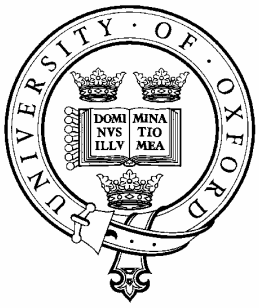

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Engineers of Jihad

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Engineers of Jihad[1]

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"You have trivialized our movement by your mundane analysis. May God have mercy on you"
Ayman al-Zawahiri

Abstract. We find that graduates from subjects such as science, engineering, and medicine are strongly overrepresented among Islamist movements in the Muslim world, though not among the extremist Islamic groups which have emerged in Western countries more recently. We also find that engineers alone are strongly over-represented among graduates in violent groups in both realms. This is all the more puzzling for engineers are virtually absent from left-wing violent extremists and only present rather than over-represented among right-wing extremists. We consider four hypotheses that could explain this pattern. Is the engineers' prominence among violent Islamists an accident of history amplified through network links, or do their technical skills make them attractive recruits? Do engineers have a 'mindset' that makes them a particularly good match for Islamism, or is their vigorous radicalization explained by the social conditions they endured in Islamic countries? We argue that the interaction between the last two causes is the most plausible explanation of our findings, casting a new light on the sources of Islamic extremism and grounding macro theories of radicalization in a micro-level perspective.

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Many Islamic radicals are not economically dispossessed, are often better educated than their peers, and quite a few went to university. Even more surprising, many of them are engineers – a profession that we would not naturally associate with a religiously inspired movement. The evidence of this puzzling link is not limited to notorious cases, such as that of Mohammad Atta, the 9/11 mastermind who trained as an architectural engineer, but is found right at the start of modern Islamic radicalism. In Egypt, where it all began in the 1970s, three of the significant violent groups were founded or led by individuals who had a technical education[2] – and so did many of their members. Saadedin Ibrahim, the first sociologist to study the early violent Islamists, interviewed 34 members of two of these groups, the Military Academy Group and al-Takfir, who were imprisoned in the late 1970s: 29 of them were either graduates or university students, and of the 25 of these for whom he reports the subject, nine were engineers, six doctors, five agronomists, two pharmacists, two were studying technical military science, and one literature (Ibrahim 1980, 1982).

Engineers were present also in a fourth radical group active in Egypt in the 70s. *Al-Gama'a al-Islamiyya* had about forty members, among them Ayman al-Zawahiri, who was later to gain worldwide notoriety as bin Laden's associate. Abdallah Schleifer, an

[2] *Al-Takfir wa'l-Hijra,* which was involved in the assassination of a cabinet minister, was founded in 1969 by Shukri Mustafa, an agricultural engineer, and former member of the Egyptian Muslim Brotherhood. Shukri was radicalized during harsh incarceration in the Tura prison and Abu Zabal concentration camp in Egypt. The second group – known as the "Military Academy Group" for it forcibly occupied the Egyptian Technical Military Academy in April 1974, from where it launched a failed attempt to march on the ruling party's headquarters – was founded in the 1970s by Salih Siriyya, a Palestinian with a doctorate in the teaching of science, who also had links with the Muslim Brotherhood and was a senior figure in the Arab League educational organisation (Ibrahim 1980). Sirriya too had been imprisoned. Finally, an electrical engineer, Muhammad Abd al-Salam Faraj played a pivotal role in the third group, *al-Jihad,* which was responsible for the assassination of President Sadat in 1981, and became the most notorious successor to the early groups (Nesser 2004; ICG 2004).

American Jew now a professor of media studies at the American University in Cairo, converted to Islam in the 1960s and subsequently befriended Zawahiri. When they first met, Zawahiri, then at medical school, gave Schleifer a tour of the campus: "during the tour, Zawahiri proudly pointed out students who were painting posters for political demonstrations, and he boasted that the Islamist movement had found its greatest recruiting success in the university's two most élite faculties—the medical and engineering schools. 'Aren't you impressed by that?' he said" (Wright 2002).

Professionals were already present in the Muslim Brotherhood in the 1940s and 1950s (Munson 2001), but the predominance of individuals from élite faculties seems to be a novelty in Islamic politics.[3] Hassan al-Banna, who founded the Muslim Brotherhood in 1928, was a school teacher; Sayyid Qutb, one of the Brotherhood's foremost leaders in the 1960s, worked as an education inspector, and many of the leading Islamic activists in the 1950s and 1960s in Egypt, Syria and North Africa came from faculties such as education or literature (Hunter 1988).

Signs of the link between Islamism and engineering are found well beyond the Middle East. Two of the three men who in 1987 founded Lashkar e-Toiba, a Sunni fundamentalist Pakistani group which fights against India's sovereignty over the State of Jammu and Kashmir, were professors at the University of Engineering and Technology of Lahore.[4] While appealing to madrasa students and the disenfranchised,

[3] For a survey of early Muslim Brotherhood arrestees in Egypt cf. Mitchell 1969: 328f. While white collar workers are strongly represented, of 180 cases, only two are listed as engineers.

[4] Zafar Iqbal and Hafiz Mohammad Saeed founded Markaz Dawa Al Irshad, which is Lashkar e-Toiba's political wing. The third founder was Abdullah Azam of the International Islamic University: http://en.wikipedia.org/wiki/Markaz_Dawa-Wal-

in South East Asia Jamaa Islamiya also recruited "many technical faculty members, including architects, engineers, geophysicists, chemists, and robotics engineers", and the three leading suspects in the September 2004 bombing of the Australian Embassy in Jakarta have an engineering background (Abuza 2006: 78). The phenomenon extends to Shiite Islamism too: engineers are prominently represented in the current, radical, Iranian cabinet,[5] among them the Iranian president himself – Mahmoud Ahmadinejad trained as a civil engineer, and was among the many engineering students at the University of Science and Technology in Teheran who played a very active role in the 1979 Islamic revolution.[6] Hezbollah, the Lebanese Shiite group, has a very strong link with engineers. Soon after it was founded in 1982, Hezbollah established Jihad al-Binaa, an organizational branch devoted to the reconstruction of civil infrastructure and private housing. According to Hezbollah expert Judith Palmer Harik, "this is an interesting organization because it is chock-full of professionals – contractors, engineers, architects, demographic experts."[7] Representatives for Jihad al-Binaa estimate that more than 2,000 of their engineers and architects have been involved in the reconstruction of Lebanon after the war with Israel in August 2006, which, considering that the estimated total Shiite male labour force in Lebanon should be less than 300,000, is a high number indeed.[8]

Irshad; www.hinduonnet.com/businessline/2001/01/05/stories/040555ra.htm (accessed November 2006).

[5] http://secularcaniranik.blogs.com/scaniranic/2005/08/whos_who_in_ahm.html (accessed October 2006).

[6] Goudarz Eghtedari, personal communication, July 2006.

[7] www.finalcall.com/artman/publish/article_2940.shtml (accessed November 2006).

[8] This estimate is obtained considering that the total Lebanese male labor force is, according to the World Bank, about 700,000 (2004) and that Shiites are about 40% of the Lebanese population (see http://devdata.worldbank.org/genderstats/genderRpt.asp?rpt=profile&cty=LBN,Lebanon&hm=home, accessed November 2006).

Several scholars have mentioned in passing the link between radical Islam and science and engineering (Bergen and Pandey 2005; Hoffman 1995; Huntington 1996: 112; Sageman 2004: 76; Schulze 1990: 22; Wickham 2002: 1; Wright 2006: 301), and some have speculated about what might explain it (Abuza 2006; Bergen and Pandey 2005; Sageman 2004: 76; Schulze 1990: 22; Waltz 1986), but no one has attempted to find a systematic confirmation of it, let alone a convincing explanation. Scholars have found evidence of a positive correlation between *level* of education and militancy both among Islamic and left-wing radicals (Russell and Miller 1977; Krueger and Maleckova 2003; Krueger 2006; Berrebi 2003; Ricolfi 2005). Almost nothing is known, however, about the link between different *types* of education and radicalization generally. Yet, there are solid theoretical grounds, and some evidence that we discuss below, to expect that certain political and ideological orientations could be either promoted or selected by the discipline one chooses to study.[9] As for being promoted, both the Marxist and the Weberian traditions would predict that professional socialization shapes, respectively, one's economic interests and one's beliefs about the causal and moral order of the world. As for being selected, there are plausible reasons to expect that the choice of different disciplines will be driven by different pre-existing talents and dispositions, some pertaining to the individual and some to his social background. In particular, the choice between subjects that are similarly demanding and rewarding, but otherwise incommensurable, could select individuals on pre-existing traits and motivations.

If confirmed, the puzzle would be more than an item worthy of a cabinet of curiosities. It could offer an unexpected vantage point to help us understand the nature

[9] For recent experimental evidence of the effects of studying economics on economic students in terms of engaging in utility maximisation see Rubinstein (2006).

of Islamic extremism and the mechanisms that led to its emergence. Scholars have produced “almost inexhaustible lists of precipitating factors, including the failure of secular modernization projects, blocked social mobility, economic malaise, Arab defeat in the 1967 war with Israel, the legacy of colonialism and cultural imperialism, and political alienation” (Wiktorowicz 2004b: 3). However, they have been unable to discriminate among them and go beyond a lame agreement “that individuals join groups and movements in response to crisis” (ibid, p.3). To deal with this over-determination, which stands in contrast with the uneven actual emergence of activism, social movement theories have stressed the key relevance of “political opportunity structures”, of “political entrepreneurs” able to frame discontent (Snow et al 1986; McAdam et al 2001; Tarrow 1998; Tilly 2004; Wiktorowicz 2004a, b), and of social networks mobilizing certain individuals rather than others (McAdam 1986; Sageman 2004). Still, the question remains whether such a conceptual framework can really explain why among much larger dissatisfied populations certain agents were the first to become radicalized and more prone to join. Social movement theorists themselves have recently advocated a move away from global theories to more mechanism-based explanations (McAdam et al 2001). By concentrating on a specific micro-level dimension of mobilization, this paper aims to contribute to this more focused research agenda.

In the first part of what follows we examine a wide range of evidence to establish the size of the engineers’ presence among Islamic radicals, both in the Muslim and in the Western world; in addition, we consider their presence in two control groups, non-violent Islamic groups as well as non-Islamic extremist groups. In the second part, we try to make sense of the pattern of findings.

Are engineers over-represented?

To discover whether the puzzle is more than mere anecdote, we compiled a list of 404 members of violent Islamist groups drawing from a variety of sources (Table 1).[10] The sample does not fully reflect what is a varied universe of unknown size (for instance, it leaves out or under-represents groups in South Asia, South East Asia, North Africa and Iraq), but is disparate enough – there are individuals from 30 nationalities, 9 larger groups and no less than a dozen smaller groups – to allow us to establish whether the puzzle holds true.

Table 1: Sample sources

Description	Source	N
International jihadis involved in 1993 World Trade Center attack, 1998 bombing of US embassies in Africa, 2002 Bali bombings, and September 11	Provided by Peter Bergen and Swati Pandey, complemented by library and internet research	75
International salafi jihadis *	Sageman (2004), combined with library and internet research	126
Hamas (Palestine)	Hamas websites, Rangwala (2005); Smith et al (2005)	81
Takfir Al-Hijra and Military Academy Group (Egypt)	Ibrahim (1980, 1982)	34
Jamaa Islamiya (South East Asia)	Singaporean government documentation	31
Islamic Jihad (Palestine)	Websites and literature	18
Sundry cases (further Afghani, Pakistani, Egyptian and Iraqi groups)	Websites and literature; daily press surveys; Smith et al (2005)	39
Total		404

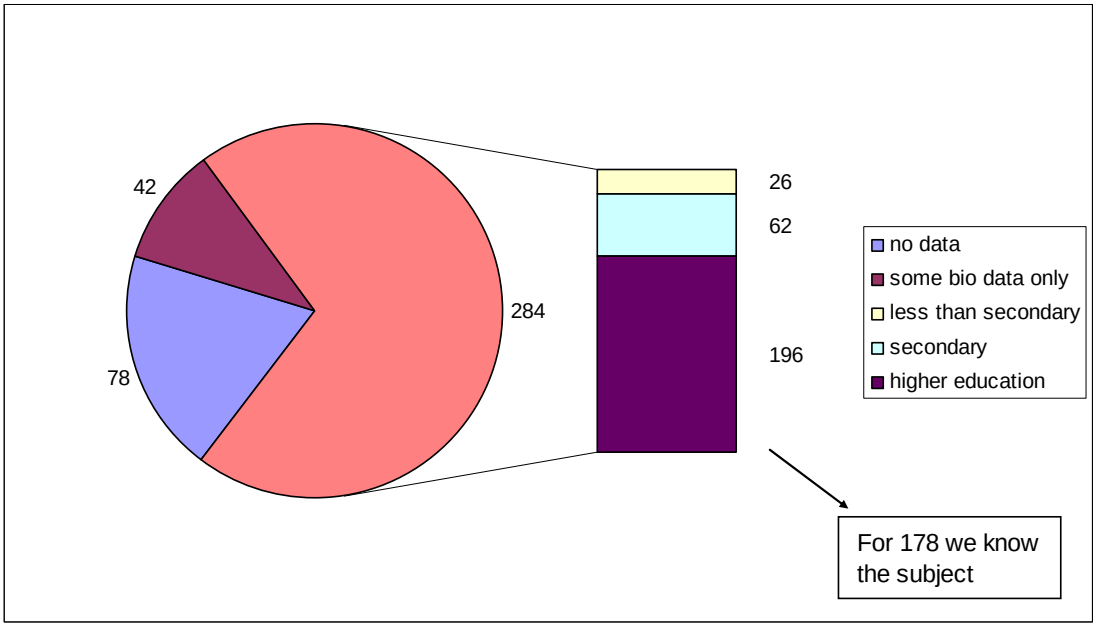
* Sageman lists 172 cases, but 46 of these overlap with the above groups. We checked for all aliases and different spellings of names, but cannot rule out double counting entirely.

[10] The list does not include violent groups operating only in a Western country which we investigate below. But one group that we include, the Maghreb Arabs who carried out attacks in both Morocco and France, had a mixture of nationalities including many who were at some point residents of France (Sageman 2004: 92, 188f.).

Education levels

We searched wherever we could for information on each of the 404 individuals in our sample, and found some biographical information for 326 cases and educational information for 284 (Figure 1).[11] Out of these, 26 had less than secondary education; 62 completed secondary education (including madrasas),[12] and 196 had higher education, whether finished or unfinished (at least 37 studied in Western countries). The share of individuals with higher education appears impressive: 69.0 per cent. It could, however, be an overestimate because reports are more likely to mention a biographical item that exists than one that is absent, and graduates are more likely to be prominent in their organization than non-graduates. Still, even if *none* of our missing cases had higher education, the share of those with higher education would be a hefty 48.5 per cent.

Figure 1: Educational attainment in our sample



[11] Our sources include academic literature, the press, governmental and non-governmental organisations and websites of the groups involved or related to them. In addition to education, we collected other biographical data whenever possible: age, time of death, function in group, socio-economic and regional background, crucial biographical experiences like migration, time of radicalization etc.

[12] In cases in which only "secondary education" was mentioned in our sources, we assumed that it had been completed.

Compare this with the enrolment rates in tertiary education in Middle Eastern and North African countries (MENA), which are strongly represented in our data base: in 1986-87, when many of the individuals in our sample studied, tertiary enrolment rates in the Arab world lay between 2.0 and 23.3 per cent, with an average of 12.2 (Longuenesse 1990: 329). In South East Asia – the second regional block in our sample – tertiary enrolment rates in the late 1990s were between 16 and 23 per cent (UNESCO 2005).[13] The overrepresentation of university-educated in our sample relative to the general population of their countries is significant at $p<.001$. There is little doubt that violent Islamist radicals have been vastly more educated than their compatriots.

Education types

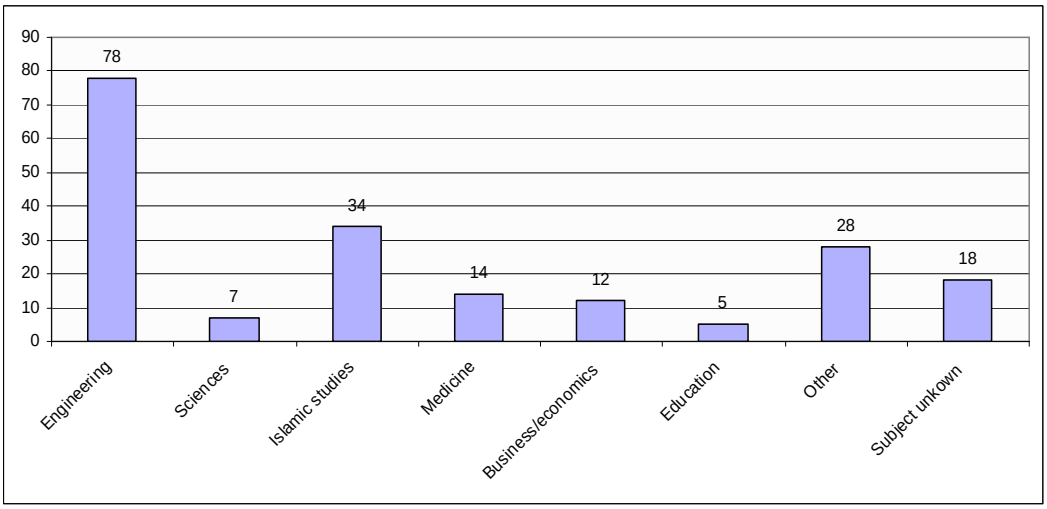
We were able to find the subject of study for 178 of the 196 cases who were engaged in higher education at some point (Figure 2). Unsurprisingly, we found that the second most numerous group was composed of 34 individuals who pursued Islamic studies. Yet, the group that comes first by far are indeed the engineers: 78 out of 178 individuals had studied this subject. This means that 44 per cent of those whose type of degree we know were engineers. They are followed at quite a distance by 14 cases in medicine, 12 in economics and business studies and seven in natural sciences.

On the whole, the individuals who studied for what we may call 'elite degrees' – engineering, medicine, and science – represent 56.7 per cent. While for all other degrees

[13] We could not obtain earlier data. It is clear from recent time series, however, that enrolment rates have been increasing. Thus, since many of our South East Asian cases studied in the mid-1980s to early 1990s, tertiary enrolment rates at that time are likely to have been even lower. For historical data on Singapore cf. www.singstat.gov.sg/papers/snippets/education.html (accessed July 2007).

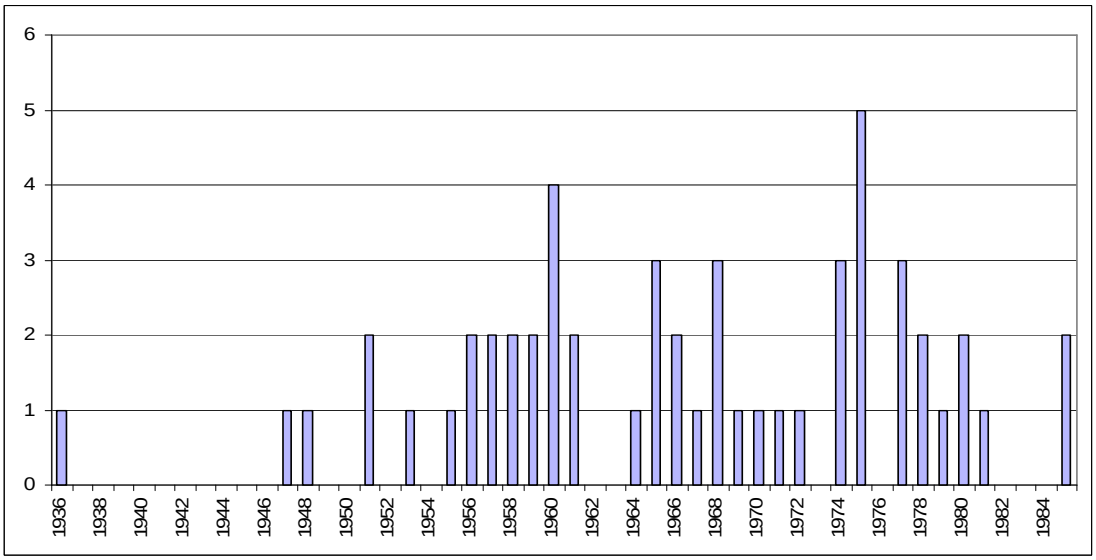
the strictness of selection varies from country to country and is generally weaker, the elite degrees are universally more demanding and have stricter admission criteria in all the countries in our sample. If we add economics and business, which in some countries such as Egypt is also a selective degree (Moore 1994: 46), we reach 63.4 per cent.

Figure 2: Higher education in our sample (196 cases)



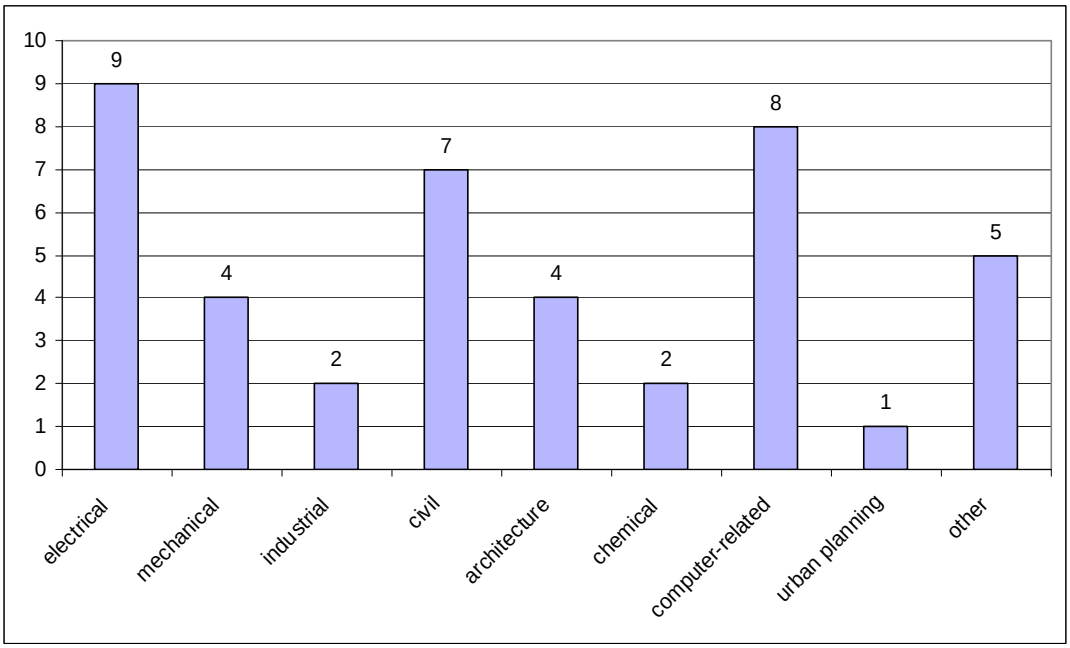
* Engineering in our definition includes computer sciences and architecture. The latter was included because it is commonly part of engineering faculties in Middle Eastern countries, as it is in European countries.
** Islamic studies includes various Islamic subjects, such as “Islamic law”, “Quranic studies”, “religion” etc.
*** Other subjects include Agriculture, Arabic Literature, English, History, Law, Media And Communications, Pharmacy, Philosophy, Psychiatry, Social Services, and Technical Military Science.

Figure 3: Year of birth of engineers in sample (54 cases)



The engineers' birthdates (for the 54 cases in which we could find out) are spread between the 1950s and the late 1970s, with the average date of birth in 1966 – slightly older than the average of the total of 284 cases of which we established the age, which is 1968. This implies that they went to university from the mid-1970s to the late 1990s, starting their courses on average in 1984-5. Among the 42 of the 78 cases for whom we could find out the precise discipline, three types of engineering predominate: electrical and civil engineering, and computer-related studies (Figure 4).

Figure 4: Types of engineers in sample (42 cases)



* One case studied both chemical engineering and computer science and hence adds to two subjects in this table, while being counted only as one case in the total
** "other" includes rare subjects

One could question the validity of our result. The list of names and the subset of individuals in it on whom we found information are both selected by the public availability of data, which in turn depends largely on whether the individuals came to the attention of the authorities because they were killed, captured or investigated. However, the chances of finding engineers relative to the chances of finding graduates in any other

subject should be unaffected by these selection biases. For a bias to occur we would have to assume that engineers are more likely than other educated individuals to be killed, caught or investigated because of greater incompetence. This seems implausible; if anything the opposite should be the case. If they fell into the investigative net they arguably did so because they were particularly active, prone to violence and able to use it, which would indeed show the existence of the correlation that interests us.

A further finding gives us confidence in the robustness of our result: the predominance of engineers is not clustered in any one of the sample groups, but spread evenly across them (Table 2). The same obtains if we re-arrange the data by the subjects' nationality (Table 3) – with the exception of Saudi Arabians which we discuss below. Strikingly, the proportion of engineers is even more uniformly distributed across both groups and countries than the proportion of individuals with higher education.

Table 2: Individuals with higher education, finished or unfinished, in total and in engineering by group

Event/group	Total	With higher education	% higher education	Subject of edu. known	Engineers	% engineers **
WTC 1993	12	12	100	12	5	41.7
Bali	23	7	30.4	6	4	66.7
African embassies	16	7	43.8	7	3	42.9
September 11	25	17	68.0	14	8	57.1
Central al-Qaeda staff*	22	9	40.9	6	4	66.7
Core Arab cluster*	14	5	35.7	4	1	25
SE Asian cluster*	3	2	66.7	1	0	0
Maghreb Arab cluster*	9	7	77.8	7	3	42.9
Hamas	81	52	64.2	48	19	39.6
Palestian Islamic Jihad	17	8	47.1	8	1	12.5
Ibrahim sample	34	29	85.3	25	9	36.0
Jemaah Islamiah	31	6	19.4	6	5	83.3
Further sundry cases	39	34	87.2	34	16	47.1
Total	326	196	60.1	178	78	43.8

* These groups are taken from Sageman (2004). If cases overlapped with the event-based categories of Bergen, they are included in the Bergen groups; so, with the exception of the Maghreb Arab cluster, the Sageman's categories are residual sets including individuals from the same network who were not directly implicated in the events.
** The share is calculated on the number of cases whose degree we know.

Table 3: Individuals with higher education, finished or unfinished, in total and in engineering by country of origin

Nationality	Total	With higher education		Subject of higher education known	Engineers*	
		N	%		N	%
Palestinian	101	63	62.4	58	20	34.5
Egyptian	69	53	76.8	46	17	37.0
Singaporean	30	5	16.7	5	4	80.0
Saudi	25	11	44.0	9	1	11.1
Indonesian	14	4	28.6	3	1	33.3
Moroccan	11	8	72.7	8	3	37.5
Kuwaiti	8	5	62.5	5	4	80.0
Lebanese	6	5	83.3	5	4	80.0
Malaysian	6	5	83.3	4	3	75.0
Jordanian	6	4	66.7	4	3	75.0
Pakistani	5	4	80.0	4	2	50.0
Syrian	4	4	100.0	4	3	75.0
Algerian	4	3	75.0	3	2	66.7
Afghan	4	4	100.0	4	2	50.0
Unit. Arab Emirates	3	3	100.0	3	2	66.7
American	3	2	66.7	2	2	100.0
Sudanese	3	2	66.7	2	1	50.0
Others**	18	10	61.1	8	3	37.5
Nationality unknown	6	1	16.7	1	1	100.0
Totals	326	196	55.6	178	78	43.8

***** The share is calculated on the number of those whose degree we know.
** These include: Algerian, Australian, British, Comoran, French, German, Guyanese, Indian, Iraqi, Irish, Kenyan, Sudanese, Tanzanian and Yemeni.

How much over-represented are they?

We estimate that the average share of engineers among the total male working population in the countries of our sample, weighted by the number of cases per country, is about 3.5 per cent.[14] If we leave out Singapore, a country with an extraordinarily high number of engineers, the share is 2.1 per cent. By contrast, even if we include all missing values in the denominator, engineers are still about 19 per cent of our total sample (78/404). This means that the share of radical Islamic

[14] This is based on labor market data from Longuenesse (1990: 328) as well as UNESCO education data (2005).

engineers is no less than nine times greater than the share we could expect if the proneness of engineers to radicalize was the same as that of the male adult population.

This massive over-representation, however, does not tell us whether engineers are also over-represented among the subset of individuals with higher education: how many engineers could we expect to become radical if they had the same proneness to do so as graduates or students in any other subject? If the countries we consider had an extra-large share of engineers among their total graduates comparable with that in our sample, our puzzle would evaporate. To address this question we must compare our results with enrolment rates. The correct term of reference is the data for *males*, since all our cases are males and males everywhere have a much higher propensity to study engineering than females. We managed to obtain detailed higher education data for all of the important countries in our sample, including MENA countries in 1986-7, when a substantial share of our men went to university.

Even among male graduates, the over-representation of engineers in our sample is present for all nationalities (except Saudi Arabia, see below). The average share of engineers among total male students of twelve relevant countries (table 4), weighted by the number of cases with higher education per nationality in our sample, is 18.0 per cent, while the ratio of engineers over those with known higher education in our sample is 43.8 per cent, that is over two and a half times greater (significant at $p<.001$). To be accurate, however, we have to consider that in our sample at least 37 subjects studied in Western countries – 25 of whom (68%) studied engineering – so to use the overall engineer ratio in the sample as the term of comparison is not entirely correct. Yet, even if we remove this group we still have a ratio of engineers of 38 per

cent (78-25/178-37) which makes their share in our sample still over twice as large as that which we would have if the proneness to radicalize were even across subjects ($p<.001$).[15]

Table 4: Proportions of male engineers in total male student body in some Islamic countries

	Enrolment rates		*% of engineers in sample*
	1986-7	*Other years*	
Palestine	--	9.0 (2003-4)	34.5
Egypt	11.7	8.3 (1995-6)	37.0
Singapore	--	75.2 (2003)	80.0
Saudi Arabia	10.6	--	11.1
Morocco	8.13	--	37.5
Kuwait	33.5	22.6 (1998-9)	80.0
Lebanon	11.0		80.0
Malaysia	--	30 (2000)*	75.0
Jordan	20.9	24.3 (2004-5)	75.0
Syria	28.4	--	75.0
Algeria	16.1	--	66.7
UAE	4.8	--	66.7

* Estimate based on total number of engineering students, assuming that gender distribution is similar to other cases.
Sources: for 1986-7 Longuenesse 1990: 329; for other years, Palestinian MoHE 2005; Arab Republic of Egypt 1996; Jordanian MoHE 2005; Kuwaiti MoHE 2001; Malaysian Department of Statistics 2002; Singaporean MoE 2006

[15] What about those who studied in the West? To establish whether they too are over-represented we need the shares of male engineering students in the West from the Arab countries in our sample. We found them only for Germany in 2004-5, where between a third and half were studying engineering or computer science (with the exception of Morocco, where the share was above 60%). In the US, where the majority of those in our sample who went abroad studied, we could not find data combining nationality and subject (or gender), but found that the share of foreign students studying engineering or computer science in 2004-5 – the vast majority of whom are males from developing countries – was 23.3% (Institute of International Education 2005). In the UK the equivalent figure for non-EU students in 2004-5 was 21.0% (Higher Education Statistics Agency 2005). Assuming these rates are stable over time, the radical engineers in our sample who studied abroad, 68 per cent, would clearly be over-represented.

If we consider the nationalities strongly represented in our sample, the over-representation is even greater: in Egypt share of engineers among male students was 11.7 per cent in 1986 (which dropped to 8.3 per cent by 1995-6)[16] while among the 46 Egyptian cases with known higher education in our sample 37 per cent (17) are engineers ($p<.001$). For Palestinians the enrolment rate was 9 per cent while out of 58 cases with known higher education 35.0 per cent (20) are engineers ($p<.001$). We can thus conclude that among violent Islamic radicals engineers are two to four times more likely to be found than the null hypothesis would predict.

Exceptions and mixed cases

When looking at the nationality of the individuals in our sample two peculiarities worth noting emerge, one concerning South East Asia and the other Saudi Arabia.

In the 30 cases we have in Singapore only 5 had higher education, four of whom are engineers.[17] So, there seems to be no overrepresentation of graduates generally, unlike in MENA countries, while there still is a very high proportion of engineers. The former finding is striking for the majority of Singaporean males attend higher education, but the latter may simply be a result of the fact that a full 75 per cent of them pursue technical degrees (Singaporean MoE 2006). On Indonesia the evidence is mixed. From our small sample it also seems a case with a smaller share of highly educated: half of the 14 Indonesians we have in the sample had a religious education mostly at secondary school level and only four had higher education. However, Noorhaidi Hasan, who interviewed 125 members of the militant Indonesian Salafi group Laskar Jihad in various parts of the

[16] This share is estimated using aggregate enrolment figures (Arab Republic of Egypt 1996) and assuming the ratio of female students has remained constant.
[17] Abuza (2003: 130) also points out that extremist recruitment in Singapore focused only on moderately educated individuals.

country, states that "[a]lmost half are students, dropouts and graduates from a dozen universities in Indonesia" and that "[t]hese students are generally enrolled in science and engineering departments (2006: 159-160). Although he does not provide precise figures, this makes it seem as if the ratio of subjects with university exposure in Indonesia is comparable to that we found for MENA countries.[18]

Saudi Arabia is also an exception but in a different way. Scattered across several of our groups there is a contingent of 25 Saudis, 11 of whom have higher education, but only one of them is an engineer. This low share gains significance when we consider another sample of Saudi Islamic insurgents collected by Thomas Hegghammer. Out of a "core"[19] of 70 violent Islamists active in the recent domestic insurgency in Saudi Arabia, he found educational data on 36, 17 of whom had college exposure. Among the 11 of these for whom the subject is known, five pursued religious degrees but again only one was an engineer.

Table 5: Individuals with higher education, finished or unfinished, and engineers in Saudi Arabia and all others

Country of origin	Total	With higher education		Subject of higher education known	Engineers	
		N	%		N	%
Saudis in our sample	25	11	44	9	1	11.1
Saudis in Hegghammer's sample	36	17	47.2	11	1	9.1
All others in our sample	301	185	61.5	169	77	45.6

* The share is calculated on the number of those whose degree we know.

[18] The number of Malaysian cases in our sample is too small to draw conclusions. Abuza (2003: 14, 130) tells us that the University of Technology Malaysia was a prime recruiting ground for extremists. This might mean that the high share of both highly educated and engineers among the small number of Malaysians, is a function of its local concentration at UTM.

[19] Hegghammer's sample includes 240 individuals, but contains little biographical data. The "core sample" refers to individuals portrayed in the kingdom's main jihadist publication or the government's most wanted lists.

Finally, among the 25 individuals involved in 9/11, there were fifteen Saudis and eight engineers. A full seven of the ten non-Saudis were engineers, but only one Saudi was. What are we to make of this exception? We will return to this later.

Western-born or -based extremists

Before attempting to explain what's 'wrong' with engineers, we must consider the further question of whether they are overrepresented also among a different group of violent Islamic extremists from the ones we considered in the first sample, namely those born in or residents of Western countries who became active in recent times, mostly after 9/11. For this purpose we assembled 265 names of Islamic extremists who are citizens or residents of a western country, and have come to western authorities' attention for carrying out or plotting a terrorist attack (the sample does not include westerners who went to the Middle East to fight or to perpetrate a suicide attack).[20]

The sample is close to the universe of violent Islamic extremists caught in the West up until the end of 2006. Out of 265 individuals, 259 are residents (many of them

[20] The bulk of individuals, 229, come from Bakker (2006) who has assembled a comprehensive list of European jihadists (p. 59f.). His original list contains 242 names, but we removed ten people, three who were acquitted in the meantime, three women and seven who are already in our main sample (born and raised in their country of origin). Bakker collected information about them (age, country of residence, custody status, criminal records etc.), but does not mention any information on our key variable, the type of education. We then added 36 additional individuals, some caught in the US, others in Europe, but whom Bakker did not include probably because their involvement emerged in 2006. Out of 265, 139 individuals were in custody in western countries in December 2006 while others had died in the attack or in connection with it. A few were on trial in December 2006 and may still be acquitted, and the fate of a few cases was not public.

citizens) of 13 western countries (see Table 6) while the remaining 6 are resident of Afghanistan, Morocco and Bosnia, but were caught because of their links with the western resident ones or involvement in plots such as the plot to attack British and American warships in the Strait of Gibraltar. The average age at the time of arrest or death was 29.

Table 6: Residence/nationality of Western-based cases.

Country	Cases
Spain	77
UK	67
France	45
Netherlands	21
Belgium	13
Italy	10
US	8
Germany	7
Denmark	6
Canada	2
Bosnia	1
Ireland	1
Sweden	1
Switzerland	1
Total	259

The database covers individuals involved in 36 planned or perpetrated terrorist acts all of which date from after 2000.[21] The average act has 18 individuals involved, the minimum being 1 and the maximum 44.

[21] Among them are the Moroccan-Spanish individuals responsible for the Madrid bombings in 2004, the Hofstad group in the Netherlands, the Lackawanna Six in the US, and the German-Jordanian-Palestinian Al-Tawhid movement. However, we do not know how many Islamic groups the sample covers (for example two acts in the Netherlands are linked to the same group), and for some plots or acts there is no information on whether the cell belonged to a larger group. Eight of these acts involved one person, such as Theo van Gogh's murder. The rest concerns clusters of connected individuals.

We searched for biographical information on the names in our list in a variety of public sources.[22] Despite the fact that most of these individuals were caught, tried or died in the West under intense media scrutiny, the outcome was more disappointing than that of our sample of Muslim world jihadists: we found information on the education of only 54 cases and information on the occupation of 38 additional cases.[23]

Table 7: Type of university degree, complete or incomplete

Type of degree	N	%
Engineering	13	59.1
Natural sciences	4	18.2
Economics, business, accountancy	3	13.6
Sports science	1	4.5
Social work	1	4.5
Total known	22	100%
Unknown	11	--
Total	33	--

Among the 54 for whom we found educational information, 21 had secondary education, while 33 had either some university exposure (20) or a university degree (13). We found information on the type of degree pursued by 22 out of those 33 (Table 7): nearly all are from 'elite degrees' and engineers alone represent 59.1%, an even larger majority than that we found in the other sample (44%). Even if the overall number of graduates we identified were lower than the real number of graduates in the sample, the distribution by degree should not be significantly biased for there is no reason why sources should report those degrees more than others. In addition, the 33

[22] We searched in *Lexis Nexis* and *Factiva* news databases and in *Google*. We also searched other news media (*20 minutos*; *Fox News; CTV News; Dutch News at dutchnews.nl; Dutch News Digest; L'Humanite)* and a series of specialized databases. All websites were consulted in May 2007. We also consulted Rodríguez (2005).
[23] These are non-overlapping with the ones with known education. Among those with known education we found the occupation of 7 cases.

individuals with known university exposure are not concentrated in one or two cells, but spread over 14 of the 36 acts or plots in the sample (Table 8)

Table 8: Degrees distribution by terrorist act or plot for the 15 out of 37 acts/plots which have at least one individual with university exposure or degree

	Engineers	Scientists	Economics, Sport Science, Social Work	Type of Degree Unknown	Total with degree or some university	Total per act
Foiled attack on the US embassy in Paris (2001)	1	0	0	0	1	11
Foiled attack on the Stade de France (2001)	4	1	0	0	5	5
"Failed 'shoe bomber attack" (2001)	0	0	0	1	1	2
The Madrid bombings (2004)	1	0	1	0	2	33
"London Fertilizer plot" (2004)	2	0	0	1	3	8
Plot to incite hatred and possession of a terrorist manual (2004)	1	0	0	0	1	1
Plot to attack financial institutions in the US and targets in the UK (2004)	3	0	0	0	3	8
The killing of the Dutch film maker Theo van Gogh (2004)	0	0	0	1	1	1
Plot "to attack existing structures and terrorizing Dutch society" (2004)	0	1	0	0	1	16
7th July bombings in London (2005)	0	0	2	0	2	4
21st July failed attack on the London metro (2005)	0	0	0	1	1	17
Plot to commit terrorist acts in Europe (2005)	1	1	0	0	2	10
Foiled transatlantic aircraft attack (2006)	0	1	0	2	3	19
"Lackawanna Cell"/al-Qaeda related training and activities in the US (2002)	0	0	0	3	3	8
Total	13	4	5	10	33	141

While the engineering overrepresentation survives in the western sample and appears even stronger, the proportion of graduates seems lower: in the sample of 404 non-Western jihadists, the share of those with higher education is no less than 48.5 per cent, while in the western sample the corresponding proportion is 12.3 per cent (33/268). Considering the much higher tertiary enrolment rates in Western countries – the average rate weighted by the number of cases in our sample is 51.5 per cent (UNESCO 2005) – this finding is striking.

We cannot be sure about education levels however. Among the 211 cases on which we have no educational information there might be an unknown number of students and graduates. Yet, even if the size of this group is uncertain, we can be fairly confident that the proportion of graduates is well below that which we found in the other sample. The number of those with secondary school is almost certainly higher than that which we found as this is less of a newsworthy item to report than a university degree. For the same reason, however, the number of graduates or university students we found is likely to be closer to the real number in the sample.

There is another reason to think that, unlike their brethrens in the first sample, the Western based extremists do not come from a would-be elite stratum. The fact that the 33 individuals with higher education are spread over 14 acts/plots tells us indirectly that the little information we have on education does not filter out more from one group than from another, but it is spread out, and this reinforces the suspicion that the reason why for so many individuals we have no educational information is because there were no significant educational accomplishments to report – for why should sources report the university education of one member of the group and not of another? If we count the proportion of graduates over only the total number of individuals involved in these 14 acts/plots rather than the 36 total we obtain 23.4 per cent (33/141), which is still 25 points lower than in the non-Western sample (48.5%).

Several further fragments of information in the database converge in increasing the suspicion that this 2nd generation of Islamic extremists in Western countries is of a lower level of both educational and occupational qualifications than their peers in Islamic countries. First, 15 individuals were 19 or younger at time of arrest or death,

too young to have had university education or a professional career. Next, 11 individuals are converts to Islam, most of them drifters or former inmates who converted while in jail. Third, among the 38 cases whose occupation at some point of their lives we found mentioned in the sources (non-overlapping with the university-exposed group), not a single one had a professional occupation.[24] Finally, Bakker found that a quarter of those on his list, which forms the bulk of our sample, had a criminal record prior to the terrorist related offence (2006: 42).

In conclusion, the evidence suggests that compared to our MENA cases, the Western based jihadists have attracted far fewer graduates and qualified individuals and many more from a lower class and lower middle class background, with an even substantial criminal component. Yet, strikingly, despite this apparent "lumpenization" of Islamic extremists in the West, we find among them proportionally even more engineers than in the first sample.[25] Similar to the Singaporean cases, the number of graduates is tiny in absolute terms, but nearly 60% of them are engineers (Table 9).

[24] Of the 38, 13 had unskilled manual or clerical jobs, 9 owned shops or were employed in retail activities, 6 had a skilled manual occupation, 5 a technical one, 3 had a military background, and 2 were clerics. We have also gathered information on the occupation of 6 university students and two graduates in the sample: 1 was a trainee probation officer, 1 hotel worker (type of work not specified), 1 chartered surveyor, 2 counsellors—at a local community centre and at a job centre, 1 worked at a debt collection agency. Of the graduates, one, an engineer, had become a cleric; the other was teaching mathematics in a French lycee.

[25] To a lesser degree, the proletarization of Islamist activism has also been observed in the Islamic world. Ibrahim (1996) documents the declining share of college-educated among the new generation of violent Egyptian Islamists. The tourist resort bombings in Egypt in 2005 were linked to radicalized Bedouins, a new phenomenon (*Christian Science Monitor*, 24 May 2006). In Morocco, Al-Qaeda recruiters have recently focused on poor slum-dwellers (*International Herald Tribune*, 11 April 2007). This phenomenon is recent and limited, however.

Table 9: Violent Islamists with higher education, finished or unfinished, in total and in engineering by world region

Region	Total	With higher education		Subject of higher education. known	Engineers *	
		N	%		N	%
West	265	33	12.5	22	13	59.1
SE Asia	50	14	28.0	12	8	66.7
MENA	254	171	67.3	156	64	41.0

***** The share is calculated on the number of those whose degree we know

Differences between violent and non-violent Islamic extremists

The individuals in the samples considered so far include only members of violent groups, but what about *non-violent* Islamic movements? One thing we know for certain is that Islamic parties and movements contain a fair share of highly educated individuals (Best 1999; Hoffman 1995; Lobmeyer 1995; Moore 1994; Munson 1986; Munson 2001; Wickham 2002). In a sample of 738 Syrian Muslim Brothers active in the 1980s 25.8 per cent were doctors, lawyers or engineers, and another 32 per cent were university or secondary school students (Lobmeyer 1995: 394). Even in Nigeria, a country with low levels of education, the leadership of the Muslim Brotherhood is "highly educated" and "the typical leader is a university graduate" (Best 1999).

With respect to the distribution of subjects there are both similarities and differences relative to the sample of violent Islamic groups in the Muslim world. The main commonality is that elite degrees are strongly represented, engineering included. In Egypt, for instance, Islamists scored their initial electoral victories in the professional associations of doctors, pharmacists and engineers in the mid-1980s, while gains in journalists' and lawyers' syndicates were more modest, and barely noticeable in commerce, agriculture and education. It took Islamists until 1992 to gain control of

the lawyers' association, which remained one of the last liberal-leftist bastions (Wickham 2002: 178, 185).[26] Islamists have also played a dominant role in Egyptian student politics since the late 1970s. In the 1990-91 elections to the Cairo university student union, Islamists won 47 of the 48 seats in the science faculty student board, all 72 in the medical faculty, and all 60 in engineering. Liberals and leftists however remained strong in economics and political science, where Islamists won only 13 out of 49 seats. Though engineering is not the only Islamist-dominated faculty, the way it was won over by Islamists seems exceptional: the Islamist landslide victory for the national student union board in 1978-79 was "especially striking in such faculties as Cairo University's faculty of engineering, which had long been regarded as a fortress of the left" (Wickham 2002: 116ff.).

Engineers are also strong among non-violent Islamist movements in other MENA countries. We already mentioned the active role played by students of engineering in the revolution in Iran, where student activists in Islamic associations generally seem to be from science and engineering faculties rather than from social sciences.[27] The Jordanian syndicate of engineers, an important forum of oppositional mobilization, is

[26] By 1995 domination was total. These are the results from the relatively free 1995 syndicate elections (Fahmy 1998: 553):

	Islamic Seats	Total seats
doctors	20	23
lawyers	45	61
pharmacists	17	25
scientists	17	25
engineers	18	25

[27] According to an Iran expert, the "exceptionally active role of science and engineering students and faculty in the Iranian political experience of the last half century is undeniable" (Hossein Partovi, personal communication, July 2006). Another researcher has commented that "in my research on student activism in Iran, I have found more science and engineering students in Islamic Associations than those from social sciences" (Akbar Mahdi, personal communication, July 2006).

dominated by Islamists and Laith Shubailat, former head of the syndicate, is a leader of the Islamist opposition.[28] In Turkey, engineers are strongly represented among Islamist parties, although these are not all politically radical (Göle 1990). Islamist sympathies have been particularly strong in the engineers' syndicate in 1970s Syria (Moore and Salloukh 2007: 66). Engineers have been prominent also among North African Islamists.[29] Conversely, administration, politics and other non-technical faculties are often latecomers to Islamist mobilization.[30]

But what about the numerical relationship of engineers to other elite degrees (OEDs) such as medicine, pharmacology and science,,often mentioned in the literature as similarly "Islamicized"? We managed to collect data on a variety of non-violent movements in eight of the Islamic countries in our sample (see Table 10).[31] They show a striking difference from our samples of violent groups: in non-violent Islamic activism engineers, although strongly present, appear to be far less dominant. They are joined by a strong, often stronger contingent of OEDs.

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[28] www.highbeam.com/doc/1P1:2389549/Leading+opponent+of+King+Hussein+is+jailed.html?refid=SEO; www.voanews.com/english/archive/2005-02/2005-02-04-voa17.cfm?CFID=3684699&CFTOKEN=41778570 (accessed in September 2005)

[29] Michael Willis, personal communication (November 2006).

[30] For Jordan cf. Longuenesse (2000: 34f). In Kuwait, administrative sciences even today remains a bastion of liberals; *Kuwait Times,* 3 September 2006.

[31] *Kuwait Times*, 26 October 2004; Azam 1997: 92-98; Stephane Lacroix, personal communication (April 2007); Hizb Ut-Tahrir 2002; Mohamad Mahdi Akif, "Speech to Introduce the Muslim Brother MPs," Intercontinental Hotel, Madinat Nasr, Cairo, 11 December 2005, as reported by Joshua Stacher, personal communication (April 2007); www.ikhwanweb.com/Home.asp?zPage=Systems&System=PressR&Press=Show&Lang=E&ID=4990 (accessed June 2007); www.parlement.ma/sitefr/partis/dep09-04-2007/total09-04-2007.shtm (accessed June 2007); web research of South East Asian movements.

Table 10: Degree distribution in non-violent Islamist groups

Country	Groups	Engineers	Other elite subjects*	Total**
Egypt	Muslim Brotherhood MPs	18	12	88
Kuwait	Islamist MPs	1	2	18
Jordan	Islamic Action Front founders	22	42	353
Syria	Hizb ut-Tahrir prisoners	10	17	59
Saudi Arabia	Islamist dissidents	0	3	5
Morocco	PJD MPs	3	9	42
Indonesia	Various parties	5	2	16
Malaysia	PAS, ABIM	0	1	4
Total		**59**	**88**	**585**

Sources: see fn 31

***** This includes medicine, pharmacology and basic sciences.

****** The OED count does not include 49 university professors whose subject was either non-elite (literature, commerce etc.) or could not be established. Their presence further underlines the high level of education of the Islamist opposition.

For example, in Egypt, in the (generally non-violent) Muslim Brotherhood engineers share both top and middle ranks with geologists, doctors, pharmacologists and other comparable subjects, and the doctors' association in particular has been a bastion of Islamists (Wickham 2002: 185). If we consider that OEDs constitute only around 10 per cent of the total male student body in the Egyptian and Jordanian cases, i.e. equal or less than engineers, OEDs appear to be clearly overrepresented among non-violent groups, at least as strongly represented as engineers.[32] By contrast, in our main sample there are only 23 OED cases and 78 engineers. While Islamist radicalization seems to

[32] By contrast, the larger and less selective faculties, such as humanities, commerce, administration and education, appear generally under-represented in three of the four cases where we could obtain detailed information (Egypt, Syria, and Morocco; Kuwait being the exception). They are also under-represented among the IAF's 17 parliamentarians in Jordan; www.jabha.net/NOWAB.ASP (accessed October 2005).

appeal to both engineers and other elite students,[33] engineers seem more prone to end up in violent groups (Table 11).[34]

Table 11: Percentages of engineers and OEDs in violent and non-violent groups

	% Engineers	% OEDs	Total (N)
Non-violent	40.1	59.9	100 (147)
Violent	77.2	22.8	100 (101)

Are engineers over-represented among non-Islamic extremists?

Finally, to establish the extent to which this phenomenon is unique to the Islamic world, we need to find out to what extent engineers are present among other kind of extremists. If engineers are prone to extremism we should find them overrepresented in other extremists groups too.

To test for this we carried out a survey of literature and several primary sources on an assortment of violent groups (Table 12). Although far from exhaustive, the gathered information covers a large set, which is diverse and rich enough to reveal the existence of clear patterns. We failed to find engineers among left-wing extremists: with the exception of a handful among anarchists, there is hardly any trace of them. This is true both in groups in which university students and graduates are few and in groups in which there is a significant presence of university students or graduates from other disciplines, mostly liberal arts ones.

[33] As far as we know, the only violent group in which the share of scientists has been very high is Japanese Aum Shinrikyo, a sect rather than a politically motivated group, which reportedly attracted economically successful high-achievers who, according to Reader (2000), suffered from spiritual malaise in modern Japanese society.

[34] When told in generic terms about our research, Holger Albrecht, an expert on Egypt, commented – without being primed by us – that although several types of professionals are represented among non-violent Egyptian Islamists, *within the latter group* the engineers seem to entertain the most radical views (personal communication, March 2006).

By contrast, among right-wing extremists, engineers if not over-represented seem at least present. Among 287 right-wing extremists and neo-Nazis in Germany and Austria involved in 33 groups, we found 29 individuals with known higher education 6 of whom were engineers. In the US extreme right, whose ideology often has a strong religious and millenarian underpinning (Handler 1990) and whose members are generally poorly educated, engineers have played a significant role as leaders of several groups: out of seven individuals for whom we were able to establish the degree, four were engineers. For instance, Dick Butler, the founder of Aryan Nation, was an aeronautical engineer and Wilhelm Schmitt, leader of the "Sheriff's Posse Comitatus" (a militant anti-government group with an anti-tax agenda and extremist Christian views) before being sentenced to 26 years in prison was an engineer with Lockheed Martin (Smith and Morgan 1994). [35]

[35] Mischa Gabowitsch also told us that "the fact that there is a disproportionate number of engineers, mathematicians, and physicists among Russian nationalists and followers of 'wacky' theories in Russia today has often been remarked upon, although I know of no publication on the subject, not to speak of any attempt at quantitative analysis". Similarly, Ariel Merari shared his impression with us that in Israel, there seems to be a difference in political orientation between people in social sciences and fine arts, who tend to be left wing, and people in the exact sciences and engineering, who tend to be right wingers.

Table 12: Graduates and engineers in non-Islamic radical groups

Anarchists	A search in the biographies of 700 international anarchists – covering 19th and 20th century individuals and most European countries, the US, Russia and several Asian countries – yielded 54 cases with a known degree, six of whom were engineers, 10 doctors, 20 lawyers, and 15 philosophers*
Post WWII Left-wing extremists	• Most 1970s *German left-wing terrorists* studied humanities (Jäger et al. 1981; von Baeyer-Katte et al. 1983) • No engineer among 17 members of the *Rote Armee Fraktion* cases with known higher education (www.rafinfo.de). • In a sample of 67 members of the Italian *Red Brigades* and other radical leftist Italian groups, which is part of a database under construction by Valeria Pizzini-Gambetta, out of 34 known education achievements, 16 had either a university degree (6) or some university exposure (10); of those, 10 were in the arts, humanities or social sciences, 3 in natural sciences, 1 in maths, 1 in physics and 1 in engineering. • Most radical *US leftists* were doctors, lawyers or had a liberal arts education (Smith and Morgan 1994) • *Latin American left-wing radicals* in late 1960s were mostly graduates of law, humanities, and medicine (Russell and Hildner 1971) • Members of the *Japanese Red Army* were mostly university students or graduates and mostly from liberal arts fields, with only very few medical doctors or students and one physicist (Patricia Steinhoff, personal communication). • No example of engineers found anywhere outside of Islamic world (Russell and Hildner, Smith and Morgan, Jäger et al., von Bayer-Katte et al., survey of dozens of websites).
Separatists	• There is no evidence of the presence of engineers. *IRA members* took humanities courses when studying in prison.** Graduates of all kind were a tiny minority. • Among 1117 cases of *ETA members* only 1.8 per cent were university graduates and 2 per cent were university students (Domínguez Iribarren 1998: 47, cited in Smith 2005).
Nazis	Engineers were strongly present in the Nazi party even early on, but no more than people with other degrees (Herf 1984: 197-8), and they were not over-represented in the Nazi leadership.
Fascists	• In Roberto Franzosi's database, constructed using newspapers from 1919 until 1923 and tracking all reported violent episodes, there is reference to some 10,703 fascists; among them only four were reported as engineers (personal communication). • "In 1935, out of a sample of 93 *federali*, 39 had no university degree, 25 described themselves as dottori without giving details, 5 were accountants and 4 engineers. There were only 5 professors and 15 lawyers; these professions had provided about half of the deputies in the pre-Fascist parliament" (Lyttelton 1973: 305-6).
Post WWII Right wing extremists	• A survey of three *German right wing parties* yields a presence of some engineers, but no over-representation compared to the share of engineers among German graduates (federal and state-level websites of Nationaldemokratische Partei Deutschlands, Republikaner and Deutsche Volksunion) • Among 287 *right-wing extremists and neo-Nazis* in Germany and Austria, we found 29 individuals with known higher education, involved in 33 groups, 6 of whom were engineers. • Among seven educated *leaders of US extreme right-wing* groups whose degree or occupation we could establish, three were educated as engineers and another one worked in the electronics industry (Smith and Morgan 1994; web surveys) • Among the technocrats surrounding Pinochet, engineers featured prominently, even among the 'Chicago Boys' who are generally believed to have been only economists (Huneeus 2000).
Jewish Under-ground	The 27 individuals involved in this extremist Israeli group active in the early 1980s were overwhelmingly well educated, in high paying occupations and very religious. They included teachers, writers, university students, geographers, a combat pilot, a chemist, a computer programmer, and two engineers (Krueger and Maleckova 2003: 137)

* Survey of biographies on <http://ytak.club.fr/index.html>

**James Spencer, personal communication, July 2006

Still, despite some presence among extreme right-wing movements, regarding the strength of over-representation across different groups and countries, the case of the *Islamic* radical engineers stands out.

As a final step to establish the limits of the phenomenon, however, we need to ask a narrower question to control not for ideology but for country conditions: do engineers have a propensity to become radicalized not in general but in *Islamic* countries in particular? Could there be something about these countries that might explain the radicalization of engineers? If this were the case we should find that engineers in Islamic countries are prominent also in radical groups other than the Islamic ones.

We searched in the biographies of 223 Palestinian political leaders active from 1967, 205 of whom had some affiliation to *non*-Islamic militant groups.[36] At least 101 of these had higher education; among the 93 cases in which the subject is reported, we found 16 doctors, 14 trained in economics or business-related subjects, 10 lawyers and 10 engineers – among them Yasir Arafat who studied civil engineering in Cairo. So, unlike in left-wing groups outside of the Islamic world, engineers are present among *non-Islamic* Palestinian groups, though they are not over-represented (cf. also Russell and Miller 1977: 28). In Egypt, the picture is mixed: the engineering syndicate with few exceptions was not politically mobilized in the 1970s when leftist opposition dominated (Wickham 2002: 188).[37] At the same time, however, the Cairo University engineering faculty was then regarded as "fortress of the left" (ibid: p.116)

[36] The other 18 cases had clear Islamist affiliations; Glen Rangwala has compiled the biographies, online at http://middleeastreference.org.uk/palbiograph.html (accessed October 2006).

[37] Wickham (2002) explains this with tighter state control and state-dependence of engineers – it is however unclear why these factors did not prevent later politicization.

and engineering students were at the forefront of 1970s student activism (Moore 1994: 208).[38]

Evidence from non-Arab Middle Eastern countries is clearer. In their survey of 350 individuals members of eighteen groups of urban left-wing revolutionaries in ten countries around the world Russell and Miller (1977) found that engineers were never a significant presence with two striking exceptions: only the Iranian and Turkish groups had a high proportion of engineers, and Iran and Turkey were the *only* Islamic countries in their survey. The leftist Turkish People's Liberation Army was founded at a technical university.[39] During the Iranian revolution, while engineering students were prominent among radical Islamists, and the Islamic wing of the national movement had many more engineers than the secular one (Chehabi 1990: 89), the students of the Polytechnic University had radical leftist leanings.[40] Engineers also featured prominently among the Mojahedin E-Khalk, a violent Islamo-Marxist hybrid (Abrahamian 1989: 229f.). Engineering students have generally played a strong role in Iranian politics during the last half century, not limited to one ideology (Chehabi 1990: 89f., 113, 120f.).

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[38] There is anecdotal evidence pointing to some degree of 'continuity of style' between Marxist groups and Islamists. In the episode we mentioned at the beginning, when Zawahiri boasted to Schleifer about the medical and engineering students in his group

> Schleifer replied that in the sixties those same faculties had been strongholds of the Marxist youth. The Islamist movement, he observed, was merely the latest trend in student rebellions. "I patronized him," Schleifer remembers. "I said, 'Listen, Ayman, I'm an ex-Marxist. When you talk, I feel like I'm back in the Party. I don't feel as if I'm with a traditional Muslim.'" He was well bred and polite, and we parted on a friendly note. But I think he was puzzled (Wright 2002).

39 MIPT Terrorism Knowledge Base <www.tkb.org/Group.jsp?groupID=4293> (accessed October 2006).

[40] Farideh Farhi, personal communication, July 2006.

While not disproportionately radical everywhere and all of the time in the Islamic world, radical engineers have not been prominent only in Islamist extremist activities, but also in left-wing groups at a time when these were considered, by revolutionarily inclined youth worldwide, as the best means to change the world. Although their presence among the latter is not as strong as among the Islamists, the mere fact that we find some is remarkable given that in non-Islamic countries they do not register at all among left-wing extremist groups.

Summary of findings

The puzzle from which we started appears to be confirmed: engineers are indeed overrepresented among violent Islamic radicals by two to four times the size we would expect. We also have a rich set of collateral findings, summarized in tables 13 and 14, which reveal variations in the presence of graduates and engineers among various groups of extremists by country, ideology and degree. These findings will at once aid and constrain our attempt at finding an explanation to our fundamental puzzle.

Table 13: Overrepresentation of university-educated individuals, engineers and OEDs in radical Islamic groups.

Country	Type of group	University educ.	Engineers	OEDs
MENA	Violent Islamists	Yes	Yes	No
	Non-violent Islamists	Yes	Yes	Yes
S. Arabia	Violent Islamists	Yes	No	None
South East Asia		No	Yes	No
Western		No	Yes	No

First, with the exception of Western and Singaporean groups, we found that university students and graduates, especially from elite degrees, are vastly over-represented

among Islamic radicals everywhere. This provides the first wide-ranging systematic confirmation that the core of the Islamic movement emerged from discontented would-be elites. Furthermore, it reveals that in the West Islamic radicalism is attracting a set of individuals with a much lower educational profile. Yet, despite the lower proportion of graduates and the larger proportion of drifters, converts and professionally unaccomplished individuals, the overrepresentation of engineers occurs not only throughout the Islamic world but even among Western-based extremists. In other words, while the overrepresentation of university educated individuals among Islamic extremists varies by country, the engineering overrepresentation seems insensitive to country variations. The only exception to the engineering phenomenon is Saudi Arabia, where engineers are only weakly present among extremists. Finally, across the divide between violent and peaceful Islamic groups we found that while engineers are overrepresented in both, OEDs are much more strongly represented among the latter. Islamism seems to be appealing to both but engineers seem much more prone to take the step to violence.

Table 14: Presence of university-educated individuals, engineers and scientists in non-Islamic radical groups (++ = strong, + = some).

Country	Type of group	University educ.	Engineers
Worldwide	Anarchists	+	+
Europe – US	Left wing extremists	++	No
Japan		++	No
Turkey – Iran		++	++
N.Irel.- Spain	Separatists	No	No
Germany	Nazis	+	+
Italy	Fascists	+	+
Europe - US	Right wing extremists	+	++
Israel		++	+
Japan		++	+

Next, if we consider the variations in the presence of engineers among non-Islamic extremists according to their ideology we find virtually no engineers on the left – in Europe, US, Japan and Latin America – even in those groups in which highly educated individuals are predominant. Only in Palestine, Iran and Turkey there was a significant presence of engineers among violent left-wing radicals in the 1970s. On the right of the political spectrum, by contrast, while not overrepresented, engineers are present in groups of various kinds all over the world – with the possible exception of the leaders of ultra right-wing groups in the US, the majority of whom are engineers even though the rank and files appear to have little or no education. In this regard the profile of these groups resembles that of the Western-based Islamists, in which a small core of technically educated joins forces with various maladjusted individuals.

How can we explain the over-representation of engineers?

The vast majority of engineers in Islamic countries did *not* join violent movements, and our account does not aim to explain why certain engineers rather than others became radicalized. The experiential trajectories of the individuals as well as their links with the 'right' networks must intervene to single out the tiny subset of individuals who ended up in violent movements. Our goal is more modest: in what follows we will try to explain only why engineers became *more* radicalized than people with other degrees. The paucity of detailed ethnographies or biographical data and the widely acknowledged difficulty in finding a consistent socio-demographic 'profile' of Islamic extremists makes this apparently limited puzzle one of the very few individual-level regularities we can use to gain deeper access to processes of

radicalization.[41] While not attempting to develop a general theory of the emergence of violent Islamic movements, let alone of the broader phenomenon represented by the growth of the Islamic fundamentalist ideology, we claim that understanding their educational composition offers a benchmark against which to test the strength of the several macro and meso explanations that have been put forward.

We will first argue that two hypotheses – random appearance of engineers as first-movers followed by diffusion through their network and the selection of engineers because of their technical skills – while plausible in theory do not survive close scrutiny. Next we will present evidence supporting two other hypotheses – engineers' peculiar cognitive traits and dispositions and the special social difficulties faced by engineers in Islamic countries. Our argument is that the pattern of results can be best explained by the interaction between these two forces. While we will not be able to provide definitive proof, which would require individual data at a level of detail that at present no scholar can easily hope to obtain, we will present the narrative that most plausibly fits our findings.

[41] A stark example of the uselessness of conventional profiling is that the German authorities after 9/11 collected and analyzed data on over 8 million individuals, whittling them down first to 32,000 and then to 1,689 on the basis of a set of demographic characteristics (male, 18-40 years old, current or former student, Islamic, legal resident in Germany, and originating from one of a list of 26 Muslim countries) and of their "relevant knowledge to carrying out a terrorist attack" (such as a pilot licence) and "familiarity with places that could constitute possible terrorist targets" (such as working in "airports, nuclear power plants, chemical plants, the rail service, laboratories and other research institutes, and also students of German language at the Goethe Institutes"). The 1,689 were investigated one by one but none of them was found to be nurturing terrorist plots. Others who were arrested by contrast did not fit the profile (Capoccia, forthcoming).

Random appearance and network diffusion

The engineering phenomenon could be explained by a historical accident and its 'natural' consequences, with no deeper meaning: illegal groups are set up in a clandestine fashion and their existence is advertised along networks of pre-existing social bonds. Their opportunities for expansion are constrained within circles of friends, colleagues and kin. If the prime movers were, even accidentally, engineering students or graduates, their network would be more likely to expand within the faculty in which they work and socialize, among like-minded people with whom they interact on a daily basis. Whether for recruits or recruiters, the opportunities follow networks lines.

This might indeed be true for the early Egyptian groups in which, as Ibrahim wrote, "three recruitment mechanisms were employed: kinship, friendship and worship" (1980: 437f). However, the more we find engineers to be over-represented in different countries and different networks the less likely it is that their presence is due to a historical contingency. Even in the most restrictive interpretation, our main sample of jihadists contains four clusters – North Africans, South East Asians, Palestinians and core Arabs – which grew independently of each other, and engineers are strongly present in all of them.[42] And although we could not include Lashkar e-Toiba's members in our sample because of a dearth of information, the two founders represent a further case of engineers as prime movers in yet another part of the world. Finally, we find that engineers are overrepresented among the Western based extremists too,

[42] The idea that the technically educated were better able at connecting with each other via the Internet and thus likely to form a virtual community (Abuza 2006: 79-80) does not apply to the individuals in our sample who largely radicalised before the Internet became widely available. For example, as late as 1998, only 4 per cent of UK households had an internet connection.

scattered over several unconnected groups. All the clusters that we considered in our various samples are mixed with respect to occupation as well as level and type of education, indicating that school and university networks were not what brought these individuals together. In only one case, the plot to attack the Stade de France Saint-Denis planned for the 6th of October 2001, all five members of the cell were professionally connected and "had in common having a university degree in mathematics, chemistry and electronics" (*Reuters*, 9 October 2003, *Agence France Presse*, 18 March 2002).

Moreover, in broad-based movements such as Hamas, network effects should become less important with the growing scale of mobilization. Also, mosques and radical preachers – often the focus of initial radicalization and recruitment – are loci which should cross-cut faculties. In so far as places of worship worked as engineers' recruitment vehicles it must mean that engineers were already attracted by them. Network ties cannot explain why certain networks radicalize while others do not, or why certain individuals in a network radicalize first while others leave the network once it radicalizes. All that network effects can explain is why individuals who lacked the 'right' network ties failed to radicalize even if they otherwise had a predisposition to do so.[43] Still, this does not imply that the *size* of the engineering contingent within each independent cluster is unaffected by network effects – it very probably is. What

[43] Sageman (2004), who makes the strongest case for pre-existing network ties to explain the expansion of salafi jihadists in general, claims that "in-group love" more than "out-group hate" (p.136) drove these movements, and that "social bonds came first, and ideology followed" (p. 133). To know the real effect of networks on radicalisation however we would need a stringent test, namely to know how many of those who had network ties with individuals or groups that *subsequently* radicalised *failed* to radicalize and left or remained at the margin of their groups. The fewer the people who left the stronger the network effects would be. But in the absence of this crucial data we cannot know.

we cannot explain by network effects are both the engineers who became prime movers and their greater willingness to stay in or join a radical network.

Selection based on technical skills

If the appearance of engineers is not a random event, something about engineers themselves or their social position in Islamic countries must explain their greater proneness to radicalization. Recruitment based on their technical skills is an obvious candidate – colleagues often 'knee-jerkily' mention this when first told about our puzzle. Technical knowledge can help in creating and handling the tools of violence as well as in maintaining clandestine communications.[44] The "master bomb maker" of the 2004 and 2005 Bali bombings, Azhari Husin, was capable of assembling sophisticated explosive devices – and trained as an engineer (*International Herald Tribune*, 2 July 2006). Technical skills appear to be highly valued in some groups: on Hamas websites, for example, admiring references to bomb-building and technical skills of activists abound, and "engineer" is used as an honorific title. Yahya Ayyash, Hamas' famous bomb-builder, killed by the Israelis in 1996, was trained in electrical engineering. He was known as "the Engineer" (al-Muhandis) in the movement.

Could it be that violent groups are deliberately recruiting individuals with technical education for those purposes, or that individuals with those skills have a comparative advantage that makes them more inclined to form or join radical groups? This might be true with respect to the *internal* allocation of tasks for specific operations – three of the four 9/11 pilots for example were engineers. However, several facts suggest that this explanation does not really work for recruitment in general.

[44] Bergen and Pandey (2006) refer to this hypothesis to explain the strong presence of technically educated in their sample.

First, we have found no evidence at all of recruits being selected by technical skills. Personal trust seems a more important criterion in the formation of, for example, al-Qaeda cells (Sageman 2004: 92) – something which would reinforce network effects. Bomb-making is usually performed by a few specialists, which would leave the high share of engineers among many organizations unexplained. That engineers are mainly sought for their ability to fill technical roles is also refuted by the case of Hamas where many engineers are prominent in senior management positions with no technical function (while many Hamas suicide bombers pursued religious degrees, Pedahzur 2005). If Hamas leaders are selected on skills, these are unlikely to be technical ones.

Next, the technology involved in most violent attacks has been relatively simple and did not require great expertise. It is much harder to obtain good quality explosives than put them to use. It is furthermore unclear how much 'hands-on' knowledge engineering studies confer. Electricians, mechanics or ex army officers might be just as good at building bombs. Lastly, it is doubtful that violent movements with a larger share of engineers have mustered a greater destructive power than groups without. Consider, for instance, the Saudi insurgency, which mounted devastating bomb attacks in 2003 and 2004; or the LTTE in Sri Lanka, the IRA and ETA separatist movements, whose members have come largely from among the poorly educated and the working class.

Selection (and self-selection) based on cognitive and character traits

The absence of selection driven by technical skills does not of course imply a lack of any selection criteria. The "constitution" of al-Qaeda from the late 1980s says that members should ideally have a college degree (Wright 2006: 142), and a training manual for jihadists mentions a series of specific traits that recruiters seek: "psychological, mental and intellectual fitness" (p.17), "discipline and obedience, patience, intelligence" (p.18), "caution and prudence" (p.19), and ability "to observe and analyze" (p.20).[45] Ayman al-Zawahiri in his memoirs wrote that al-Jihad aimed at recruiting members with a firm adherence to Islamic principles and likely to be perseverant, patient, and steadfast:

> Hence comes the importance of the issue of leadership in Islamic action in general and jihad action in particular and the nation's need for a scientific, struggling, and *rational* leadership that could guide the nation, amidst the mighty storms and hurricanes, toward its goal with awareness and *prudence*, without losing sight of its path, stumbling aimlessly, or reversing its course (al-Zawahiri 2001, quoted in Smith et al. 2005, our emphasis).

According to a British intelligence dossier (*The Sunday Times*, 10 July 2005),[46] Islamic "extremists are known to target schools and colleges where young people may be very *inquisitive* but *less challenging* and more susceptible to extremist

[45] The 140 pages long document, entitled "Military Studies in the Jihad against the Tyrants", was found during a police raid on the apartment of Nazih-Wadih Raghie, in Manchester on 10 May 2000. It was used in court in the trial, held in New York from January to May 2001, against four men charged in the bombing of two American embassies in East Africa in 1998. The document is identified in the trial files as "Government Exhibit 1677". Date and author are unknown.

[46] This was prepared jointly by the Foreign and Home Office for Tony Blair following the Madrid bombings in March 2004 and leaked to *The Sunday Times*.

reasoning/arguments" (*The Sunday Times*, 10 July 2005, our emphasis). The dossier's choice of adjectives is interesting: we can find people who are inquisitive *and* challenging or supine *and* unchallenging, but the combination of a sharp mind with a loyal acceptance of authority – of rationality and prudence as al-Zawahiri wrote – may exist among accountants, but is unlikely to be common among those ready to choose extreme paths.

Could the traits that recruiters seek be more frequent among engineers? The British intelligence dossier further states that "a network of 'extremist recruiters' is circulating on campuses targeting people with 'technical and professional qualifications', particularly engineering and IT degrees."[47] And, in a different part of the world, "Jemaah Islamiyah has actively recruited in leading technical institutes, including the University of Technology of Malaysia, Universitas Semerang, and Bandung Institute of Technology" (Abuza 2006: 78).

We could thus hypothesise that personal dispositions and style of thinking among engineers differ from those of students in other subjects in ways that could make them more prone to become involved in violent forms of radicalisation, not just as willing recruits but as prime movers. Two of our findings, while not a proof, are compatible with the 'mindset' hypothesis and the targeted recruitment that might exploit it. First, even among Western-based jihadists, among whom there are very few graduates, 60 per cent are engineers. In Singapore moreover, where conditions are very different from the MENA region, Islamic extremists seem to have a profile similar to that of the Western sample with fewer graduates and more disenfranchised men among their

[47] The dossier is online at: www.timesonline.co.uk/tol/news/uk/article542420.ece (accessed in October 2006).

ranks, and yet engineers are still dominant. This suggests that even when no other graduates are attracted to Islamism some engineers still are. More generally, while the overrepresentation of university educated individuals among Islamic extremists varies by country, the engineering overrepresentation seems insensitive to country variations, as if indifferent to social conditions. Second, even though OEDs too are robustly present among non-violent Islamic groups in Islamic countries, only the engineers seem to go a step further forming or joining violent groups. There may of course be factors other than the mindset that distinguish engineers from other graduates (see below). Yet, as we argue in what follows, mindset alone distinguishes engineers in a striking fashion.

The mindset hypothesis predicts that we should find engineers to have (i) more extreme ideological tendencies than people in other disciplines, and (ii) a greater predilection towards joining radical political groups in general. If engineers really do have a special mindset these predictions should be verifiable independently of Islamism. Our findings concerning non-Islamic extremists show that, to some extent, (ii) is the case, but with respect to right-wing groups only. If engineers radicalise, they do so on the right of the political spectrum, not on the left. If their mindset explains this divide, then it would imply that they are inclined towards pursuing radical change only if this is aimed at establishing a strong social order. Italian engineers were attracted by Fascism's corporate ideology and vigorously supported Mussolini's regime (Tacchi 1994), and German engineers gave their enthusiastic backing to Fritz Todt, the man who re-organised the engineers of the Third Reich and whose ideology combined rapid technological progress with a reactionary worldview (Herf 1984: 199-201). Without their unconditional collaboration it is inconceivable that Germany could have become a military-industrial

giant in less than a decade. Might a distinctive view of politics and society have affinity with the engineering mentality?

Political opinions of engineers

We searched for evidence to test prediction (i), namely the distinctiveness of engineers' political-ideological orientation. The best data we could find in this regard comes from a survey of faculty members in undergraduate colleges and universities throughout the United States carried out in 1984 by the Opinion Research Corporation, at the behest of the Carnegie Foundation for the Advancement of Teaching (Carnegie Foundation 1984). Of the 9,968 faculty sampled 5,057 (50.7 %) returned completed mail questionnaires. We selected the males and looked at their self-reported political and religious views according to whether their highest degree was in engineering, economics and business, medicine, natural sciences, art and humanities, social sciences, and law. We left out the small or heterogeneous subjects.[48]

[48] Subjects we included in the degree categories are the following. *Engineering*: Aeronautical/Astronautical, Chemical, Civil, Electrical, Mechanical, general/other. *Natural Sciences*: Chemistry, Physics, Earth Sciences (incl. Geology), general/other physical sciences; Biology, Bacteriology, Molecular Biology, Virology, Microbiology, Botany, Biochemistry, Physiology and Anatomy, Zoology, general/other biological sciences; *Medicine*: Medicine, Dentistry, Nursing, other health-related fields. *Economics*: Economics, Business Management and Commerce. *Social Sciences*: Anthropology, Archaeology, Political Science and Government, Sociology, Social Work, Psychology, Geography, Home Economics, other social sciences. *Arts* and *Humanities*: Art, Dramatics and Speech, Music, other fine arts; English Language and Literature, French, German, Spanish, other foreign languages, History, Philosophy, general/other humanities. *Not included (*774 cases): Education, Religion and Theology, Physical Education, Library Science, Journalism, Industrial Arts, Vocational/Technical, Home Economics, Agriculture and Forestry, Design, All other fields.

Table 15: Percentage distributions of self-reported political views by highest degree achieved, males only

	Left	Liberal	Middle of the road	Moderately conservative	Strongly conservative	Total
Engineering	1.4	20.3	20.7	41.9	15.7	100 (217)
Economics & Business	2.1	15.3	31.5	40.0	11.1	100 (235)
Medicine	5.2	27.9	24.4	37.8	4.7	100 (172)
Natural Sciences	3.6	34.4	28.63	30.0	3.5	100 (751)
Law	16.7	36.1	22.2	25.0	0.0	100 (36)
Arts & humanities	8.8	41.8	28.0	18.7	2.7	100 (679)
Social sciences	12.9	49.7	18.8	15.0	3.6	100 (394)
Total	6.5 (161)	35.4 (879)	26.1 (648)	27.0 (670)	5.1 (126)	100.0 (2484)

Source: our elaboration on Carnegie Foundation National Survey of Higher Education 1984

The results are startling (Table 15). The proportion of engineers who declare themselves to be on the right of the political spectrum is greater than in any other disciplinary group: 57.6 per cent of them are either conservative or strongly conservative, as compared to 51.1 of economists, 42.5 of doctors and 33.5 per cent of scientists, 21.4 per cent of those in the humanities, and 18.6 per cent of the social scientists, the least right-wing of all disciplinary groups. Engineers are also one and a half to 16 times more likely to be “strongly conservative” than those in other subjects, and only 1.4 per cent of them are on the left, as opposed to 12.9 per cent in the social sciences and 16.7 in law. By what seems like an uncanny coincidence, the four fields at the top of the conservatism scale – engineering, economics, medicine, and science – are the same four secular fields we found at the top of our main jihadist sample.

This finding is not new. In an article in *Science*, Ladd and Lipset (1972) uncovered the same result using an earlier and much larger survey of the Carnegie Foundation on

American academics carried out in 1969. They also report other evidence of engineers' uniquely pronounced right-wing propensity: they were disproportionately Republicans and voted disproportionately for Nixon, the only academics to do so more than the average population.[49] They were also the strongest supporters of both the Vietnam war and of classified weapons research on campus. "No other variable, we have found, differentiates politically among American academics as effectively as their professional field" (1972: 1091).

One might wonder whether this right wing propensity has anything to do with our puzzle. First, one may question whether this mindset is unique to *academic* engineers. The answer is likely to be negative: Ladd and Lipset (1975) also calculated the political opinions of students rather than academics by degree. And again it is clear that engineering students are more conservative than students in any other subject. This obtains for both 'un-socialised' students in the first four semesters as it does for those in subsequent semesters (Ladd and Lipset 1975: 74-5; see also Table 17 below).

Next, one may question whether the phenomenon is uniquely *American*. Some old evidence suggests that the same right-wing bias occurs in the Middle East: a 1948 survey of 3890 Cairo University students recorded the highest sympathies for fascist ideology among engineering students – 9 per cent, followed by 7 per cent among science students and 5 per cent among agriculture and medicine students (Botman 1984: 70).[50] A survey of Canadian professors also found that engineers are the least liberal of all (Nakhaie and Brym

[49] There are more engineers among Republicans in Congress than among Democrats also in more recent times (Amass 2004).The same source reports that, in a sample of 900 NYU psychology students, those with conservative views were much more likely to consider engineering as an enjoyable profession.

[50] Scientists have also the highest share of individuals with no political affiliation (12%) while engineers have the lowest (3%).

1999). We shall return to this question below, after considering engineers' religious attitudes.

Their mindset may explain why we find engineers among right-wing extremists and virtually none among left-wing ones, but why should it help us to explain their attraction to *Islamism*? A plausible answer is that the Islamists' *Weltanschauung* shares several features with the worldviews found in the extreme right. One such feature is a corporatist and mechanistic view of the ideal society. Reinhard Schulze has detected a "cybernetic view of society" in modern Islamism (1990: 22), which aims at preserving integrity in the social order. Extremist Islamist literature rejects Western pluralism and argues for a unified, ordered society ruled by a strong Islamic leader, in which an authoritative division of labour is created between men and women, Muslims and non-Muslims, political leaders and their flock. The fear of social chaos is a leitmotif of Islamist thought (Hoffman 1995: 218f.).

Furthermore, the characteristics which Lipset and Raab (1971) consider as defining of right-wing extremism map out near-perfectly on those of Islamic extremism. One, which they call "monism", is "the tendency to treat cleavage and ambivalence as illegitimate (…) the repression of difference and dissent, the closing down of the market place of ideas" (p.6).[51] A second feature, "simplism", is the "unambiguous ascription of single causes and remedies for multifactored phenomena" (p.7), which in turn is closely related

[51] Sageman speculates that al-Qaeda members were individuals looking for easy truths, attracted by "unambiguous" fields like engineering or medicine, where there is little room for uncertainty (2004: 116).

to seeing history as shaped by the clash between good and evil, and conspiratorially ascribing the forces of evil to one identifiable foe.[52]

While monism and simplism may be shared by left-wing extremism, the last feature, which Lipset and Raab call "preservatism", is typical only of the right. Unlike left-wing extremism which aims at broadening the lines of power and privilege, preservatism aims to restore a lost, often mythical order of privileges and authority, and, in the authors' view, emerges as a backlash against displacement or status deprivation in a period of sharp social change. Preservatism does not appear in just one guise: depending on circumstances it emerges as anti-state or pro-state, as individualism or collectivism. But in its underlying craving for a lost order, its match with the radical Islamic ideology is undeniable: the theme of returning to the order of the prophet's early community is omnipresent in most salafist and jihadist ideology.

In her detailed ethnography, Nilufer Göle found evidence of the above ideological features among *Islamist* engineers in Turkey: she shows that they entertain a strong

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[52] In early September 2007 Iranian president Mahmoud Ahmadinejad – one of the country's most radical politicians with a PhD on transport engineering from Teheran's Science and Technology University and the author several of scientific papers – delivered a speech to Iranian academics, which exudes those features to such an extent that we cannot resist quoting him at length:

> In some discussions I told them [those inside Iran pressing for compromise over fears the United States could launch a military strike because of the nuclear standoff with the West]: "I am an engineer and I am examining the issue. They do not dare wage war against us and I base this on a double proof'" […] [First] I tell them: "I am an engineer and I am a master in calculation and tabulation. I draw up tables. For hours, I write out different hypotheses. I reject, I reason. I reason with planning and I make a conclusion. They cannot make problems for Iran." [Second] "I believe in what God says. God says that those who walk in the path of righteousness will be victorious. What reason can you have for believing God will not keep this promise?" (AFP, 3 September 2007).

belief in the superiority of logical and technical approaches towards societal issues, and see themselves as problem solvers, as "social engineers", superior to the Kemalist elite of jurists preoccupied with debates on abstract ideas (1990: 172f.). They assume to know the "one best way" of improving society, and feel therefore entitled to speak in the interests of all (Göle 1990: 174). According to Olivier Roy, Islamist intellectuals, many of whom he says have a technical or scientific education, criticize the "messy" Western social sciences because they challenge the unity and divine order of the world, while, by contrast, the sciences, pure and applied, reflect the "the coherence of the whole, the rationality of the one [God]" (Roy 1992: 271; Hanafi 1997: 148).[53] In line with "simplism", modern radical Islamism often has little truck with the nuance and ambiguity of established Islamic theology (Roy 1990, 2004).[54] When Bernard Haykel asked the engineers and scientists among the numerous fundamentalist Islamists he interviewed what it was about Salafi thought that appealed to them, they pointed to its intellectually clean, unambiguous and all-encompassing nature (personal communication, September 2007).

Whether American, Canadian or Islamic, and whether due to selection or field socialisation, a disproportionate share of engineers seems to have a mindset that inclines them to entertain the quintessential right-wing features of "monism" – 'why argue when there is *one* best solution' – and of "simplism" – 'if only people were rational, remedies would be simple'.

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[53] In Jordan, politically organized engineers use the ideological language of a "scientific" vanguard rather than dealing with concrete – and possibly messier – policy issues, as doctors do (Longuenesse 2000: 28f.).

[54] It has also been suggested that the mechanistic, unquestioning way in which engineering is taught in the Middle East nowadays has a special affinity to scripturalist versions of Islam (Henry 1994: 216).

Religiosity of engineers

The Carnegie survey reveals an even more surprising fact, hitherto unnoticed,[55] that strengthens the suspicion that the engineers' mindset plays a part in their proneness not only to radicalise to the right of the political spectrum but do so *with a religious slant*: engineers turn out to be by far the most religious group of all academics – 66.5 per cent, followed again by 61.7 in economics, 49.9 in sciences, 48.8 per cent of social scientists, 46.3 of doctors and 44.1 per cent of lawyers, the most sceptical of the lot. Engineers and economists are also those who oppose religion least (3.7% and 3.0%), and, together with the humanities, those who more strongly embrace it (Table 16).

Table 16: Percentage distributions of self-reported views on religion by highest degree achieved, males only

	Opposing religion	Indifferent to religion	Moderately religious	Deeply religious	Total
Engineering	3.7	29.8	51.6	14.9	100 (215)
Economics & Business	3.0	35.3	47.2	14.5	100 (235)
Natural Sciences	11.8	38.3	37.3	12.6	100 (747)
Arts & Humanities	7.5	34.6	42.8	15.2	100 (683)
Social sciences	9.3	41.9	41.7	7.1	100 (396)
Medicine	6.2	47.5	35.6	10.7	100 (177)
Law	5.9	50.0	35.3	8.8	100 (34)
Total	8.2 (204)	37.6 (936)	41.5 (1033)	12.6 (314)	100 (2487)

Source: our elaboration on Carnegie Foundation National Survey of Higher Education 1984

[55] Stark, Iannaccone, and Finke (1996; 1998) use an earlier Carnegie Survey and show that "mathematicians and scientists" are the most religious of all scholarly fields, but do not give separate data for engineering. Cf. however the online debates on the so called "Salem Hypothesis" (named after Bruce Salem), "a name for a correlation that has been observed amongst scientists, between subscribing to creationism and working in an engineering discipline." http://richarddawkins.net/article,774,The-Salem-Hypothesis,Bruce-Salem; http://sandwalk.blogspot.com/2007/03/salem-conjecture.html (accessed May 2007).

The gap between engineering and the other disciplines shows even more clearly if we consider political and religious views jointly (Table 17, first column): nearly half of the engineers in the sample are both conservative *and* religious (46%), followed by economists and, at quite some distance, by doctors and scientists. Engineers are four times more religious and conservative than social scientists (11.0), and three times more so than people in the arts and humanities (14.3%). The subjects at the top of the religious-conservative scale are, once again, exactly the same we have in our jihadist sample.

Table 17: Proportions of subjects who are both conservative and religious as opposed to anything else, among academics, graduates and undergraduates, males only*

	Academics N = 2456	Graduates N = 18241	Undergraduates * N = 25377
Engineering	46.0 (99)	27.2 (833)	16.5 (641)
Economics & Business	34.6 (80)	25.5 (768)	14.3 (545)
Medicine	24.9 (43)	22.3 (417)	--
Sciences	21.8 (161)	18.0 (760)	12.9 (846)
Arts & Humanities	14.6 (98)	11.0 (260)	9.4 (551)
Law	14.3 (5)	13.1 (199)	--
Social sciences	11.0 (43)	8.6 (187)	6.3 (332)

Source: our elaboration on two Carnegie Foundation National Surveys of Higher Education, 1984 for academics and 1969 for graduates and undergraduates.
*Medicine and law are not included for these subjects are not available at undergraduate level in the US

We also tested the effect of the various university degrees on the probability of being both conservative *and* religious through a logistic regression, which allowed us to control for other variables (Table 18): relative to being a social scientist, the base category, being a scientist or doctor, an economist or an engineer have all strong and significant positive effects. The strongest of all by far is associated to being an

engineer: the odds of being both religious *and* conservative rather than anything else are *seven* times greater for engineers relative to the odds of a social scientist.[56]

Table 18: Probability of being both conservative *and* religious, logistic regression coefficients, males only (N= 2365)

	Coefficients	Significance	Exponentials
Age in years	.019	.001	1.019
Married	.291	.089	1.338
Children	-.017	.983	.983
Engineer	1.953	.000	7.053
Economist	1.443	.000	4.233
Scientist & doctor	.811	.000	2.251
Lawyer	.345	.540	1.411
Art & humanities	.208	.305	1.231
Excellent department	.350	.008	1.419
Not published last 2 years	.401	.003	1.493
Not expecting publications	.504	.000	1.655
Constant	-2.585	.000	.075

-2 Log likelihood ratio 2196.939
R square (Cox & Snell) .093

Finally, using the much larger Carnegie survey of 1969 which included thousands of students, we were also able to calculate the proportions of individuals, among graduates and undergraduates, who are conservative *and* religious by their university degree (Table 17, columns 2 and 3).[57] While the proportions are lower than among academics the ranking is exactly the same, with engineers firmly at the top. Since

[56] To make this assertion we use the exponentials, which measure how many times being in the position expressed by the independent variable modifies the odds of being religious and conservative relative to the odds of being anything else. This is a simpler way of translating the effects measured by a logistic regression into understandable prose than using percentage variations; since the logistic function is non linear, percentage variations change according to the point in the logistic curve where one measures them, while odd ratios do not.

[57] The date of this survey can be obtained at ICPSR, at the University of Michigan, www.icpsr.umich.edu/.

students, especially undergraduates, are not a selected group as academics are, this is a strong indication that the more religious and right wing political orientations are not limited to academics, but extend to people with an engineering degree generally. These findings make a strong case for the existence of a distinctive engineering mindset.

How universal is the mindset?

The data we used so far on both political and religious attitudes concerns only the US, so we do not know whether this combination of traits is found also among engineers in other countries. Engineering programs are probably similar all over the world, yet who gets selected into them might vary from country to country: social position and prestige of engineering could differ, as could the broader socio-political context that drives specific constituencies to opt for engineering degrees. Unfortunately, there is a surprising dearth of data on political or religious orientations by type of degree. In the many surveys around the world which we checked, the type of degree is not recorded; and in the very few cases in which it is, the number of graduates is either too small or opinions are not recorded. We have however been able to assemble some data of lesser quality on non-US countries which indicate that engineers disproportionately combine religiousness and a conservative ideology elsewhere too.

The data are from the International Social Survey Programme, a series of annual cross-national opinion surveys on samples of the general population, in which each year is focused on a different social and political topic. We chose the ISSP surveys of 1998, the most recent set to focus on religion and to include also information on the location of respondents on the left-right political spectrum, thus allowing us to

analyse jointly political and religious attitudes.[58] The surveys do not include the type of degree, so to identify the 'engineers' we had to rely on occupation. We included all occupations that either had "engineer" in their title or were clearly of an engineering nature according to our understanding, such as for instance town planners, metallurgists or computing systems designers. This is an imperfect solution that blurs the borders of our target group: on the one hand, among 'engineers' it includes cases of non-engineering graduates – such as physicists or other scientists – who work in an engineering occupation; and, on the other, it excludes all the engineers who work in other positions, many of them managerial. For this reason, we also coded all managerial positions as a separate category. The two remaining categories are all other occupations and those individuals who did not answer, refused to answer or to whom the question concerning occupation was not applicable.

We excluded the US for we wanted to test whether the phenomenon holds elsewhere, and included 16 mostly developed countries,[59] for which the ISSP surveys provided

[58] The 1991 ISSP surveys were also aimed at religiosity and contained information on political attitudes, but they turned out to contain too few cases (962) to produce statistically significant results. The 1991 data are not strictly commensurable with the 1998 surveys, so we decided not to merge the two. The questions on religion in 1991 were phrased and answers coded differently, and the location on the political spectrum was derived from voting preference, not from a subjective self-assessment on a left-right scale as in 1998. Moreover, a different set of countries qualified for inclusion and occupational classifications differed strongly from country to country, whereas in 1998 they were standardized according to the 1988 ISCO classification. All results from 1991, however, even if statistically insignificant, point in the same direction as the results from the 1998 survey.

[59] We decided to exclude post-communist countries due to the specific historical circumstances of the engineering profession in the transition from technocratic socialism to market economy. If included in the sample, we reach similar results as those described below, but with lower or no significance. By themselves, post-communist countries yield too low cases numbers (834 altogether in 1998) for significant results. The general pattern however resembles what is described below: Engineers are less religious and more to the right than their university-educated peers.

detailed and standardised occupational information; finally, we considered only males with university exposure, for a total 2816 individuals.[60]

Table 19: Conservative and religious individuals by occupation in 16 countries, male graduates only

	Total	Conservative		Religious		Conservative and Religious			
						Actual		Expected	
		N	%	N	%	N	%	N	%
Engineers	244	60	24.6	93	38.1	34	13.9	23	9.4
Managers	337	117	34.7	154	45.7	54	16.0	54	15.9
Other occupations	1752	403	23.0	814	46.5	199	11.4	187	10.7
N. A.	483	116	24.0	253	52.4	62	12.8	61	12.6
Totals	2816	696	24.7	1314	46.6	349	12.4	324	11.5

Source: 1998 ISSP surveys, www.issp.org.

The results (Table 19) differ from those of the Carnegie surveys in a crucial respect. Unlike academic and student engineers in the US, occupationally defined the engineers in the 16 countries are *less* religious than other graduates (at $p<0.01$). In most of the developed world, as one would expect, a technical education seems to go along with a secular worldview. Matters are more mixed with respect to political attitudes. Engineers are a little more to the right than the average, but the difference is not statistically significant;[61] managers by contrast – among whom together with economics and business graduates there must be many engineers – are significantly more to the right (also at $p<0.01$).

Interestingly, however, engineers are above average in *combining* religiosity and conservatism, surpassed only by managers. Furthermore, among engineers alone the

[60] Australia, West Germany, Ireland, Netherlands, Norway, Sweden, New Zealand, Canada, Philippines, Israel, Spain, France, Cyprus, Portugal, Denmark and Switzerland

[61] This finding is not statistically significant, but the same weak bias is found in all other data sets mentioned above: 1991 data and data on post-communist countries.

two attributes present an interaction effect and the proportion of those who combine both of them is higher than the null hypothesis would predict – i.e. the prediction that the two attributes are independent. The actual rate is nearly one and a half time greater than the expected rate, and the difference between the two rates is significant at $p<0.05$ (0.023). This means that, *despite* being overall less religious and only weakly more conservative, a small set of engineers is still a great deal more likely than one would expect, compared to any of the other occupational groups of graduates, to combine the two potentially radicalizing features.[62] This reinforces the Carnegie finding in a crucial regard, and represents further evidence of the presence of an engineering mindset. Even if it affects only a small subset of engineers, it is still so distinctive that it could explain the difference in the propensity to radicalise.

Sources of the mindset

The sources of the mindset are a puzzle in their own right. It is implausible to think that students of engineering come to their courses *tabula rasa* and that their mindset is shaped purely by studying this subject. Furthermore, the fact that the same differences are also found among students, who are less socialised into the profession than academics, strongly suggests that to some extent people with a certain *forma mentis* are driven to study engineering and that this also predisposes them towards conservatism *and* religiosity. We suspect that 'engineer' may well be a proxy for a type of person attracted by and present in other technical-scientific degrees too, though not as frequently as among engineers. The deeper traits that make up 'the engineering mindset', in other words, are likely to be found

[62] In the 1991data, engineers combine religiosity and conservatism more frequently than any other group, including managers, and also surpass the null hypothesis.

also among a fraction of the individuals who end up in subjects which bear similarities to engineering.[63]

Ladd and Lipset, especially in their later work, concede that certain types of individuals self-select into specific degrees, a proposition which they substantiate with data on freshmen's political attitudes by degree which matches those of academics (1975: 69, 74-76). However, like the few other social scientists who have dealt with the phenomenon,[64] they also say that field socialisation could play a part in shaping engineers' right wing propensity. First, they argue that "the more closely a discipline is linked to the business world, the more conservative (…) it is likely to be" (1972: 1094). While they find that the social class of origin has no effect on political orientations, they argue that the closeness to industrial activities defines engineers' interests and these in turn incline them to conservatism. Next, they argue that engineers' political leanings could be the result of their

[63] We do not know which these deeper traits are. Some evidence suggests that traits connected with autism might be good candidates. Simon Baron Cohen and his Cambridge colleagues who study autism found that among the relatives of 641 Cambridge students in maths, engineering and physics there were 6 cases of autism while only 1 case was reported for 652 control students in literature (Baron-Cohen et al. 1998). In another study that used a sample of 919 families with a child with autism, 28.4 per cent had either a father or grandfather who was an engineer, compared to only 15 per cent in a control group of families (Baron-Cohen et al. 1997). This does not mean that engineers are more likely to be autistic, only more likely to have offspring that are and be themselves at the high-functioning end of the Autistic Spectrum Disorder. ASD subjects display a set of behavioural characteristics – fear of uncertainty and change, impaired social interaction, lack of empathy, obsession with orderly patterns – that could, one can speculate, underpin the political and religious dispositions of 'the engineering mindset'. Recent psychological research on the cognition of conservative and liberal individuals links conservatism to milder variants of similar patterns: rejection of uncertainty and ambiguity, clinging to established routines, and a clinging for "closure" (Amodio et al 2007; Jost et al 2003). More directly linked to engineers, researchers have shown that yawning, an action linked to empathy, is much less contagious among engineering than among psychology students; the former are also less good at identifying a person's emotional state by looking at an image of their eyes with the rest of the face obscured (http://news.bbc.co.uk/1/hi/sci/tech/6988155.stm, accessed in September 2007).

[64] For a discussion and references to evidence on the effect of field socialisation see Nakhaie and Brym (1999: 334-5).

anti-intellectual vocational education that instead of producing a sceptical frame of mind, trains engineers to use rather than to produce knowledge (p. 1094). In this respect, they have a predecessor. Friedrich von Hayek, in 1952, made a strong case for the peculiarity of the engineering mentality, which in his view is the result of an education which does not train them to understand individuals and their world as the outcome of a social process in which spontaneous behaviours and interactions play a significant part. Rather, it fosters on them a script in which a strict 'rational' control of processes plays the key role (1952: 94- 102): this would make them on the one hand less adept at dealing with the confusing causality of the social and political realms and the compromise and circumspection that these entail, and on the other hand inclined to think that societies should operate orderly akin to well-functioning machines – a feature which is reminiscent of the Islamist engineers in Nilufer Göle's account. "It is not surprising", Hayek concluded, "that many of the more active minds among those so trained sooner or later react violently against the deficiencies of their education and develop a passion for imposing on society the order which they are unable to detect by the means with which they are familiar" (Hayek 1952: 102).

The engineers' social conditions in Islamic countries

Two of our empirical findings indicate that even if it could be proven beyond dispute the mindset hypothesis cannot be the whole story. First, while the overrepresentation of engineers occurs in all areas of the world regardless of social conditions, the presence of graduates of all types among radicals varies: while in MENA countries we have over 50 per cent of them, in both the Western-based and some of the South East Asian groups their presence is much smaller. This suggests that country conditions must play a part in radicalising if not engineers in particular then graduates

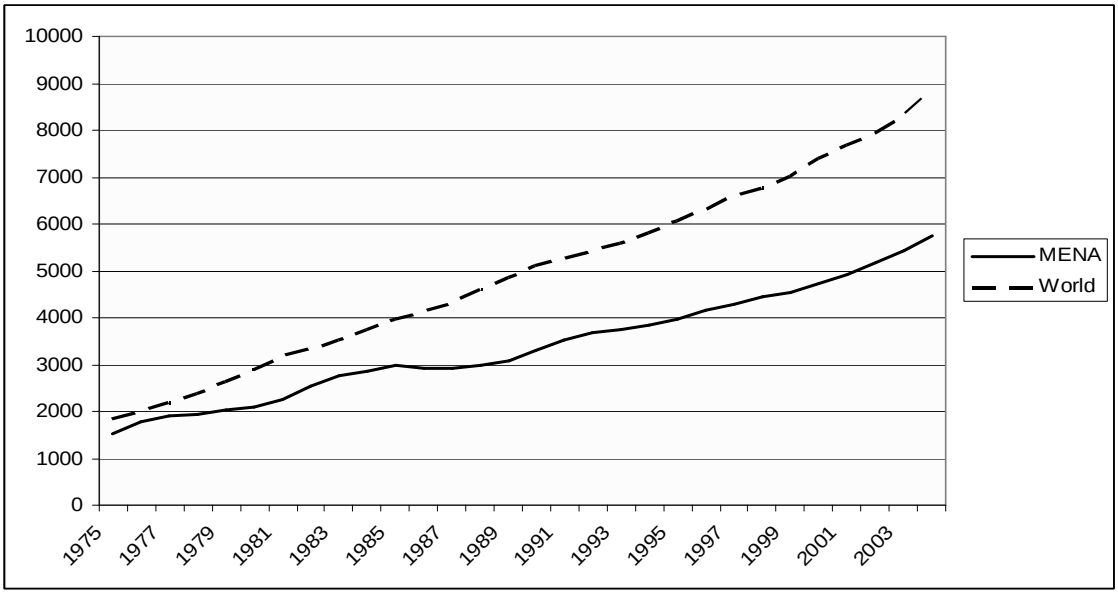
generally. Next, consider the strong presence of engineers among left-wing extremists in 1970s Turkey and Iran, and their moderate presence in the Palestinian Fatah, contrary to their glaring absence everywhere else in this type of groups. This again suggests that conditions in some Islamic countries must have mattered quite strongly to push some engineers, even against their putative right wing inclinations, to radicalise in what was at the time the main form of anti-establishment opposition. Which are the social conditions that fit this pattern? And why should the Saudi cases, alone among the Islamists in our main sample, make exception?

The position of engineers in Middle Eastern and North African countries

Researching MENA educational systems we encountered time and again a prominent feature of engineering: together with medicine and natural sciences, it is the most prestigious subject and has high entry requirements (Moore 1994: 46f.; Cornand 1990: 192; Sonbol 1988: 26f.; Kepel 1993: 136f.). Enrolling for an engineering degree is a strong sign of above-average talent and ambition – unlike most other selection processes in the region, university admission to demanding subjects seems to be based on merit. A degree in engineering carries more than a mere technical status (Cornand 1990, Wickham 2002), and many students choose it as much because of their interest in the subject as because of the prestige it confers (Hanafi 1990: 173). Many MENA regimes entertained a technocratic rhetoric of development and actively encouraged the growth of technical faculties and the mass enrolment of students (Richards and Waterbury 1996: 133-142). Even more than other elite subjects engineering has had a special attraction. It is of more direct practical value, it conveys an established solidity lacking in more academic pursuits, and arguably does not lead one to challenge traditional religious tenets (Chehabi 1990: 89f.).

Individuals with above-average skills selected on merit are, one would expect, particularly exposed to the frustration and the sense of injustice that comes from finding their professional future hampered by lack of opportunities. This happened on a large scale as a result of economic development failures. MENA countries have largely failed to develop advanced industries or technological capacities (Longuenesse 1990; Oxford Analytica 2006; UNDP 2003a: 97-109), and since the 1970s they have progressively lost out in terms of per capita income with respect to the rest of the world (Figure 5). A particularly painful economic crisis set in with the collapse of the oil price after 1982, right around the time in which many engineers in our sample went through university and became radicalised. The labour market in the Gulf states, which had previously absorbed surplus degree holders from, for instance, Egypt, shrank strongly relative to the number of graduates (Henry and Springborg 2001: 36-38; Abdel Jabber 1993: 155).

Figure 5: Gross national income per capita, world and Middle Eastern and North African countries (US$, PPP)



Source: World Bank, World Development Indicators

The effect of the lack of opportunities was intensified by the corrupt, state-driven job allocation. Without personal connections, it became almost impossible to find employment commensurate with one's education (Waltz 1986: 662; Moore 1994: 217; Wickham 2002: 54-5). The perception that once a degree has been earned, professional success depends on connections rather than on skills and personal sacrifice is particularly galling for the technically educated at the top of the educational pyramid. "For the [Egyptian] graduates who had been socialized to view themselves as a meritocratic elite, perhaps the greatest source of bitterness was what they perceived as an erosion of the link between merit and reward" (Wickham 2002: 159).

It appears that engineers and OEDs found themselves perfectly and painfully placed at a high-voltage point of intersection in which high ambitions and high frustration collided. They felt fooled by the development rhetoric of their regimes and felt they deserved more than they could get. They were not just frustrated on a self-interested level, but felt unable to discharge a *collective* responsibility in modernizing Islamic countries, to live up professionally to their role as "vanguards" of society in which regimes had cast them (Wickham 2002: 32; Apter 1965: 219f.). This negative experience is a very plausible factor that contributed to their radicalisation. While it was felt more by people with higher education than by the rest of the population, and could thus explain the general over-representation of the highly educated among Islamic radicals, it was felt even more strongly by the high achievers.[65]

[65] The delayed Islamist mobilization in the agricultural syndicate in Egypt – a subject ostensibly close to engineering – could be the outcome of particularly tight state control over the agricultural sector (Wickham 2004: 185ff.). In line with our account,

These signs point to a classic explanation of the onset of rebel movements – *frustrated rising expectations* and *relative deprivation* – dating back to Aristotle and Tocqueville (Davies 1962; Gurr 1970; Salert 1976; Finkel and Rule 1986). This explanation, out of fashion in the last 20 years, has been traditionally used to explain inter-country differences in radicalisation, while in this case it could account not so much for the emergence of the movement as a whole as for the group composition within each country's radical sector. It could explain why more graduates generally radicalised in MENA and why more engineers and OEDs in particular did so. Conversely, it could also explain why in the West and in Singapore, both of which unlike MENA countries have seen very successful economic development, much fewer graduates are found among radicals.[66]

From Egypt to Saudi Arabia

Egypt, the country in which our puzzle first emerged, fits this account almost perfectly. Ibrahim, in his early study, already noted that due to the demanding nature of the technical subjects, most activists ranked "decidedly high in both motivation and achievement"[67]; he linked the emergence of radical movements among other things to the decrease in social mobility in the 1970s, which hit the middle classes the hardest (1980: 447). (Zawahiri, who read Ibrahim's study in prison, later told him: "You have trivialized our movement by your mundane analysis. May God have mercy on you",

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it could however also be a result of agriculture's much lower status as discipline (cf. Moore p. 46).

[66] Indonesia is arguably located somewhere between MENA and Singapore in terms of economic development and labour market chances – which could explain the moderate share of Indonesian graduates in our sample, incidentally located between the MENA and Western ratios.

[67] In Ibrahim's sample 14 of the 18 students were majoring in subjects with small enrolment numbers and high admissions requirements: medicine, engineering, pharmacy and military technical science (1980: 440).

quoted in Wright 2002.) During Nasser's "socialist years", from 1960 to 1966, the university system was opened to lower-class students and enrolment greatly expanded. With scant regard to economic rationality, Nasser offered state employment to all new graduates. By 1969, the state employed "virtually all" Egyptian engineers, scientists and agronomists, more than 87 per cent of physicians, and two thirds of lawyers. Nasser's regime created an expectation of universal mobility (Moore 1994: 66-73; Kepel 1993: 11).

When development stuttered and Egypt lost the 1967 war, students, who had been socialized and mobilized into his ideology like no other group, were the most disillusioned. Protests occurred from the 1960s on, first dominated by leftist slogans, but turning to Islamic rhetoric in the 1970s, which proved particularly attractive to young migrants due to their conservative values and their social marginalization (Wickham 2002: 122). Despite the surfeit of engineers and the scarcity of technicians (Wickham 2002: 25-27; Moore 1994: 6f.), Nasser's successor, Sadat, further increased the provincial intake into Egyptian higher education in the 1970s and, at first, even supported Islamist students against the leftist threat (Kepel 1993: 129-171. By the 1980s, with the bureaucratic ranks crowded by previous generations, the state job guarantee progressively weakened and with the oil price crash the Gulf states' labour markets shrank further (Moore 1994: 126-130; 214f.). Many graduates preferred joblessness even to relatively well-paying menial jobs, and for numerous young Egyptians marriage became unaffordable. Making a virtue out of necessity, many graduates tried to restore their dignity by declaring their adherence to anti-materialist Islamic morality (Hoffman 1995: 208).

Other Arab countries underwent similar developments, producing large numbers of graduates whom local job markets were unable to absorb (Hoffman 1995: 208; Richards and Waterbury 1996: 118-123). Engineers' numbers grew more than the average growth of graduates in the 1970s (Longuenesse 1990: 372, 408; Longuenesse 2000), and they experienced reduced labour market opportunities in all Arab republics (Akkache 1990; Hanafi 1990; Cornand 1990, Longuenesse 1990).[68] In economically isolated Palestine, where many engineers were forced to work as mechanics or plumbers, the phenomenon became particularly pronounced.[69]

If frustration with dismal professional opportunities indeed contributed to their radicalization, we should find less radical engineers where conditions were more favourable. This is exactly what the exception of Saudi Arabia seems to demonstrate. Saudi Arabia is the only nation whose violent radicals show no over-representation of engineers in our sample, even though the proportion of engineers in the population is comparable to that of other Arab states.[70] There is very good evidence that Saudi engineers have had much better labour market chances than their peers in any of the non-Gulf MENA states. While there is a large unemployment problem for secondary

[68] Some scholars would consider Iran to be a counter case (e.g. Kurzman 2003). It was growing rather rapidly in the 1970s and had not yet experienced the glut of degree holders of other Middle Eastern states. Many young Iranian engineers might have had bright labour market chances. Iran did however experience strong imbalances in economic development and several sudden setbacks right in the years prior to the 1979 revolution, which, according to Keddie (1983), can be plausibly explained by the "frustrated expectations" hypothesis (cf. also Foran 2005: 79f.; Milani 1994: 96ff.; Hoffman 1995: 209).

[69] According to Sageman – who briefly mentions relative deprivation as a necessary condition of radicalisation – many al-Qaeda members, although quite gifted, did not have full-time jobs (Sageman 2004: 92; 95). While the group has a good number of people from wealthy families mobility closure is not absent in the group at large.

[70] 10.6% among males in the mid-1980s (Longuenesse 1990: 329). Figures for the 1990s and early 2000s are similar: Kingdom of Saudi Arabia, *Statistical Yearbook*, various issues.

school graduates and for graduates from Islamic departments (Diwan and Girgis 2002; UNDP 2003b: 10f., 68, 109; Bahgat 1999) – strongly represented in our sample – the Saudi market has been able to absorb all its graduates from prestigious technical subjects. The Saudi private sector has time and again petitioned the government to produce more graduates with technical education,[71] and development plans have repeatedly pointed to the need for more technically educated nationals (Saudi Ministry of Planning 1999, 2004). Job market chances for highly educated have further improved in recent years as the government has been exerting pressure for hiring nationals rather than foreigners.[72] Although state employment still plays a large role in the distribution of Saudi oil rents, the Saudi private sector is among the most dynamic in the region and has been recruiting good personnel.[73] As the human resources manager of a large Saudi bank told one of us, unlike in other countries where business graduates are the most sought after, their first recruitment target are the engineers.[74] While there is little demand for humanities or Islamic studies degrees, there are now even signs of scarcity of engineers (*Saudi Gazette*, 21 May 2006, 3 December 2006; *Bahrain Tribune*, 21 April 2006; *Arab News*, 12 April 2007; *Khaleej Times*, 21 June 2007). With such favourable labour market conditions it is even surprising that we still find two engineers in our samples.

[71] Interviews with private sector representatives, Riyadh, 2003 to 2005.
[72] [reference to book-length research of author II]
[73] From 2004 to 2005 alone, the number of Saudis employed in the private sector grew from 486,000 to 623,000; cf. Saudi Arabian Monetary Agency, *Forty-Second Annual Report*, p. 281.
[74] Interview with Norlida Azmi, assistant general manager, SAMBA Financial Group, Riyadh, December 2005.

Western dominance and local failures

Frustration with the personal and collective consequences of failed economic development is the most plausible gun powder, the absence of which would have been sufficient *to prevent* the overrepresentation of elite degree graduates among Islamic radicals, as it did prevent it among Western groups and in those which emerged in highly developed Singapore. However, this explanation accounts neither for why, among elite graduates, it was mostly the engineers who took mobilization to violent extremes or why among Western groups we still find engineers in small numbers but vastly overrepresented. Before we consider this question, however, and even though it was never our aim to explain all the features of radical Islamic militants, we should further point out that relative deprivation does not exhaustively account for all the types of individuals that mobilized under the flags of radical Islam. First, a contingent of disenfranchised were also recruited and joined the highly educated, in different proportions but everywhere. Next, the biographies of some of the protagonists do not fit the blocked mobility account, at least not in the narrow individualistic sense. Among prime movers and leaders we find individuals who came from upper middle class families or who abandoned (or could plausibly have pursued) a good career. At the same time, some secondary school leavers too joined the movement even before directly experiencing any labour market difficulty on the graduate labour market (Waltz 1986: 662; Hanafi 1997: 148). Thus, the breadth of appeal suggests that radical Islam has become an attractive channel for a type of frustration whose chemistry cannot be entirely reduced to the effects of high expectations clashing against labour market exclusion.

Furthermore, even before the Iraq war, radicals' anger was not directed only against their national states of origin, but took a distinctive anti-Western colour. The focus of the radicalisation too therefore cannot be fully accounted for by relative deprivation per se. Three forces might have arguably intensified and shaped the direction of the frustration, among those with elite degrees. First, modern engineering and science curricula are a gigantic showcase of Western technological achievements, which put the backwardness of MENA societies in sharp relief (Moore 1994: 12f.; Hanafi 1997). Unlike those who pursue humanities or law degrees, engineers, doctors and scientists find it harder to ignore their thriving counterparts in the outside world (Hoffman 1995: 210). Unlike in the humanities, in the field of technology the West appears "monolithic and properly hegemonic" (Waltz 1986: 666), and students of these disciplines cannot as easily segregate their universe from the developed world. The contrast between Western achievements and their countries' failures could have engendered a sense of *collective* frustration, which was felt more intensely by those with elite degrees.

Next, those who studied in the West, itself a sign of an even greater ambition and willingness to sacrifice than studying in Islamic countries, had reasons to feel even more deprived: there are at least 25 engineers in our sample who studied abroad, a ratio that strongly suggests that they are vastly over-represented among radical engineers (see fn. 15). At once attracted by Western achievements but disadvantaged in both home and Western countries' labour markets, their cognitive dissonance was possibly aggravated by the direct exposure to an alien cultural environment. Those who studied in the West are more likely to have suffered not just from envy and resentment, emotions that derive from unfavourable comparisons experienced

remotely, but also from anger and hatred, emotions aroused by cultural displacement (Wright 2006: 304) and direct humiliating interactions. These emotions are more likely to trigger action-responses (Elster 1999) – a desire to destroy the object of hatred, the West and its impure social mores, and a passionate embrace of traditional religious values. Mohamed Atta often bemoaned Western influence in Arab cities (Holmes 2005): according to Dittmar Machule, his thesis supervisor at the Technical University of Hamburg-Harburg in north Germany, Atta hated skyscrapers because in the city of Aleppo, on which he wrote his doctoral dissertation, tall buildings stole the privacy of the traditional Arab homes in whose courtyard women were once able to remove their veils unseen by strangers (Rose 2004).

Third, even those who did not go abroad found reasons to feel frustrated by Western technological dominance at home: resentment appears to have been fuelled by the competition of foreign firms, especially in public constructions funded by MENA states and international aid organisations. In Egypt in 1993 there were 60.000 foreign experts, 12.000 of whom were Americans, whose income often for the same job was manifold greater than that of local engineers – there are several testimonies of how much bitterness this caused not just towards foreigners but also towards the state guilty of privileging the latter over local resources (Moore 1994: 98; Hanafi 1997: 212).

Why only engineers?

Relative deprivation and frustrated expectations, as well the concomitant causes which might have shaped it as an anti-western movement, can explain why both engineering and OEDs are over-represented among Islamists of all descriptions. Still,

engineers alone appear to be particularly strongly represented among violent groups. Even in the spectrum of non-violent Islamist parties, engineers seem to have been more strongly represented among the more radical ones both in Turkey (Demiralp 2006: 21) and in Egypt.[75] Most other degrees were not as demanding and did not have as many high achievers as engineering did. Yet medicine, natural sciences and, in some countries, economics are just as prestigious and difficult to get into, and the graduates in these fields did not have much better chances for professional development than engineers. They may thus have had just as many reasons to feel resentful towards the West as engineers did.[76] So what made the extra difference?

An explanation could lie in a social selection effect that could expose engineers to an even greater degree of frustration than that experienced by students of other subjects. If engineers came from a lower social background than medicine or science students did, they would have also incurred greater relative costs for their education and entertained higher expectations of social advancement. Many of the early Islamist activists had a provincial background (Waltz 1986: 655; Hoffman 1995; Kepel 1993: 73, 163f.), including the original Egyptian fundamentalists (Ibrahim 1980: 438f.). Students in the radicalized Iranian University of Science and Technology also mostly came from the provinces.[77] If this was a contributing factor of radicalisation generally, and if engineers in particular came more frequently from a provincial background than other students did, then more of them would have suffered from the displacement

[75] Personal communication with Holger Albrecht, March 2006.
[76] In Syria, mechanical, chemical, electrical and electronic engineering have high grade requirements, although below those of medicine, dentistry, pharmaceutics, civil engineering and architecture (Cornand 1990: 192). In Jordan, prestigious university programs such as pharmacy or medicine require the highest grade average, 80% (Cunningham and Sarayra 1993: 120).
[77] Goudarz Eghtedari, personal communication, July 2006.

caused by moving to the city for their studies. These features may have made engineers' anger and frustration more marked leading proportionally more of them to embrace radical 'solutions'. However, since evidence on class and geographical origins is scarce, this explanation remains speculative.[78]

The other hypothesis that could explain why only engineers are over-represented among violent groups has to do with their mindset, which could have sorted equally frustrated people into different responses. We have already rehearsed the general evidence for a (more) radical mindset among engineers. Specifically with regard to professional frustration, the Carnegie survey reveals another striking peculiarity of engineers: the academic output reported by respondents – measured by the number of publications in the past two years and by whether they expected their current research to lead to publications – is inversely correlated with having conservative and religious views. Strikingly, a low level of publications is associated with having conservative-religious views far more strongly among engineers than among academics in all other subjects. The proportion of conservative *and* religious scientists and doctors goes from 17.5 per cent among those who expect to publish in the near future to 33.5 per cent among those who lack that expectation; among engineers it leaps from 34.0 per cent to a stunning 70.4 per cent – as among scientists and doctors it doubles, but from a base which is twice as large (Table 20).

[78] In Egypt, engineering students in the 1970s had a higher-class background than students of law, but that may not mean much for law is the least prestigious subject (Moore 1994: 112, 217). Abrahamian explains the prominence of engineers among the Iranian Mojahedin e-Khalk with the fact that engineering was the hardest subject that attracted the most ambitious individuals from traditional lower middle class families (1989: 229f.).

Table 20: Percentage of respondents within each degree who are both conservative *and* religious broken down by whether they expect their research to lead to publications, males only

	Publications expected					
	Yes (A)	N *	No (B)	N *	B-A	B*100/A
Engineers	34.0	144	70.4	71	+36.4	2.07
Scientists & doctors	17.5	702	33.5	239	+16.0	1.91
Economists	29.8	151	37.8	90	+8.0	1.26
Other subjects	10.7	751	17.9	368	+7.2	1.67

* The total number of cases on which the percentages are calculated
Source: our elaboration on Carnegie Foundation National Survey of Higher Education 1984

Considering the same link from another direction and looking at the distribution of individuals by degree among those who are conservative-religious, we find that, when we switch from those who expect to publish to those who do not (Table 21), the share of engineers grows while that of both scientists and doctors diminishes.

Table 21: Percentage distributions of respondents who are both conservative *and* religious broken down by degree and by whether they expect their research to lead to publications, males only

Conservative & religious→	Engineers	Economists	Scientists & Doctors	Other subjects	Total
Publications expected	16.5	15.2	41.4	26.9	100 (N=297)
Publications not expected	21.7	14.8	34.8	28.7	100 (N=230)
%Δ	31.5	- 2.6	-15.9	6.7	

Source: our elaboration on Carnegie Foundation National Survey of Higher Education 1984

This effect survives very well a logistic regression in which we inserted interaction variables between degree and academic output: just being an engineer makes one much more likely to have conservative-religious views, but being an engineer who

expects *no* publication from his research has a further very strong significant positive effect, regardless even of previous publications and department quality (Table 22). Consider the effects on the odds of being religious *and* conservative relative to the odds of being anything else: with respect to the base category of an academically successful non-engineer just being *non-successful* makes these odds 1.3 times greater. Being a successful *engineer* makes the same odds 4.8 times greater, but being an *unsuccessful engineer* makes them a staggering 7.7 times greater.[79]

Table 22: Probability of being both conservative *and* religious, logistic regression coefficients with interaction variables, US academics, males only (N= 2232)

	Coefficients	Significance	Exponentials
Age in years	.016	.003	1.016
Married	.350	.037	1.419
Children	.031	.807	1.031
Engineer	1.210	.000	3.353
Excellent department	.359	.006	1.432
Not published last 2 years	.435	.002	1.544
Not expecting publications	.335	.013	1.320
Engineer not published	-.660	.095	0.517
Engineer not expecting pub.s	1.119	.006	3.062
Constant	-2.899	.000	

-2 Log likelihood ratio 2225.085
R square (Cox & Snell) .070

Source: our elaboration on Carnegie Foundation National Survey of Higher Education 1984

[79] See fn. 56; when there are interaction terms the exponentials associated to the individual variables and to that of their interaction variable must be added together to calculate the variation in the odd ratio 'caused' by the interaction: 3.353 (engineer) + 1.320 (not expecting publications) + 3.062 (engineer not expecting publications) = 7.735.

We cannot be certain that this finding identifies a casual effect,[80] but a plausible interpretation is that engineers are more troubled by professional frustrations than individuals in other subjects, and, as a result, more likely to react to times of crisis by embracing extreme conservative-religious views.

Repression and the framing of resentment

We now have the elements of a potentially explosive concoction. However, this would have remained inert had two conditions not lit the fuse. One was the harsh repression on the part of the authoritarian Islamic governments, which by all accounts played a crucial part in inducing radicalisation generally regardless of the engineering phenomenon. Al-Zawahiri talks about the torture that took place in the

[80] Ladd and Lipset (1972) found the same correlation, but considered only the political and not the religious orientations and used a different measure: they took those who had published ten or more articles in the previous two years and held positions at elite universities, whom they defined as "achievers", and found them to be much more liberal than the "rank and file" even though on average older; "overall, the differences among achievers in engineering and the several natural science disciplines are much smaller that the differences among the rank and file" (pp.1096-7). They interpret the correlation as spurious, however, arguing that the more liberal leanings of those with higher academic productivity result from their greater intellectual prowess and sharper critical faculties: to put it crudely the dumber one is the more likely one will be both right wing *and* unproductive. This interpretation, however, cannot account for why the incremental variations in religiosity and right-wing views when switching from the productive to the unproductive is much more marked among engineers than among scientists.

> "dirty Egyptian jails . . . where we suffered the severest inhuman treatment. There they kicked us, they beat us, they whipped us with electric cables, they shocked us with electricity! They shocked us with electricity! And they used the wild dogs! And they used the wild dogs! And they hung us over the edges of the doors" – here he bends over to demonstrate – "with our hands tied at the back! They arrested the wives, the mothers, the fathers, the sisters, and the sons! (…)" Egypt's prisons became a factory for producing militants whose need for retribution—they called it "justice"— was all-consuming (Wright 2002).

Without repression we may not have had violent radicalization regardless of the engineering phenomenon. In Turkey, a country in which both democratic institutions and economic development have been in relatively better shape, we find few violent Islamic extremists of any kind. Liberal social and political contexts diffuse conflict and shape it into more conventional mobilization, while authoritarianism and political exclusion concentrate conflict and shape it into anti-state and violent mobilization. Repressive and corrupt regimes that failed to live up to their developmental promises narrowed the openings for frustrated elites to manifest their opposition. Other than acquiescence, joining radical movements became the only option (Hafez 2003; Tarrow 1998; Tilly 2004; Wiktorowicz 2004).

Secondly, the Islamist opposition, the only credible anti-establishment political movements in MENA countries since the 1980s, was able to frame the discontent. Appealing to religious law, Islamic movements rode this dissatisfaction promising the accountability and fairness which these regimes have been so sorely lacking. Muslim

Brothers found strong support among lower-middle and middle class students (Wickham 2002: 115). Young people were accorded prominence in Islamist movements, which gave them a sense of importance and mission they could not otherwise obtain in a patriarchal, nepotistic and immobile system (Wickham 2002: 2, 62, 84, 140).

By themselves, however, neither repression nor the availability of Islamism is capable of explaining the overrepresentation of the engineers, as they could have affected anyone. The effects of repression could be of two kinds: either engineers were already overrepresented among the opposition movements targeted by repression and became radicalised by the experience just like everyone else; repression would thus be relevant for everyone whether engineers or non engineers in the same way. Or engineers were not initially overrepresented among those who suffered from repression, but responded to it in a more extreme way; in this case repression might have interacted with the mindset leading more engineers to become violent extremists. The stronger presence of OEDs among peaceful Islamists movements makes the latter more plausible for in so far as repression targeted Islamic movements of all descriptions, OEDs too should have been exposed to it.

To be relevant for our puzzle, the availability of Islamic radical ideology must also have interacted with 'the engineering mindset' in a special way. By canvassing a stricter version of the religion, it offered the best available opportunity to strengthen the flagging cultural confidence of would-be modernizing élites vis-à-vis Western hegemony, and became the haven for frustrated individuals of high potential. Islamic ideology proved a peculiarly well suited means to reduce the cognitive dissonance and

turn resentment into a political resource. But it was by incorporating both traditionalist and modern elements that it might have proved especially appealing to the more conservative engineers. This is arguably the crucial juncture at which the effects of frustrated expectations, individual as well as collective, joined forces with the engineering mindset. Where would-be militant engineers had the choice between joining a secular and traditional leftist group or an Islamic one, they chose the latter in greater numbers: in 1970s Iran humanities and social science students dominated among Marxist guerrillas, whereas "physical sciences" dominated among the Islamo-marxist Mojahedin E-Khalk (Hoffman 1995: 206). And in Palestine proportionally many more engineers opted to join Hamas than secular Fatah.

Conclusions

The most plausible explanation of the engineers' over-representation among violent Islamic radicals everywhere lies in the joint effect of two causes. To convey how our account fits the pattern of findings we can reason counterfactually. Without the severe lack of professional opportunities that they had to endure in MENA countries we would not find an over-representation of graduates, especially from elite degrees, among violent Islamic radicals – as indeed we do *not* find it either in the West, in Singapore or even in Saudi Arabia where we know that graduates fared much better professionally. In all these areas violent Islamism has attracted proportionally many more marginal individuals with lower education and professional qualifications. Saudi extremists seem to reflect Saudi society in general, with neither an overrepresentation of graduates nor an elite bias among them. In the case of Singapore – arguably the closest to the West in economic terms – the sample is even below the average level of education, and in the West the proportion is smaller still. This pattern clearly points to

the importance of relative deprivation and frustrated expectations, a theory that may have been abandoned too hastily, partly perhaps because it was applied at too macro a level, that is to explain country rather than group differences.

However, without their mindset, which inclines them to take more extreme conservative and religious positions everywhere, even in MENA countries engineers would have behaved as those with OEDs largely limiting themselves to non-violent forms of radicalisation, and would not register in relative terms as strongly as they do. The mindset could also explain why even in the Western and South East Asian groups in which graduates did not experience the same professional frustration they had in MENA countries, the engineers' overrepresentation is strong. Even if there are very few graduates, most of them are engineers. In the case of MENA countries deprivation and mindset seem to have worked together, selecting elite graduates first and engineers among them, which could explain the much larger scale of the phenomenon, while in the West and in Singapore mindset alone seems to explain the phenomenon, which in absolute term is much smaller.

The only other case in which we find a trace of engineers' prominence outside of Islamic violent groups is, consistently with the mindset hypothesis, among the most extreme right-wing movements, especially in the US and in Germany, where it is all the more striking again given the general low level of education of the members of such groups. Here we have perhaps the only other case in which the mindset alone has activated engineers into resorting to violent action – their absolute number is tiny, but disproportionate relative to other types of graduates.

Both discontent and mindset would not have had the effect they did in inducing the would-be modernising elites of the technically educated to become extremists were it not for the emergence of Islamism as the only credible political opposition to authoritarian and corrupt establishments. Social movement theories help us to capture how the protest is "framed" by drawing on local cultural resources and an Islamic rhetoric of probity, offering social and political renovation through tradition. Yet, they can explain neither the different trajectories of engineers relative to OEDs – violent vs. non-violent movements – nor the disproportionate presence of engineers among radicals outside of conventional social movements: engineers predominate among small, cell-based organizations that are uprooted from their social context, and among 'globalized' radicals in the West (Sageman 2004; Roy 2004). The more widespread the engineers' phenomenon is the less it can be explained as the outcome of a specific, context-dependent opportunity of "framing". We have shown that it is very broad indeed and hence cannot be exclusively dependent on local socio-economic, political or cultural opportunity structures. The fact that radicalisation now occurs in Western countries too suggests that the presence of democratic channels, especially with the events of post 9/11 and the Iraq war, no longer suffices to prevent it, as it may have done in Turkey, and that the movement has now found its own momentum and draws its resources from new channels. Still it continues to attract engineers.

We do not know how exactly these various elements – the mindset, the expectations and the experience – interacted to produce the radicalisation of only some engineers and not others, indeed not of most of them. There is a micro level of analysis that a fully satisfactory explanation should ideally achieve that eludes us. Only detailed biographies, of both those who did radicalise and those who did not, with information

on individuals' trajectories and dispositions would allow us reconstruct the precise micro-causality of that process.

What we do know is that at the time of writing the phenomenon shows no signs of abating. On the 30th of June 2007 a Jeep Cherokee loaded with propane canisters was driven into the glass doors of the main terminal at Glasgow International Airport and set on fire causing much damage but no casualties among the public. Of the two men who were arrested in flagrante, Bilal Talal Samad Abdullah is a medical doctor, born in Britain from Iraqi parents; the other, Kafeel Ahmed, was an Indian engineer. In 2001, he "joined Queens University in Belfast, Ireland to do his M.Phil in aeronautical engineering, completing it in 2003. He did his PhD in computational fluid dynamics at the department of design and technology, Anglia Polytechnic University" (*The Times of India*, 6 July 2007). Ahmed, who had suffered severe burns in the attack, died on the 2nd of August 2007

On the 14th of July 2007 Hicham Dokkali, a 30 year old Moroccan with no previous record of extremist activities, tried to blow up a coach load of tourists in the city of Meknes in a botched suicide attack, which he planned to carry out using a butane gas bottle. He blew off his arm but did not kill anyone. Dokkali worked as a tax officer but was trained as an engineer (*Middle East Online*, 14 July 2007).

On the 4th of August 2007 two Egyptian men were stopped with pipe bombs in their car near a U.S Navy base in South Carolina where enemy combatants have been held. They have now been indicted on federal charges of carrying explosive materials across state lines. Ahmed Abdellatif Sherif Mohamed, 24, is an engineering graduate

and teaching assistant at the University of South Florida in Tampa, Florida, and Youssef Samir Megahed, 21, is an engineering student (*The Associated Press*, 31 August 2007).

On the 5th of September 2007 police arrested three men allegedly preparing a massive bombing campaign targeting Americans and US installations in Germany. Adem Yilmaz, a 29 years old man born in Turkey, worked as train porter, became unemployed, and drifted onto the Islamist scene. The other two are German converts. Daniel Martin Schneider, 22, reportedly comes from a middle class family, and left his gymnasium in 12th form despite having good grades, supposedly because he did not want to be taught by women. He went to Egypt to learn Arabic, did military service in Germany, followed by odd jobs and a stint in a militant training camp in Pakistan. Fritz Martin Gelowicz, 28, described as the leader of the Islamic Jihad Union terror cell, also went to a training camp in Pakistan in 2006, and comes from divorced middle class parents: his mother is a doctor and his father an engineer. He recently married a German-Turkish woman. A few days before his arrest, he "mystified his parents by visiting them both and bidding them farewell". In 2003 he had enrolled for a combined economics and engineering degree at the University of Applied Sciences in Ulm (*WTOP News.com* 7 September 2007; *Sunday Times* 7 September 2007; *Die Zeit*, 6 September 2007; *Tagesspiegel*, 9 September 2007).

Bibliography

Abdel Jabber, Tayseer. 1993. "Inter-Arab Labor Movements: Problems and Prospects", in Said El-Naggar (ed.), *Economic Development of the Arab Countries: Selected Issues*, Washington: International Monetary Fund, 145-162

Abrahamian, Ervand. 1989. *The Iranian Mojahedin*, New Haven, London: Yale University Press

Abuza, Zachary. 2003. *Militant Islam in Southeast Asia: Crucible of Terror*, Boulder, London: Lynne Rienner

Abuza, Zachary. 2006. 'Education and Radicalization: Jemaah Islamiyah Recruitment in South East Asia', in James J.F. Forest (ed.), *The Making of a Terrorist. Recruitment, Training and Root Causes*, Westport and London: Praeger Security International, Vol. 1: 66-83

Akkache, Ahmed. 1990. 'Ingenieurs et Emploi: Quelques Donnees sur l'Algerie', in Longuenesse, 147-154

al-Zawahiri, Ayman. 2001. *Knights under the Prophet's Banner*, London: al-Sharq al-Awsat

Amass, Ty. 2004. *Empirical Evaluation of Political Ideology as Social Cognition*, Honors Thesis, Politics Department, New York University.

Amodio, David, John Jost, Sarah Master and Cindy Yee. 2007. 'Neurocognitive Correlates of Liberalism and Conservatism', *Nature Neuroscience*, 9 September (advance online publication)

Apter, David E. 1965. *The Politics of Modernization*, Chicago: University of Chicago Press

Azam, Ahmad Jamil. 1997. 'The Islamic Action Front Party ', in Hani al-Hourani and Hussain Abu Ruma (eds.), *The Islamic Movements and Organizations in Jordan*, Amman: Al-Urdun Al-Jadid Research Center/Sindbad Publishing House, 91-140 (in Arabic)

Bahgat, Gawdat. 1999. 'Education in the Gulf Monarchies: Retrospect and Prospect', *International Review of Education*, Vol. 45, No. 2: 127-136

Bakker Edwin. 2006. 'Jihadi Terrorists in Europe', *Security Paper* No. 2, Clingendael: Netherlands Institute of International Affairs

Baron-Cohen, Simon, Sally Wheelwright, Carol Stott, et. al.1997. 'Is there a Link between Engineering and Autism?', *Autism*, 1: 153-163

Baron-Cohen, Simon, Patrick Bolton, Sally Wheelwright, et al. 1998. 'Autism Occurs more often in Families of Physicists, Engineers, and Mathematicians', *Autism*, 2: 296-301

Bergen, Peter and Swati Pandey. 2005. 'The Myth of the Madrassa', *New York Times*, 15 June

Bergen, Peter and Swati Pandey. 2006. 'The Madrassa Scapegoat', *Washington Quarterly*, 29 (2): 117-125

Berrebi, Claude. 2003. *Evidence about the Link between Education, Poverty, and Terrorism among Palestinians*, Princeton University, Department of Economics, Industrial Relations Section, Working Paper No. 477

Best, Shedrack. 1999. 'The Islamist Challenge: The Nigerian Shiite Movement', in Monique Mekenkamp, Paul van Tongeren, Hans van de Veen (eds.), *Searching for Peace in Africa: An Overview of Conflict Prevention and Management Activities*, Utrecht: European Platform for conflict prevention and Transformation

Botman, Selma. 1984. *Oppositional Politics in Egypt: The Communist Movement, 1936-1954*, PhD Harvard

Capoccia, Giovanni, forthcoming. 'Institutional Change and Constitutional Tradition: Responses to 9/11 in Germany', in Martha Crenshaw (ed.), *The Consequences of Counterterrorist Policies in Democracies*, New York, Russell Sage

Carnegie Foundation. 1984. National Survey of Higher Education, online at <www.thearda.com/Archive/Files/Descriptions/NSHEF84.asp>

Chang, Timothy and Daphne Chang. 2000. *The Role of the Myers-Briggs Type Indicator In Electrical Engineering Education*, working paper, International Conference on Engineering Education, Taipei, online at <www.ineer.org/Events/ICEE2000/Proceedings/papers/MD6-2.pdf>

Chehabi, Houchang E**.** 1990. *Iranian Politics and Religious Modernism: the Liberation Movement of Iran under the Shah and Khomeini*, Ithaca: Cornell University Press

Cornand, Jocelyne. 1990. 'Le Role des Ingenieurs dans le Secteur Privé en Syrie: Le Cas du Textil', in Longuenesse, 187-200

Cunningham, Robert and Yasin Sarayrah. 1993. *Wasta: the Hidden Force in Middle Eastern Society*, Westport, London: Praeger

Davies, James C. 1962. 'Toward a Theory of Revolution' *American Sociological Review*, 27 (1): 5-19

Demiralp, Seda. 2006. 'The Rise of Islamic Capital and the Decline of Islamic Radicalism in Turkey', paper presented at the annual conference of the Midwest Political Science Association

Diwan, Ishac and Maurice Girgis. 2002. *Labor Force and Development in Saudi Arabia*, paper prepared for the Symposium on the Future Vision for the Saudi Economy organized by the Ministry of Planning, Riyadh, September 2002

Egypt, Arab Republic of. 1996. *Development of Education in Arab Republic of Egypt*, report presented to International Conference on Education, Geneva <www.ibe.unesco.org/countries/countryDossier/natrep96/egypt96.pdf>

Elster, Jon. 1999. *Alchemies of the Mind*, Cambridge: Cambridge University Press

Fahmy, Ninette S. 1998. 'The Performance of the Muslim Brotherhood in the Egyptian Syndicates: An Alternative Formula for Reform?', *Middle East Journal*, 52 (4): 551-562

Finkel, Steven E. and James B. Rule. 1986. 'Relative Deprivation and Related Psychological Theories of Civil Violence', in Kurt Lang and Gladys Engel Lang (eds.), *Research in Social Movements, Conflicts and Change*, London: Jai Press

Foran, John. 2005. *Taking Power: on the Origins of Third World Revolutions*, Cambridge: Cambridge University Press

Göle, Nilufer. 1990. 'Ingenieurs Islamistes et Etudiantes Voile en Turquie: entre le Totalitarisme et l'Individualisme', in Gilles Kepel and Yann Richard (eds.) *Intellectuels et Militants de l'Islam Contemporain*, Paris: Editions du Seuil, 167-192

Gurr, Ted. 1970. *Why Men Rebel*, Princeton, NJ: Princeton University Press

Hafez, Mohammed. 2003. *Why Muslims Rebel: Repression and Resistance in the Islamic World*, Boulder, London: Lynne Rienner

Hanafi, Sari. 1990. 'La Formation des Ingénieurs en Syrie et son Adaptation aux Besoins de la Societe', in Longuenesse, 171-185

Hanafi, Sari. 1997. *La Syrie des Ingénieurs. Une Perspective Comparée avec l'Egypte*, Paris: Editions Karthala.

Handler, Jeffrey. 1990. 'Socioeconomic Profile of an American Terrorist: 1960s and 1970s', in *Terrorism*, 13 (3): 195-213

Hasan, Noorhaidi 2006. *Laskar Jihad. Islam, Militancy, and th Quest for Identity in Post-new order Indonesia.* Ithaca: Southeast Asia Program Publications, Cornell University

Hayek, Friedrich A. 1952. *The Counter-revolution in Science*, Glencoe, Ill.: The Free Press

Hegghammer, Thomas. 2006. *Terrorist Recruitment and Radicalisation in Saudi Arabia*, manuscript, London

Henry, Clement M. 1994. *Images of Development: Egyptian Engineers in Search of Industry*, Cairo: American University in Cairo Press

Henry, Clement M. and Robert Springborg. 2001. *Globalization and the Politics of Development in the Middle East*, Cambridge: Cambridge University Press

Herf, Jeffrey. 1984. *Reactionary Modernism. Technology, Culture, and Politics in Weimar and the Third Reich*. Cambridge: Cambridge University Press

Higher Education Statistics Agency. 2005. *Students Tables* <www.hesa.ac.uk/holisdocs/pubinfo/student/subject0405.htm>

Hizb ut-Tahrir. 2002. *List of those arreste*d from Hizb ut-Tahrir, <www.hizb-ut-tahrir.org/english/english.html>

Hoffman, Valerie. 1995. 'Muslim Fundamentalists: Psychosocial Profiles', in M.E. Marty and R.S. Appleby (eds.), *Fundamentalisms Comprehended*, vol. 5 of The Fundamentalisms Project, Chicago: University of Chicago Press, 199–230

Holmes, Stephen. 2005. 'Al-Qaeda, September 11, 2001', in D.Gambetta (ed.), *Making Sense of Suicide Missions*, Oxford: Oxford University Press, 131-172

Hunneus, Carlos. 2000. 'Technocrats and Politicians in an Authoritarian Regime. The "ODEPLAN boys" and the "Gremialists" in Pinochet's Chile', *Journal of Latin American Studies*, 32 (2): 461-501

Hunter, Shireen T., ed. 1988. *The Politics of Islamic Revivalism: Diversity and Unity*, Bloomington: Indiana University Press

Huntington, Samuel. 1996. *The Clash of Civilizations and the Remaking of World Order*, New York: Simon & Schuster

Ibrahim, Saad Eddin. 1982. 'Anatomy of Egypt's Militant Islamic Groups: Methodological Note and Preliminary Findings', *International Journal of Middle East Studies*, 12 (4): 423-453

Ibrahim, Saad Eddin. 1982. 'Egypt's Islamic Militants', *MERIP Reports*, No. 103, February: 5-14

Ibrahim, Saad Eddin. 1996. 'Reform and Frustration in Egypt', *Journal of Democracy*, 7 (4): 125-135

Institute of International Education. 2005. *Open Doors Online* <http://opendoors.iienetwork.org/?p=69694>

International Crisis Group. 2004. *Islamism in North Africa II: Egypt's Opportunity*, Cairo/Brussels: ICG

Jäger, Herbert, Gerhard Schmidtchen, and Lieselotte Süllwold. 1981 *Analysen zum Terrorismus Vol. 2, Lebenslaufanalysen*, Opladen, Germany: WDV

Jordanian Ministry of Higher Education. 2005. Enrolment statistics. <www.mohe.gov.jo> (in Arabic)

Jost, John, Arie Kruglanski, Jack Glaser and Frank Sulloway. 2003. 'Political Conservatism as Motivated Social Cognition', *Psychological Bulletin*, 129 (3): 339-375

Keddie, Nikkie. 1983. 'Iranian Revolutions in Comparative Perspective', *American Historical Review*, 88 (3): 579-598

Kepel, Gilles. 1993. *The Prophet and Pharaoh: Muslim Extremism in Egypt*, paperback edition, Berkeley and Los Angeles: University of California Press

Krueger, Alan B. 2007. *What Makes a Terrorist? Economics and the Roots of Terrorism*, Princeton: Princeton University Press.

Krueger, Alan B. and Jitka Maleckova. 2003. 'Education, Poverty and Terrorism: Is There a Causal Connection?', *Journal of Economic Perspectives,* 17: 119–144

Kurzman, Charles. 2003. 'The Qum Protests and the Coming of the Iranian Revolution, 1975 and 1978', *Social Science History*, 27 (3): 287-325

Kuwaiti Ministry of Education. 2001. *National Report*, presented to the 46th session of the International Conference on Education, Geneva <www.ibe.unesco.org/International/ICE/natrap/Kuwait_Scan_4.pdf>

Ladd, Carll E. Jr. and Seymour M. Lipset. 1972. 'Politics of Academics Natural Scientists and Engineers', *Science*, 176: 1091-1100

Ladd, Carll E. Jr. and Seymour M. Lipset. 1975. *The Divided Academy: Professors and Politics*, New York: McGraw-Hill

Lipset, Seymour M. and Earl Raab. 1971. *The Politics of Unreason. Right-wing Extremism in America, 1790-1970*, London: Heinemann

Lobmeyer, Hans Günter. 1995. *Opposition und Widerstand in Syrien*, Hamburg: Deutsches Orient-Institut

Longuenesse, Elisabeth, ed. 1990. *Batisseurs et Bureaucrates: Ingénieurs et Société au Maghreb et au Moyen-Orient: table-ronde CNRS tenue à Lyon du 16 au 18 mars 1989*, Etudes sur le monde arabe, no 4, Lyon: Maison de l'Orient

Longuenesse, Elisabeth. 2000. 'Les Syndicats Professionnels en Jordanie, Enjeux de Société et Lutte Nationale', GREMMO working paper (Groupe de recherches et d'études sur la méditerranée et le moyen orient), <http://halshs.archives-ouvertes.fr/halshs-00111075/en/>

Lyttelton, Adrian. 1973. *The Seizure of Power. Fascism in Italy 1919-1929*, London: Widenfeld and Nicolson

Malaysian Department of Statistics, Population and Housing Census. 2002. <www.statistics.gov.my/english/frameset_news.php?file=pressedu>

McAdam, Doug. 1986. 'Recruitment to High-Risk Activism: The Case of Freedom Summer', *American Journal of Sociology*, 92 (1): 64-90

McAdam, Doug, Sidney Tarrow, Charles Tilly. 2001 *Dynamics of Contention*, Cambridge, UK: Cambridge University Press

Milani, Mohsen. 1994. *The Making of Iran's Islamic Revolution*, 2nd edition, Boulder; Oxford: Westview

Mitchell, Richard. 1969. *The Society of the Muslim Brothers*, London, Oxford University Press

Moore, Pete and Bassel Salloukh. 2007. 'Struggles under Authoritarianism: Regimes, States, and Professional Associations in the Arab World', *International Journal of Middle East Studies*, 39 (2): 53-76

Munson, Henry Jr. 1986. 'The Social Base of Islamic Militancy in Morocco', *Middle East Journal*, 40 (2): 267-284

Munson, Ziad. 2001. 'Islamic Mobilization: Social Movement Theory and the Muslim Brotherhood', *The Sociological Quarterly*, 42 (4): 487-510

Nakhaie, Reza M. and Robert J. Brym. 1999. 'The Political Attitudes of Canadian Professors', *Canadian Journal of Sociology*, 24 (3): 329-353

Nesser, Petter. 2004. *Jihad in Europe – a Survey of the Motivations for Sunni Islamist Terrorism in Post-millennium Europe*, Norwegian Defence Research Establishment <http://rapporter.ffi.no/rapporter/2004/01146.pdf>

Nesser, Petter. 2006. *How Does Radicalization Occur in Europe?*, Presentation given at the Second Inter-Agency Radicalization Conference, hosted by the US Department of Homeland Security, Washington DC, July 2006 < www.mil.no/multimedia/archive/00080/DHS_foredrag_80480a.pdf>

Oxford Analytica. 2006. 'Middle East: Intra-Regional Trade to Expand Slowly', *In-Depth Analysis*, Oxford, 19 April 2006

Palestinian Ministry of Higher Education. 2005. Enrolment Statistics <www.mohe.gov.ps> (in Arabic)

Pedahzur, Ami. 2005. *Suicide Terrorism*, Cambridge: Polity Press (also, The changing Patterns of Suicide terrorism, PowerPoint presentation, <terrorismexperts.org/changing_patterns.ppt>)

Rangwala, Glenn. 2005. Palestinian Biographies. <http://middleeastreference.org.uk/indexbio.html>

Reader, Ian. 2000. *Religious Violence in Contemporary Japan*, Richmond, Surrey: Routledge Curzon.

Ricolfi, Luca. 2005. 'Palestinians, 1981-2003', in D. Gambetta (ed.), *Making Sense of Suicide Missions*, Oxford: Oxford University Press, 77-129

Richards, Alan and John Waterbury. 1996. *A Political Economy of the Middle East*, 2nd ed., Boulder: Westview Press

Rodríguez, José A. 2005. 'Terrorist Network: In its weakness lies its strength', Working Papers EPP-LEA, Grupo de Estudios de Poder y Privilegio, Departament de Sociologia i Anàlisi de les Organitzacions, Universitat de Barcelona

Rose, David. 2004. '9/11: The European Dimension', unpublished section of contribution to Rose, D., Burrough, B. and Zeman, N. (2004). 'The Path to 9/11', *Vanity Fair*, New York. September 2004.

Roy, Olivier. 1990. 'Les nouveaux intellectuels islamistes: essai d'approche philosophique', in Gilles Kepel and Yann Richard (eds.) *Intellectuels et Militants de l'Islam Contemporain*, Paris: Editions du Seuil, 261-283

Roy, Olivier. 2004. *Globalised Islam: the Search for a New Ummah*, London: Hurst & Co

Rubinstein, Ariel. 2006. 'A sceptic's comment on the study of economics', *The Economic Journal*, 116 (March): C1-C9

Russell, Charles A. and Robert E. Hildner. 1971. 'Urban Insurgency in Latin America: its Implications for the Future', *Air University Review*, 22 (6): 54-64

Russell, Charles A. and Bowman Miller. 1977. 'Profile of a Terrorist', *Terrorism*, 1 (1): 17-34

Salert, Barbara. 1976. *Revolutions and Revolutionary*, New York: Elsevier

Sageman, Marc. 2004. *Understanding Terror Networks*, Philadelphia: University of Pennsylvania Press

Saudi Arabia, Kingdom of. *Annual Statistical Yearbook*, various issues

Saudi Arabian Monetary Agency. 2006. *Forty-Second Annual Report*

Saudi Arabian Ministry of Planning. 1999. *Seventh Development Plan*

Saudi Arabian Ministry of Planning. 2004. *Eighth Development Plan*

Schulz, Reinhard. 1990. 'Zum Hintergrund Islamischer Politischer Bewegungen', in Bahman Nirumand (ed.), *Im Namen Allahs. Islamische Gruppen und der Fundamentalismus in der Bundesrepublik Deutschland*, Dreisam-Verlag: Köln

Singaporean Ministry of Education. 2006. *Education Statistics Digest*

Singaporean Ministry of Home Affairs. 2003. *White Paper - The Jemaah Islamiyah Arrests and the Threat of Terrorism*

Smith, Brent and Kathryn Morgan. 1994. 'Terrorists Right and Left: Empirical Issues in Profiling American Terrorists`, in *Studies in Conflict and Terrorism*, 17 (1): 39-57

Smith, Shawna, Yuan-Ling Chiao, Aaron Johnston., et. al. 2003. 'Why Are Islamic Militants More Likely to Emerge from Science/Engineering Departments?' Students' Project, Hilary Term, University of Oxford, Department of Sociology

Snow, David A., E. Burke Rochford, Steven K. Wordon, and Robert D. Benford. 1986. 'Frame Alignment Processes, Micromobilization, and Movement Participation', *American Sociological Review*, 51 (4): 464-81.

Sonbol, Amira el-Azhary. 1988. 'Egypt', in Hunter (ed.), 23-38

Stark, Rodney, Laurence R. Iannaccone, and Roger Finke. 1996. "Religion, Science, and Rationality." *American Economic Review Papers and Proceedings* 86 (2): 433-437

Stark, Rodney, Laurence R. Iannaccone, and Roger Finke. 1998. 'Rationality and the "Religious Mind"' *Economic Inquiry*, 36: 373-89

Tacchi, Francesca. 1994. 'L'Ingegnere, il Tecnico della "Nuova" Società Fascista', in Gabriele Turi (ed.), *Libere Professioni e Fascismo*, Franco Angeli: Milano, 177-216

Tarrow, Sidney. 1998. *Power in Movement: Social Movements and Contentious Politics*, Cambridge: Cambridge University Press

Tilly, Charles. 2004. *Social Movements, 1768-2004*, Boulder: Paradigm Publishers

Tocqueville, Alexis de. [1857] 1988. *The Ancien Régime*. London: J.M. Dent & Sons

UNDP. 2003a. *The Arab Human Development Report*. New York: United Nations Development Programme, Regional Bureau for Arab States

UNDP. 2003b. *National Human Development Report: Saudi Arabia*, Riyadh: United National Development Program/Saudi Ministry of Economy and Planning

UNESCO. 2005. *Education Trends in Perspective – Analysis of the World Education Indicators*, Montreal: Unesco Institute for Statistics; Paris: Organisation for Economic Co-Operation and Development.

von Baeyer-Katte, Wanda and Dieter Claessens, Hubert Feger, et. al .1983. *Analysen zum Terrorismus*, Vol. 3, Gruppenprozesse, Opladen, Germany: WDV

Waltz, Susan. 1986. ‘Islamist Appeal in Tunisia’, *Middle East Journal*, 40 (4): 651-670

Wickham, Carrie. 2002. *Mobilizing Islam: Religion, Activism and Political Change in Egypt*, New York; Chichester: Columbia University Press

Wiktorowicz, Quintan, ed. 2004a. *Islamic Activism: a Social Movement Theory Approach*, Bloomington: Indiana University Press

Wiktorowicz, Quintan. 2004b. ‘Joining the Cause: Al-Muhajiroun and Radical Islam’, paper presented at workshop on Roots of Islamic Radicalism, Yale University

Wright, Lawrence. 2002. ‘The Man behind bin Laden’, *The New Yorker*, 16 September

Wright, Lawrence. 2006. *The Looming Tower: Al-Qaeda and the Road to 9/11*, New York: Knopf