Fighting Al Qaeda: the role of modern Maths and the medieval inquisition

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Medieval history has valuable lessons for the present day fight against Al-Qaeda and global terrorism. Historians know a lot about how the Inquisition attempted to suppress heresy in the 13th and 14th centuries. Very recent advances in the mathematics of describing networks give powerful insights into how ideas or viruses might spread across social networks. Just as importantly, they tell us how best they might be contained.

When we combine the two, we get a better understanding of why some of the Inquisition's strategies failed, and why the ones which they eventually adopted were successful. The Inquisition may help us defeat modern terror..

Inquisitors had come into being in the mid thirteenth century to fight the Cathars, the dualist heretics, who posited that the world was the creation of an evil god which accounted for the amount of misery within it. Catharism had become endemic in the societies of southern France and Italy and the propagation and spread of heresy had become a preoccupation of many Catholic writers. The parallel with disease was common, as a writer in the south of France put it: "Just as one bunch of grapes can take on a sickly colour from the aspect of its neighbour, …so, [following the example of Toulouse], neighbouring towns and villages in which heresiarchs had put down their roots were caught up in the shoots put out by that city's unbelief, and became infected with the dreadful plague."

Early attempts at the eradication of the 'epidemic' had been crude, such as the so-called Albigensian Crusade of 1209 which had carried indiscriminate warfare to the south of France. The storming of the town of Béziers rapidly became infamous among contemporaries: "Knowing from the confessions of these Catholics that they were mixed up with heretics, [the crusaders] said to the abbot. 'What shall we do, lord? We cannot tell the good from the bad. The abbot, ……is said to have said: 'Kill them all. For God knows his own.' Thus innumerable persons were killed in that city."

By the time these words were written in 1220, the strategy of trying to contain heresy by suppression of the population at random was recognised as being futile and shortly afterwards specialist investigators or inquisitors were appointed from the leading religious orders. The growing body of knowledge of heresy and how to deal with it became codified in books, the most famous of which was by the Dominican friar Bernard Gui. His *Practica Inquisitionis* was completed in 1323-24. The name Gui may be more generally familiar, for the name was used by Umberto Eco for the caricature of an inquisitor in *The Name of the Rose*.

The successful strategies were based upon increased understanding of the nature of the social networks across which heresy spread, and within which

heresy persisted despite ferocious attempts to suppress it. Despite the popular view of medieval Europe as a stagnant society, ideas could and sometimes did travel rapidly through a comparatively small network of educated churchmen. A few people exercised a disproportionate influence on the spread of ideas. Most individuals had few social contacts, their lives being lived within the confines of their own villages. But a small number, whether actual heretics or merely guides and messengers who carried news and gossip with them, travelled widely and frequently.

This type of network, in which a few people are connected to large numbers of others and most have a very small number of connections, has a very modern feel. Recently, work by physicist Albert-Laszlo Barabasi and colleagues at Notre Dame has shown that the world wide web has similar features. Gene Stanley of Boston University, the editor of *Physica A*, has demonstrated that the pattern of sexual contacts has the same sort of structure.

Of course, the work of Barabasi and Stanley and others involves much more than simply counting up the number of connections each individual, or node, has on a network. They have demonstrated empirically that these particular networks are of a particular mathematical type which are known as 'scale-free'. Scale-free networks involve a particular relationship between the number of connections which any individual has, and the overall frequency with which this number is observed. The exact nature of this need not concern us here, but its fundamental feature is that it implies that very few people have lots of connections, and most have just a few.

New viruses occur all the time, whether they are actual diseases, computer viruses, heretical ideas, or whatever. Scale-free networks have very distinct mathematical properties when it comes to describing the spread of an idea or a virus. Robert May, the former Government chief scientist, is one of an increasing number who have recently worked on this issue.

In standard mathematical models of how epidemics spread, individuals are implicitly connected on a particular non-scale-free network. In such a network, unless a virus infects more than a critical percentage of a population, whether people or computers, it will inevitably fade and die of its own accord. The precise critical value will depend on the particular circumstances, but we know how to calculate it. Further, a strategy of inoculating the population at random will succeed in stopping the disease, again providing that more than a critical percentage are protected in this way.

All this changes on scale-free networks. In principle, *any* virus can spread throughout the entire population. There is no critical threshold to pass. And random inoculation, even of a very high percentage of the population, has only a very low chance of success. To be successful, the small number of highly connected individuals have to be specifically targeted.

Of course, we can never know the precise mathematical structure of medieval social networks in the same way we can know about the world wide web. But its qualitative properties seem similar. For example it is another distinguishing

property of scale-free networks that viruses live for much longer than they do in standard models of epidemics. The same sort of persistence is seen with heresy. For example, Catholic writers preparing reports for the 1274 Council of Lyon thought the threat from Catharism was over, yet the last Cathar was only burnt in 1321 and a Cathar revival led by only ten *perfecti* (Cathar priests) around 1300 in southern France found ready converts and caused a major panic among Catholic churchmen.

The Inquisition gradually evolved a successful strategy which involved exactly the targeting of highly connected individuals such as guides and messengers. Gui in his manual, for example, was not interested in the beliefs of the individual being questioned. Rather, he counselled that suspects be asked: "Whether he had any familiar association with heretics; when; how; And who was responsible for it". The physical organisation of the network was of particular interest: "Whether he received any heretical person or persons in his home; Who they were; who brought them there;….who visited them there and escorted them thence". Those identified as heretics always faced the risk of imprisonment or burning, but increasingly the tactic of leaving contacts at liberty but forcing them to wear yellow crosses was used. In this way, other members of society were dissuaded from consorting with them.

Whether knowledge of scale-free networks is articulated through inquisition manuals or mathematical formulae there may be lessons for us now in how to best deal with al-Qaeda. We do not know the precise structure of al-Qaeda's network, and indeed evidence would suggest that it is very loose, but certainly there seem to be a very small number of charismatic individuals whose ideas inspire larger numbers of less connected individuals. In Iraq, the Americans issued their famous pack of cards, of key people in the Saddam network to be detained. The capture of one of these is regarded as far more important than detaining thousands of Iraqi foot soldiers.

Modern maths tells us that the best strategies for containing a virus, or a network of terrorists, depends critically on the type of network which connects the relevant individuals. Medieval history gives us a dramatic illustration of why this is the case. Once they appreciated more clearly the type of social network they were dealing with, the Inquisitors succeeded. The challenge for modern society is to find ways of containing viruses or terrorism without resorting to the same apparatus of repression and cruelty.