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Structure and Performance in a Violent Extremist Network: The Small-world Solution

Michael Kenney[1], Stephen Coulthart[2], and Dominick Wright[3]

Abstract

This study combines network science and ethnography to explore how al-Muhajiroun, a banned Islamist network, continued its high-risk activism despite being targeted for disruption by British authorities. We analyze news reports, interviews, and field notes using social network analysis and qualitative content analysis to test hypotheses pertaining to network structure and performance. Our analysis suggests that the activist network's structural properties had important implications for its performance during three separate time periods. What began as a centralized, scale-free-like, small-world network centered on a charismatic leader evolved into a more decentralized "small-world-like" network featuring clusters of local activists connected through multiple bridges. This structure allowed the activist network to engage in contentious politics even as its environment became increasingly hostile. We conclude by discussing the implications of al-Muhajiroun's small-world solution for scholars and policy makers.

[1]Graduate School of Public and International Affairs, University of Pittsburgh, Pittsburgh, PA, USA
[2]National Security Studies Institute, University of Texas at El Paso, TX, USA
[3]Department of Defense, Washington, DC, USA

Corresponding Author:
Michael Kenney, Graduate School of Public and International Affairs, University of Pittsburgh, 3935 Wesley W. Posvar Hall, 230 South Bouquet Street, Pittsburgh, PA 15216, USA.
Email: mkenney@pitt.edu

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Countering violent extremism has become one of the principal security challenges facing Western democracies. This challenge has grown in recent years as thousands of young Europeans, including over 700 men and women from Britain, migrate to Syria and Iraq to fight against the Bashar al-Assad regime and help build the "Islamic State" declared by Abu Bakr al-Baghdadi. In Britain, authorities have sought to counter this threat by targeting individuals and networks believed to be radicalizing young men and women into violent extremism. A primary target of these efforts is al-Muhajiroun, an illegal activist network that seeks to establish Islamic rule within Britain—and globally. Since its formation in January 1996, al-Muhajiroun has radicalized hundreds of young men and women into its syncretic interpretation of Salafi-jihadism and Islamism. While it specializes in nonviolent activism, individuals associated with the network have carried out acts of political violence, including a suicide bombing that killed three people and injured fifty-five more in Tel Aviv in 2003, the brutal slaying of an off-duty soldier on the streets of London in May 2013, and the first two suicide bombings by British nationals in Iraq and Syria in February and November 2014.

Following the 7/7 bombings in 2005, British authorities cracked down on al-Muhajiroun and other groups they believed were inciting young people to political violence. The government outlawed al-Muhajiroun, making it a crime for individuals to mobilize on its behalf, and targeted its *emir*, Omar Bakri Mohammed, and other leaders for arrest and prosecution. British police enforced the ban against al-Muhajiroun by disrupting its public talks, arresting activists at demonstrations and public preaching (*da'wah*) stalls, and raiding their homes and educational centers. Then, in September 2014, as Britain and other Western countries became increasingly concerned about the flow of young citizens to the Islamic State in Iraq and Syria, counterterrorism police officers executed a series of raids targeting the network's leaders, arresting Anjem Choudary and eight other activists on suspicion of encouraging terrorism and belonging to a banned organization.[1]

Despite the pressure, al-Muhajiroun has not only survived, it has continued its activism, both locally and internationally. On the local scene, activists preach to passersby at da'wah stalls they organize on some of the busiest high streets in London and other cities. They also continue to organize public demonstrations on a range of issues. In the summer of 2014, activists held rallies and handed out leaflets announcing their support for the Islamic State in Iraq and Syria (ISIS). Since the September 2014 roundup of network leaders, activists have staged protests in London, Birmingham, Cardiff, and Luton. Internationally, activists helped create a series of like-minded groups in Belgium, Holland, and other countries, modeled after their popular Islam4UK and Shariah4UK platforms. When British authorities

made it difficult for al-Muhajiroun to arrange their public events in brick-and-mortar venues, the network moved its activism online, aggressively promoting its transnational agenda and ideology through a variety of websites and social media.

What explains al-Muhajiroun's resilience? How has the transnational activist network continued to mobilize its supporters in the face of government force? This article examines these questions by combining ethnography and network science to explore how al-Muhajiroun evolved in response to pressure. In focusing intently on a single case, a "dark network" British officials have prioritized in their efforts to counter violent extremism, we have collected, coded, and analyzed extensive data spanning eighteen years, including field work carried out between 2010 and 2014. Blending these data allows us to incorporate longitudinal and ethnographic perspectives that are missing in many studies of illicit networks. Our analysis suggests that al-Muhajiroun responded to environmental hostility by becoming less centralized and more tightly clustered over time. What began as a centralized, "scale-free-like" network centered on a charismatic leader evolved into a more decentralized "small-world-like" network featuring clusters of local activists connected through multiple bridges. This small-world structure was essential to al-Muhajiroun's ability to mobilize its supporters even as the British government sought to destroy it.

Theory and Hypotheses

Networks have received substantial attention from students of international relations in recent years (McClurg and Lazer 2014). Scholars have sought to understand how networks of intergovernmental organizations influence cooperation and conflict between states (Hafner-Burton and Montgomery 2006; Maoz 2010); how networks of transnational advocacy groups spread human rights norms and constrain state behavior (Keck and Sikkink 1998); and how networks of government agencies and nongovernmental organizations standardize practices and regulations in such diverse fields as arms control, international finance, and environmental protection (Kahler 2009).

Recent scholarship on social networks in international relations seeks to explain how node-level centrality, often conceptualized as power, affects political behavior (Hafner-Burton, Kahler, and Montgomery 2009; Murdie 2014). While these studies have advanced our knowledge of political networks, we pursue an alternative theoretical path. In contrast to recent studies, we focus on the topology of the overall network, exploring how al-Muhajiroun's macro-level structure changed over time and influenced network performance. Consistent with sociological research on network topology (Uzzi and Spiro 2005; Watts 2003), we highlight three basic types of networks—distributed, scale free, and small world—and their impact on performance outcomes, in this case al-Muhajiroun's ability to withstand environmental hostility.

Many theories about network structures begin with baseline analyses of distributed networks, also known as random or Erdös-Rényi networks. In distributed systems, connections between nodes occur at random, according to a uniform

probability. Several features follow from this. In distributed networks, most nodes have around the same number of connections, while few nodes have many or few links (Lake and Wong 2009, 129). In such networks, power, typically defined in terms of a node's centrality in the network, is evenly distributed, while hierarchy, conceived as the centrality rankings of all nodes in the network, is decentralized (Hafner-Burton, Kahler, and Montgomery 2009). Distributed networks contain little clustering: two connected nodes do not have a higher probability of sharing connections to other nodes. Moreover, in distributed networks, the diameter, which refers to the largest number of links separating two nodes, is large compared to other types of networks. These features influence network behavior and performance. Diffusion tends to be slow in distributed systems, as information or other resources must travel relatively long paths to spread across the network. If distributed networks are not particularly efficient, they are resilient to attacks that remove targeted nodes and their connections (Watts 2003).

In scale-free networks, connections between nodes are not randomly distributed. Scale-free networks grow when nodes preferentially attach themselves to well-connected nodes. This "rich get richer" phenomenon creates centralized networks that follow a power-law distribution of ties whereby a few highly connected hubs link to many poorly connected nodes. Hubs enjoy a preponderance of power through their central position, which allows them to shape the flow of information and resources in the network. As in distributed systems, these features impact network behavior and performance. Information and other resources spread rapidly in scale-free systems because they pass through highly connected hubs. Unlike random networks, scale-free systems are efficient engines of diffusion. However, this strength becomes a weakness when scale-free networks are targeted for selective, as opposed to random, disruption. The select removal of a small number of hubs can significantly degrade the performance of these systems. Without hubs to unite it, the network can fracture into isolated components (Barabási 2002).

Small-world networks are distinguished by two features: high local clustering and short path lengths (Watts and Strogatz 1998). In small worlds, two connected nodes often share links to other nodes. These overlapping connections create clusters of nodes that connect tightly to each other but loosely to the rest of the network. Nodes that bridge different clusters provide shortcuts that allow information and other resources to hop from cluster to cluster. These shortcuts give small-world networks their short average path lengths and "small-world" feel.[2]

As with distributed and scale-free systems, the structural properties of small-world networks affect network behavior and performance. In small worlds, information and resources travel the entire network in few steps. This allows for faster rates of diffusion than distributed systems, but slower rates than scale-free networks. In small-world networks, resources do not necessarily flow through hubs that dominate the entire system, as they do in scale-free networks. Instead, in small worlds, resources flow through "bridges" that connect different clusters. A bridge is not necessarily a hub because a bridge node that connects two clusters may have as little

as two links, one to each cluster (Xu and Chen 2008, 64). A hub, in contrast, has many links. Unlike a scale-free network, which can be eliminated through the removal of its leadership, small worlds can exist with or without dominant hubs, as long as there are bridges linking different clusters (Sageman 2004, 140). When small-world networks have multiple bridges spanning different clusters they are resistant to the removal of individual bridges (Xu and Chen 2008, 64). This makes them more resilient to the elimination of centralized hubs than scale-free systems (Watts 2004). Indeed, a scale-free network that finds its hub removed may transform itself into a small-world network with multiple bridges. As we discuss below, these features of small-world networks have significant implications for al-Muhajiroun and other illicit networks that operate in hostile environments.

Random, scale-free, and small-world networks have not received a great deal of attention from international relations scholars. This is surprising, given the prevalence of scale-free and small-world systems in research on real-world networks, including commercial airlines, Hollywood actors, power grids, corporate alliances, the Internet, scientific collaboration, and brain cells (Uzzi and Spiro 2005, 492; Watts and Strogatz 1998; Barabási 2002). Focusing on topology allows researchers to grasp the link between network structure and performance. This is important to understanding how structural changes can impact network behavior or performance. We address this gap in the international relations literature by exploring how changes in al-Muhajiroun's topology affected its ability to continue its activism in an increasingly hostile environment.

Unlike international relations scholars, students of so-called dark networks, including terrorist groups and drug trafficking organizations, have shown considerable interest in their scale-free and small-world properties. In his seminal analysis of the 9/11 attack network, Vladis Krebs argues that Mohammed Atta and other al-Qaeda operatives formed a small-world system that contained high local clustering and short path lengths. According to Krebs, this structure was essential, allowing the geographically dispersed network to coordinate its activities and execute the attacks (2002). In his influential analysis of al-Qaeda, Sageman (2004) repeatedly characterizes the transnational movement as a small-world network with dense clusters of friends who interact frequently with each other. According to Sageman, al-Qaeda's "dense interactivity" makes it impervious to leadership decapitation. However, he also suggests that if authorities remove enough nodes that bridge different clusters, the global terrorist network will split apart into "isolated, noncommunicating islands of nodes" (140).

While Sageman does not provide statistical measures in support of his analysis, Xu and Chen (2008) measure al-Qaeda using his original data, along with three other dark networks, for average path lengths, clustering coefficients, and power-law degree distributions. After comparing these networks against simulations of distributed networks of the same size, they conclude that all four networks are scale free and small world. By their own admission, Xu and Chen's (2008, 65) findings are based on a "static view" of the networks they studied. But like their "bright"

counterparts, dark networks are not static. They change over time, adjusting their connections and activities in response to internal and external pressures, including government efforts to destroy them.

Hoping to measure changes in network structure over time, a small number of scholars have sought to incorporate longitudinal analyses in their studies (Carley, Lee, and Krackhardt 2002; Everton and Cunningham 2013). We build on this research by analyzing the structure of al-Muhajiroun during three separate time periods corresponding to major events in its history. Research on dark networks suggests that as repression increases, the network will become more decentralized to protect itself (Everton 2012). We assume that during al-Muhajiroun's early years, when repression was low, we will observe a more centralized, scale-free-like structure. However, as state pressure increases, we expect that the network will shed its scale-free structure and decentralize into localized clusters or "cells," suggestive of small-world networks.

Hypothesis 1: Prior to the application of state power, al-Muhajiroun will be a scale-free-like network.

Hypothesis 2: After the application of state power, al-Muhajiroun will become more decentralized and small-world-like.

Hypotheses on structural properties tell only part of our explanatory story. Measures of network structure do not tell us much about how networks mobilize and engage in contentious politics. Despite their interest in network types, few dark network studies explicitly link structural properties to performance outcomes. In recognition of this gap, researchers have begun to explore the relationship between structure and performance. In their analysis of terrorist attack networks, Helfstein and Wright (2011) find that as terrorists near attack completion, their networks become increasingly dense. The growth in strong, dense ties among nodes allows them to plan, coordinate, and execute their attacks (Helfstein and Wright 2011; Xu and Chen 2008, 62). In their analysis of the Noordin Top terrorist network, Everton and Cunningham (2013) observe that when confronted with hostile environments some terrorist groups become more decentralized, which allows them to continue their operations despite state pressure.

These studies do not systematically explore whether the dark network's type, specifically its small-world properties, help account for its performance under challenging circumstances. While Helfstein and Wright find that their increasingly dense terrorist networks are not scale free, they do not consider the possibility that they may be small worlds, even though their measures for clustering coefficient and average path length are consistent with small-world topologies (2011, 805). Everton and Cunningham disregard either possibility, declining to test their dark networks for scale-free or small-world properties. In testing al-Muhajiroun's networks for both, we contribute to the literature on dark networks. Specifically, we build on Everton's and Cunningham's insight regarding decentralization and environmental

Table 1. Time Periods for Measuring Al-Muhajiroun.

Time periods	Dates	Events
1	January 1, 1996, to August 5, 2005	From al-Muhajiroun's founding in Britain to day before Omar Bakri permanently leaves Britain for Lebanon (shortly after 7/7 attacks in London)
2	August 6, 2005, to May 30, 2009	Day Bakri leaves for Lebanon to the day relaunch of al-Muhajiroun is announced
3	May 31, 2009, to November 30, 2012	Day after al-Muhajiroun relaunch to end of data collection

hostility to hypothesize that al-Muhajiroun's proposed shift to a more decentralized small-world network facilitated its activism in recent years:

> **Hypothesis 3:** A shift from a scale-free-like to a more decentralized, small-world-like network structure will allow al-Muhajiroun to mobilize for collective action in an increasingly hostile environment.

Data and Methods

We evaluate these hypotheses using a mixed methods research design, leveraging the strengths of quantitative and qualitative methodologies. To determine how al-Muhajiroun's structure changed over time, we use social network analysis of secondary source data to measure the network's small-world and scale-free properties. As noted, these structural measures tell only part of our causal story. If al-Muhajiroun's structure did change over time, we still need to know why it changed, and what effect this change had on the activist network's ability to mobilize supporters. This requires opening the "black box" of al-Muhajiroun, to understand how government policy affected its performance. For this, we draw on our ethnographic research and content analysis of interviews and field notes.

We collected data for our social network analysis by purposively sampling news articles from Lexis-Nexis using a variety of search terms related to al-Muhajiroun, including the names of various spin-off groups. Our final data set contained more than 3,000 news reports on al-Muhajiroun and its spin-off groups published between January 1996 and November 2012. We parsed the networks that emerged from these data into three time periods corresponding to major events in the group's history (see Table 1). Measuring each network allowed us to track changes in al-Muhajiroun's structure over time, adding an essential dynamic component to our understanding of al-Muhajiroun's evolution, particularly when combined with our interpretation of the interviews and field notes.

After parsing the networks into three time periods, we created a thesaurus or list of al-Muhajiroun members and associates to extract nodes or "agents" (individuals in the network) from several thousand newspaper documents. Because the results of

our social network analysis would depend greatly on the quality of our thesaurus, we devoted considerable energy to creating the cleanest list of agents we could, based on our subject matter expertise and ethnographic data on al-Muhajiroun. We revised this draft thesaurus by verifying that each individual on our list was a member or associate of al-Muhajiroun based on their participation in network activities. After removing "false positives," our final thesaurus contained 364 unique agents that either belonged to al-Muhajiroun or were operationally associated with the network.

We then processed our newspaper data with our refined thesaurus using AutoMap, a content analysis program that extracts networks from texts. AutoMap generates a network based upon the proximity of agents in the thesaurus that appears in the same text, depending on a user-defined "window." The extraction settings we used in this study connected individuals who were mentioned in the same news report, irrespective of the number of words between them. If two agents were mentioned in the same news report, they were coded as being connected regardless of their position in the article.[3] This allowed us to create a bipartite network of al-Muhajiroun activists for each time period based on their associations with each other through the news reports. We used news reports as the source of our relational data because a detailed account of associations in the dark network across all three periods was not available.

The networks derived from the news reports represent a credible proxy for the structure of al-Muhajiroun from 1996 through 2012. We draw this conclusion on the basis of research mapping networks using news reports and our own efforts to fine-tune the tools we used to extract the networks from our data. To understand the usefulness of news reports for mapping dark networks, Gerdes and Carley (2009) extracted and compared networks of pre-9/11 al-Qaeda from two data sources: the 9/11 Commission report and news articles. The 9/11 Commission report draws from 2.5 million pages of declassified documents and interviews and is possibly the most comprehensive open-source account of al-Qaeda available (2004). As such, the report represents a suitable benchmark to compare against news reports. Gerdes and Carley found the al-Qaeda network derived from the news reports in their data set was similar in structure to those drawn from the 9/11 Commission report.

To ensure that the al-Muhajiroun networks extracted from the news reports in our data set represented suitable proxies for the networks' structures, we cross-checked the extracted networks with observations from dozens of interviews and years of ethnographic research.[4] The ethnographic methods, described in more detail below, allowed us to analyze other properties in the networks, such as leadership changes and information sharing, complementing our structural analysis.

To determine whether al-Muhajiroun was scale free, small world, or something else, we used aggregate measures of network structure. Our aggregate analysis used different algorithms to place the observed networks on a continuum of possible values for structural properties, including node degree and clustering. We recognize that there are other techniques for analyzing longitudinal networks, including exponential random graph models (ERGMs), stochastic actor-oriented models(SAOMs),

and separable temporal exponential random graph models (STERGMs). While ERGMs are appropriate for examining micro-level processes across time, our hypotheses focus on macro-level network structure. SAOMs and STERGMs model network formation as dual functions of node and tie creation as well as dissolution. Both methods do not readily extend to the study of illicit networks because the choice to dissolve membership or a connection is not exclusively the choice of individuals. Authorities play a role in this as well, particularly in outlawed networks such as al-Muhajiroun that have long been targeted for government disruption. Neither SAOMs nor STERGMs adequately account for such strategic, third-party effects common to illicit networks. ERGMs can be used to model third-party effects, but such a micro-level analysis of network structure is beyond the scope of this article.[5]

In analyzing the aggregate structure of al-Muhajiroun networks, we use the terms scale-free-like and small-world-like to clarify that our observed networks differ from theorized ideal types. Sometimes networks are reported in the research literature as being scale free or small world when they might be more accurately described as similar to these ideal types. For example, a network's distribution of nodes might be close—but not identical—to a power-law distribution indicating a scale-free network. Clauset, Shalizi, and Newman (2009) examined twenty-four data sets describing real-world phenomena that have been characterized in the literature as having power-law distributions. They found that most did not, though many were close. This is especially the case with social networks, where ideal types are rarely observed.

Our first aggregate test was to determine whether the al-Muhajiroun networks were scale free by examining the relative distribution of node degree. Node degree is a count of all connections a node shares with other nodes in the network. The relative frequency of node degree produces a distribution that can be analyzed to see how closely it follows a power law, a signature feature of scale-free networks (Barabási 2002). According to Clauset, Shalizi, and Newman (2009, 2), a value x follows a power-law distribution if it is drawn from a probability distribution:

$$p(x) \propto x^{-\alpha}. \tag{1}$$

The exponent, α, is a scaling parameter that shapes the distribution and tends to fall in the range $2 < \alpha < 3$, with some exceptions. Determining whether an observed distribution exhibits the properties of a power law involves estimating α using a maximum likelihood estimation (MLE) procedure. Clauset and his colleagues suggest a two-step procedure that we use here.[6] The first step is to estimate a value for α that applies to the observed distribution. The next step is to compare the observed distribution of α against a simulated distribution for the same parameter. If the observed and simulated distributions are not different and the estimated α is within range, we consider the observed distribution to follow a power law and the network to be scale free. If the observed and simulated distributions are not significantly different, but the estimated α falls outside the range $2 < \alpha < 3$, we consider the network to be scale-free-like. We discuss this "likeness" category in greater detail below.

A second aggregate test measures whether an observed network exhibits small-world properties as described by Watts and Strogatz (1998). As discussed earlier, small-world networks are characterized by shorter average path lengths and higher clustering than distributed networks of similar size. When two nodes have connections with one another and they share connections with a third node, a relational triangle forms between them. This is a form of clustering that can be measured. A high degree of clustering occurs when a node's connections in a network form more triangles than found in distributed networks.

In their seminal contribution, Watts and Strogatz (1998) show how the simple process of rewiring a ring lattice creates small-world networks characterized by high clustering coefficients and short path lengths, which can be expressed in a small-world quotient.[7] While this contribution has been valuable, it produced a broad class of networks, all considered small worlds. In response, Humphries and Gurney (2008) created a more nuanced measure, one that builds on Watts and Strogatz but proposes a continuous measure of small-world indicators.[8] Like Watts and Strogatz, Humphries and Gurney derive their measure of small-world properties by comparing an observed network, nw_g, to a random network with the same number of nodes and ties, nw_{rand}. This measure consists of three components. The first component is Humphries and Gurney's version of clustering, $C.^{\Delta}$. This is a ratio with three times the number of triangles in a network in the numerator and the total number of path lengths equal to a length of two in the denominator.[9]

$$C.^{\Delta} = \frac{3 \times \text{number of triangles}}{\text{number of paths of length 2}} \tag{2}$$

The second component is a clustering ratio, which places the clustering value for nw_g in the numerator and the clustering value for nw_{rand} in the denominator.

$$\gamma_g^{\Delta} = \frac{C_g^{\Delta}}{C_{rand}^{\Delta}} \tag{3}$$

The third component begins with the mean value of the minimum path length between all node pairs in a network, $L.$, and then combines them to form a ratio.

$$\lambda_g = \frac{L_g}{L_{rand}} \tag{4}$$

These three components are then combined to create a quantitative metric of "small-world-ness," essentially a ratio of ratios.

$$S^{\Delta} = \frac{\gamma_g^{\Delta}}{\lambda_g} \tag{5}$$

According to Humphries and Gurney, a network is small world if $S^{\Delta} > 1$. We use this same definition in our analysis of al-Muhajiroun while making a small change to Humphries and Gurney's procedures. Rather than calculating a single score based

upon comparison to only one random network, we calculate an average small-world score drawn from a comparison of 1,000 random simulations. This modification adds confidence to our final assessment of al-Muhajiroun's small-world-ness. If a network's Humphries and Gurney (HG) score is less than but within one standard deviation of 1, we consider the network to be small-world-like.

The first author gathered the primary source data for this study during several months of field work in London between November 2010 and December 2014. During six separate trips, he observed and interacted with dozens of al-Muhajiroun activists at numerous protests, da'wah stalls, public lectures, and other events to gain a better understanding of the network's day-to-day functioning. He also conducted over eighty interviews with forty-seven different activists, using a combination of snowball sampling and purposive sampling to identify respondents. These respondents ranged from al-Muhajiroun's leaders in Britain to senior veterans who have been involved in the network for many years, to rank-and-file activists. In addition, the first author interviewed thirty-nine respondents from outside the network including several former network activists. For a list of interviews and field notes cited in this article, see Online Appendix A.

When respondents gave permission, the first author recorded their interviews using a digital audio recorder. Independent transcribers converted these audio files into verbatim transcripts. The first author imported the interview transcripts and field notes into *NVivo* 10.0, a software program designed for coding and interpreting large amounts of text. He read through each document line-by-line, using *NVivo*, to identify 1,464 themes and subthemes related to decision-making, hierarchy, leadership, adaptation, and other relevant concepts. In this article, we draw on these themes to supplement our network analysis of al-Muhajiroun.

Al-Muhajiroun as a Scale-free-like and Small-world Network

Similar to the dark networks studied by Xu and Chen, al-Muhajiroun displayed characteristics of scale-free-like and small-world networks in its early years. Our aggregate tests of network structure during this period show al-Muhajiroun to be scale free or nearly scale free in the first time period, depending on the x-floor value set for estimating node degree distribution in the network. When the x-floor is set at 2, the estimated exponent value, $\hat{\alpha}$, for al-Muhajiroun is 1.84 (Kolmogorov–Smirnov [K-S] statistic $= .14$, $p = .085$), just outside the power-law distribution range identified by Clauset and his colleagues. When the x-floor is set at 3, the estimated exponent value, $\hat{\alpha}$, is 2.02, just within scale-free range (K-S statistic $= .17$, $p = .05$).[10]

Al-Muhajiroun also displayed properties of small-world networks during its early years. As shown in Figure 1, the network's HG score during period 1 was greater than one. This indicates that the network's average path length was short enough and its clustering high enough for it to be classified as a small-world system. The aggregate tests also confirm that al-Muhajiroun was not a distributed or random network during this period.

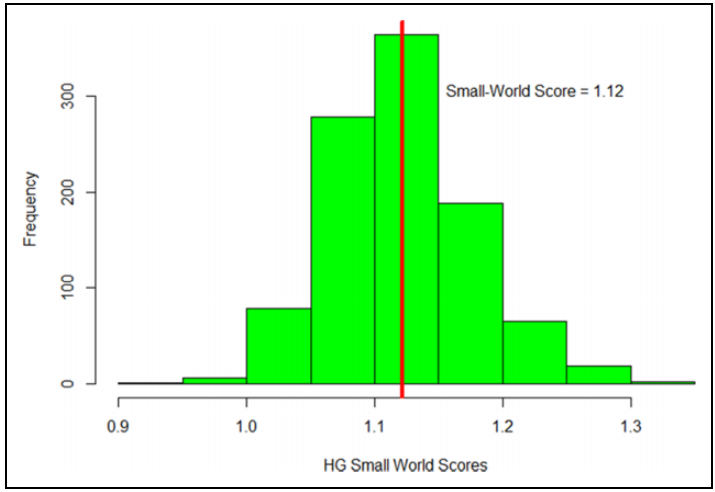

Figure 1. Humphries and Gurney small-world test during time period 1, trials = 1,000.

These structural measures provide important insights into the topology of the activist network during its formative years. At a time when al-Muhajiroun operated relatively unhindered in British society, activists developed a centralized network around Omar Bakri. Indeed, during this period, al-Muhajiroun resembled a scale-free-like and small-world network characterized by a dominant, highly connected hub linked to a large number of moderately connected nodes. As with other scale-free systems, it was the hub—in this case, Bakri—that largely defined the network's structure.

Although useful, these results do not tell us much about how this structure affected al-Muhajiroun's performance. For this, we turn to our interviews with current and former activists in the network. Qualitative analysis of these primary sources confirms and extends the findings from our structural tests of al-Muhajiroun's topology.

During al-Muhajiroun's early years, the activist network essentially revolved around its charismatic leader and central hub. Omar Bakri Mohammed, "was the main person," observes one former activist who was involved in the network during this period. "Everyone used to go to him to make any decisions on any activities or anything that they wanted to happen."[11] Omar Bakri crafted al-Muhajiroun's ideological vision, oversaw its activism, and exercised formal authority on administrative matters within the network (Wiktorowicz 2005, 51 and 106). In addition to being al-Muhajiroun's administrative leader, Bakri was its religious scholar as well, instructing his students at public talks and private *halaqahs* (study circles) activists competed to get into. "It would be an honor to be in a circle with OBM," recalls a former participant, referring to Bakri by his initials, "everyone would be fighting over, 'oh, we need to go to halaqah with OBM.'"[12]

As befitting his central role in the scale-free network, Omar Bakri exerted substantial authority over his followers. He was respected by al-Muhajiroun activists for his knowledge of Islamic scripture, his ability to connect with them on a personal level, and his willingness to engage them for extended periods, often stretching deep into the night (Wiktorowicz 2005; Ronson 2002).[13] Activists who studied with Bakri frequently spoke of his personal charisma, his sense of humor, and his accessibility, which they contrasted with the stiffness and formality of the clerics they encountered in London's mosques.[14]

Like other scale-free networks, al-Muhajiroun expanded rapidly during these years, growing from a handful of followers to several hundred activists, as participants preferentially attached themselves to the charismatic hub. Recruits flocked to Bakri's fiery lectures, delivered in mosques and community centers throughout Britain, and the network's high-profile events, including the "Rally for Islam" held in London's Trafalgar Square in 1998. Activists recruited aggressively during the late 1990s, exploiting their networks of friends and family members, and reaching out to other recruits through da'wah stalls, often held in local neighborhoods during market days. Finishing each other's sentences, two former participants recall how quickly al-Muhajiroun grew in their neighborhood during this period.

Former activist:	It was the big thing .... We were actively part of them [al-Muhajiroun] ... it was the thing to do because it was growing at that time ... everyone used to be involved.
Former associate:	It proliferated rather quickly in local mosques.
Former activist:	Rapidly, rapidly.
Former associate:	Communities had to put a stop to it because everyone who was under 20, 21 was involved, or knew of it or attended events or was sympathetic to—
Former activist:	To the cause. We all used to agree with it.
Former associate:	We were very young and the whole community was electrically charged with it.
Former activist:	It was a buzz. We all got a buzz out of it. The kind of events we used to have, the talks and the demonstrations we used to do. Everyone used to get a buzz out of it. It was like a kid with a new toy ... It was brilliant.[15]

If al-Muhajiroun's rapid expansion and Omar Bakri's dominant position captured its scale-free nature during this period, the halaqah epitomized its small-world-ness. The halaqah was a neighborhood-based, invitation-only study circle that doubled as the network's organizational vehicle. Study circles, which met weekly to discuss Bakri's teachings, contained tightly knit clusters of local activists who carried out much of the network's day-to-day activism. Halaqahs contained anywhere from half a dozen to two dozen participants, depending on activists' ability to recruit new members and keep them involved over time.[16] Halaqah members were expected to

attend several meetings each week, including a closed study circle, an open circle that allowed outsiders, and at least one da'wah stall.[17] Activists often formed intense friendship bonds with each other, developed over time through repeated face-to-face interaction. "You would always be together," explains one former activist who was deeply involved in al-Muhajiroun during these years. "You'd spend time together, even socially. You'd hang out together, maybe at each other's houses, or at events, or just hanging out."[18]

The purpose of all this hanging out was to develop strong ties with fellow activists in order to deepen their commitment to the cause, build group solidarity, and facilitate their involvement in high-risk activism.[19] This was something that Omar Bakri himself encouraged. According to one activist with strong family ties to the network leader, Bakri instructed his charges "to spend time with each other, to keep close with your brother so it would build a bond between you."[20] Halaqah leaders mobilized their study circles for collective action, including da'wah stalls and protests. Network leaders, Omar Bakri and Anjem Choudary, regularly bridged different halaqahs by delivering talks and loosely supervising their activities. High-profile demonstrations were organized through Bakri's headquarters in Tottenham, which also produced the leaflets and other ideological materials used by activists. Bakri also led by example, joining activists at da'wah stalls and handing out leaflets to passersby (Ronson 2002; Wiktorowicz 2005).

In this fashion, al-Muhajiroun's scale-free-like, centralized small-world structure mobilized top-down, through Bakri's inspiration and leadership, and bottom-up, through the local halaqahs. During a period when its environment was relatively calm, this structure produced a high level of performance, in the form of extensive activism. Network members and associates organized da'wah stalls, public conferences, and demonstrations on a regular basis. "There was always something going on," recalls one former activist.[21]

From Scale-free to Decentralized Small-world Network

In the wake of 9/11 and other terrorist attacks, British authorities began to enforce existing antiterrorism legislation against al-Muhajiroun more aggressively, while also targeting the network with new authorities granted under the revised Terrorism Act. The pressure reached a climax in the aftermath of the London Underground bombings in 2005. After making inflammatory comments about the bombings, Omar Bakri sought to escape growing calls for his arrest on treason charges by traveling to Lebanon, ostensibly to visit his mother. A week later, the British Home Secretary announced that Bakri would not be allowed to return to the United Kingdom, transforming his temporary sojourn into permanent exile. Over the next several years, the authorities intensified the pressure on al-Muhajiroun in Britain by banning its most prominent spin-off groups and convicting several leading activists of inciting racial hatred, soliciting murder for terrorist purposes, and terrorist fund-raising.

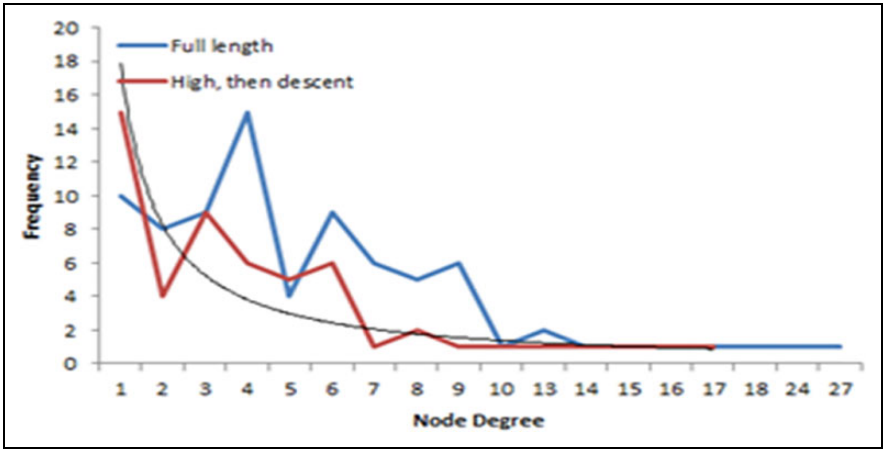

Figure 2. Node distribution during time period 2.

What, if any, impact did these developments have on al-Muhajiroun's structure? Did the activist network change from a scale-free-like, centralized small-world network to something else? To help us answer these questions, we apply the same structural measures of scale-free and small-world properties used to measure al-Muhajiroun during its early years (time period 1). Now, however, we apply these tests to al-Muhajiroun networks extracted from the newspaper data after Omar Bakri left Britain in the wake of the 7/7 bombings (time period 2) and after activists publicly relaunched al-Muhajiroun several years later (time period 3).

Figure 2 shows the results of the scale-free tests during time period 2. Similar to al-Muhajiroun during its early years, the network's node degree distribution in the second period resembles a power law. Few nodes have many connections while many nodes have few, as indicated in the degree distribution's "long tail." This appears to suggest that the activist network remained scale free after the intensification of state power against it. Unlike the early years, however, al-Muhajiroun's power-law distribution in time period 2 is ambiguous. When the x-floor is set at 4, the estimated exponent value, $\hat{\alpha}$, for al-Muhajiroun is 2.43 (K–S statistic = .13 and $p = .34$), within the established range of a power-law distribution. However, the degree distribution's tail declines unevenly. This suggests that the distribution does not significantly resemble a power law, even when the x-floor value is set near the end of the distribution at 9 ($R^2 = .778$).

If al-Muhajiroun was no longer unambiguously scale free in time period 2, what was it? Did the activist network retain its small-world structure, despite being under pressure from the authorities? Results from the HG test of small-world properties, shown in Figure 3, suggest that it did. During the second period, al-Muhajiroun still approximates a small-world network, despite experiencing a decline in its small-world score, from 1.12 in the first period to 0.997 in the second.

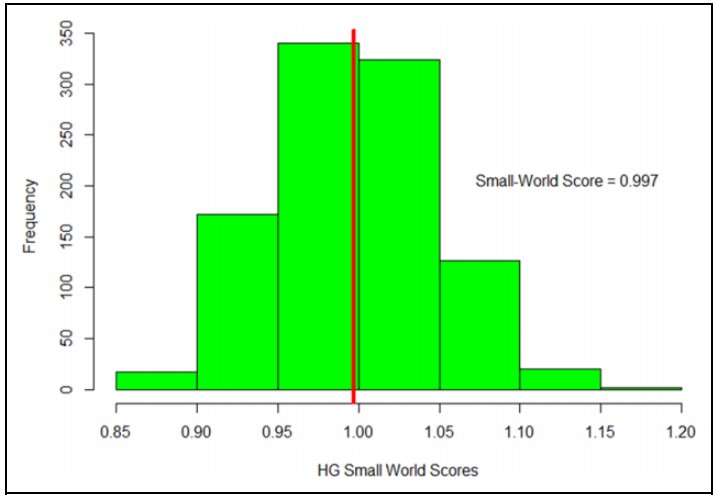

Figure 3. Humphries and Gurney small-world test during time period 2, trials = 1,000.

The persistence of al-Muhajiroun's small-world-ness in time period 2 is impressive, given the pressure exerted by British authorities on the activist network during these years. Did the changes experienced by al-Muhajiroun in the aftermath of Omar Bakri's exile represent a short-term departure from its tradition of revolving around a central figure or did the activist network continue down a different structural path? To answer this question, we apply the aggregate tests of al-Muhajiroun's scale-free properties to the final time period in our longitudinal data, measured several years after Bakri left Britain and shortly after activists relaunched the al-Muhajiroun platform in 2009 (time period 3). If al-Muhajiroun fully recovered by this time and reestablished its previous pattern of organization, we would expect to see the network become scale free again while continuing to build its small-world properties.

The results suggest that al-Muhajiroun did not return to its scale-free-like form following the application of state power against it. With an x-floor set to 3, the estimated exponent value, $\hat{\alpha}$, was 0.667 (K-S statistic = .15 and $p = .14$), far below the minimum threshold value of 2. Structurally, instead of containing a few hubs with many connections and many nodes with few connections, in the final period the network contained many nodes with moderate amounts of connections. Well-connected nodes still existed, Omar Bakri among them, but no hubs dominated the network the way Bakri had during the first period. Social power diffused throughout the network, with ties becoming more evenly distributed across nodes.

Does the persistence of well-connected nodes in al-Muhajiroun suggest that it retained its small-world character during the final period? According to results from the HG test (Figure 4), the activist network's small-world score declined slightly, from 0.997 in the second period to 0.92 in the third. This suggests that al-Muhajiroun

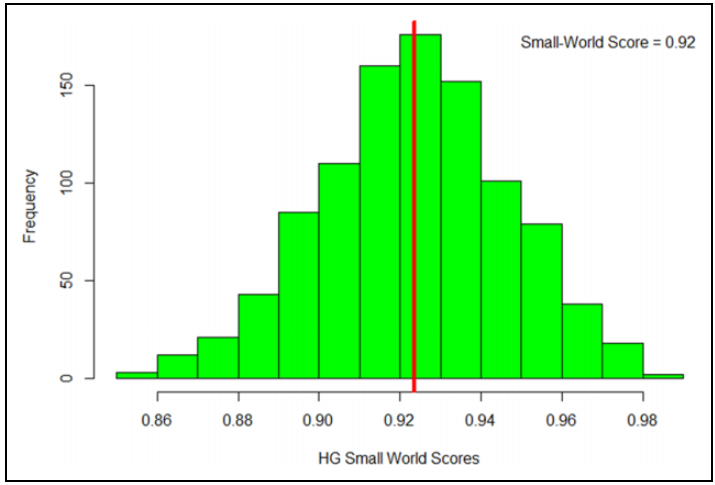

Figure 4. Humphries and Gurney small-world test during time period 3, trials = 1,000.

remained small-world-like, as it evolved from a centralized network with scale-free and small-world properties to a more dispersed, small-world system with multiple, moderately connected bridge nodes.

We can summarize the macro-level results above by plotting al-Muhajiroun's scale-free and small-world properties during all three time periods on a single graph. As mentioned earlier, our analysis distinguishes between "scale-free" and scale-free-like and between "small-world" and small-world-like networks. These distinctions are based on the assumption that some networks may not be purely scale free or small world but exhibit structural properties that are similar enough to these types to be "like" them. Consequently, our two likeness categories extend the boundaries of the ideal types, but only slightly. To be considered scale free or small world, the network must have a parameter value that falls within specific boundaries of the node degree distribution or the HG small-world score. As defined above, scale-free networks have a degree distribution exponent, α, that falls in the range $2 < \alpha < 3$. Small-world networks have an HG score, S^{Δ}, greater than 1. Scale-free likeness and small-world likeness each contain an interval that extends the boundaries for both types of structures. We define small-world-like by extending the $S^{\Delta} > 1$ boundary to values falling within one standard deviation (i.e., mean $-$ 1 *SD*) of the measure using our 1,000 simulation networks sample. If the network's HG score is less than but within one standard deviation of 1, we consider it to be small-world-like. We consider the network to be scale-free-like if the network's observed and simulated degree distributions are not significantly different, but the estimated exponent falls outside the range $2 < \alpha < 3$.

Using these definitions, we plot the al-Muhajiroun networks for each time period below. In Figure 5, the vertical axis corresponds to the network's HG score, S^{Δ},

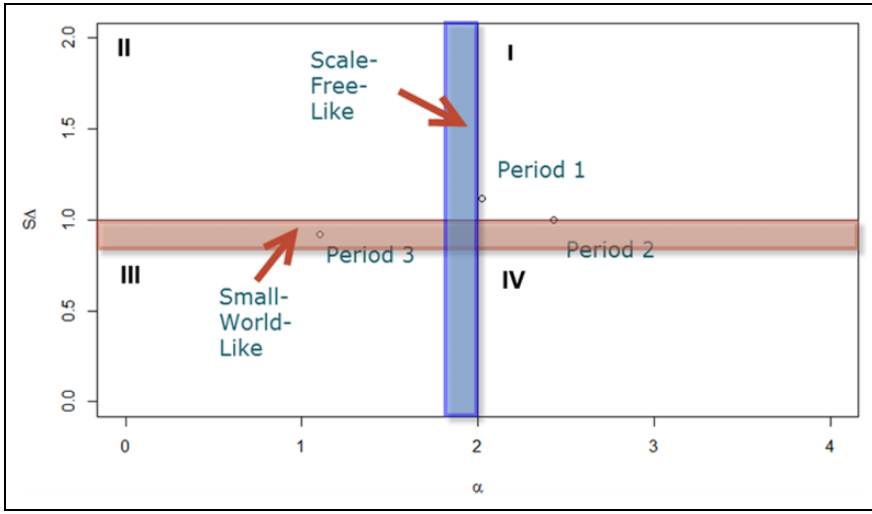

Figure 5. Al-Muhajiroun's network structures during all three time periods.

while the horizontal axis corresponds to the network's node degree distribution exponent, α. The bold lines that mark S^{Δ} at the value 1 and α at the value 2 represent the minimal conditions for placement in the scale-free or small-world categories. In this figure, quadrant I is scale-free and small-world, quadrant II is small world only, quadrant III is neither scale free nor small world, and quadrant IV is scale free only. The shaded areas in the graph correspond to the likeness extensions for each structure. The horizontal pink-shaded area represents small-world-like, while the vertical blue-shaded area signifies scale-free-like.

As shown in the graph, al-Muhajiroun displayed scale-free-like and small-world properties during its early years, before law enforcement pressure against the activist network intensified. This is consistent with our first hypothesis, which suggests that al-Muhajiroun, like other dark networks, will be scale-free-like prior to the application of state power against it. During the second time period, al-Muhajiroun exhibited both scale-free and small-world-like properties. This appears to contradict our first hypothesis, given that the activist network apparently maintained its scale-free form after the British government exerted significant pressure against it. However, as noted above, the scale-free results for time period 2 are ambiguous: the network tail's uneven decline suggests that the degree distribution does not significantly resemble a power law. Finally, in the third time period, al-Muhajiroun exhibited properties of a small-world-like network only. This is consistent with our second hypothesis. The activist network remained small-world-like, as it evolved from a centralized network with scale-free and small-world properties to a more diffuse system. Even as its scale-free properties declined, al-Muhajiroun remained small-world-like.

We believe that al-Muhajiroun's small-world-ness may help explain why the activist network has been so resilient in the face of counterterrorism pressure. Our third and final hypothesis proposes that the activist network's shift from a centralized, scale-free-like structure to a more decentralized, small-world-like form will allow it to mobilize in a more hostile environment. Evaluating this hypothesis requires that we move beyond measuring al-Muhajiroun's structural properties to examining how its activists engage in contentious politics. To better understand this crucial link between network structure and performance, we return to our ethnographic data.

Validating the Quantitative Results: Results from the Field

Al-Muhajiroun's transformation from a scale-free network to a more diffuse small-world-like network containing multiple bridge nodes and clusters is consistent with primary source data we collected during our field work. Numerous interviews and observations of network protests, da'wah stalls, and private talks between November 2010 and December 2014 suggest that longtime activists in Britain, including Anjem Choudary, Trevor "Abu Izzadeen" Brooks, Mizanur "Abu Baraa" Rahman, and Abdul "Abu Walaa" Muhid, essentially replaced Omar Bakri as the day-to-day leaders of the network. Since their emir's departure to Lebanon, these veterans have stepped up, leading conferences, speaking to the media, and performing other activities once reserved for Bakri. "There are some really strong personalities within the group now," confirms an officer who specializes in al-Muhajiroun for the London Metropolitan Police. "There's quite a few of them."[22] These veteran activists lead group activities in different areas and provide essential bridging connections between them. None of the new leaders are as esteemed among activists as Bakri, but they work together to ensure a sense of continuity and cohesiveness that continues over a decade after Bakri's departure to Lebanon.

In each area, leaders form clusters of al-Muhajiroun activists who organize da'wah stalls and demonstrations on a regular basis. The basic unit of organization remains the halaqah. At the time of our field work, groups in East, West, and South London had their own study circles, composed of local activists and their recruits who met regularly to plan and carry out activities. Significantly, different veteran activists interact with the same halaqahs, allowing information and resources to flow from cluster to cluster across multiple bridges. In addition to organizing local activities, halaqahs mobilize participants for special events involving different circles. These include large da'wah stalls called "Islamic roadshows" and political protests at different locations in London and other cities. Halaqah participants form strong friendship bonds through frequent interaction in weekly study sessions, da'wah stalls, and demonstrations, as they did when Omar Bakri was still around. At network events, activists work together to set up tables and tents, make protest signs, distribute printed literature and compact discs, and record their activities for posting on the Internet. "We're close brothers," explained one network activist as he handed

out leaflets with several colleagues at a da'wah stall in East London, "we don't have to be flesh and blood, we're brothers and we just help each other out with what needs to be done."[23]

Al-Muhajiroun's small-world-ness is frequently on display at such events, particularly large gatherings involving activists from different clusters. Consistent with the network's small-world orientation, activists often arrive in small groups of participants from their halaqah. At one protest, held at the Saudi Embassy in London, one of the network's leading activists from East London appeared with a group of brothers from his local halaqah, all of them chanting protest slogans.[24] A week later, different clusters of activists arrived separately at an Islamic roadshow in Wembley.[25] Before, during, and after these events, activists socialized mostly with other brothers from their halaqahs. While cross-cluster contact was permitted, bridge nodes were the most active in engaging activists from different groups, whom they knew from delivering talks and participating in other events run by the local halaqahs. At the conclusion of the larger roadshows and protests, clusters often left the same way they arrived, with their halaqah brothers.

Interviews and field observations suggest that in recent years, al-Muhajiroun has not been as active as it was during Omar Bakri's tenure in Britain.[26] In this sense, the network's performance has declined, as it has become more diffuse and decentralized. Yet, the activist network continues to mobilize its remaining followers and recruit new ones to the cause. During our field work, we observed activists frequently calling people to Islam in da'wah stalls and roadshows on some of London's busiest market streets, while protesting everything from the Lebanese government's arrest of Omar Bakri in 2010, to the Saudi Arabian government's treatment of political dissidents in 2011, to the London Olympic Games in 2012, and to the British Parliament's consideration of a bill that would ban the burka in 2013.[27] Many of the same veteran activists participated in these events, but each year new activists appeared, joining veterans to "command good and forbid evil." After a London magistrate barred several leading activists from participating in da'wah stalls following their September 2014 arrests, some of them continued to do so. At one event near the Olympic Park in Stratford, East London in December 2014, the first author observed two of the arrested activists calling people to Islam as part of a larger cluster of network activists engaged in public da'wah. Also in attendance was a newer leading activist whose role in the network has increased since the September 2014 arrests, along with several recruits not seen at al-Muhajiroun events in previous years.[28]

The tenacity of al-Muhajiroun's activism highlights the resilience of its decentralized, small-world-like form. Consistent with our final hypothesis, al-Muhajiroun's shift to a more distributed, yet clustered structure facilitated its ability to mobilize its supporters even as British authorities arrested its members, disrupted its protests, outlawed its spin-off groups, and, more recently, forbade its leaders from engaging in public da'wah.

At least two mechanisms, both of which we observed during our research, help explain al-Muhajiroun's persistence as a small-world network and its performance in

recent years. The first mechanism linking al-Muhajiroun's structure to its performance was the emergence of several bridge nodes that allowed the network to replace its original emir and centralized hub. In the new configuration, clusters were connected not by a single hub but multiple bridges. This allowed information and other resources to spread throughout the network even after Omar Bakri left Britain. Anjem Choudary and other leading activists connected to the same local clusters, providing redundant links between them. These activists were less connected than Bakri had been during the early years, but connected enough to provide robust shortcuts between clusters. This prevented clusters from splitting into isolated islands of nodes when individual leaders were arrested and, in some cases, convicted of criminal offenses. When all these leaders were rounded up in September 2014 on suspicion of supporting terrorism, other bridges emerged to maintain connections between clusters, continuing to unite the network into a larger, cohesive whole.

The second mechanism linking al-Muhajiroun's small-world-like structure to its performance was the neighborhood-based study circle. Local halaqahs remained the organizational vehicle through which activists engaged in contentious politics and recruited new members. Halaqahs in East, West, and South London formed tightly linked clusters of activists who met regularly to interact, hear private talks, and absorb the network's ideology. These local clusters organized da'wah stalls in their neighborhoods and coordinated with other halaqahs on larger events. The halaqahs also served as an entry point for new recruits who approached activists at da'wah stalls and other public events. Individuals who expressed interest in the network's ideas would be invited to private talks organized by the halaqahs. At these talks, recruits would interact with activists who would begin the process of socializing them to the network's interpretation of Islamic scripture and world politics. While not all recruits were receptive to al-Muhajiroun's ideas, enough of them were to allow the network to replenish its ranks when other activists ceased their involvement. In this manner, the network continued to attract newcomers and mobilize them for collective action even as British authorities arrested their leaders and banned their spin-off groups.

Conclusion

British counterterrorism authorities today face a weakened, but resilient, al-Muhajiroun network, one that continues to radicalize young men and women into violent extremism despite the government's efforts to disrupt it. Following the application of state pressure, al-Muhajiroun evolved from a centralized scale-free-like network to a more decentralized, small-world-like system. This small-world structure offers an organizational "solution" to the activist network's collective action needs through two mechanisms. First, the small-world configuration provides multiple bridges between clusters that allow information and other resources to spread throughout the network, even when leading activists are removed from the system. Second, local clusters in the form of halaqahs allow activists to interact

frequently, coordinate their activities, and recruit new members to replace participants who are removed due to government pressure.

These findings suggest that network structure has important implications for performance. Small-world networks with multiple bridges spanning clusters are self-annealing (Christakis and Fowler 2009, 293). When one bridge—even a hub as centralized as Omar Bakri—collapses, others emerge to bridge the gap and keep the resources flowing, allowing the network to overcome the disruption. Al-Muhajiroun's small-world-ness allowed it to survive Bakri's departure and continue to mobilize its followers and engage in contentious politics. While this smaller, decentralized network is less active than al-Muhajiroun was during its halcyon days, the resilience of its structure, and the zeal of its activists, suggests that it will continue to mobilize even as the authorities continue to target it.

Despite a growing literature on social and organizational network analysis in recent years, small-world networks have received scant attention from international relations scholars. We find this puzzling. If small worlds are as consequential to network performance as our research suggests, it may be time for more scholars to embrace "the dark side." In joining researchers of dark networks who look beyond centrality defined as power to explore how topology shapes outcomes, they will help us understand the crucial link between network structure and performance. To the extent that this article contributes to this understanding, it does so modestly, with all the constraints facing case studies. The broader applicability of our findings must be confirmed, or countered, through additional research. We suspect that such efforts will be worthwhile for scholars interested in advancing our knowledge of bright and dark networks and for government officials interested in combating violent nonstate actors more effectively.

Indeed, the policy implications of al-Muhajiroun's transformation are readily apparent. At the most general level, the transformation reminds us that when states engage in "counter netwar" the pressure they exert on their adversaries can have profoundly unintended consequences. In both the war on drugs and the war on terror, government attempts to destroy the largest, most successful dark networks did not end or even severely disrupt the supply of either transnational commodity. Instead, it led to the decentralization of both, as smaller, harder-to-eliminate adversaries emerged to replace the drug "cartels" and terrorist "kingpins" who preceded them (Kenney 2007). Similarly, al-Muhajiroun responded to state pressure by decentralizing into a more diffuse, small-world form. This structure proved more resistant to the state's targeted attacks than the scale-free form it assumed during its early years.

The al-Muhajiroun of today is unlikely to be destroyed with the removal of one or two highly connected nodes, including Anjem Choudary and Mizanur Rahman, soon-to-be on trial in Britain for allegedly supporting the Islamic State. This suggests that a strategy of leadership decapitation against the activist network will not destroy it. The best authorities can hope to achieve through such an approach is temporary disruption, as targeted activists are replaced by others outside the government's plan of attack. This finding has implications for other dark networks.

Recent studies have shown that killing the leaders of underground enterprises often does not work. Instead of eliminating these networks, targeted killings can lead to their revitalization, as other leaders emerge to replace decapitated nodes (Jordan 2009, 2014; Price 2012).

Al-Muhajiroun's small-world solution has additional implications for dark networks. Illicit actors that operate in hostile environments characterized by state agencies trying to destroy them are likely to benefit from densely linked clusters and redundant bridge nodes. Small, snug clusters allow individuals to coordinate their activities while minimizing their exposure to external actors who seek to destroy them. Multiple bridges protect small worlds by allowing information and other resources to jump from cluster to cluster through redundant shortcuts. While these structural properties may not be optimally suited to all dark networks, they have provided some illicit actors such as al-Muhajiroun a measure of flexibility they lacked when assuming more centralized, scale-free forms. Al-Qaeda experienced a similar metamorphosis in the war on terror when its original, relatively centralized structure ("al Qaeda Central") transformed into a more diffuse global movement characterized by largely autonomous local clusters linked through shared goals and a common ideology (the "al Qaeda Movement"). ISIS, which already relies on informal clusters of supporters to recruit fighters from Western Europe and the United States (Vidino and Hughes 2015), may eventually experience a similar transformation once coalition forces and their allies bring their superior resources more effectively to bear on the fledging Islamic State. As the war on terror unfolds in the months and years ahead, scholars and practitioners would do well to remember the lessons of al-Muhajiroun's solution by focusing on the connectivity and cohesion in dark small-world networks.

Authors' Note

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Declaration of Conflicting Interests

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Supplementary Material

Supplementary material for this article is available online.

Notes

1. While several activists were later freed and their criminal investigations terminated, two of the network's leading activists, Anjem Choudary and Mizanur Rahman, face prosecution by British authorities for allegedly "inviting support" for the Islamic State.
2. Path length refers to the average number of nodes that must be crossed in the shortest path between any two nodes in the network (see Watts 1999; Valente 2010).
3. We adopted this approach after experimenting with various window sizes that produced unrealistically sparse networks. Some might object that our approach is likely to produce false positives, connecting agents that should not be connected. While we cannot discount this possibility entirely, we do not believe this is a significant source of error in our extraction process, given the "cleanliness" of our thesaurus, which contains few, if any, individuals who were not actively involved with al-Muhajiroun at some point, and the brevity of the news articles, many of which are short wire reports. For more discussion of this and other issues related to the challenges and opportunities of combining computational network analysis with ethnography to study dark networks, see Kenney and Coulthart (2015).
4. Our efforts to check the validity of the news report data are detailed in greater depth in Kenney and Coulthart (2015).
5. For an analysis that does include exponential random graph models, see Kenney, Wright, and Coulthart (2014).
6. Few empirically observed distributions conform to a power law throughout their entire range of x values. Hence, it is necessary to inspect the observed frequency distribution (e.g., as a histogram) and to determine where to set the "floor" that defines the subset of x values that follow a power law. Fitting a power law to the distribution provides an estimate for α to use as a starting point for the maximum likelihood estimation (MLE) procedure. In our case, we supply several measures to the "igraph 0.7.1" R package 3.1.0 and its power.law.fit function, including x, x as a discrete value, the x-range floor, and the prior estimate of α. This produces an MLE for α in the form of $\hat{\alpha}$, along with an evaluation for statistical significance difference between the observed distribution and a power-law distribution simulated according to $\hat{\alpha}$.
7. Also known as a "regular" network, a ring lattice is a structure with nodes arranged in a circle. Connections between nodes occur among immediate neighbors as well as neighbors who are one path length away. Beginning with a ring lattice and rewiring its connections with probability p progressively produces a random network as p nears one.
8. Working independently, Uzzi and Spiro (2005) create another small-world measure that is identical to Humphries and Gurney's, according to Everton (2012).
9. Watts and Strogatz use a slightly different measure for clustering:

$$c_i^{WS} = \frac{2E_i}{k_i(k_i - 1)}$$

Here, c_i^{WS} is the clustering value for node i, which is two times the number of edges or connections shared among its neighbors divided by the degree of i times its degree minus one. The quantity produces marginally different behavior than the clustering measure defined by Humphries and Gurney.

10. An additional check on the results involved comparing the distribution of connections produced using the two different x-floor values to simulated networks undergoing preferential attachment generative processes parameterized at $\hat{\alpha} = 1.84$ and 2.02, respectively. In both cases, results supported rejecting the hypothesis that the two samples came from different distributions.
11. Interview with former al-Muhajiroun activist, East London, June 18, 2011. Also, interviews with former al-Muhajiroun activists, West London, December 13, 2010, and June 21, 2011.
12. Interview with former al-Muhajiroun associate, London, June 14, 2011.
13. Interviews with former al-Muhajiroun activists, West London, June 21, 2011, and East London, June 26, 2011; interview with veteran al-Muhajiroun activist, East London, December 7, 2010.
14. Interview with former al-Muhajiroun activist, East London, June 26, 2011; interview with veteran al-Muhajiroun activist, East London, December 7, 2010.
15. Interview with former al-Muhajiroun activist and former al-Muhajiroun associate, East London, June 18, 2011.
16. Interview with al-Muhajiroun activist, East London, November 6, 2010; interviews with two former al-Muhajiroun members, West London, December 13, 2010.
17. Interviews with two former al-Muhajiroun members, West London, December 13, 2010.
18. Interview with former al-Muhajiroun activist, East London, June 26, 2011.
19. Al-Muhajiroun is not unique in this respect. Scholars have emphasized the importance of personal interactions for building trust and group solidarity in numerous underground organizations, including Sinn Fein, the Italian Red Brigades, and the nineteenth-century Russian anarchist group, People's Will. See McCauley and Moskalenko (2011), 54-55; Della Porta (1995); and White (1988).
20. Author's interview with al-Muhajiroun activist, East London, June 17, 2011. This activist later emigrated to Syria where he was reportedly killed fighting on behalf of Islamic State in Iraq and Syria.
21. Interview with former al-Muhajiroun activist, East London, June 18, 2011.
22. Interview with officer, London Metropolitan Police, Central London, June 29, 2011.
23. Interview with al-Muhajiroun activist, East London, November 13, 2010. Also, field notes from *Supporters of Sunnah* da'wah stall in East London, November 13, 2010.
24. Field notes from protest at Saudi Arabian Embassy, Central London, June 17, 2011.
25. Field notes from Islamic roadshow in Wembley, Northwest London, June 25, 2011.
26. Interviews with al-Muhajiroun activists, East London, September 4, 2013; former al-Muhajiroun activist, East London, June 26, 2011; and US government official, London, December 3, 2010.
27. Field notes from different locations in London, November 15, 2010; June 17, 2011; June 25, 2011; July 21, 2012; and September 6, 2013.
28. Field notes, East London, December 13, 2014.

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