfarraj, battalalgoos, m_bukairy, k_alshenaif, khalaf_h, allahim, alrotayyan, algassabinasser, fayez_malki, AbdullahK5, mustafa_gha, farisf9, Adhwan, Almatrafi, Ali_Alalyani, TurkiAlajmah, SarahD, almousa_su, ALMRISEUL,alasmari, OthmanAlomeir, and AhlamAlShamsi.	

Cluster	Feature	Examples
NonArab	Arab news sources	Official source:s spagov and AlArabiya_KSA, Al-Riyadh, and OKAZ_online). Non-official sources: ajlnews and AjelNews24, Top-SaudiNews2, AlwatanNews24, KSA24, Akhbaar24 and News_Brk24.
	Western-based Im-migrants	Ayaan, miss9afi, YasMohammedxx, NadiaMurad-Basee.
	Western-based Atheist accounts	CEMB_forum, ExmuslimsOrg, RichardDawkins, SamHarrisOrg, billmaher, BillNye, joerogan, neiltyson, Bassamius, EgyptianRedpill, MoThe-Atheist, 3arabAtheist, Atheist_Iran, Aliyah_Saleem, MaryamNamazie, ArminNavabi, aliamjadrizvi, SarahTheHaider, and cenkuygur.
	Western influential accounts	WhiteHouse, realDonaldTrump, BarackObama, BillClinton, FLOTUS, IvankaTrump, HillaryClinton, JustinTrudeau, BernieSanders, Oprah, BillGates, and Nigel_Farage.
	Western-based or-ganisations	UN, UNHumanRights, HumanistsInt, and AHAFoundation, hrw, amnesty, WHO, UNICEF, Refugees and FEMEN_Movement
	Non-Arabic news & media	AJEnglish, Reuters, Charlie_Hebdo_, NatGeo, nytimes, guardian, BBCNews, CNN, SkyNews, CBSNews, washingtonpost and WSJ.

Cluster	Feature	Examples
ArbSch	Muslim scholars	MohamadAlarefe, Dr_alqarnee, salman_alodah, NabilAlawadhy, mh.awadi, almonajjid, SalehAlmoghamy, MohsenAlAwajy, AdnanAlarour, naser-alomar, abdulaziztarefe, KhalidMAIDrees, Ahmed-Spea, MongizAlsaqqar, Ali_Alomary, BiN_BAAAZ (symbolic account), Bin_Bayyah (symbolic account) alsha3rawy (symbolic account), ibnQaim (symbolic account), Dr_EyadQun, and FadelSoliman;
	women academics and Islamic scholars	rokaya_mohareb_, Nawal_Al3eed_, and Dr_NoraAlsaad.
	Theists discuss atheism	Dr_EyadQun, FadelSoliman, DrDimashqiah, abosaleh95, AhmadyuAlsayed, DrHeshamAzmy, qarnirashad, NABIH_SABBAGH, MongizAlsaqqar, Sami_Al_Zain, abunawaf1397a, Ex_AtheistGirL, g3rhg, antirandom, 3_icare, Mrbrary, and AntiShubohat
	Political and social activists and whistleblowers	saadalfagih, almass3ari, nasser_duwailah, Altabtabie, DrHAKEM, aalodah, oamaz7, abo1fares, Bassam-Jaara, HadiAlabdallah, MohamadAhwaze, abo3asam, Ahdjadid, mujtahidd, and AboShla5Libraly
	Islamic studies centres, institutions, and programs	takweencenter, Almohawer_T, Wesal_TV, kamil_alsorah, braheen_center, IslamQAcom, Dalail-centre, yaqeenet, ZADTVChannel, Wesal_TV, and safa_tv.
	journalists and TV presenters	Jkhashoggi, MousaAlomar, falsunaidy, anwarmalek, and HadiAlabdallah
News	Muslim scholars	alqaradawy, DrAliGomaa, amrkhaled and alhabibali

Cluster	Feature	Examples
	Presidents and Royal family members	TamimBinHamad, KingAbdullahII, Muhammad-Morsi, QueenRania, ABZayed, HSHkMohd, Saif-BZayed, HamdanMohammed, saadhariri, AlsisiOfficial, rterdogan_ar, BarackObama_Ar, Israelipm_ar
	Arab political thinkers and public figures	abelbariatwan, AzmiBishara, TawakkolKarman, walidjoumblatt, and ElBaradei, HamdeenSabahy, AlaaMubarak_, HamzawyAmr, NaguibSawiris, AymanNour, YosriFouda;
	Arab journalists, writers and TV presenters	abelbariatwan, kasimf, FatimaNaoot, wassilaoulmi, YosriFouda, Assaadtaha, jaberalharmi, TamimBarghouti, AbdullahElshrif, and arahmanyusuf
	Professional football players, singers, show presenters and football clubs	MoSalah, Rihanna, Oprah and elissakh, Cristiano, GarethBale11, MesutOzil1088, SergioRamos, GalalAmer, AhlamMostghanmi, AlaaAswany, Rihanna, Jlo, katyperry, elissakh, amrdiab, KadimAlSahirORG, NancyAjram, najwakaram, HaifaWehbe, 7sainaljassmi, HamzaNamira, ahelmy, OfficialHenedy, kalnaga, youssef.hussen, Oprah Winfrey, Amradib, MustafaHosny; realmadrid, AlAhly, ManUtd, FCBarcelona, Cityarabia, LFC, AlAhly, and ZSCOfficial;
Info	Theistic accounts that organise electronic attack infotainment accounts	Anti_Godlessnes, SalwaSsee, UUI0U, s33qa1, tahany452, and aljawhrah_m AQWAL_MATHORA, videonet_, developtherself, WynKSA, Fastest_spread, and NawafNetwork

Table 7.4: Maps From Clusters Codes to The Corresponding Theme of Community

7.2.2 Mentions (Accounts Mentioned by dataset) - Chapter 4

Cluster	Feature	Examples
ArbInfl	Non-Official Arabic News	AjelNews24, SaudiNews50, KSA24, sabqorg, HashKSA, ReNgo_Sport, Akhbaar24, News_Brk24, ajlnews, KSASociety
	Official Arabic News	spagov, AJArabic, AlArabiya_Brk, alekhbariy-atv, AlArabiya skynewsarabia, aawsat_News, OKAZ_online
	Arabic Football Clubs	Alhilal_FC, AlNassrFC, ittihad
	Football player	SamiAlJaber, Fahadalhurifi, MoSalah
	Arabic Royal Family Members and Presidents	KingSalman, HSHkMohd, abdulrahman, sat-tam_al_saud, MohamedBinZayed, Alwaleed_Talal, althani_faisal, saadhariri
	Arabic Public Figures	Turki_alalshikh, Dhahi_Khalfan, fayez_malki, HaniB-inbrek, yousef_hussen, DrAlnefisi, TawakkolKarman, kasimf
	Journalists, writers, activists and presenters	alkhames, TurkiHALhamad1, LoujainHathloul, oamaz7, LatifahAshaalan, A_AlAthbah, yousef_hussen, LoveLiberty, gathami, DrAlnefisi, HadiAlabdallah, TawakkolKarman, wassilaoulmi, kasimf, Meshal_Alami, Fahd_Alshelaimi, MousaAlomar, Adhwan, waleedalfarraj, fahadalahmdi, mustafa_gha, Abdulkhaleq_UAE,
Muslim Scholars	abdulaziztarefe, waseem_yousef, alturifi1, Dr_alqarnee, DrAdnanIbrahim, almonajjid, MohamadAlarefe, NabilAlawadhy, salman_alodah, Ibrahim_aldwish, mohamadalsaidi1	

Cluster	Feature	Examples
ArbAth	Non-Arabic Accounts	Sweden_AR, EdyCohen, IsraelArabic, AvichayAdraee, NorwayAr, ArabicObama
	Religious discussion	Azizalqenaei ^a , Ayadjamaladdin, CurseOfIslam
RelDis	Muslim scholars & writers	^a http://elsada.net/author/abelzizialqenaei/ mh_awadi, AbdllahAlneaimi, DrHeshamAzmy, YZaa-treh, mishari_alafasy, iyad_elbaghdadi (<i>A famous Arabic activist</i>).
	Infotainment	TheTopVideo, ajplusarabi, EH3H
	News	WatanNews, 3ajel_ksa, AlraiMediaGroup
	Secularists criticise Islam	Na9eR_Dashti, sameh_asker, khaledmontaser
	Ex-Muslims criticise Islam	BrotherRasheed, DrTalebJawad, Taufikism16
	Scientific accounts	OmarExplains, youssefalbanay, EvolutionFaults
	Writers, journalists and scholars	Dr_EyadQun, abduallahrushdy, TareqAlSuwaidan, DrDimashqiah, othmanalkamees, MongizAl-saqqar, alduferi1969, FadelSoliman, waleed_1_975, Sheikh_alHabib, ahmedabdumaher, liliandaoud, abusulayman, NadimKoteich, SAlghobari
NonArab	Groups and organisations and programs	3almanyon, FreeThinkersRom, Sudanathiest, ExMuslimvoice, IBelieveInSci, kamil_alsorah, alawaloon, yaqeennet, NatGao_Arabic, a9elabdel, SaudiExMuslims, MominounWB
	Controversial political activists	MadawiDr, TurkiShalhoub, TareqAlSuwaidan, alia_ww, MaysAlsuwaidan
	News sources	aa_arabic, AlarabyTV, News90Saudi, an7a_com, 7eyad, aleqtisadiah
NonArab	Singers	elissakh, shamsofficial, mounir_musiic
	Western-based Immigrants	Ayaan, miss9afi, hamed_samad, and YasMohammedxx.

Cluster	Feature	Examples
	Western-based Atheist accounts	CEMB_forum, ExmuslimsOrg, RichardDawkins, SamHarrisOrg, billmaher, joerogan, neiltyson, MoTheAtheist, Atheist_Iran, Aliyah_Saleem, MaryamNamazie, ArminNavabi, aliamjadrizvi, SarahTheHaider, and cenkuygur.
	Western influential accounts	WhiteHouse, realDonaldTrump, BarackObama, HillaryClinton, JustinTrudeau, BernieSanders, DonaldJTrumpJr, and Nigel_Farage
	Non-Arabic news & media	AJEnglish, Reuters, nytimes, guardian, BBCWorld, CNN, SkyNews, CBSNews, RT_com, DailyMailUK, and washingtonpost.

Table 7.5: Maps From Clusters Codes to The Corresponding Theme of Community

7.2.3 Influential Accounts Followed by Dataset - Chapter 4

The accounts that are listed here are the top accounts that followed by the seedlist accounts from each cluster, i.e. the users that have most followers from the dataset. We considered only the public and accessible account that are not from our seedlist. Also, to have a better understanding of the influential users, we included the accounts that are mostly active and well known in the communities.

Cluster	Account	Description
ArbAth	mol7d_Arabi	A personal account for a humanist and atheist who seeks to spread science and concepts of humanity and equality. Almost all tweets in Arabic and criticise the idea of Deity and mainly in Islam.
	AtheistGhost	An account that does not represent a named individual. The bio states that he is 'Antitheist, Hashemite, Born Muslim, Saudi'. The timeline contains different topics that criticise the conflicts on religious bases in India, Arabs governments (mainly Saudi), Israel and the recent normalisation agreement between some Arab countries and Israel. It also mocking Islam and Quran (the Islamic holy book) by tweeting about 74 scripts that mocking suras. The main content of the timeline are retweets. The bio is written in both Arabic and English, while the tweets are either in Arabic or English.
	_PROMETHEUS_1	Atheistic account that criticises religions and mainly Islam and Christianity. Most tweets are in Arabic while some are in English. The account does not show any personal information.

Cluster	Account	Description
	Affeist	Atheistic account that criticises religions and mainly Islam. Most tweets are in Arabic while some are in English. The account does not show any personal information and tweeting in both Arabic and English languages.
	Azizalqenaiei	An account that represents a well known Kuwaiti activist. The bio states that he was detained in Kuwait for his opinion, and he is a journalist writer. Also, it asks his visitors not to read his writings if they lack brave. The account demands secular, rational and westernised community in Arab and mainly Gulf countries. He believes that religions must be reformed, humanised and rationalised. To reform Islam, Quran and Hadith must be reformed (i.e. remove some of their contents) to have a better version of Islam otherwise, there is no way to reform it.
	CurseOfIslam	An account that does not represent a named individual. The account name and screen name criticise Islam in both Arabic and English languages (Curse Of Islam - لعنة الإسلام). The bio states a very clear position towards Islam by stating that 'Islam is the most dangerous thing that faces humanity, Muslims are its first victims, and the only service that we can offer them is liberating them from Islam'. The account mocking Islam by ridiculing Quranic verses, Hadiths, and Prophetic biography. The bios and almost all tweets are in Arabic.

Cluster	Account	Description
	Liberal Infidel	An account that uses a female name (Sarah the Liberal سارة الليبرالية) The bio states that ‘People who don’t like their beliefs being laughed at , shouldn’t have such funny beliefs.’. The account mocking Islam by ridiculing Quranic verses, Hadiths, and Prophetic biography. The bios in English while almost all tweets are in Arabic.
	anawint2	A parody account that criticises Islam.
	TamirKalil	A Reconsidering postulates is necessary in a changing world. The world is wombs that pushes and a land that swallows up, and nothing after that. No to racism in all its manifestations!.
	youssefalbanay	A theoretical physicist, and cosmology specialist from Kuwait. The account is purely scientific and cite or explain physical experiments and explorations without discussing religious beliefs and views.
	ra7eeq_ma5toun	A Sarcastic account that criticise Muslim communities and Islam by mentioning some worship practices in a sarcastic way. It does not represent a person nor a characteristic of an individual.
	Al_Qosaimi ¹	A symbolic account for a Saudi writer and intellectual (died in 1996). He is one of them most controversial Arab intellectuals in the 20th centuries. He changed his position from defending Islamic Salafism to defending atheism.

¹<https://english.alarabiya.net/en/variety/2016/10/22/Meet-the-Arab-agnostic-who-went-his-own-way-in-the-1940s.html>,
<https://www.al-monitor.com/pulse/originals/2014/03/gulf-atheism-uae-islam-religion.html>

Cluster	Account	Description
	TurkiHAlhamad ²	<p>A controversial Saudi writer who demands secular community. He describes himself as a Muslim who believe in Allah is the god, Muhammad is the prophet, and Islam is his religion, but he is infidel in all religious preachers. According to an interview with him in Okaz newspaper, he mentioned that he was jailed three times in Saudi for his opinion. However, these experiences helped him to refined his intellectual, to get rid of extreme ideologies, and to raise up to the first step on the consciousness ladder. Alhamad believes that Arab intellectuals affected mostly with their ideological convictions and thinks. Alhamad believes that atheism wave among Arabs was wider and much greater during the Sahwa than nowadays. Sahwa is a widespread political, cultural, and religious movements that started after 1979 mainly in Saudi and some Arab and Islamic countries. In addition, Alhamad says that Atheism among Arabs has not turned into a phenomenon; although, the increasing in margin of freedom. However, he confirm that these are unconfirmed predictions without any evidence.</p>
	SouadALshammary ³	<p>A Saudi women's rights activist. She demanded Saudi women rights, challenged guardianship law in Saudi, and co-funded the online Saudi Liberal Network discussion group which aims to a Liberal community. She was detained in 2014 for about three months because of insulting Islam, inciting Saudi women to challenge guardianship laws, and criticising Islamic scripts and authorities in Saudi in her on Twitter.</p>

²<https://www.okaz.com.sa/culture/culture/2025301>

³<https://www.theguardian.com/world/2015/feb/01/saudi-arabia-frees-raif-badawi-associate>

Cluster	Account	Description
	<p data-bbox="459 208 687 248">LoujainHathloul⁴</p> <p data-bbox="459 813 600 853">squemny⁵</p>	<p data-bbox="770 208 1449 808">A Saudi women’s rights activist. She demanded for gender equality, and registered to run for a seat in the municipal council in her home country. She was detained for several times since 2014 for demanding women’s rights in driving cars and challenging women’s guardianship laws in Saudi. She was in prison during conducting this study. However, she published a clarification statement in her website in both Arabic and English to explain her participation in some foreign media. She also refused the way that the journalists used her interviews to broadcast an unbalanced and sensational documentary.</p> <p data-bbox="770 813 1449 1704">An account that is created by fans of a well known public figure from Egypt. The bio states that Sayyid Al-Qemani is an Egyptian writer and researcher specialised in the philosophy of religions, Islamic history and religious social studies. In a video tweet content, he states that Alazhar is a terrorist body and his fellows are challenging it in international courts. Personally, Al-Qemni criticise religions and mainly Islam and oppose Egyptian government as it grants freedom to some religious foundations in Egypt such as Al Azhar and Dar al-Ifta al Misriyyah (Egyptian Islamic Institution for religious provisions). In a conference in Brussels in 2016, he claimed that Islam is a brutal religion that imposes a desert-theme lifestyle and thoughts. He believes Secularism is the solution for the social crisis in Arab world, as it has succeeded wherever it is applied, and secularism is the conscience of humanity.</p>

⁴<https://www.nytimes.com/2019/01/26/opinion/sunday/loujain-al-hathloul-saudi.html>,
<https://www.nytimes.com/2018/10/08/world/middleeast/saudi-jamal-khashoggi-dissent.html>,
<http://www.loujainhathloul.com/myarticles/enstatement>

⁵<https://www.youtube.com/watch?v=WPnL5xPEPac>

Cluster	Account	Description
RelDis	AtheismAcademy	An account that does not represent a person nor a body. It promotes atheism and criticise religions by mentioning Quranic verses (ayas) or Islamic hadiths and discuss it or criticise it. It also discuss Christian and Usually it tweets in Arabic and attach pictures to cite what it discuss or to criticise it.
	SerajAlghamdi	A Saudi cartoonist who uses his cartoons and Twitter accounts to spread social awareness and criticise social malpractice. The tweets criticise how extremists and some religious scholars understand Islam but without criticising any religion.
	Omar_exmuslim	The account criticises Islam. In the bio it states that Islam is nothing but a biblical heritage with a desert flavor. The timeline contains tweets that discuss different topics from the Islamic provisions. There is no tweets about atheism or intellectual thoughts. The account do not represent a specific person.
	Kareemontah	The geo-location is described to be in Iraq. The account is not personal nor body but it discuss different topics relevant to religions. It criticise the religious and political conflicts between the main Islamic sects in Iraq (Sunnis and Shiites). The account it clearly affected by the usability in Iraq and its neighbour countries.

Cluster	Account	Description
	coolevian10	The account does not show specific person, belief or affiliation in its name nor in its description. However, in tweets the account clearly states that all religions are invented by human being and denying this comes from living in a weak culture or a person with limit think. The account tweets about space exploration and refuting religions, mainly Islam.
	Asa_Elawaleen	A twitter account that mainly criticise Islam. The tweets discuss Islamic maxims linguistically.
	DrTalebJawad	A non-Verified account for Saudi psychiatrist. He states in the bio that he manages another Twitter account SaudiExMuslims and the founder of Saudi Rights Movement (SaRiM). His tweets are written in Arabic and discuss different topics about Islam to criticise it and to criticise the Muslim communities.
	NasaInArabic ⁶	An account for a voluntary initiative that aims to enrich Arab societies by translating and publishing everything related to physics and science from different sources, mainly for space exploration. The initiative, as stated in the bio, aims to provide an Arabic education reference to develop and educate Arab societies. It does not indicate any religious affiliation.

⁶<https://nasainarabic.net/main/interactive>

Cluster	Account	Description
	mqasem ⁷	A Personal account for a Kuwaiti academic scientist and writer. His name is Mohamed Qasem and he has the PhD degree in electronics and electrical engineering. In 2015, Nature Middle East named him as one of the top science communicators in the Arab World. Qasem use his social media accounts over Twitter, YouTube, Facebook Podcast to communicate science to Arabs and to encourage them to explore it. The account does not show any affiliation nor discussing religious topics.
	NawalElSaadawi ⁸	A verified account of Dr. Nawal El Saadawi, an Egyptian novelist, writer, and medical doctor. She criticise all religions and mainly monotheists Abrahamic religions, i.e. Islam, Christianity and Judaism. The main discussions in the timeline are relevant to women's rights, freedom or speech and ridiculing religions. All religions are politic, and contradict with common sense.
	SherifGaber ⁹	A non-verified account for an Egyptian blogger. He discusses and mocks topics which Muslims say they are their principles and sanctities. He also discusses social topics relevant to women's rights, veil, LGBT. According to several sources, he tried to flee Egypt in 2018, when he was detained for a while by Egyptian security. In late 2019, he appeared in a YouTube clip asking for people's support to flee Egypt.

⁷<https://www.natureasia.com/en/nmiddleeast/article/10.1038/nmiddleeast.2015.130>,
<http://mqasem.net/>

⁸<https://www.youtube.com/watch?v=1brUb7Yezw8>

⁹<https://www.bbc.com/arabic/trending-47199747>

Cluster	Account	Description
	Na9eR_Dashti	A non-verified account for the Kuwaiti secular activist Naser Dashti. He actively discusses his point of view with Muslims, both Sunni and Shiit sects. He is a member of Tanweer Center for Culture in Kuwait. His tweets are in Arabic and reflect his opinions in religious and national (i.e. topics) topics.
	AhmedHarqan ¹⁰	A non-verified account for an Egyptian man. He is well known for his radical conversion from being Salafi Muslim to be an Ex-Muslim atheist for about of 10 years, and returning to Islam. He suffered from a dramatic story as he is banned from travelling to leave his country and to join his wife.
ArbInfl	KingSalman	A verified account for King Salman Al Saud, a prominent member of Saudi royal family and the King of Kingdom of Saudi Arabia.
	TalalAbdulaziz	A verified account for Talal bin Abdulaziz (1931-2018), a prominent member of Saudi royal family.
	M_Naif_Alsaud	A verified account for Mohammed bin Nayef, a prominent member of Saudi royal family and the former crown prince in Saudi Arabia.
	nawafbinfaisal	A verified account for Nawaf bin Faisal, a member of the Saudi royal family.
	Alwaleed_Talal	A verified account for Alwaleed bin Talal bin Abdulaziz, a prominent member of Saudi royal family and popular businessman.

¹⁰<https://www.youtube.com/watch?v=CTsrD0jASb0>

Cluster	Account	Description
	MohamedBinZayed	A verified account for Mohamed Bin Zayed, a prominent member of one of royal families in Emirates and the crown prince of Abu Dhabi and the vice president of UAE.
	HamdanMohammed	A verified account for Hamdan Bin Mohammed, a prominent member of one of royal families in Emirates and the crown prince of Dubai.
	faisalbinturki1	A verified account for Faisal bin Turki, a member of Saudi royal family. The former president of Al Nasr football club in Saudi Arabia.
	abdullahthanii	A verified account for Abdullah bin Ali Al Thani, a member of Qatari royal family.
	AdelAljubeir	A verified account for Adel Aljubeir Minister of State for Foreign Affairs and member of the Council of Ministers.
	Badermasaker	A verified account for Bader Al Asaker Head of The Private Office of the Saudi Crown Prince Muhammad bin Salman and the Chairman of Misk initiative center.
	Abdulkhaleq_UAE	A non verified account for Abdulkhaleq Abdulla, a professor of political science from Arab Emirates.
	salrashed	A non verified account for Salah Alrashed, a Kuwaiti social activist. He describes himself as a thinker who motivates thoughts and builds a timeline that is full of love, peace and tanweer. He is a well known investor in social reform and personal development with Islamic background.

Cluster	Account	Description
	Walidfitaihi	A verified account for Walid Fitaihi, an American-Saudi physician. He is a popular Saudi reformist and motivational TV presenter. He is active over the social media to broadcast his ideas and beliefs. The timeline tweets are mainly in Arabic with some of them in English. The tweets about his business and personal messages and ideas.
	algassabinasser ¹¹	A verified account for a well known and controversial Saudi Arabian actor, and one of the judges in the Arabs Got Talent TV show. He participated in several series that illustrate Saudi society and criticise religious bodies and traditions in Saudi Arabia. In 2000, there was a fatwa that forbidden some series of Tash ma Tash (“No Big Deal”) that he participated in. He also played some roles in a satire TV series that criticise ISIS. The account is personal and used to interact with others, publish news about his activities and there are some critic tweets for social behaviours.
	Y20	A verified Saudi former football player. He played for the national team of Saudi Arabia and for Al Hilal Saudi Football Club. The timeline show regular tweets that reflect solidarity with Saudi government leaders and does not show any religious discussion.
	t_donkeys	A sarcastic account that criticise social mistakes of Arab Twitter users. It does not criticise religions but the interpretations that contradict with the general understanding.

¹¹<https://edition.cnn.com/2015/06/22/middleeast/anti-isis-satire/index.html>,
<https://ar.islamway.net/article/2531/> (arabic source),

Cluster	Account	Description
	MLSD_SA	An unknown user with a one tweet timeline. The tweet is a Quranic recitation. It has more than 5000 followers.
	saleh_alturige ¹²	An account for a Saudi sport analyst, writer and sport journalist and the former handball player in Al Ahli Club in Saudi Arabia. The account interested in sports discussions in Saudi Arabia and does not discuss religious topics.
	Dr_Mhd_Shahrour ¹³	A verified account for Muhammad Shahrur, a controversial academic specialised in civil engineering at Damascus University. He is the founder of the contemporary reading of Quran and Islam with unprecedented understandings and explanations. He tried to “reconciling” Islam with modern philosophy as well as the rational worldview of the natural sciences. Since he introduced his methodology of reading Islam in his book in 1990, multiple Islamic institutions and many Muslim scholars opposed it as it neglects some of essential sources of Islamic religion. For example, there is a tweet that stated that Algerian authorities seized 7 out of his 9 books after the Algerian book fair “Salon international du livre d’Alger SILA”.
	nadinealbdear	A verified account for Nadine Al Badir, a Saudi writer and TV presenter. She demands a liberal society and criticise the Saudi religious bodies and some Islamic laws.
	NorwayAr	An infotainment account that tweets about Norway. The language of account is Arabic.

¹²<https://www.youtube.com/watch?v=xLmP31avoEM>

¹³

Cluster	Account	Description
	Almatrafi	A verified account for the Saudi journalist Khalid Almatrafi.
	OKAZ_online	A verified account for the Saudi Daily newspaper Okaz.
	Awraaq	An infotainment account. Its tweets include several topics including Islamic maxims.
	Fahadalhurifi	A non verified account for the former Saudi football player Fahad Alhurifi.
	SamiAlJaber	The verified account for the former Saudi football player Sami AlJaber.
	altemyat	The verified account for the former Saudi football player Nawaf Altemyat.
	Alhilal_FC	The verified account for Al Hilal Saudi football club.
	AlNassrFC	The verified account for Al Nassr Saudi football club.
	ittihad	The verified account for Al-Ittihad Saudi football club.
NonArab	AtheistRepublic	An account the described as a community of godless heathens who share their views and help each other express their atheism. Its timeline tweets are mainly in English. It criticises all religions and mainly Islam and Christianity and their societies in Arab countries.

Cluster	Account	Description
	Bassamius	A non verified account of Bassam Al-Baghdady. He describes himself as author, translator and the founder of Centre for Secular Education in Sweden. The tweets are mainly in Arabic and sometimes in Swedish. He is active over social media, demands secular communities, and criticises religions.
	elonmusk	A verified account for a well known billionaire Engineer. The timeline does not show any religious affiliation. It covers several topics relevant to space exploration, XSpace, AI, and Tesla cars.
	BillGates	A verified account for the American computer programmer, businessman, and philanthropist; the billionaire Bill Gates. The co-founder of Microsoft and the charitable foundation Bill and Melinda Gates Foundation. The account tweets cover several topics such as personal activities, international organisations, and health-related news without mentioning religions.
	ThinkAtheist	An account that tweets about atheism and religions. It criticise religions and mainly Christianity and Islam. Interestingly, there are some tweets that mention atheism and atheists in a funny way. Tweets talk about the societies in America.
	CNN	The verified account for the CNN News, the American news-based television.
	POTUS	The verified account for the president of the United States of America.
	realDonaldTrump	The verified personal account of the president of the United States of America Donald Trump.

Cluster	Account	Description
	BarackObama	The verified personal account of the former president of the United States of America Barack Obama.
	FLOTUS	The verified account of the Office of First Lady in the United States of America, Melania Trump.
	IvankaTrump	The verified account for Ivanka Trump, the Advisor of the US president Donald Trump and his daughter.
	DonaldJTrumpJr	The verified account for Donald John Trump Jr. the American businessman and the eldest child of US president Donald Trump. According to CNN, he was a political adviser and central member of his father's presidential campaign in 2016.
	raif_badawi	The verified and official account of Raif Badawi, the writer from Saudi Arabia and the creator of the website Free Saudi Liberals, and the recipient of Sakharov Prize in 2015. As he is imprisoned, the account is managed by his wife, miss9afi who fled Saudi with their children and live in Canada. The tweets are in several languages and mainly in Arabic and English that demand his freedom, and a secular community in Saudi Arabia.
	miss9afi	The verified account of Ensaf Haidar, the Saudi-Canadian human rights activist. She describes herself as proud wife of raif_badawi, the imprisoned Saudi activist. The tweets are mainly in English and French.
	NadiaMuradBasee	The verified account of the Iraqi Yazidi human rights activist and survivor of genocide, 2018 Nobel Peace Prize Laureate, and the founder of Nadia's Initiative

Cluster	Account	Description
	Ayaan ¹⁴	Verified account for the Somali, Dutch, American writer, Ayaan Hirsi Ali. She describes herself as human rights activist, the founder of AHA Foundation, and Hoover Institution's fellow. She demands radical and immediate reformation to Islam especially for women's rights. Even the claim that there are mix of bad and good things in Islam, just like a basket of apples, some are rotten and others are good is refused by her because, according to Ms Ali, the whole basket is rotten.
	benshapiro ¹⁵	The verified account of Ben Shapiro is an Orthodox Jew, as he described himself, an American conservative political commentator and media host who labelled more than 800 million Muslims from around the world as radicals in his show "Reality Check". His conclusion was based on controversial and selective criteria and measurements taken from surveys conducted by Pew Research in 2011. The criteria fluctuated among opinions about women's honour killing, stances toward Bin Laden, 9/11 terrorist attack and Shari'a Law. For instance, he considered 32% of Turkey as radicals because they said honour killing is "sometime justified" and 143 millions of Indonesian Muslims as radicals because they blame US and Israel for 9/11.
	9GAG	The verified account for entertainment website 9GAG.com.

¹⁴<https://www.politico.com/magazine/story/2015/03/ayaan-hirsi-ali-a-hero-for-our-time-116404>,
<https://nypost.com/2015/03/22/activist-argues-for-a-complete-reformation-of-islam/>

¹⁵<https://www.youtube.com/watch?v=6L2Jil03qmI>,
<https://www.politifact.com/factchecks/2014/nov/05/ben-shapiro/shapiro-says-majority-muslims-are-radicals/>

Cluster	Account	Description
	CBSNews	The verified account for the CBS News, the American news-based television.
	BBCNews	The verified account for the BBC News, the British Broadcast Channel.
	FoxNews	The verified account of the American cable news television channel as described in the bio.
	ABC	The verified account of the Australian Broadcasting Corporation (ABC) news television channel as described in the bio.
	UNHumanRights	The verified account of the United Nations Human Rights Office.

Cluster	Account	Description
ArbSch	MohamadAlarefe ¹⁶	<p>A verified account for the famous Saudi Islamic cleric, Mohamad Al Arefe, who described himself as Muslim scholar. Al Arefe is one of the active clerics during the last two decades, and used to deliver religious preaches personally and over the media within Arab countries and Western countries. He is detained in Saudi Arabia since the beginning of 2019 due to his relations with Qatar's leaders, and his sympathy with and Muslim Brotherhoods, which both are criminalised in Saudi legalisation. His critics claim that his preaches contain bigotry, incitement of jihad, and criticising women's rights activists, Jews, and Shiite sect. Some critics claimed that he prayed for the controversial terror-related Bin Laden which we could not confirm due to broken urls. On the other hand, his supporters claim that his position was consistent with the general trend of the Saudi government to support the Syrian people in the war that the Syrian government waged against them. Al Arifi claimed that no one should go to Syria without a clear goal and with the permission of his country's leaders and scholars fatwa. Al Arefe's timeline support this claim as many tweets show solidarity with the new Saudi leaders and especially the crown prince, Mohammad Bin Salman. The Twitter timeline contains tweets about his lessons, fatwa, and advises for Muslims. The tweets are in Arabic while some of them includes images and videos. However, the timeline does not contain tweets before 2018. There is no tweet about atheism or atheists.</p>

¹⁶<https://www.meforum.org/61388/big-tech-and-islamist-hate-speech>,
<https://www.trtworld.com/opinion/reported-ruling-to-execute-saudi-scholars-marks-new-realms-of->

Cluster	Account	Description
	Dr_alqarnee ¹⁷	A verified account for the Saudi scholar and writer, A'id Al Qarnee. He is the writer of the most sold Arabic book "Dont be Sad" which was translated to 29 different languages . He is well known for the dramatic change in his stances toward Turkey and Qatar. The timeline tweets are written in Arabic and contains prays, charitable activities, and reminders for his Muslim followers in addition to advertisements for his books. There is no tweet about atheism or atheists.
	Alafasy	The verified Twitter account of Kuwaiti Quran reciter and singer (Munshed). The account tweets are mainly in Arabic and contains reciting Quran, personal messages, and interactions with regional events. There is no discussion regarding atheism or atheist except one tweet that he criticised Muhammad Shahrur (Listed in ArbInfl Dr_Mhd.Shahrour) and consider him as an infidelity phenomenon.
	FadelSoliman ¹⁸	The verified Twitter account of a Muslim lecturer, orator, author and film maker. He is the director and one of presenters of bridges foundation. The foundation aims to build bridges between Muslims and non-Muslims, confronting Islamophobia and to defend Islam.

<http://almoslim.net/node/145383>,
<https://www.youtube.com/watch?v=qnpfsr9p7n4>,
<https://www.alalamtv.net/news/1559557/> (Arabic),
<https://www.youtube.com/watch?v=azkZPDB1PG4>,
<https://www.youtube.com/watch?v=wsWEJh6FsIY>
¹⁷<https://www.youtube.com/watch?v=yR70QEJRgYQ>,
<https://www.youtube.com/watch?v=YXIZihPIkpw>
¹⁸<https://bridges-foundation.org/our-presenters/>,
<https://www.youtube.com/watch?v=3g0aXFv3ckE>

Cluster	Account	Description
	salman_alodah ¹⁹	<p>A verified account for the famous Saudi Islamic cleric, Salman Alodah. The bio shows that the account is currently managed by his son, Abdullah. Alodah is a well known Muslim scholar due to his activity in mid 1990s when he co-founded the the Committee for the Defence of Legitimate Rights which challenged the Saudi government and led to imprison him between 1994 and 1999. In the last two decades Alodah participated in several TV shows and programs in different TV channels which most of them about personal development and social reforms. Many journalists criticised him for being a member of Muslim Brotherhood, being a leader of Sahwa in Saudi Arabia in 1980s and 1990s, and his ties with Qatar leaders. Since 2017, he was arrested because of publishing a Tweet that asks God “to join their hearts for the good of their people”, according to his son Abdullah. With more than 13 million follower on Twitter, Alodah is considered one of the most influential users among social media Arab users. His Twitter account consist mainly of prays, reminders and preaches to Muslims in addition to posts about social and personal development. There is no tweet about atheism or atheists, but he mentioned atheism in his book ‘With Allah” pages 92 and 94. In fact, we believe that Alodah’s life is an interesting social case that must be studied in detail. For example, the huge differences between the English and Arabic versions of his life story on Wikipedia show how important to study this phenom.</p>

¹⁹<https://journals.sagepub.com/doi/abs/10.1177/0021909606067407>,
<https://www.youtube.com/watch?v=t5w5rnehiVY>,

Cluster	Account	Description
	NabilAlawadhy ²⁰	The verified Twitter account of Kuwaiti Muslim scholar, writer, TV presenter, academic, journalist, preacher, and philanthropist. His critics attacks him as they consider him an extremist preacher and member of Muslim Brotherhoods. His Kuwaiti nationality was withdrawn by Kuwaiti authorities in 2014 which then returned it to him in 2018. He used to issue annual programs that he preaches to Islamic values through storytelling, in addition to his efforts to support charitable developmental projects delivered by different institutions. His Twitter account has more than 11 million followers. His Twitter timeline contains several topics such as prays (dua), charitable opportunities, and personal messages. There is no tweet that discusses atheism, although he mentioned it in some of his public speeches.
	mujtahidd	A non verified Twitter account that criticises what it considers social, economic and political faults and issues in Saudi Arabia. Some of its followers consider it a trustworthy source of leaks from the source of the Saudi while others consider it as a source of noise. Its tweets attract interactions and responses from opposing accounts, either supportive or opposing.
	Talhabeeb	The verified Twitter account of the Saudi Psychologist Tariq alhabeeb.

<https://arabic.cnn.com/middle-east/article/2020/07/19/alouda-publishes-details-father-meeting-king>,
<https://www.alarabiya.net/articles/2010/01/02/96033.html> (Arabic),
<https://www.meforum.org/61388/big-tech-and-islamist-hate-speech>,
<https://www.okaz.com.sa/article/307701>,
<https://arabi21.com/story/976785/>,
<https://thenewkhalij.news/article/61346/>

²⁰<http://ara.tv/wd3k4>, <https://arabi21.com/story/1131885>

Cluster	Account	Description
	TareqAlSuwaidan ²¹	The verified Twitter account of Kuwaiti Muslim scholar, writer, TV presenter, academic researcher, preacher, and trainer. His critics attacks him as they consider him an extremist preacher and member of Muslim Brotherhoods. He produced more than 73 books and 42 series of multimedia with more than 1134 videos and audios in leadership, management, entrepreneurship, innovation, personal developments, history and Islamic topics. His Twitter timeline contains several topics such as advertisements to training sessions and courses, charitable opportunities, news, and personal messages. There is no tweet that discusses atheism, although he mentioned in some interviews that freedom of belief, speech and practice should be granted to everyone including atheists. He stated that thoughts must be faced by thoughts not the power of law.
	mh_awadi	The verified Twitter account of Kuwaiti Muslim scholar, writer, TV presenter, academic researcher and preacher Mohammed Al Awadi. The account's tweets are in Arabic and mainly to send personal messages, religious preaches and maxims, and to reflect his stances of regional news and events.
	naseralomar	The verified Twitter account of the Saudi Islamic scholar Naser Alomar.
	abdulaziztarefe	The verified Twitter account of the Saudi Islamic scholar Abdulaziz al-Tarefe.

²¹<http://ara.tv/wd3k4>,
<https://arabi21.com/story/1131885>,
<https://www.youtube.com/watch?v=QSLFzF65f-0> (Arabic),
<https://www.youtube.com/watch?v=0hQui59FMow>

Cluster	Account	Description
News	BrotherRasheed ²²	Non verified account for the author and TV presenter, Brother Rasheed. His name is Rachid Hamami, and he is an Ex-Muslim Christian from Morocco. The timeline tweets are in Arabic and English, and they are mainly to criticise Islam and Muslim figures, and to mention some scenes from his TV show. He is popularity due to his former TV show Daring Questions (in Arabic سؤال جرئ) which was broadcasted for about 12 years, and Let's Be Clear (In Arabic بكل وضوح). Both programs criticise Islam and provide comparison between Islam and Christianity.
	hanyfreedom	Non verified account for user described himself as an Egyptian atheist from Christian background. The tweets are written in Arabic and are published from linked Facebook account to create connections between Arab atheist for marriage.
	MigosAtheos	Non verified account for user named herself as Egyptian atheist. Its tweets are in Arabic and criticise Islam.
	Bronia_Gaston	Non verified account for user described herself as an anti-theists atheist from Sudan.
	p852aIVjrrXC4dy	Non verified account for user named herself as Kurdish Deist. The tweets are mainly in Arabic language and criticise Islam, Muslims, and Arab countries.

²²<https://ledesk.ma/grandangle/le-coming-out-des-marocains-protestants/>

Cluster	Account	Description
	karan19891989	Non verified account for user named himself as Karan. He described himself as secularist and tanweeri. The account criticise Islam.
	iBorkaaN	Non verified account for user named himself as Hamad Jasem. He described himself as tanweeri and human rights activist from Kuwait. The account criticise social issues and traditions in Kuwait.
	DrDonna2014	Non verified account for user named herself as Donna Youssef. She described herself as humanist and rationalist.
	Fatma_Alsayegh	Non verified account for user named herself as Fatma Al Sayegh from Kuwait. She described herself as Tanweeri Shiite woman.
	AJArabic	Verified account for Arabic news source funded by Qatar official bodies broadcasts from Qatar.
	cnnarabic	Verified account for Arabic news that is launched by non-Arabic and Western news source (CNN), broadcasts from UAE
	AlArabiya ²³	Verified account for Arabic news source broadcasts from UAE and it is funded by official bodies from Saudi.
	kasimf	Verified account for Syrian-British journalist Faisal Qasim who directs The Opposite Direction program at Aljazeera network channel.

²³http://news.bbc.co.uk/1/hi/world/middle_east/3236654.stm

Cluster	Account	Description
	BBCArabic	Verified account for Arabic news that is operated by non-Arabic and Western news source (BBC), broadcasts from UK
	RTarabic	Verified account for Arabic news and infotainment that is operated by a non-Arabic, Russian, company.
	AlsisiOfficial	Verified account for Abdel Fattah Al-Sisi, the president of the Arab Republic of Egypt. The screen name of the account is AlsisiOfficial which gives an indication that it is a personal account.
	muhammadmorsi ²⁴	A non verified account for Muhammad Morsi, the former president of the Arab Republic of Egypt and the the first democratically elected leader of Egypt.
	RTErdogan rterdogan_ar	Verified accounts for the Turkish president.
	TamimBinHamad	Verified account for Tamim bin Hamad al-Thani, the Emir of Qatar.
	KingAbdullahII	Verified account for Abdullah bin AlHussein, the King of Jordan.
	QueenRania	Verified account for the Queen Rania of Jordan.
	BarackObama_Ar	Parody account for the former president of the United States Barack Obama in Arabic.
	Israelipm_ar	Verified Arabic account for the Israeli Prime Minister.

²⁴<https://www.washingtoninstitute.org/policy-analysis/view/whos-who-in-the-muslim-brotherhood>,
<https://edition.cnn.com/2012/06/30/world/africa/egypt-morsi/>,
<https://www.freepressjournal.in/world/who-was-mohamed-morsi-how-did-he-die-why-is-it-suspicious>

Cluster	Account	Description
	ElBaradei ²⁵	Verified account for the Egyptian lawyer, and government official Mohamed ElBaradei. ElBaradei served as the director general of the International Atomic Energy Agency between 1997-2009, and the interim vice president of Egypt in 2013. He was awarded the Nobel Prize for Peace In 2005 jointly with the IAEA. He was one of the controversial political activists on social media due to his opinions towards Egyptian former president Mohamad Mursi, the Egyptian coup in 2013, the incidents in Egypt the followed that coup, and the death of both former presidents of Egypt, Mursi and Mubarak. We believe that ElBaradei is an interesting phenom to study in depth as an international-Arabian figure.
	AzmiBishara	Controversial Arabic thinker and writer.
	abdelbariatwan	Arabic thinker and writer.
	youssef_hussen	Verified account for the Egyptian satirist Youssef Hussen and the presenter of Joe Show.
	TawakkolKarman ²⁶	Verified account for Yemeni activist, and the Nobel Peace Prize laureate, Tawakkol Karman. She is a member of Facebook Oversight Board.

²⁵<https://www.nobelprize.org/prizes/peace/2005/elbaradei/biographical/>,
<https://www.britannica.com/biography/Mohamed-ElBaradei>,
<https://www.spiegel.de/international/world/interview-with-egyptian-politician-mohamed-elbaradei-a-909976.html>,
<https://arabi21.com/story/1247909/>,
<https://www.middleeasteye.net/news/egyptian-politician-mohamed-elbaradei-heckled-during-london-lecture>

²⁶<https://www.oversightboard.com/meet-the-board/>

Cluster	Account	Description
	Nizariat	A non verified symbolic account for the Arab poet Nizar Qabbani. It defined itself as the largest account on Twitter for fans and lovers of Nizar Qabbani's poetry. It has about 3.7 million followers.
	Wam_Shakespeare	A non verified symbolic account for the English writer and poet William Shakespeare. It tweets in Arabic language and followed by 1.9 million.
	adab	Arabic culture and poet
	AvichayAdraee	Israeli public figure
	KimKardashian	Non Arabic singer (Barbadians)
	rihanna	The verified account for Rihanna, a Non Arabic, Barbadian, singer.
	NancyAjram	Arabic singer (Lebanese)
	elissakh	Arabic singer (Lebanese)
	amrwaked	Arabic filmmaker and musician.
	MoSalah	Egyptian football player plays in British Premier League
	trikaofficial	The verified account for the Egyptian retired professional footballer Mohamed Aboutrika
	Cristiano	A Portuguese professional footballer.
	USAbilAraby	The verified account of the US foreign affairs in Arabic.
	hrw_ar	The Verified account of the Human Rights Watch in Arabic.

Cluster	Account	Description
	AmnestyAR	The Verified account of the Amnesty in Arabic.
	UNarabic	The Verified account of the United Nations in Arabic.
	ICRC_ar	The Verified account of the International Committee of the Red Cross in Arabic.
	UNHCR_Arabic	The Verified account of the UNHCR in Arabic.
	DrAbolfotoh	The Verified account of the Egyptian presidential candidate Dr. Abdelmonem Abolfotoh.
	AhmedShafikEG	The Verified account of the former Prime Minister of Egypt and the Egyptian presidential candidate Dr. Ahmed Shafik.
	ArianaGrande	The Verified account of the American singer, songwriter, and actress, Ariana Grande.
	islambehery	Non-verified account of the Egyptian writer, researcher and TV shows presenter, Islam Behery.
	MohammedMAHSOOB	Verified account of the Egyptian politician and former Minister of Parliamentary Affairs, Mohamed MAHSOOB.
	AlaaMubarak_	Verified account of the son of the Egyptian former President, Alaa Mubarak.
	walidjoumblatt	Verified account of the Lebanese politician, the President of the Progressive Socialist Party of Lebanon, and member of Lebanese parliament, Walid Joumblatt.

Cluster	Account	Description
Info	ArabicBest	Arabic infotainment account with more than 5 million follower. Some of its tweets include Islamic contents.
	TheArabHash	Arabic infotainment account with about 3.9 million follower. The vast majority of its tweets relevant to Saudi Arabia and Gulf countries.
	TfTeeeSH	Arabic un-official news source account from Kuwait. Its tweets are about Kuwaiti local news.
	TheTopVideo	Arabic infotainment account with about 2.5 million follower.
	liferdefempire	Arabic un-official news source account from Kuwait. Its tweets are about Kuwaiti local news.
	Omar_Amulhem	Arabic presenter and social media activist from Saudi. He has about 2.5 million follower.
	developtherself	An Arabic infotainment account that is interested in personal development content. The main contents of tweets are multimedia.
	abualia77	A personal account from UAE.
	7iii8	Arabic infotainment account from Saudi
	1M00O	A personal account from UAE.
7oppp	A personal account from yemen	
IKhaled	personal account from Kuwait	

Table 7.6: Analysis of the Influential Accounts In each Cluster

Topic Title	Topic #	Top Used Tokens
Arguing & Discussing	26	عين شيطان عادة فشل مستقبل زين نجاح رأى حظ راجع
Metaphysics	38	سأل دنيا أعطى نور توقع أجاب ورد زي حرف آخرة
Attitudes	21	صحيح حرام استحق فرق اختار نوم حلال قرد بشرية تحية
	22	صديق فتح عدو ذهب قريب بعيد سعادة أجمل مسألة درى
	23	جميل بمن أحسن هدى احترام رائع حلو جو وراء تصدق
	39	حفظ خوف سعيد لبس خاف فيلم واجب مريض ثقة جرب
Business	37	دخل مال جنة نار عرض أعلى مالك سوق دولار سعر
Events Relevant to Time and History	10	عاش دائم انتهى أبد قليل زمن وصف جمال زال حلم
Football Clubs	4	قدم شر نصر لعب دور هلال لاعب نادي مستوى فريق
Freedom	18	حرية حي رحمة شخصية برنامج شأن فقير رجا تعبير تدخل
Gov., Nation and Socio-Political in Middle East	1	حكم وطن نظام طالب قانون شعب حكومة سياسي مواطن حاكم
	9	شعب سعودية سعودي أمريكا سوريا موقف يماني معروف
	36	مرحلة سوري سيد مصر مصري قادم بناء جيل سلمان قرار تعليم قصر
Health & Well-being	7	حاجة ألم حلقة أستاذ حملة طيب بال تعب ساعد فلس
	31	أحب صحة فصل أخبر عفو أزمة وزارة مصير ظرف وظيفة
Marriage & Women	11	مرأة علاقة زواج زوج زوجة حرم جنس قصد ضرب جسد
Multimedia	40	صورة جديد نشر شاهد مقطع قديم ثورة شارع سيارة قرن
News and Events	45	خاص خبر مصدر رسالة موقع نقل انتظر دفع سر سب
Others	8	شو إلهاد عيد رابط مركز تفصيل ضبط تالي قمر رياض
	12	أكبر غبي غباء جهد ضر السعوديه كمية عون ترجمة شف
	25	ههه صغير مافي شغل ضحك أعرف حجر اساس ابي عيال
	27	نهاية درجة إمارة عامل ماء بداية عيب شرب بحر حضارة
	30	شيخ صالح أحمد عقيدة عبدالله شرح سلطان طاعة رح مذهب
	32	مكان آية جمع نزل زمان أكل سورة محل جبل شجرة
	33	سمع صوت قران لبنان خط لبناني صفحة رسم عالي أسبوع
	41	طيب رزق كويت استغفر شهد تاب أجنبي بحرين هداية طاغي

	44	عمر أبو أ ب رضي مدرسة جامعة طال قناة طول عصر
	46	رأي عم فيديو شرف تعليق شخصي ود فتوى اسف قائمة
	47	نص دكتور غريب وقع نظرة سفر أعجب عجيب تذكر ضرورة
Relationship and Interactions	3	سؤال تغريد دعا ساعة دعوة دعاء شرط احترام ودع خطأ
	17	بنت راح صار تكلم موضوع طبع صح حبيب عادي معا
	34	حساب حسب مؤمن تويتر كلب والد ميت بر ارحم اغفر
Political & Religious Confrontations and Violence	13	قتل أصبح ملك بلد ولد حر وحد دم كافر قاتل
	29	طفل مشكلة مجتمع حل نساء يهودي قتل مسيحي جريمة دافع
	42	هدف حزن فرح نصف إسرائيل شهيد تحقيق عجز خالد حقق
	48	قوة إيران حرب عراق مدينة حزب إرهاب منطقة أمريكي إرهابي
Religious Legislation	2	حب يد رأس باب رفع فوق قطع حمار شهادة سرق
Suffering	15	حالة مرض ليل شمس كورونا طويل فترة علاج أصاب نهار
	49	تمنى أسود لعن غضب قضية هرب توفيق حذر رواية مناقق
Theism, Belief and Disbelief	14	إيمان قصة شك حجاب قدرة شركة مادة فرنسي فطرة شرعي
	16	عبد رحم خرج ذنب ظلم دخول منزل خروج رحمن قدس
	19	إله اله إبراهيم ظالم عادل سترغز إنجاز فرنسا لعنة
	20	نبي سلم كذب صلى مات موت صدق آمن كفر رسول
	24	أهل بيت صلاة سلام رسول مسجد وفق إمام جماعة بخاري
	35	ذكر حديث قرآن قول حسن ظن ولي كريم أرسل لسان
Thoughts and Logic	6	كتب نظر ديني إسلامي تاريخ حقيقة جهل غرب قيمة فكر
	28	كتاب بحث فهم معنى علمي تطور قرأ لغة نظرية تفسير
	43	أراد جعل لماذا فكر استطاع طريقة شاء حاول تفكير حجة
Universe, Creator & Existence	0	ملحد وجود دليل بشر كون اعتقد موجود خالق فكرة تغير
	5	أرض خلق كلمة مرة عظيم حمد سبحانه سماء شهر تعالى

Table 7.7: Topics Grouped Based on their Titles.

7.3 Detailed Description of topics - Chapter 5 -

Arguing and Discussing Metaphysics:

This topic gives an indication that accounts discuss and argue about topics relevant to metaphysics. Based on the terms including evil eye, devil, future success, luck, life and hereafter, the topic is relevant to the religious-based metaphysics.

Attitudes:

Tweets in this topic discuss topics related to attitudes, opinions, and actions toward others, events, or situations. This is clear from terms including valid, forbidden, halal, choose, deserves, friend, enemy, fear, and trust.

Business:

This cluster clearly shows that there is discussion about business, money and finance. This is clear from tokens such as income, money, offer, higher, market, owner, Dollar, and price.

Events Relevant to Time and life:

This cluster shows that there is kind of discussion about time and life; as we can see from tokens such as lived, permanent, finished, dream and gone.

Football Clubs:

This cluster illustrates that there is a discussion about football match(es). This is clear from tokens such as Alnasur and Alhilal; which are Saudi football clubs. There are also tokens such as play, player, club and team.

Freedom:

This cluster shows that some tweets talk about personal freedom and demanding mercy and kindness towards poor people. It indicates that the accounts might discuss political freedom, or religious freedom. It is worthy to further analyse the full tweets that are considered in this cluster.

Government, Nation and Socio-Political in Middle East:

This topic contains three clusters in which indicates that it might be widely discussed by the accounts in our dataset. From the frequent tokens we can see that it discuss subjects relevant to the governments located or at least involved in the Middle East such as US, Saudi, Yemen, Egypt and Syria. It also shows the power of nations in this region too such as Salman, Egyptian, ruler and law.

Health and Well-being:

This topic includes two clusters in which both of them related to a different subjects within health and well-being. This is clear from tokens including physician, pain, campaign, and fatigue. On the other hand the other cluster includes tokens such as health, minister, crisis, and fate. However, deep analysis is required to clearly describe the relevancy of the topic.

Marriage and Women:

This cluster shows that there is a specific discussion for the women rights in marriage in religion. In fact almost all tokens are relevant to the same topic, such as woman, relationship, marriage, husband, wife and sex. Also, hit and body give a preliminary indication that the discussion is about the laws of marriage and relationships in Islam.

Multimedia:

As the topic name illustrates, this cluster shows that the groups discussed topics relevant to multimedia and broadcasting. This is clear from tokens such as image, clip and watch. However other tokens might lead to having this topic within a specific context such as century and revolution.

News and Events:

This topics shows that the groups discuss topics relevant to publishing and sharing news. Almost all tokens are relevant to the topics, however, further investigation is required to find if we can combine cluster 40 and cluster 45 in one topic.

Relationship and Interactions:

This topic maps three clusters in which they reflect kind of relationship and interactions. This is clear from tokens such as pray, supplication, respect, farewell, speak, right, lover, together, have mercy and forgive. In fact, clusters mapped this topic are not quite clear and straightforward and further analysis for the tweets mapped to these cluster are required to have clear and correct mapping.

Political and Religious Confrontations and Violence:

This topic is clear and mapping it to the relevant cluster is straightforward. It shows that the groups discussed topics relevant to political and religious based violence and conflicts in the Middle East. This is clear from tokens such as kill, blood, infidel, Jew, Christian, terrorism, Israel, Iran, martyr and murderer.

Religious Legislation:

This cluster suggests that there are some discussions related to Sharia law in Islam. This is clear from tokens such as hand, cut, testimony and stole. However, due to some noisy tokens, further and deep analysis for the mapped tweets is required to have better understanding for this topic.

Suffering:

This topic is mapped to two clusters. The first shows that the groups discussed topics relevant to being unwell and mainly from Corona virus and the wide closure in the world. The second cluster relevant to religious based suffering (such as curse, hypocrite); and psychological based suffers such as wish, anger, case, escape and conciliation.

Theism / Belief and Disbelief:

This topic as expected to have large number of clusters. The clusters show that it has relevant topics to religions and mainly Islam. This clear from the wide range of tokens in all clusters such as faith, veil, sharia, Rahman, sin, slave, God, Abraham, curse, prophet, pray and messenger... etc. However, There is a common token relevant to France found in two clusters. This might be relevant to the sanction campaign against France that Muslims have on social media.

Thoughts and Logic:

This topic is one of the most clear to identify from the cluster features (i.e. tokens). We can see that from the three clusters that are mapped to it. We have tokens such as books, history, truth, value, thought evolution, theory, think, argument...etc. We expect that qualitative analysis for the relevant tweets will give us interesting story about the discussions with in the groups.

Universe, Creator and Existence:

This topic shows that there are discussions about believing and disbelieving in Divinity and the creator of the universe. This is clear from several tokens in both mapped clusters such as atheist, evidence, existence, creator, universe, earth, create or creation, praise, glory and almighty. In fact this topic requires further qualitative analysis for the relevant tweets to better understand the discussions and the relevant groups.

Others:

This topic includes several heterogeneous clusters with non-related tokens. There is no clear and specific topic that can be grasped by some of the tokens. Instead, almost each token talks about different topics. For instance, tokens such as sheikh (which includes the political leader, religious scholar in Islam or old and respectful man). There are also other tokens within the same context such as obedience and Sultan (which have the meaning or ruler). However, other tokens are not related such as Ahmad, creed, Abdullah foreigner, and father... etc.


7.4 Network Tool

In order to make some qualitative analysis, we were interested in understanding how accounts are represented and existed in our dataset. So, we build a tool that helps us with providing the accounts' information from Twitter and illustrates how the account is connected with our dataset. The account's information is loaded from Twitter, while the network interaction are loaded from a stored database.

Figure 7.1 shows the meta data of the thesis author as they are available in Twitter. These data are not stored in any mean and just loaded into the page upon request from Twitter. However, Figures 7.2, 7.3 and 7.4 show the interactions with the author and two random accounts with the dataset network. We hide the information of the sample accounts for their privacy.

Please enter screen name

YoussefHariri1



screen_name :YoussefHariri1

location :UK, Damascus

description :سوري ، عربي ، مسلم . Muslim, Arab, Syrian; PhD candidate @InfAtEd

followers_count :245

friends_count :412

listed_count :2

Account creation time: 2012-04-16 21:43:14

verified :False

protected :False

statuses_count :421

Account's last tweet:

2022-09-21 10:37:12

يرتب لك المحتوى بطريقة ذكية وبسيطة. أقضي مدة طويلة في التضييقات . Power Point تطبيق رائع لبرنامج RT @mqasem: ... البسيطة. هذا التطبيق يزيل حمل ه

Figure 7.1: Am I Here Tool Showing the Information of the Author

Network_Data

This account is not in the seedlist!

This account do not follow any account from our seedlist

This account is not followed by any account from our seedlist

YoussefHariri1

This account was no tweet retweeted by any account from our seedlist

Retweeted By

YoussefHariri1

Mentioned By

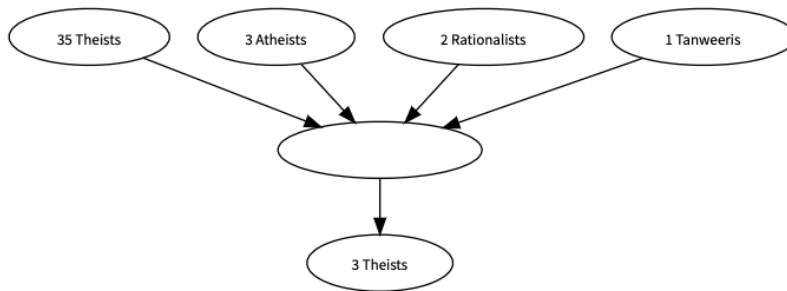
This account was not mentioned by any account from our seedlist

YoussefHariri1

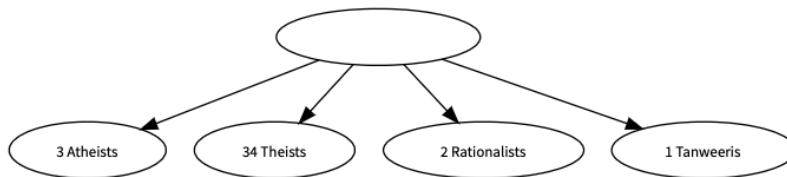
Figure 7.2: Am I Here Tool Showing the Interactions of the Author with the Dataset

Network_Data

This account is not in the seedlist!



Retweeted By



Mentioned By

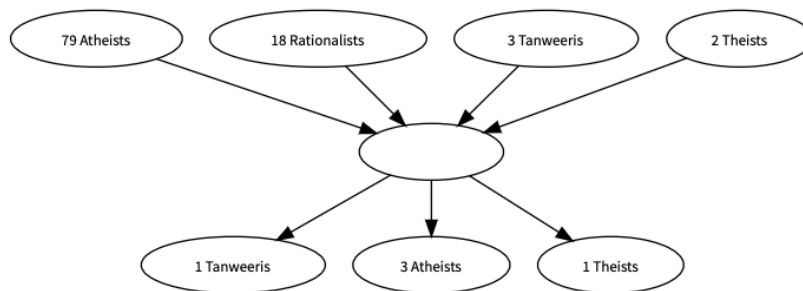
This account was not mentioned by any account from our seedlist



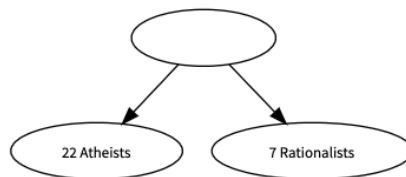
Figure 7.3: Am I Here Tool Showing a Sample of the Interactions with the Dataset

Network_Data

This account is not in the seedlist!



Retweeted By



Mentioned By

This account was not mentioned by any account from our seedlist



Figure 7.4: Am I Here Tool Showing a Sample of the Interactions with the Dataset