From Grievance to Martyrdom: A Mathematical Perspective on the Journey of Radicalisation

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1 Introduction

There has never been a time in history when the world has been more connected. It is a condition that is going to increase. From the light speeds of the internet and television communication, passing content and material between countries that are increasingly tightly coupled; to the growth of emails, and citizen journalism, exploiting video phones and Twitter; to the empowerment of individuals through blogs and social media. Events in one location can have a major impact on the audiences in other parts of the world; hardening attitudes and creating polarised reactions. Now we have a \Digital Society" [1] within which everybody is both close up to and far away from everybody else. The *Vietnam War e ect*, where attitudes about the military involvement and its raison d'etre were shaped in the living rooms of America, is now a business that operates on a 24-7 basis. Opinions, beliefs and attitudes around the world are being modulated by the images conveyed by the media and by individuals. It is in an emotional environment (such as where the scenes transmitted around the world in, say, the direct aftermath of a drone attack that has killed apparently innocent civilians,) that radicalisation can occur. People, around the world, can suddenly feel it is their time to act and move beyond the passive to the active.

Ted Gurr's book [2] provides a range of insights as to why people become active and turn to violence. The Vietnam War protests provided the backdrop and demonstrated the power of the media to motivate people to become involved in political violence. The situation in the run up to the Second Gulf War showed these three factors writ large and operating at a

available today play a hugely important part in creating the conditions for people to become involved in some form of political violence. The media can be instrumental in facilitating the mobilisation structures. These structures, or channels, provide the means by which people can have their attitudes and beliefs shaped; seeing events through the magnifying glass of immediate perception.

organisation. The development of a series of regional franchises in the Yemen (Al Qaeda in the Arabian Peninsula) and in the Maghreb and the Sahel have shown how terrorist groups can fragment and maintain their relevance on the international stage. It has shown how easy it is for terrorist groups to morph and adapt to circumstances, paradoxically using the connectivity of the Internet and the media to reach out and a ect public opinion; using events to maintain and heighten the sense of grievance felt by many in the Muslim world.

While it is agile, an organisation Al Qaeda does have its weaknesses. One of these is its inability to harness and focus the e ort of the franchises. The groups involved, such as Al-Shabab in Somalia, have tended to focus upon their desire to build an Islamic state in Somalia. They focus on the near-enemy: the Transitional Government of Somalia. Recently in Somalia, Pakistan and the Yemen there is prima facia evidence emerging from a combination of actions and statements that indicate these organisations are moving from being locally focused onto a broader view of where they should conduct violence to achieve their ends. The failed Christmas Day attack over Detroit, the attack on the Japanese Oil Tanker in the Persian Gulf in August 2010 and the threat by AQAP and Al-Shabab in July to close the strategically vital Bab al-Mandab Strait at the southern end of the Red Sea are all measures that have an increasingly international agenda.

The current genre of terrorist groups show exibility and agility in other ways, reaching out speci cally to their target audiences and providing access to social services and humanitarian relief when natural disasters strike. One example of this agility that is inherent in contemporary terrorist movements has shown itself in Pakistan in the wake of the oods that a ected much of the North East of the country in August 2010. Groups that the west would readily designate as terrorists moved quickly to ll the vacuum created by the absence of formal governance structures in the region controlled by Islamabad. This ability to deliver humanitarian aid into these situations is a tactic employed by groups, such as Hamas and Hezbollah. Where state government fails, non-state actors show great agility and opportunism in seizing moments where the state-based government fails to enhance their standing with people in the local community. Their support in such di cult times is partly politically motivated. But it also has an underlying and more sinister intent; to secure the supply of foot-soldiers that can maintain their campaign of violence. Contemporary terrorist movements know how to pull a range of levers to achieve their aims.

The terrorist attacks in Mumbai were designed to have an impact on a global stage. They were to have a strategic impact; with news coverage lasting for days as the Indian authorities struggled to contain the situation. Given the way the events played out through the media it is not di cult to see why some commentators have labelled this the Indian equivalent of September 11th.

The attacks in Mumbai and the sectarian nature of the violence in Iraq in the wake of the invasion in 2003 have arguably created a new genre of terrorism that seeks mass casualty attacks even in places of worship. Pakistan has su ered a number of attacks that have speci cally targeted Muslims whose interpretation of Islam di ers as they follow other schools, such as Su sm. These tactics, aimed at speci c audiences, belie the weaknesses at the heart of the ideology of Al Qaeda. They are vulnerable to accusations that they adopt a stance of selective reading of the Koran; placing a greater emphasis upon their literal interpretations of what are sometimes referred to as the Sword Verses.

One speci c issue that goes to the heart of this selective analysis are the arguments that arise from the accusation that when Al Qaeda and its a liates kill Muslims that this is not permitted in the Koran. Actions where such events occur routinely create a knock-on e ect in social network sites; where debates rage between people with varying claims as to their legitimacy. Increasingly the justi cation at the heart of Al Qaedas ideology is being questioned. Learned Muslim scholars are feeling able to come forward and challenge the interpretations of the Holy Book. The theological study published in London by the leading Muslim cleric Dr Qadri is an example of this trend. Muslims are therefore being bombarded with a range of viewpoints and analysis of what is right and wrong; through a range of communications channels. The situation they face is a dynamic one as people with di ering claims to legitimacy o er what might to some appear to be contradictory interpretations of the cannon of Islam.

It is against this complex backdrop that law enforcement and security authorities in the west must operate. Many of the issues discussed above fuel sentiment in western societies that are becoming increasingly multicultural. There is however an asymmetry at the heart of development of these new societies where the bene ts of being a member of the community do not appear to be fairly distributed. For many, democracy is not a shining example of how to live their lives; the bene ts accrued by others do not seem to ow fairly and racism remains an enduring problem.

This environment a ects the way that many second generation immigrants into western societies view their lives. They become prone to having their traditional attitudes and beliefs instilled in them by their parents challenged. They nd it increasingly di cult to reconcile the actions of their Government, such as the when the United Kingdom armed forces participated in the invasion of Iraq against widespread public disquiet, with their own emergent perspective. The seeds of these views were sown in the con ict in the Balkans when the west appeared to stand by and do nothing to help when Muslim populations were the victim of genocide. Russians wars in Chechnya also added fuel to res and created a large repository of imagery and videos that still circulate on the Internet; infecting young and impressionable minds.

Obama to adopt a more conciliatory rhetoric removing the language of the war on terror with all its ability to be manipulated by terrorist movements such as Al Qaeda. Other measures need to be developed and implemented at the operational [within state] and at the local level [within communities]

lection. While beyond the scope of the current paper, this exploitation is in our minds. If new (news) events (initially) radicalize a large population to join the board; how will we detect and monitor this? And how do we expect any possible interventions to prevent such a population bulge surviving up to the highest squares, and how soon should any interventions be timed? At this stage we can only speculate: but there could be useful methods of data collection informing not just the populations at various squares on the board, but also estimating the dynamic progression rates, from square to square, and via whatever ladders can be identi ed. The dynamics of the transitions need to inform the dynamics (timing and duration) of the response. Moreover perhaps we could infer the existence of ladders from aberrant journeys (narratives)?

Making the snakes and ladders concept become a quantitive tool is certainly a possibility - but here we focus on the conceptual and immediate learning bene ts by taking a mathematical perspective on the various journeys to radicalisation.

2 Modelling journeys through behavioural states

Consider a number of behavioral states through which people may transit on their individual journeys. Though the states are common, just like the squares on the snakes and ladders board, each individual's journey may be quite di erent. Not everybody moves through each state and the residence time within state may be highly individual . The states themselves should be de ned as a partition of some multidimensional feature space. That space certainly contains dimensions such as levels of identi cation with the \cause", level of passive support, preparedness to act and plan. These might be observable in terms of the individuals' use of language and their adoption of the group identity, or their compliance, or gift of passive help or nancial

This model is thus a simple three state system (a three square snakes and ladders board).

We have an external population, who are inactive as far as the whole idealogy or terrorist activity is concerned. Such individuals are e ectively

Further suppose we have a number of parallel similar systems, representing populations within di erent states/regions, indexed by $i; = 1; 2; :::; M$.

In general we will let $z_i = (x_1; x_2; :::)^T$ be the state population vector for the ith (region based) system. Then we have

$$\underline{z}_i = F(z_i):$$

Let z^* denote the single system equilibrium, where $F(z^*$

of the set of states. This Y_i takes one of a discrete set of state values. Transitions take place as a result of an individual current state and possibly its history as well as the current external activity and even the in uence (and state location) of certain other agents in play. This is a classical complex system, with each individuals own (isolated dynamics) coupled through transient or persistent network e ects, and open to external forcing. So we can also allow for one o or occasional (pulsed) activities from the security services.

A simple model could be in discrete time: let $Y_{i;k} = Y_i(t_k)$ denote the state of the ith individual at the k time period (day, week, month,..), corresponding to time t_k.

Let $\mathbf{Y}_k = (Y_{1;k}; Y_{1;k}; :::; Y_{1;k})^T$ denote the states of the entire population (perhaps with state zero represented not yet interested or active - yet to get on the S&L board). Then the evolution of the ith individual will depend on his or her own history; the current state-locations of others; current and recent external events (at home or abroad or in theaters relevant) denoted e_k in the kth time step; and the current and recent actions of the security services, denoted s_k in the kth time step. We have some stochastic evolution rule of the form

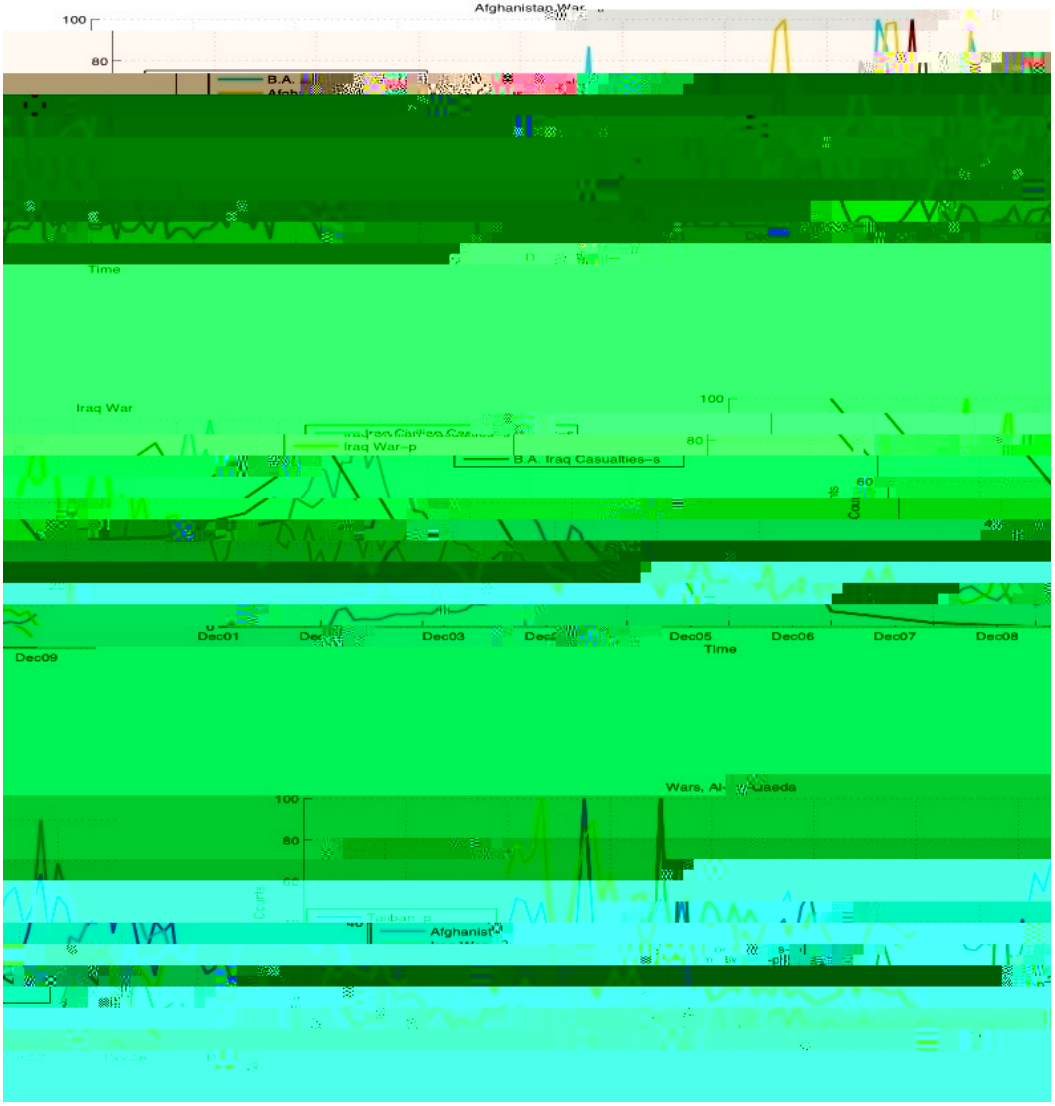
$$Y_{i;k+1} = \mathcal{F}(Y_{i;k}; Y_{i;k-1}; :::; \mathbf{Y}_k; e_k; e_{k-1}; :::; s_k; s_{k-1}; ::: \mid \ _i):$$

For example, given all of the arguments (and history) such information may x the probability that the individual makes the transition from its current state (Y_k) to any future state. And thus, biased though these possible transitions may be, the individual makes a stochastic state to state transition. Since memory e ects are allowed here this is not a simple Markov chain; and we also allow for coupling between individuals, and well as di erent forms of extrenailties. Here $_i$ denotes some xed parameters employed within the de nition of $\mathcal{F}$ that makes individuals distinctive.

Such a model would be amenable to a simulation approach if required. We foresee this as being especially useful where there are strong networking e ects. In the population group model, each group is a well mixed sub popluation and groups impact on each other in a uniform (democratically) smoothed manner. But in practice networking and in uencing may be highly individual. Hence some individuals will naturally be more isolated while

3 Observable communications

a matter of words


Afghanistan War
100
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Iraq War–p
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individuals may be very e cient at hearing everything. The mathematics involves consideration of a sequence of communication networks, and the de nition of matrix valued functionals representing the **communicability** of the network; measuring the ability of any speci c person to percolate messages, fairly immediately or over time, to any other person [16, 17, 18], and especially [19, 20].

This has opened up a number of exciting possibilities. For example if we

of these are empty. We depict the number of emails per day in Figure 5. It is a very sparse sequence at both the begininng and the end.

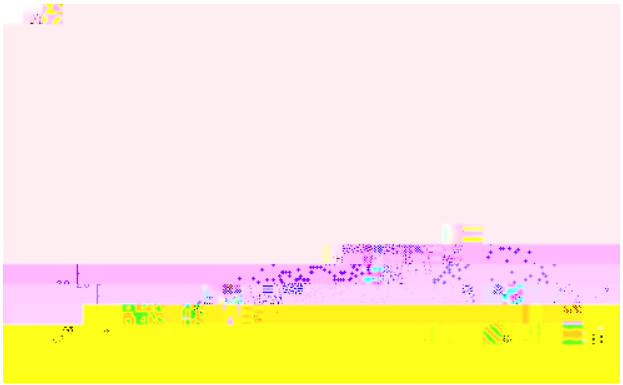
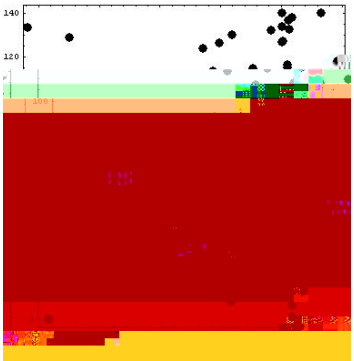


Figure 5. Number of all emails (to all contacts) versus day in the sample.



journey of radicalisation, and integrates across any and all of the complex

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Appendix 1: A population model

Using the notation introduced within section 2.1 we have:

$$\underline{x}_0 = b - \ {}_1 x_0 x_1;$$

$$\underline{x}_1 = \ {}_1 x_0 x_1 - \ {}_2 x_1 x_2 - a_1 x_1;$$

$$\underline{x}_2 = \ {}_2 x_1 x_2 - a_2 x_2:$$

Here $\underline{x}_i$ denotes the time derivative dx_i/dt. There are two possible rest point: a \no-threat" equilibrium

$$(x_0^*; x_1^*; x_2^*) = (a_1/ \ {}_1; b/a_1; 0);$$

and an \active threat" equilibrium

$$(x_0^*; x_1^*; x_2^*) = (b \ {}_2/a_2 \ {}_1; a_2/ \ {}_2; -a_1/ \ {}_2 + b/a_2):$$

The second exists if and only if $b \ {}_2 > a_1 a_2$. Indeed for $b \ {}_2 < a_1 a_2$ the \no-threat" equilibrium is a stable attracting rest point for the system. At $b \ {}_2 = a_1 a_2$ it su ers a loss of stability, and the \active threat" equilibrium bifurcates away, and continues as a stable rest point, with threat $x_2^*(a_1; a_2) = -a_1/ \ {}_2 + b/a_2$, as the product $a_1 a_2$ increases.

Now consider the ability to set or control the capture rates. In the $(a_1; a_2)$1 [illegible]