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Working Paper No 2012-38
November 2012

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5 November 2012, 7500 words

Abstract

Using social network analysis, our first aim is to illuminate the relationships between the Islamists and the rebels involved in the Malian conflict. We use a selection of newspaper articles to demonstrate that the connection between Islamists and rebels depends on brokers who passed from the Tuareg rebellion to radical groups. Our second objective is to detail the internal relationships within each of the subgroups. Our findings show how Islamists were affected by the accidental disappearance of one the AQMI regional emirs and how the death of one of the architects of the Tuareg rebellion affected rebel cohesion.

Keywords: terrorism; Islamists; Tuareg rebellion; social network analysis; Al-Qaeda in the Islamic Maghreb; Sahel; Sahara

[1] The authors thank Alain Antil and Charles Thomas for their useful comments on earlier versions of the article.

1. Introduction

The nature and extent of terrorist activities in the Sahel and in the Sahara has, until recently, been uncertain (International Crisis Group 2005, Antil 2006, Keenan 2009). Was the rash of kidnappings and assassinations the work of the Algerian secret service, or of religious extremists? Was the Malian government playing with fire by turning a blind eye to the gradual infiltration and establishment of armed groups from Algeria in the north of the country? Since the end of 2011, however, authorities have been forced to conclude that Islamic terrorism in Mali is a reality. Al-Qaeda in the Islamic Maghreb (AQIM) militants and their local affiliates are active in the major cities and roads across the northern half of the country. Several weeks were all it took for these forces to drive the Malian army out of the largest desert in the world, leading to the partition of Mali.

The religious extremists were able to gain a foothold in northern Mali because of their alliance with the Tuareg rebels of the National Movement for the Liberation of Azawad (MNLA) in the first months of their 2012 offensive. The alliance has since dissolved due to conflicts between the Islamists and Tuareg rebels to the advantage of the former who now control not only military operations north of Mopti, but also trafficking into the Sahara and Sahel, a region well known as a zone of informal and illegal activities (Brachet et al. 2011, Retaillé and Walther 2011a). The rise of Islamist forces and their aim to institute a new political regime based on the strict application of *Sharia* law has severely frustrated the rebel's own nationalist agenda.

The military, Islamists and rebels, however, are not perfectly distinct groups. In general, the personal allegiances of individuals have been changeable according to shifting opportunities: some Tuareg from the Malian army have joined with the rebels of the MNLA in a quest to conquer the north of the country, whereas some rebels joined with the Islamists when it appeared that they would be the winning side. The cooperative and conflicting relations between these actors have not previously been studied using social network analysis (SNA). Studies on Sahara-Sahelian terrorism have tended to focus on the historical development of terrorist groups (Larémont 2011, Emerson 2011), radical propaganda (Torres Sorianoa 2010, 2011), or the geopolitical challenges and counterterrorism measures (Cline 2007, Pham 2010). None of these approached employs network analysis to establish and analyze key actors or their relationship to one another such has been used in studies of terrorist groups elsewhere in

the world (Krebs 2002, Koschade 2006, Rodriguez 2005, Basu 2006, Carley 2003, 2006, Carley, Lee and Krackhardt 2002, McCulloh, Carley and Webb 2007).

Using SNA, the first aim of this article is to illuminate the relationships between individuals belonging to Islamist and rebel groups. To what degree are they connected? Are they distinctive subgroups or are these groups strongly integrated? We use a selection of newspaper articles published between 2010 and 2012 to demonstrate that the connection between Islamists and rebels depends on a small number of brokers who passed from the Tuareg rebellion to Islamist groups. Our second objective is to detail the internal relationships within each of the subgroups. Our findings show how Islamists were affected by the accidental disappearance in 2012 of one the AQMI regional emirs and how the death of one of the architects of the Tuareg rebellion affected rebel cohesion. This article highlights the instability and fragile nature of social relations in the Sahel-Sahara region.

2. Case study and methodology

2.1. The Malian conflict

In 2003, under pressure from the army and Algerian intelligence, terrorists from the Salafist Group for Preaching and Combat (GSPC) – which became Al-Qaeda in the Islamic Maghreb (AQIM) in 2007 – fled to the Malian desert after kidnapping thirty European tourists in southern Algeria. These groups, tolerated by the government of Mali, began to build political and familial alliances with the Tuareg and Arab tribes (Retaillé and Walther 2011b). AQIM leader Mokhtar Belmokhtar, in particular, is reported to have married four women from prominent Tuareg and Bérabiche origin (Larémont 2011).

At the dawn of 2010 conditions for the development of extremist groups – such as the Movement for Oneness and Jihad in West Africa (Mujao), formed in 2011, and Ansar al-Dine formed in 2012 – were particularly favorable. These groups drew members from Malian Tuareg as well as Arabs and Algerians. Kidnapping and cross-border trafficking sustained these groups and, thanks to the fall of Muammar Qaddafi in Libya in 2011 and of Amadou Toumani Touré in Mali in 2012, enabled them to lead a broad based offensive against the disorganized and under resourced Malian army. In the first months of the conflict a provisional alliance between the Islamists and MNLA rebels permitted the rapid advance of troops and the capture of the cities of Kidal, Timbuktu and Gao (Map 1). However, it wasn't

long until AQIM, Ansar al-Dine and Mujao Islamists forced out the forces of the MNLA, even chasing them from their own occupied cities. The survivors surrendered, disappeared, or changed sides.

Map 1. Map of Mali showing the region claimed as 'Azawad'

Sources: Bernus (1993), MNLA website, authors. Cartography: authors.

So what happened? MNLA forces thought that an alliance with these developing terrorist organizations could help them establish Azawad, their own independent state. What they didn't realize was that the strength and survival of terrorist networks depends on constant movement. Terrorist cells are not concerned with acquiring land or expending resources to control territory (Retaillé and Walther forthcoming). After using the nomad's knowledge and networks to gain control of key routes and settlements the AQIM and Ansar al-Dine dissolved the alliance and drove home their point by destroying the tombs of the saints of Timbuktu. As a result none of the diplomatic missions led by the Malian government, its neighbors, by international institutions such as the Economic Community of West African States (ECOWAS) or by western allies succeeded in arresting the progress of extremists in Mali.

2.2. Methodology

Given the dangerous conditions of doing fieldwork in the Sahara-Sahel region, collecting first-hand information on the Islamist and rebel networks is something of a challenge. Consequently we opted to use publicly available data from the media as a basis for our analysis. The advantages and disadvantages of this method have been widely discussed in the literature (see Ressler 2006, Krebs 2002, Rothenberg 2002, Sageman 2004, Roberts and Everton 2011). As is often the case in analyzing terrorist networks from publicly available sources, missing actors or missing links are likely to alter the centrality measures conducted in our work, which calls for caution regarding the interpretation of the rank of each actor.

Despite these shortcomings, social network analysis can provide an important contribution to understanding the conflict. Indeed, the Malian case offers the opportunity to analyze a group of actors that normally operates through a covert network. Since the mid-2000s, Mali has offered a sanctuary as well as a promotional platform for a large number of ambitious individuals tied to terrorist groups. Many of them have openly appeared in the media, giving interviews, or been photographed in action. Dozens of portraits and biographies have been published in the media. The unusual publicity around terrorists and rebels engaged in the Mali conflict strongly contrasts with the lives of most of the terrorists around the world and reduces the risks of missing an extremely important actor or neglecting a crucial connection.

Our network analysis is based on the analysis of a selection of articles published between July 2010 and September 2012 by the French daily *Le Monde* (27 items) and the weekly *Jeune Afrique* (30 articles). We used the keywords 'Al-Qaeda', 'AQIM', 'Mujao', 'MNLA', 'Ansar al-Dine', 'Malian rebellion', 'Islamism' and / or 'terrorism' to select the most pertinent articles among the hundreds that were dedicated to the Malian conflict during this period. Thanks to their special envoys and informants, both *Le Monde* and *Jeune Afrique* are generally well informed about the evolution of the political and military situation in the region and have proved a reliable source of information. The period between 2010 and 2012 was chosen as it covers not only the recent conflict between the Malian army, the Tuareg rebellion and the AQMI affiliated terrorists, but also some of the earlier violent events that include killings and abductions in the Sahel-Sahara region (see Walther and Retaillé 2010). The period 2010-2012 also coincides with a renewed interest in terrorism in the French media after the abduction of several employees of Areva, a French nuclear energy firm, in October 2010 in Niger. This selection of articles was supplemented by a review of 25 articles

published on African news websites such as African 1, Tamtaminfo, Sahara Media, Occitan Touareg and Maliactu, and El Watan.

Our second step was to look for all the names and surnames contained in this corpus of 82 texts. Because our analysis focuses on the relationship between Islamist and rebels we have deliberately ignored the names of government politicians, soldiers from the Malian army and representatives of regional organizations. Our database is composed of 42 players including 28 Islamists and 14 rebels. Among the Islamists are representatives of Al-Qaeda in the Islamic Maghreb (AQIM), the Movement for Oneness and Jihad in West Africa (Mujao), Ansar al-Dine, the Salafist Group for Preaching and Combat (GSPC) and the Libyan Islamic Fighting Group (LIFG). These groups have different philosophies and are referred to as 'Salafist', 'Jihadist' or 'Jihadist Salafists' in the literature. In this paper, we classify all these actors as 'Islamist' and refer the reader to the scholarly work distinguishing between the religious movements (see Meijer 2009, Egerton 2011, Ould Mohamed 2012). Among the rebels, we found representatives from the National Movement for the Liberation of Azawad (MNLA) and the May 23, 2006 Democratic Alliance for Change (ADC).

The spelling of names and surnames can greatly vary depending on the language and the authors of the articles and terrorists are well known to use several nicknames or *noms de guerre*. For example, Mokhtar Belmokhtar, an influential AQIM emir of the region, is also known as Laouar, Belawar, Bal'ur, le Borgne (all referring to the fact that he is one-eyed) and Khaled Abou al-Abbas. Abdelhamid Abou Zeid, another AQIM emir, is known as Mohamed Ghadir or Ghedir, Abid Hammadou, and Abdoul Hamid al-Sufi, among others. Because of such variance in the names of the actors, it was necessary to ascertain whether the identified individual were unique through a list of potential aliases for each. In addition, the texts analyzed sometimes evoked deceased individuals, such as Nabil Sahraoui (2004), Ibrahim Ag Bahanga (2011), Bouna Ag Tahib (2012) and Nabil Abu Alkama (2012), captured individuals such as Abderazak El Para (2004) or Necib Tayeb (2012), or individuals who surrendered to government forces such as Hassan Hattab (2007). Since our analysis is restricted to the last two years of the Malian conflict, we did not consider individuals who deceased, were captured or surrendered before 2010.

Our third step was to identify whether any of the 42 actors was connected to any of the others. We determined that a tie existed between two actors if they had participated in a common

political or military event, whatever the duration or location of the encounter. Such *operational ties* result, for example, from a political meeting, a training in Afghanistan, Iraq or Libya, a participation in combat, a negotiation for hostage release, or an involvement with a killing, an abduction or a bombing. Data were also collected on the terrorist or rebel organizational membership and on the official role of each of the actors in the seven organizations described earlier. We resisted the temptation to assume that all members of the same organization were necessarily interconnected because our interest is less in hierarchical relationships within existing organizations than in discovering the relationship actually reported in the literature. This work is a preliminary attempt to describe the connections between terrorists and rebels and only reflects a partial aspect of the complexity of the relations exchanged within or between these groups. Our dataset does not include friendship and kinship ties, neither does it provide information on internal communication, location, or financing.

3. Network analysis

In this section we first look to what extent the Islamists and rebels are interconnected in network terms before turning our attention to the internal organization of both AQIM and the MNLA. Different measures of centrality are used to characterize the position of a node in the network: degree, betweenness and closeness (Freeman 1979). The total degree centrality of a node corresponds to the normalized sum of its row and column degrees. Individuals with a high total degree centrality are connected to many others, which give them access to various ideological and financial resources. The betweenness centrality of a node corresponds to its position as a broker or gatekeeper between other nodes. Individuals with a high betweenness centrality are potentially influential because other actors need to pass through them to access other actors. The closeness centrality refers to the inverse of the average distance from a node to the other nodes of the network. Individuals scoring high on this measure are closer to the other and can spread information between nodes easily.

3.1. How Islamists and rebels are connected

The scale of activities and governance structures of terrorist networks vary widely across the world. Some networks primarily conduct their activities on a local scale while some other groups operate at a global level. Building on Uzzi's (1996) and Burt's (2005) ideas that successful networks must balance embeddedness and brokerage, Everton (2012) recently

argued that any successful network should avoid being too 'provincial' (high levels of clustering and an abundance of strong ties), and being too 'cosmopolitan' (low levels of clustering and weak ties). In addition, efficient networks must also maintain a balance between heterarchy and hierarchy, which means that they should avoid being decentralized in too many cells but at the same time should not be centralized around a single central actor (Morselli, Giguère and Petit 2007, van der Hulst 2011). The 9/11 network offers a good illustration of a network with a high level of security but a low level of information exchange between its members. This was primarily due to the high average distance between hijackers and presence of alternative routes that permitted the dissemination of information even if important nodes we compromised (Krebs 2002).

As shown in Table 1, the provincial-cosmopolitan balance can be analyzed through several measures, including density, average degree centrality, clustering coefficients and small world quotients. The heterarchy-hierarchy balance can be measured with degree, closeness and betweenness centralization, which all show how centralized a network is, or by calculating the variance of degree centrality.

Table 1. Comparison of terrorist network's topographical metrics

	Whole network	**Islamists sub-network**	**Rebels sub-network**
Number of nodes	42	30	14
Number of links	68	47	21
Number of isolates	6	4	2
Provincial-cosmopolitan balance			
Density	0.079	0.108	0.231
Network fragmentation	0.268	0.270	0.275
Average degree	3.238	2.889	2.800
Clustering coefficient (CC)	0.336	0.361	0.279
Clustering coefficient ratio	6.109	4.056	3.669
Average path length distance (APL)	2.975	2.428	2.152
Average path length distance ratio	0.972	0.951	1.009
Small-world quotient	6.285	4.265	3.636
Heterarchy-hierarchy balance			

Degree centralization	0.199	0.322	0.269
Betweenness centralization	0.396	0.268	0.187
Closeness centralization	0.056	0.080	0.135
Degree centrality variance	51.503	128.570	266.667

Calculations by the authors using ORA (Carley 2012) and UCINET (Borgatti et al. 2002).

Results show that the network composed of both Islamists and rebels is more 'cosmopolitan' than 'provincial': its low density, relatively low level of clustering and small-world quotient suggest that it is composed of sub-networks characterized by nodes that are not nearest neighbors but can be reached through relatively few intermediaries. The whole network also appears to be relatively non-hierarchical as shown by a low degree centralization value. This network is actually very similar to the Noordin Top's Terrorist Trust Network studied by Roberts and Everton (2011) and Everton (2012), who is believed to be responsible for several bombings in Indonesia in the 2000s. Similarities between the two networks can be found in terms of density (.079, .081), clustering coefficient (.336, .356), degree centralization (.199, .216) and degree centrality variance (51.503, 53.487).

Table 2 shows that the top 5 actors with the highest centrality almost all belong to one of the three terrorist groups AQMI, Mujao or Ansar al-Dine (in grey). AQIM national emir Abdelmalek Droukdel and his appointed Saharan emirs Mokhtar Belmokhtar, Abou Zeid, Yahyia and Abou Hamman appear among the most central actors whatever the measure of centrality considered. Nabil Abu Alkama, the fourth appointed Saharan emir, who died in 2012 in a car accident, is an exception. Among MNLA rebels, Ibrahim Ag Bahanga, who died in 2011, also in a car accident, is one of the most prominent agents. Ag Bahanga was considered one of the most radical leaders of the Tuareg rebellion. Secretary General Bilal Ag Cherif and two representatives of political affairs, Hama Ag Sid'Hamed and Mahmoud Ag Aghaly, also scores high in terms of centrality. Mohamed Ag Nakim is the only MNLA military representative with a high score.

Our descriptive analysis of the Malian terrorist network indicates that the "usual suspects", i.e. the most prominent actors are the ones most reachable within this network. Centrality and Closeness are highly correlated and in this case there are no surprises on the profile of actors. Degree centrality scores show that the network is composed of a limited number of highly connected actors from the three main Islamist groups, such as Mokhtar Belmokhtar (AQIM),

Hamada Ould Khairou (Mujao) and Iyad Ag Ghaly (Ansar al-Dine) and a large number of loosely connected agents. Highly connected actors correspond to agents who coordinate the activities of the network in the absence of a strong core. Closeness centrality scores give a roughly similar picture: the agents with the highest scores are, again, the Saharan emirs of AQIM as well as the leaders of the two other Islamist groups, the Malian Ag Ghaly (Ansar al-Dine) and the Mauritanian Ould Khairou (Mujao), whose prominence may be explained by the fact that, being a spokesman, he has been frequently mentioned in the newspapers.

Table 2. Top-scoring nodes for selected centrality measures

Degree		**Betweenness**		**Closeness**	
Hamada Ould Khairou (Mujao)	0.314	Iyad Ag Ghaly (Ansar al-Dine)	0.582	Iyad Ag Ghaly (Ansar al-Dine)	0.538
Iyad Ag Ghaly (Ansar al-Dine)	0.314	Hamada Ould Khairou (Mujao)	0.307	Mokhtar Belmokhtar (AQIM)	0.467
Mokhtar Belmokhtar (AQIM)	0.286	Hama Ag Sid'Hamed (MNLA)	0.205	Hamada Ould Khairou (Mujao)	0.461
Ibrahim Ag Bahanga (MNLA)	0.200	Mokhtar Belmokhtar (AQIM)	0.200	Abou Zeid (AQIM)	0.443
Abou Zeid (AQIM)	0.171	Ibrahim Ag Bahanga (MNLA)	0.119	Hama Ag Sid'Hamed (MNLA)	0.432
Bilal Ag Cherif (MNLA)	0.171	Moussa Ag Assarid (MNLA)	0.113	Ibrahim Ag Bahanga (MNLA)	0.427
Hama Ag Sid'Hamed (MNLA)	0.171	Yahyia Abou Hamman (AQIM)	0.094	Yahyia Abou Hamman (AQIM)	0.417
Mahmoud Ag Aghaly (MNLA)	0.171	Abou Zeid (AQIM)	0.092	Alghabass Ag Intalla (Ansar al-Dine)	0.402
Mohamed Ag Najim (MNLA)	0.171	Bilal Ag Cherif (MNLA)	0.079	Ahmada Ag Bibi (Ansar al-Dine)	0.398
Yahyia Abou Hamman (AQIM)	0.171	Alghabass Ag Intalla (Ansar al-Dine)	0.069	Hassan Fagaga (ADC)	0.380
Size	36		36		36
Mean	0.108	Mean	0.058	Mean	0.349
Std. dev.	0.081	Std. dev.	0.113	Std. dev.	0.067

Calculations by the authors using ORA (Carley 2012). Note: Islamists are indicated in grey and rebels in white.

Betweenness centrality indicates that there is considerable brokerage between the actors, since two actors – Iyad Ag Ghaly and Hamada Ould Khairou – have incredibly higher brokerage benefits than would be expected by chance. The picture however has to be substantially qualified when looking at Honest Brokerage, a much more sophisticated measure that identifies actors who provide unique connections or exclusive control of resources between other social actors. After Size and Pairs, Table 3 presents three raw Honest Brokerage Indices (HBI) and three normalized ones (nHBI) for a selection of top-scoring agents. HBI0 corresponds to pure brokerage, which means that there is no tie between any pair of alters joined by a broker. HBI1 is weak brokerage, which means that one directed tie is allowed between pairs of alters joined by a broker, and HBI2 represents non-brokerage, i.e. alters who have tie to a broker have two-way tie with each other as well (Christopoulos and Quaglia 2009). Results show that the two key actors Ag Ghaly and Ould Khairou are structurally equivalent in brokerage terms. AQIM leader Mokhtar Belmokhtar is slightly less relevant than the top two and then there are another six of their lieutenants that are structurally similar with one another (although their honest brokerage scores vary) in terms of their brokerage volume (number of pairs). A much more nuanced picture of brokerage has emerged.

Table 3. Top-scoring agents for Honest Brokerage indices

N°	Agent	Size	Pairs	HBIO	HBI1	HBI2	nHBI0	nHBI1	nHBI2
1	Bilal Ag Cherif	6	15	11	0	4	0.733	0.000	0.267
3	Hama Ag Sid'Hamed	6	15	7	0	8	0.467	0.000	0.533
6	Ibrahim Ag Bahanga	7	21	12	0	9	0.571	0.000	0.429
8	Mahmoud Ag Aghaly	6	15	5	0	10	0.333	0.000	0.667
9	Mohamed Ag Najim	6	15	8	0	7	0.533	0.000	0.467
20	Abou Zeid	6	15	8	0	7	0.533	0.000	0.467
27	Hamada Ould Khairou	11	55	45	0	10	0.818	0.000	0.182
28	Iyad Ag Ghaly	11	55	45	0	10	0.818	0.000	0.182
33	Mokhtar Belmokhtar	10	45	32	0	13	0.711	0.000	0.289
40	Yahyia Abou Hamman	6	15	8	0	7	0.533	0.000	0.467

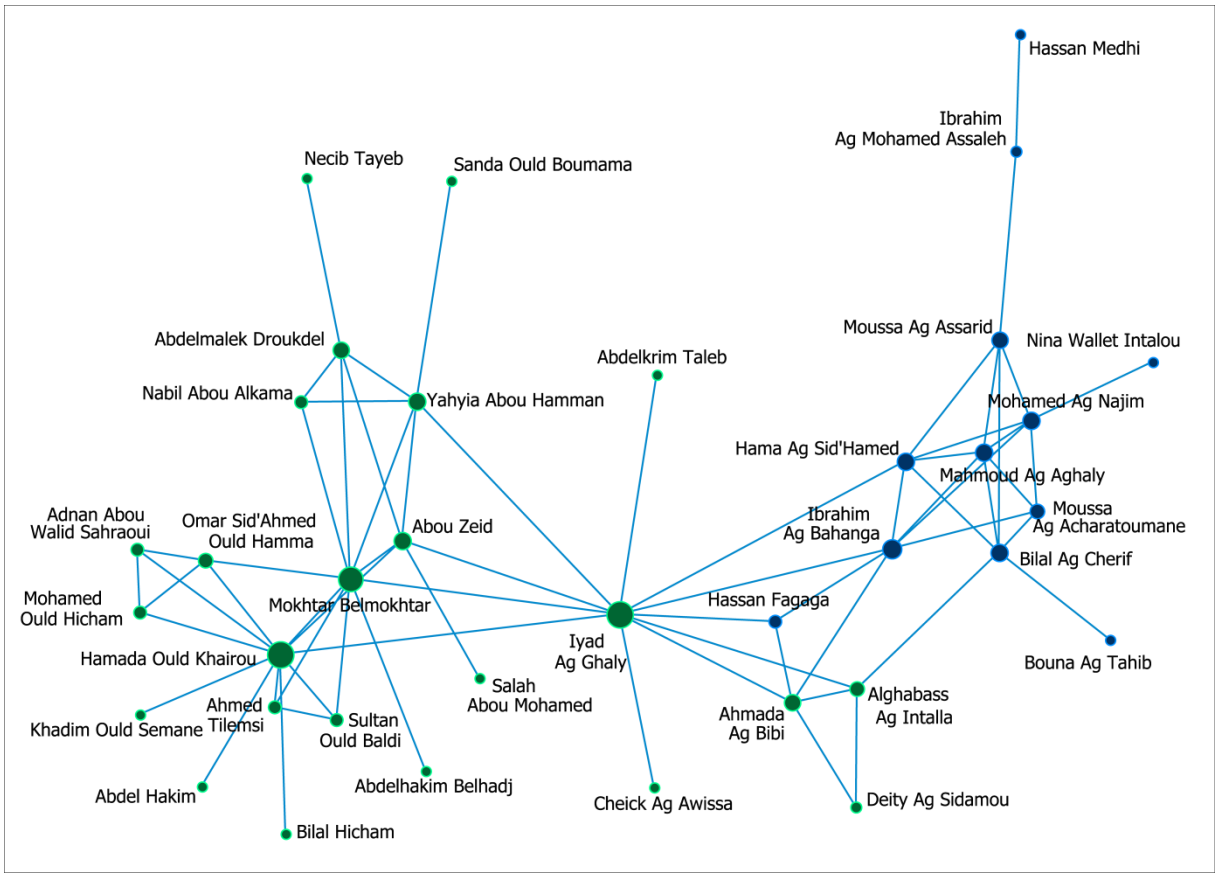
Calculations by the authors using UCINET (Borgatti et al. 2002).

The graph presented in Figure 1 shows how the Islamist and rebels are connected and how important each node is in terms of degree centrality. The more ties, the larger the nodes are. As with the rest of the paper, Islamists appear in green and rebels in blue.

As in other terrorist networks, actors who belong to a large number of distinct sub-structures where every agent is connected to every other agent (cliques) are found among senior leaders. Mokhtar Belmokhtar, the first Sahara emir to be appointed by AQIM, has the highest score in number of cliques (6 cliques), followed by Iyad Ag Ghaly, the leader of Ansar al-Dine and Mahmoud Ag Aghaly (5), MNLA President of the Political Bureau (5 cliques each).

Islamist leader Iyad Ag Ghaly may not be involved in as many cliques as Belmokhtar but he definitively holds an exceptional structural position in terms of brokerage. As shown in Table 2, his betweenness centrality score of .582 is almost twice as high as the one of Mujao leader Hamada Ould Khairou (.307), the next in line. Ag Ghaly connects the two largest cliques: the one composed of 12 Islamist actors on the left of Figure 2, and the one composed of 10 actors from both Islamist and rebel groups on the right.

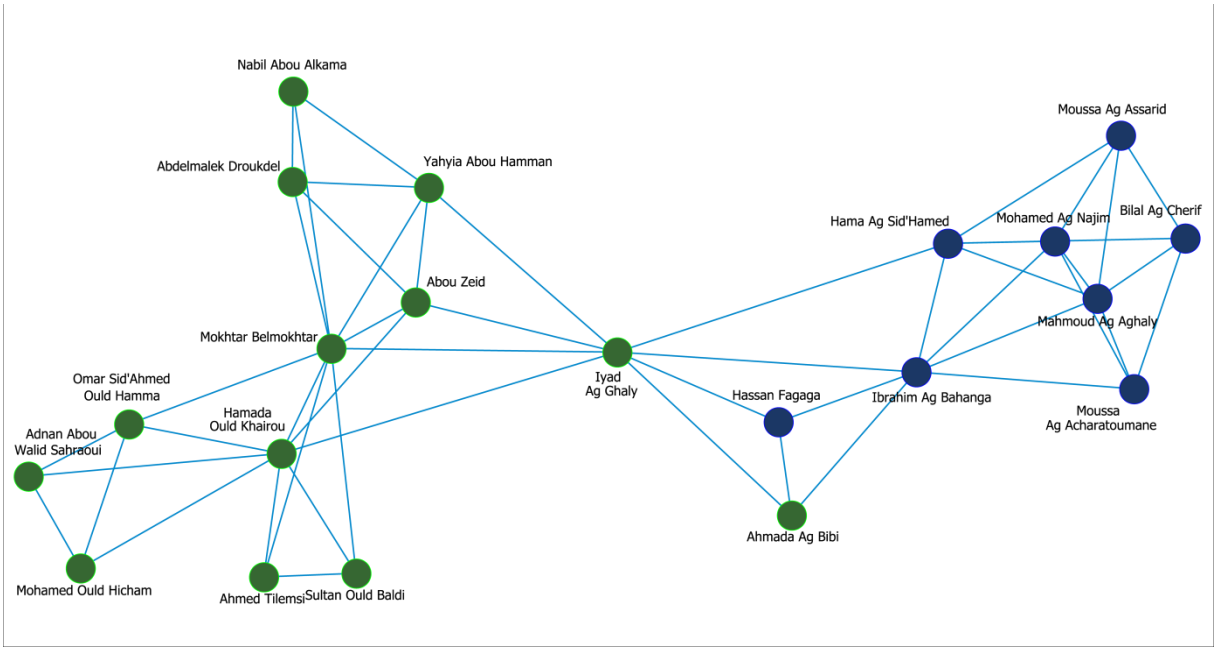
Figure 1. Network degree centrality



Source: authors using ORA (Carley 2012). Note: Islamists in green, rebels in blue. Isolates are not shown.

The impact of the hypothetical removal of Ag Ghaly would be extremely important in network terms since the network would break out in two major components. By comparing the values of the overall fragmentation of the network before and after the removal of Ag Ghaly, one can observe that this agent is the one whose disappearance would lead to the greater fragmentation of the network (+155%), while the hypothetical removal of Mokhtar Belmokhtar (+18%), Hamada Ould Khairou (+47%) and Abou Zeid (18%), three emirs of AQIM, would lead to significantly less disruption.

Figure 2. All-in-all cliques showing Iyad Ag Ghaly's prominent brokerage position



Source: authors using ORA (Carley 2012). Note: Islamists in green, rebels in blue.

The key position of Ag Ghaly can be explained by the fact that the network is highly homophilous, i.e. that Islamists and rebels tend to exchange more with actors from their own group rather than with another group. This gives a prominent advantage to brokers who can bridge the two groups. The E-I index, which measures the number of external ties minus the number of internal ties divided by the total number of ties (Krackhardt and Stern 1998) is strongly negative (-.735) and significant at $p<0.05$, which clearly indicates more internal ties. Only seven actors out of 42 have ties to another other group (16.7%) and only six out of 68 ties are exchanged between sub-groups (8.8%). Three of these ties go through Iyad Ag Ghaly, which gives him a great potential influence by controlling information, knowledge and resources exchanged between the sub-groups of the network. Other inter-groups ties involve

Ahmada Ag Bibi and Alghabass Ag Intalla among the Islamists, and Hassan Fagaga, Ibrahim Ag Bahanga, Hama Ag Sid'Ahmed and Bilal Ag Cherif among the rebels.

Iyad Ag Ghaly does not occupy a brokerage position by chance. Over the last decades he has successively been a fighter in the Islamic Legion of Muammar Gaddafi in the 1980s, a rebel in the 1990-1996 Tuareg rebellion, a negotiator in the release of European hostages (2003 and 2010), a consular councilor for the government of Mali in Saudi Arabia (2010), before trying to take the lead of the MNLA in 2011 and finally founding the Islamist group Ansar al-Dine. He is also not the only one in the region to have changed sides: Oumar Ould Hamaha was a Malian military in the 1990s before becoming commander of Ansar al-Dine at the beginning of the year 2012, and fighting with the Islamist movement Mujao in Douentza in September 2012. A number of influential Tuareg such as Deputies Ahmada Ag Bibi and Alghabass Intalla also joined the ranks of Ansar al-Dine from MNLA. These changes highlight the extreme fragility of local alliances in the Sahel-Sahara region, which very often rely more on family or tribal values than on formal organizations.

3.2. Internal ties within Islamists and rebels

The Islamist sub-network is structurally organized around different cells that are usually coordinated by a senior agent, very often a regional emir of AQIM or the leader of an affiliated organization. Table 4 shows how central the top actors are in terms of degree, betweenness and closeness. Mujao leader Ould Khairou and AQMI emirs such as Mokhtar Belmokhtar or Abou Zeid are particularly central actors while Iyad Ag Ghaly, who is not only a broker between the Islamists and the rebels but also has one of the highest betweenness centrality scores (.287) in his own sub-group.

Table 4. Islamist sub-network: Top-scoring nodes for selected centrality measures

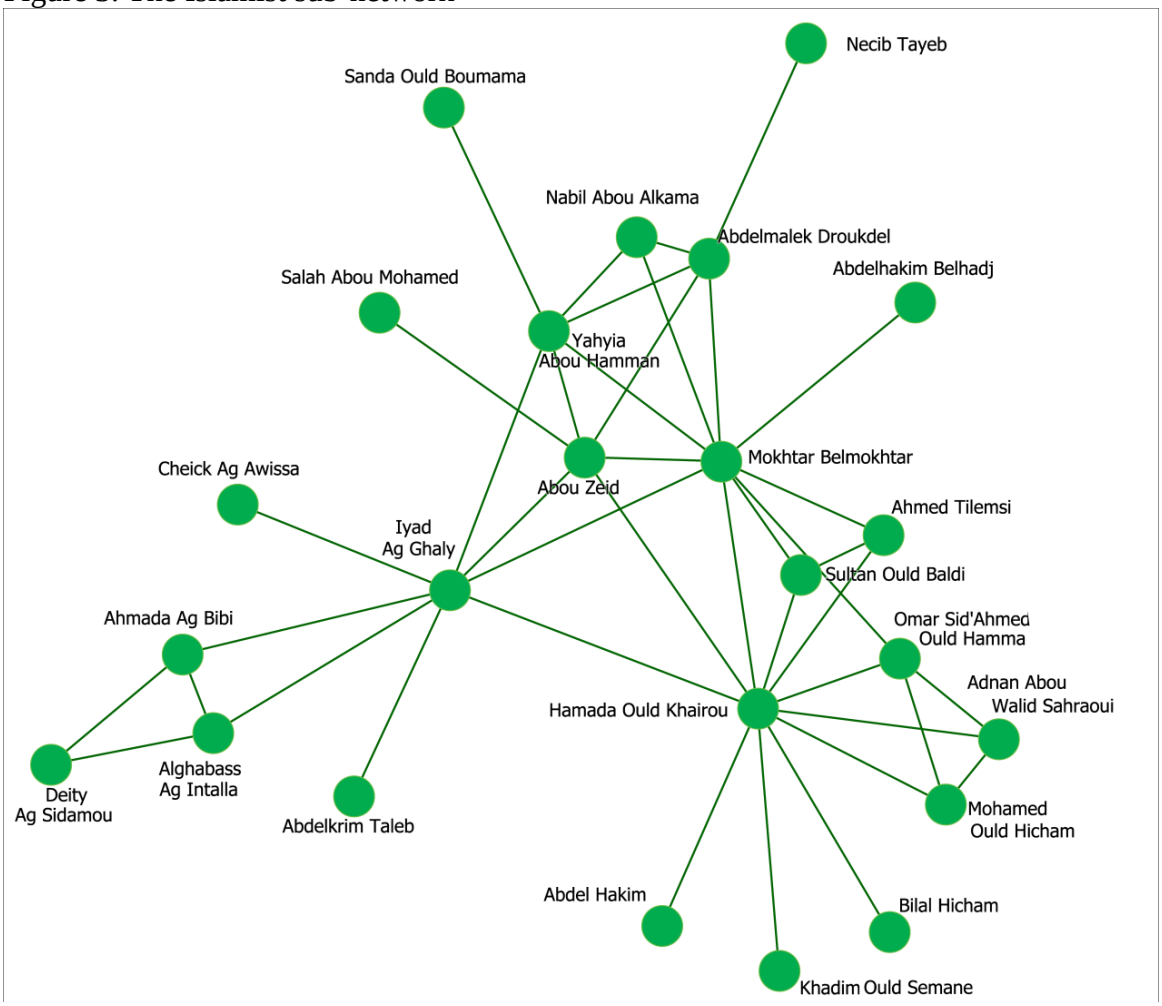
Degree		**Betweenness**		**Closeness**	
Hamada Ould Khairou	0.407	Hamada Ould Khairou	0.298	Mokhtar Belmokhtar	0.181
Mokhtar Belmokhtar	0.370	Iyad Ag Ghaly	0.287	Hamada Ould Khairou	0.180
Iyad Ag Ghaly	0.296	Mokhtar Belmokhtar	0.214	Iyad Ag Ghaly	0.179
Abou Zeid	0.222	Abou Zeid	0.100	Abou Zeid	0.176
Yahyia Abou Hamman	0.222	Yahyia Abou Hamman	0.085	Yahyia Abou Hamman	0.171
Abdelmalek Droukdel	0.185	Abdelmalek Droukdel	0.065	Omar Sid'Ahmed Ould Hamma	0.166

Mean	0.108	Mean	0.040	Mean	0.144
Std. dev.	0.107	Std. dev.	0.083	Std. dev.	0.045

Calculations by the author using ORA (Carley 2012).

Figure 3 provides a visualization of the ties within the Islamist sub-network. The graph notably shows the relations between the national leader Abdelmalek Droukdel, from Kabylia in Algeria, and the regional emirs that have successively been appointed to rule the Sahara-Sahel region: Mokhtar Belmokhtar, Abou Zeid, Yahyia Abou Hamman and Nabil Abu Alkama.

Figure 3. The Islamist sub-network



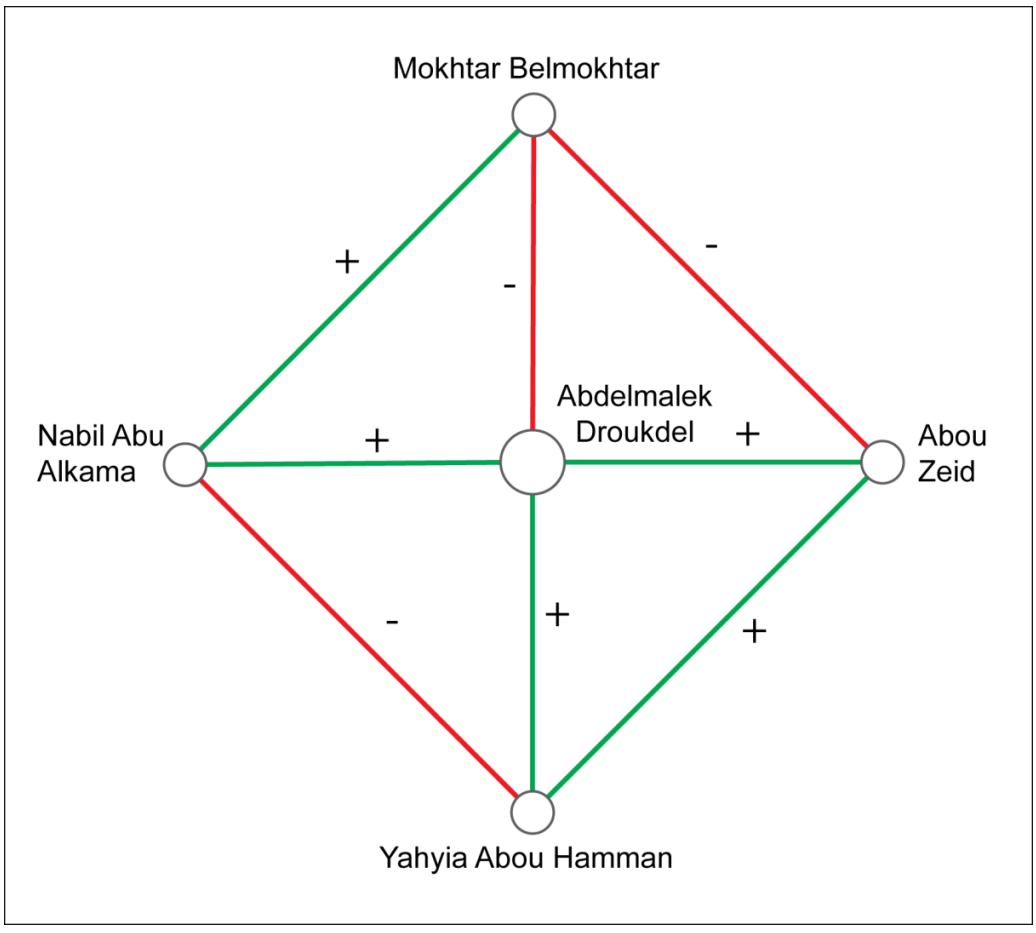
Source: authors using ORA (Carley 2012).

According to Abu al-Ma'ali (2012) and Larémont (2011), Mokhtar Belmokhtar was the first to be appointed Head of the 'Masked Battalion', named after the turban worn by Tuareg people of the Sahel-Sahara region. Belmokhtar was replaced in the mid 2000s by Abou Zeid,

who took the head of the 'Tariq Ibn Ziyad Battalion', named after the general who led the Islamic conquest of Spain in the 8th century. Disagreement between Belmokhtar and Abou Zeid led to the appointment of a third Emir, Yahyia Abu Ammar, in 2007, which reformed the military structure and divided the Sahara-Sahel into four formations: the 'Masked Battalion', the 'Tariq Ibn Ziyad Battalion', the al-Firaq Squadron led by himself and the al-Ansar Squadron led by Abdelkrim Taleb, the only non-Algerian leader. Following his rapprochement with Abou Zeid, Yahyia Abu Ammar was then replaced by Nabil Abu Alkama, who, until his death, has apparently maintained good relations with Belmokhtar.

As Figure 4 shows, the relations between Droukdel and the other Saharan emirs form four triads. According to the 'balance hypothesis' developed by Heider (1946), a balanced state exists if a triad contains three positive relationships, that is to say if three players all appreciate each other, or if the triad contains two negative and a positive ties, meaning that two players share the same negative apprehension of a third (Kadushin 2012).

Figure 4. Triadic theoretical relations between AQIM national and regional emirs



Sources: Abu al-Ma'ali 2012, Larémont 2011 and the authors.

Figure 4 shows that the oldest triad (Triad 1), consisting of Abdelmalek Droukdel and the first two emirs Mokhtar Belmokhtar and Abou Zeid, can theoretically be considered stable (two negative ties and one positive tie), as well as Triad 2 consisting of the second and third Sahara emirs Yahyia Abu Hamman and Abou Zeid (three positive relationships). The other triads are theoretically unstable because they are formed from two positive and one negative tie. The tie between Yahyia Abu Hamman and Nabil Abu Alkama was supposed negative because the latter was named in place of the former. Under the 'balanced hypothesis', unstable triads tend to evolve toward stable triads insofar as instability produces tensions that lead players to seek other forms of relationships. Among the four emirs successively appointed by Abdelmalek Droukdel, Abou Zeid was the only one in a position where he had an interest in maintaining the status quo, since two stable triads surrounded him, while Nabil Abu Alkama was in a reverse position.

His death in 2012 raised the question of the leadership of AQIM in the Sahel-Sahara region, particularly between Belmokhtar Mokhtar and Abou Zeid who, as noted earlier, were not known for maintaining good relationships. To address the question of the succession of the regional emir, Abdelmalek Droukdel dispatched Necib Tayeb, his representative in the region, in August 2012 but Tayeb was captured by Algerian security forces. In strictly network terms, however, the disappearance of Nabil Abu Alkama had no major effect on the structure of the sub-network, as shown in Table 5. The values calculated before and after the disappearance of the agent indicate that the network is a little less clustered (-6.03%) but the other measures were only marginally affected.

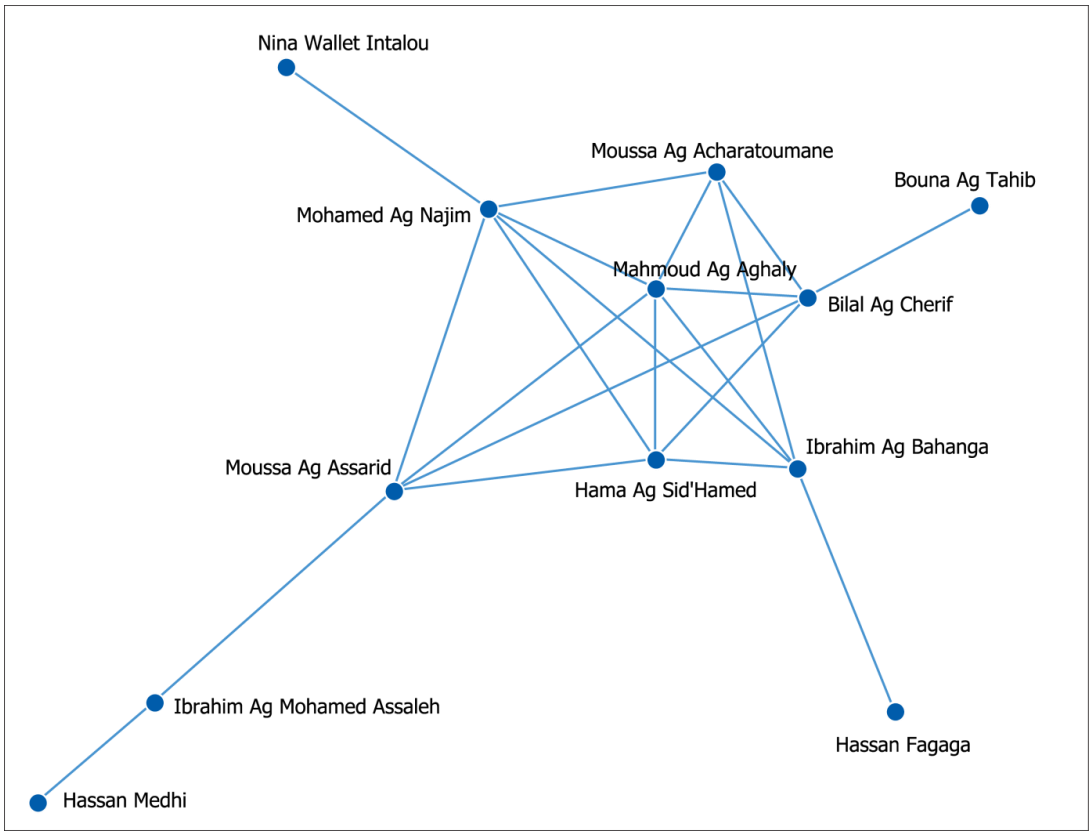
Table 5. Immediate impact of the removal of Nabil Abu Alkama on the Islamist sub-network

	Before	**After**	**Percent change**
Overall Complexity	0.108	0.108	-0.19%
Diffusion	0.943	0.941	-0.27%
Clustering Coefficient	0.361	0.340	-6.03%
Characteristic Path Length	2.428	2.431	+0.14%
Social Density	0.108	0.108	-0.19%
Average Communication Speed	0.412	0.411	-0.14%
Fragmentation	0.270	0.279	+3.47%

Calculations by the authors using ORA (Carley 2012).

It is now time to turn to the internal organization of the rebel sub-network. As shown in Figure 5, this network is structured around a clique of seven actors: Ag Cherif, Ag Assarid, Ag Aghaly, Ag Sid'Hamed, Ag Acharatoumane, and Ag Bahanga.

Figure 5. The rebel sub-network



Source: the authors.

These actors unsurprisingly score high according to the centrality measures shown in Table 6. Among those central agents, Ag Aghaly, who is President of the political bureau and Ag Najim, who is Head of military operations, have a particularly high total degree (.545) and closeness centrality (.647 and .611).

Table 6. Rebel component of the network: Top-scoring nodes for selected centrality measures

Total degree centrality		**Betweenness centrality**		**Closeness centrality**	
Mahmoud Ag Aghaly	0.545	Moussa Ag Assarid	0.345	Mahmoud Ag Aghaly	0.647
Mohamed Ag Najim	0.545	Mohamed Ag Najim	0.241	Moussa Ag Assarid	0.611
Bilal Ag Cherif	0.455	Bilal Ag Cherif	0.205	Hama Ag Sid'Hamed	0.611
Ibrahim Ag Bahanga	0.455	Ibrahim Ag Bahanga	0.186	Mohamed Ag Najim	0.611

Moussa Ag Assarid	0.455	Ibrahim Ag Mohamed Assaleh	0.182	Bilal Ag Cherif	0.550
Hama Ag Sid'Hamed	0.455	Mahmoud Ag Aghaly	0.102	Ibrahim Ag Bahanga	0.524
Mean	0.318	Mean	0.115	Mean	0.493
Std. dev.	0.184	Std. dev.	0.110	Std. dev.	0.114

Calculations by the authors using ORA (Carley 2012).

As with AQMI, MNLA was also affected by the death of one of its key members, Ibrahim Ag Bahanga in August 2011. Ag Bahanga was a fighter of Tuareg origin who had never really acknowledged the Algiers Agreements signed between the Malian government and the representatives of the May 23, 2006 Democratic Alliance for Change (ADC) to end the 2006 Tuareg rebellion, and as a consequence, exiled in Libya. Contrary to Nabil Abu Alkama, whose case was examined earlier, the disappearance of Ibrahim Ag Bahanga resulted in important changes in the rebels sub-network, notably as far as diffusion is concerned (-20.16%), which means that rebels are socially further apart than they used to be. As shown in Table 7, the network is also slightly less clustered than before (-3.35%), its path lengths are shorter (-6.01%) and its density has decreased (-11.11%).

Table 7. Immediate impact of the removal of Ibrahim Ag Bahanga on the rebels sub-network

	Before	**After**	**Percent change**
Overall Complexity	0.231	0.205	-11.11%
Diffusion	0.661	0.528	-20.16%
Clustering Coefficient	0.279	0.269	-3.35%
Characteristic Path Length	2.152	2.022	-6.01%
Social Density	0.231	0.205	-11.11%
Average Communication Speed	0.465	0.495	+6.39%
Fragmentation	0.275	0.423	+54.00%

Calculations by the authors using ORA (Carley 2012).

4. Conclusion

Gone are the days when the presence and danger of Islamism terrorism in the Sahara-Sahel region could be contested. The recent conflict in North Mali explicitly shows that several well-equipped and ideologically motivated extremist groups have established dominance over a large portion of Malian territory, ruling the main cities and progressively introducing Sharia

law. The success of such groups has been made possible by a temporary alliance between the terrorists of AQIM, Mujao and Ansar al-Dine on the one hand and the Tuareg-dominated MNLA rebels. Following the eviction of the MNLA fighters from most of the Malian cities, the failure of the Malian government to rebuild solid institutions and the current unlikelihood that the Malian army can reconquer the lost territory, terrorist leaders enjoy a freedom of movement that is nearly unrivaled elsewhere in the world.

Using publicly available data, this paper outlined the potential value of social network analysis to study the network formed by terrorists and rebels in this part of West Africa. We found that Islamists and rebels are interconnected through powerful brokers who, as Iyad Ag Ghaly, the leader of Ansar al-Dine, have passed from the rebellion to radical groups. These findings contradict the common idea that Tuareg are reluctant to engage into extremist religious activities. Our results also confirm some of the general findings highlighted in the terror networks literature. First of all, the network is composed of a small number of highly connected Islamists and rebels, who play a coordination role in a structure that has no visible central control hierarchy and a low density. The fact that there are alternative routes in the network is also consistent with existing literature. Senior leaders, such as the regional emirs appointed from Algeria belong to a multiplicity of cells, which give flexibility to the overall organization and resistant to threats. As shown in the second part of the paper, such threats are far from being rare in the life of terror networks: several important actors have been killed or captured over the last two years. The accidental death of two leaders of AQIM and MNLA has had different consequences: while the effect on the cohesion of the terrorist sub-network has been limited the loss of a radical MNLA leader has lead the nodes to be farther apart.

Building on Carley et al. (2003) and Tsvetovat and Carley (2005), these observations suggest that the next step is to study Islamists-rebels connections by combining information about the kind of knowledge and resources exchanged through the network, the tasks and roles performed by the agents, the type of organization, as well as the location where events or meetings have taken place[2]. Combining these sources of data would provide a much more complex picture of the social structure of the Islamic and rebel network in the region and

[2] This could be done by using one of the open source database available online, for example the University of Maryland Global Terrorism Database (GTD), which provides information on terrorist events around the world from 1970 through 2010 (http://www.start.umd.edu/gtd/about/).

address the fact that we conducted our study on a single-mode network with binary data and ignored multiplexity, i.e. the combination of several dimensions in network analysis.

In a mobile environment such as the Sahel-Sahara region, the inclusion of space in network analysis appears particularly promising. Terrorism is, together with international migration, cross-border smuggling, or cross-border investment flows, challenging the vision of nation-states as containers (Flint 2003) as well as the tools used by geographers so far to analyze mobility, such as place and distance. Terrorists have found favorable conditions to develop their activities in the north of Mali precisely because they can be easily mobile and exploit the weakness of territorial states. Further research is needed to grasp the spatiality of such mobile actors who do not rely on fixed locations or territories.

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