Chapter 3

Applying a network perspective to organised crime

The previous chapter focussed on definitional aspects of organised crime, including organised criminal activities and organised criminal groups. That chapter also provided an overview of the three ideal types of social organisation: hierarchies, markets, and networks. This chapter focusses on the foundations of network theory and concepts relevant to the study of organised criminal groups. To that end, the chapter provides some necessary background that sets the scene for the content of subsequent chapters. In particular, we introduce some metrics that are used in social network analysis (SNA). It is not our aim to teach the reader how to conduct SNA (for those interested, we recommend Borgatti, Everett, & Johnson, 2018; Morselli, 2009b) but, rather, to provide sufficient background on how SNA can be used to analyse and understand criminal networks. We will discuss whole-network measures and measures of positional importance in networks, punctuated by examples from the literature on criminal networks. We then discuss how actor-level characteristics can be incorporated within a network perspective to help shed light on the structure and operation of organised criminal groups. In later chapters, we will return to the concepts and metrics introduced in this chapter when we discuss the strengths and weaknesses of criminal networks and the strategies used by law enforcement agencies to disrupt such networks.

Network theory and concepts

Network theory seeks to understand interconnections between *things*, whether those things are animals, telegraph poles, airports, webpages, or people. The structure of these interconnections emerges as a complete network from the individual dyadic relationships between pairs of things, usually referred to as *nodes*. SNA seeks to identify patterns in social structures and then relate those structures to the overall functioning or operation of the network. In social networks, the nodes are usually humans and are referred to as *actors,* although sometimes the nodes can be collections of humans, such as teams, clubs, or even organisations. A network can be conceptualised as the nodes (i.e., actors) that make up the network and the links or ties between the nodes (e.g., friendships that connect the actors) and the emerging patterns, structures, and the nature of the relationships between actors. For example, Figure 3.1 displays a network of friendships between five people. From the network map, we can see that Person E has only one friend, Person D. Person D has two friends: Person E and Person C. Persons A, B, and C are all friends with each other (this type of social structure, resembling a triangle, is called a triad).

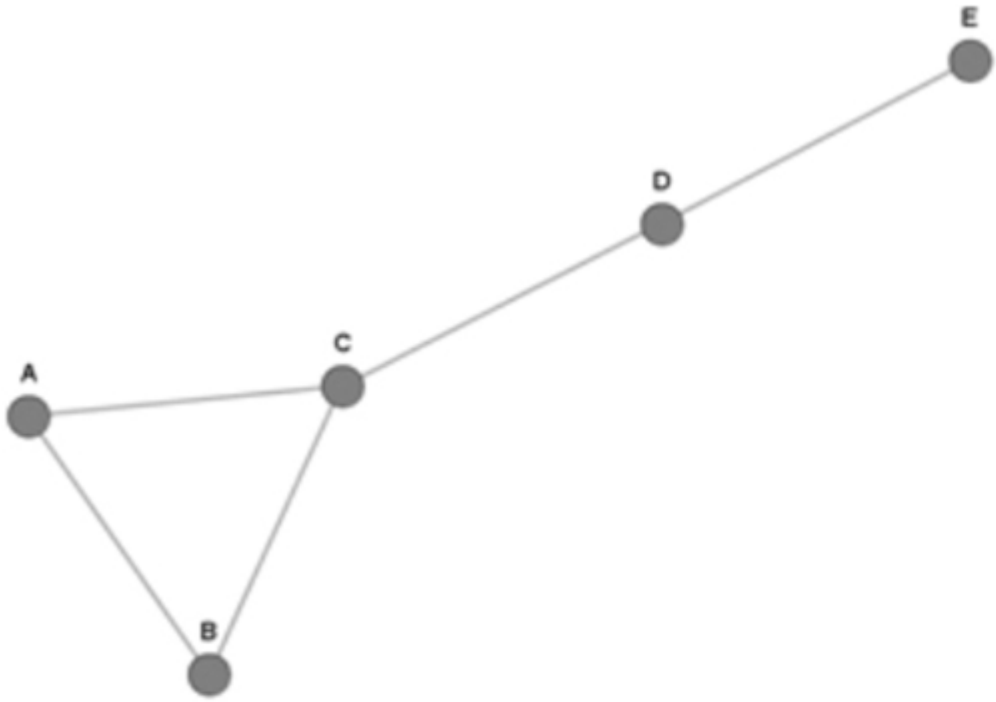

Figure 3.1 A network representing friendships among five people.

Robins (2015, p. 18) defined a social network as ‘a set of social actors and a relationship among them in the form of dyadic relational ties’. Network analysis usually includes a description of network structure and the connectedness of actors and then some interpretation that relates these structures to network outcomes (e.g., profitability of a company; Borgatti & Halgin, 2011). Social networks are distinct from other types of nonhuman networks (e.g., a network of webpages, an electricity grid) because actors in the network have motivation and intentionality (see Robins, 2011). That is, humans can be motivated by a range of sources including emotional states, needs, and desires (e.g., the desire for money). Nonetheless, actors in the network are *embedded* within, and influenced by, the social dynamics of the network. Particular social structures and interpersonal relationships can influence the behaviours, opinions, and attitudes of individuals within the network (e.g., Moody & White, 2003). For example, one might be influenced by friends to engage in particular behaviours, such as drinking or smoking, usually referred to as peer influence. The concept of network embeddedness implies that actors in a network do not behave as entirely autonomous units, but they influence and are influenced by the social and network context (Granovetter, 1985).

Networks are dynamic social structures. They change and evolve as ties are formed and broken, or weakened and strengthened. Network ties are more likely to form between two individuals when they are located in close proximity to each other (e.g., two individuals who are neighbours are more likely to form a tie compared with two people who live several streets apart). Ties are also more likely between two actors who share similar characteristics, such as class, education, ethnicity, occupation, sex, and gender. This tendency to form ties with people who share similar characteristics, described in the proverb ‘birds of a feather flock together’, is known as *homophily* (meaning love of the same).

Network ties can be undirected or directed. In the case of the former, there is no direction represented by the tie and the connection between the two actors applies equally to both actors (e.g., Person A considers Person B a friend, and B considers A a friend). Directed ties, in contrast, represent the direction of the relationship or exchange. For example, A might consider B a friend, but B does not consider A to be a friend (see Figure 3.2). Or, in the case of an organised criminal group (Borgatti et al., 2009), Person A (a wholesale dealer) may provide illicit drugs to Person B (a retail-level dealer).

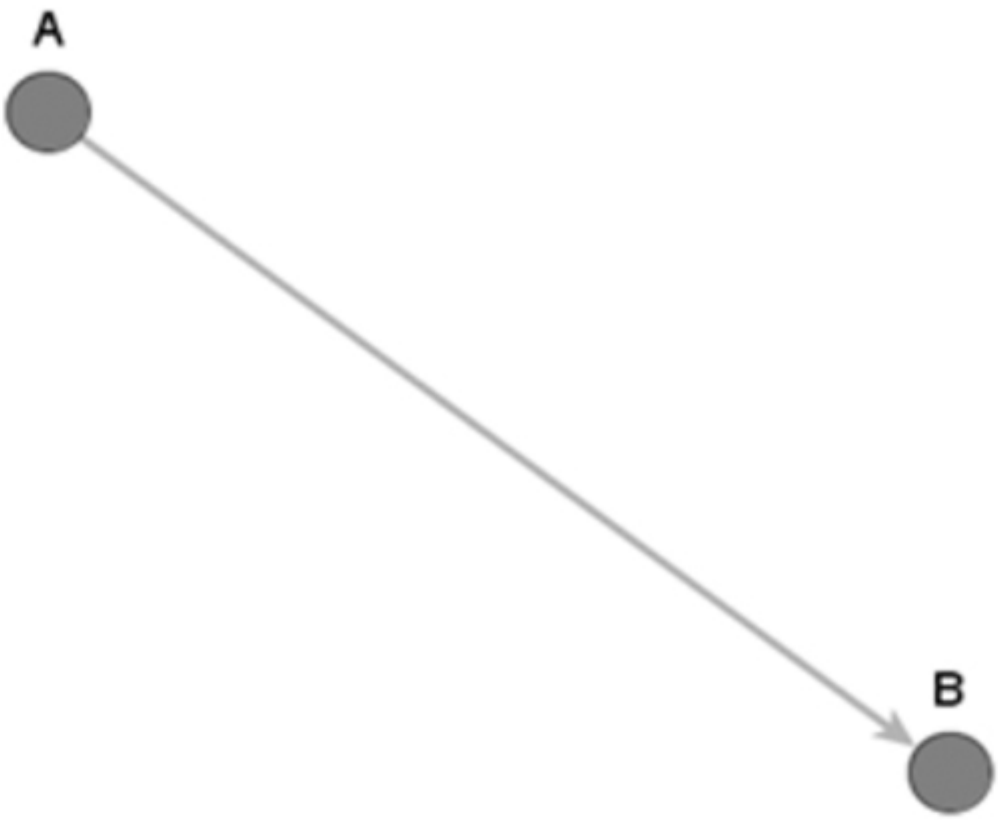

Figure 3.2 A directed tie.

Actors within social networks can be characterised as possessing certain attributes or resources, for example, experience, skills, knowledge, or leadership capacity. Attributes include demographic characteristics (e.g., age, sex, ethnicity, and socioeconomic characteristics), attitudes, personality traits, and skills (e.g., the ability to transform a set of chemicals into illicit drugs). At the aggregate level, these characteristics can also apply to groups or organisations (e. g., type of organisation and organisation size). Such characteristics are often referred to as actor-level attributes and can be considered as the human capital that is possessed by network actors. We will introduce the network capital framework, comprised of both social capital and human capital, later in the chapter. For now, it is important to note that networks comprise both the social connections of actors, and the particular characteristics or attributes of each actor in the network.

Some networks are considered *multiplex*, meaning that actors within the network are connected with each other via multiple different types of ties, or through multiple different types of relationships. For example, ties might be of two types representing that two actors are both friends and family members. In the case of flows of resources in organised criminal groups, two people might be connected by the flow of illicit guns. For example, if Person A were a gun dealer on the black market, and Person B wanted to purchase a gun on the illicit market, Person A provides the illicit gun to Person B who then pays Person A for the gun. In network terms, the gun flows from Person A to Person B, and money moves from Person B to Person A. Papachristos and Smith (2013), in their study of the embedded and multiplex nature of Al Capone, found that Capone's network spanned three social spheres (criminal, legitimate, and personal). Seventy per cent of the 1,883 individuals identified operated solely in the criminal environment, while 30 per cent of the individuals in Capone's network had ties to more than one social sphere. For example, the Hawthorne Dog Racing Club, which was opened by Capone and several of his associates, had 57 ties, including business associates, familial ties, attorney-client ties, political associations, and political corruption associations. These associations make evident the highly *multiplex* nature of organised criminal groups.

Multiplexity can also be understood as representing the strength of the relationships an actor has with network partners as a function of the number of different types of ties that connect them. For example, compare Person A and Person B as work colleagues only, compared with the case in which they also play sport on weekend, drink with each other after work, and are also brothers. In organised criminal networks, trust may be enhanced where the links between two participants include being brothers, legal business partners in a construction company, and collaborators in the manufacture and trafficking of methamphetamine. Such multiplex ties can enhance trust as the two individuals interact and collaborate in more than one context. Familial ties can be a strong foundation for high trust ties (we explore this further in Chapter 4). In organisational networks, such as interagency law enforcement networks, multiplex ties may be an indication of the strength and durability of ties between organisations because such ties not only facilitate links between organisations, but they also ensure such links are sustained even if one type of tie ceases to exist.

Networks can be described in different ways based on their overall structure and interconnectedness. For example, hub and spoke networks have one actor at the centre (high centrality), with the actor having connections with others who may or may not be connected with each other. A hub and spoke or star network is a highly dense network in which all actors are connected (see Figure 3.3) while a chain network is a network in which actors are connected to one other actor and are characterised by low density (overall connectedness; see Figure 3.4). The different configurations have implications for the overall functioning of the network. For example, in the hub and spoke network below, information can move quickly and easily among all actors in the network. In the chain network, information will move more slowly as it needs to pass through many more actors. For example, a message being relayed from Actor A to Actor F must pass through all actors, whereas the increased redundancy of ties in the hub and spoke network means that messages can be relayed between all actors via a maximum of only two steps (i.e., through Actor A).

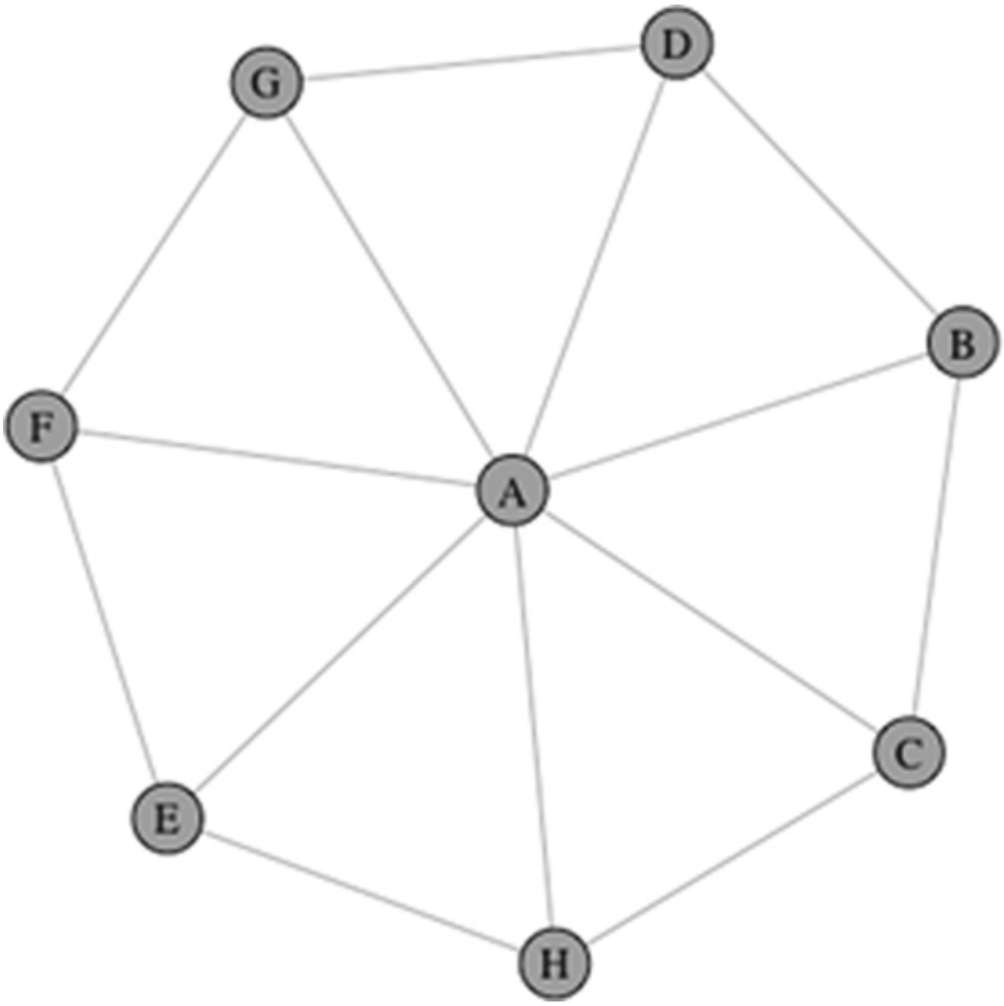

Figure 3.3 A hub and spoke (or star) network.

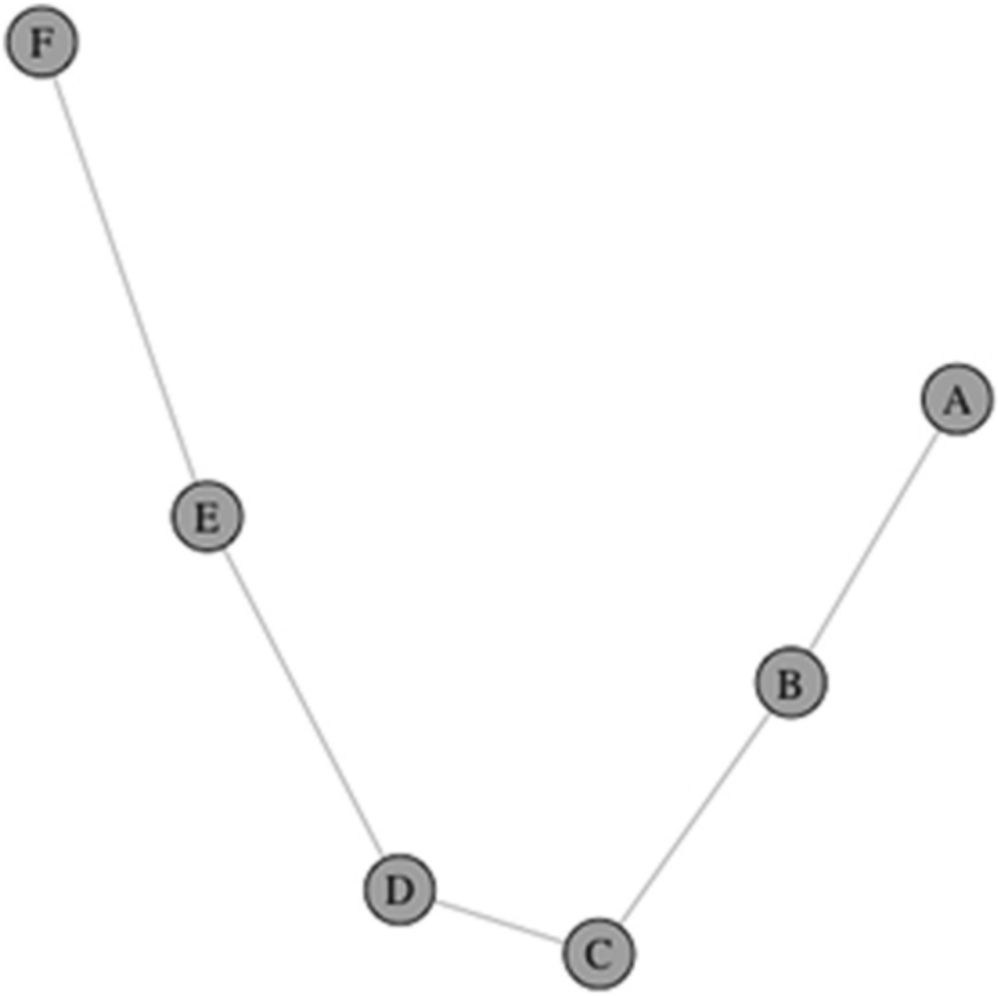

Figure 3.4 A chain network.

Networks can be analysed using SNA, which is a set of analytical techniques, grounded in mathematical graph theory, that can be used for visualising the network and observing patterns in the ties between actors (Scott, 1991). For example, SNA can be used to determine the network positions of actors relative to other actors and to identify actors who are particularly active or influential in the network. Actors who have a proportionally large number of connections to other actors or are positioned strategically between other actors as ‘brokers’, may be able to mobilise resources or transfer information to share knowledge more efficiently. For example, in an organised criminal group, an actor with a very large number of ties to others may be highly influential in the network or may be a very active member of the group. On the other hand, a group member who is positioned in between many other actors may be able to control the flow of information and/or resources through the network. There are a number of different metrics or measures that can be generated through the use of SNA. Some of these metrics tell us something about the overall structure of the network, while others offer information about the social power and influence of individual actors within the network. We now turn to these measures.

Network metrics and measures

Network metrics can be applied to whole networks and the actors comprising the network. We discuss the main concepts and measures in each of these contexts in turn.

Whole-network measures

Using SNA, one can calculate a set of whole-network measures: measures that provide insights into the structure of an overall network. *Network size* is a count of the number of actors or nodes within a network. *Network diameter* is defined as the longest of all the shortest paths between all pairs of nodes in the network. Network diameter is a measure of the number of actors that must be crossed to travel from one side of the network to the other (the path between any two actors in a network is called the path length). *Path length* is the distance 'travelled' between two actors in the network, for which each step in the path is the distance between two actors along existing links or ties between actors. So, in Figure 3.5, the path length between Actor A and Actor D is 3. *Network density* is a measure of the connectivity or cohesiveness of the network as a whole, usually expressed as the proportion of potential ties between network actors that are actually observed in the network. Density is sensitive to network size, such that larger networks tend to have lower density scores, as the probability of all potential ties being present decreases as the potential number of ties increases. *Average degree centrality* is an alternate measure of network cohesiveness, measuring the average connectedness of all actors in the network. Average degree centrality is not sensitive to network size, so it can be used to compare the cohesiveness of a number of networks of different sizes or to compare the cohesiveness of one network across time (especially if the network grows in size over time).

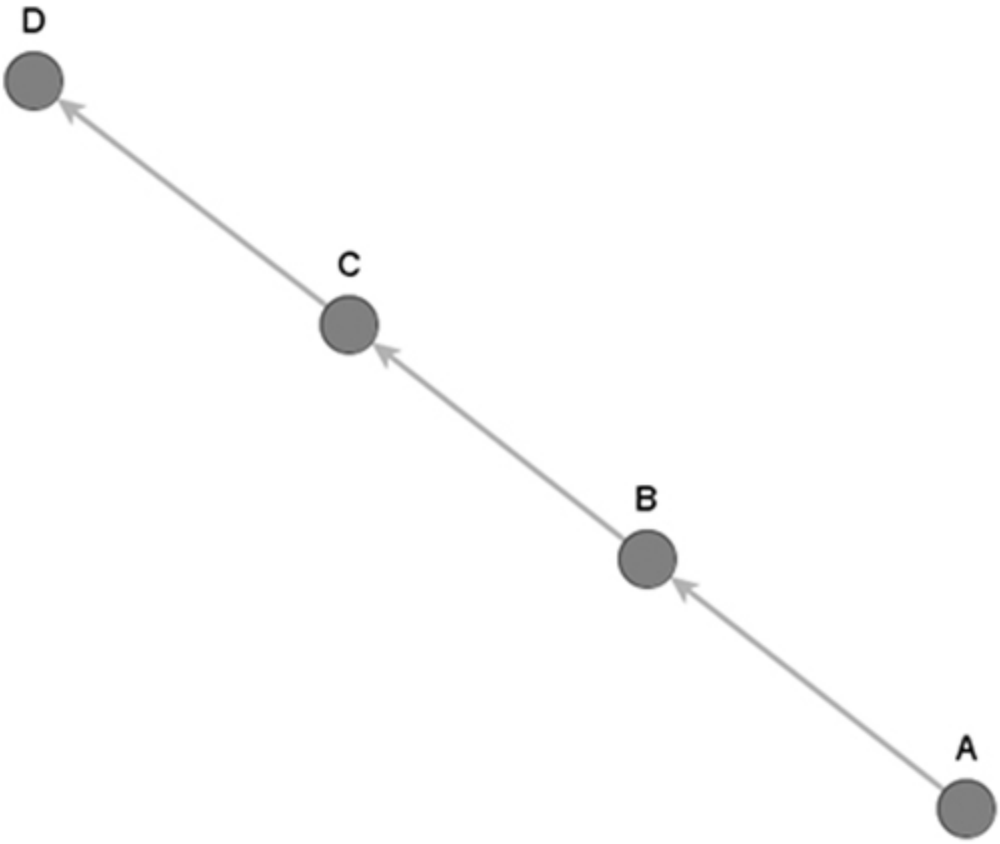

Figure 3.5 Path lengths.

Density

Density is a measure of the interrelations or density of contacts within a network. A formula recommended by Barnes (1969) can be used to calculate density:

$$100 \times \frac{na}{\frac{1}{2} n \times (n - 1)}$$

In this formula, *na* = the number of actual ties, *n* = the number of actors, and the formula in the denominator = the number of theoretically possible ties. A density score lower than 80 per cent suggests a group of loosely connected individuals with little or no contact between groups responsible for managing tasks (Ianni & Ianni, 1990). Calculations of the density of organised criminal groups range between 5.3 and 12.3 per cent (e.g., Bright, Hughes, & Chalmers, 2012; Morselli, 2009b; Morselli & Petit, 2007; Natarajan, 2006). These are generally sparse networks in which only between 5 and 12 per cent of all possible ties between actors are actually present. The small size of criminal networks may be a function of the licit contexts in which they operate, the challenge of ensuring trust between actors, and the need for some actors to remain less visible by restricting their total number of connections. We discuss these issues in more detail in Chapter 4.

Centralisation

Centralisation refers to the extent to which a network is dominated by one or more highly central nodes (or hubs). Networks with high centralisation may have one or two actors who have many more connections compared with the rest of the network, inferring that power or influence might be concentrated with these highly connected actors. Networks with low centralisation tend to have most actors with approximately the same number of connections, meaning power or influence are more dispersed through the entire network. For example, the network displayed in Figure 3.6 is a highly centralised network in which one actor (RJW) has many more connections compared with other actors; this actor is a hub. The centralisation of this network is 60.5 per cent, indicating that the network is centralised around one or two primary hubs. The network is a representation of an organised criminal group involved in interstate drug trafficking in Australia in the 1990s.

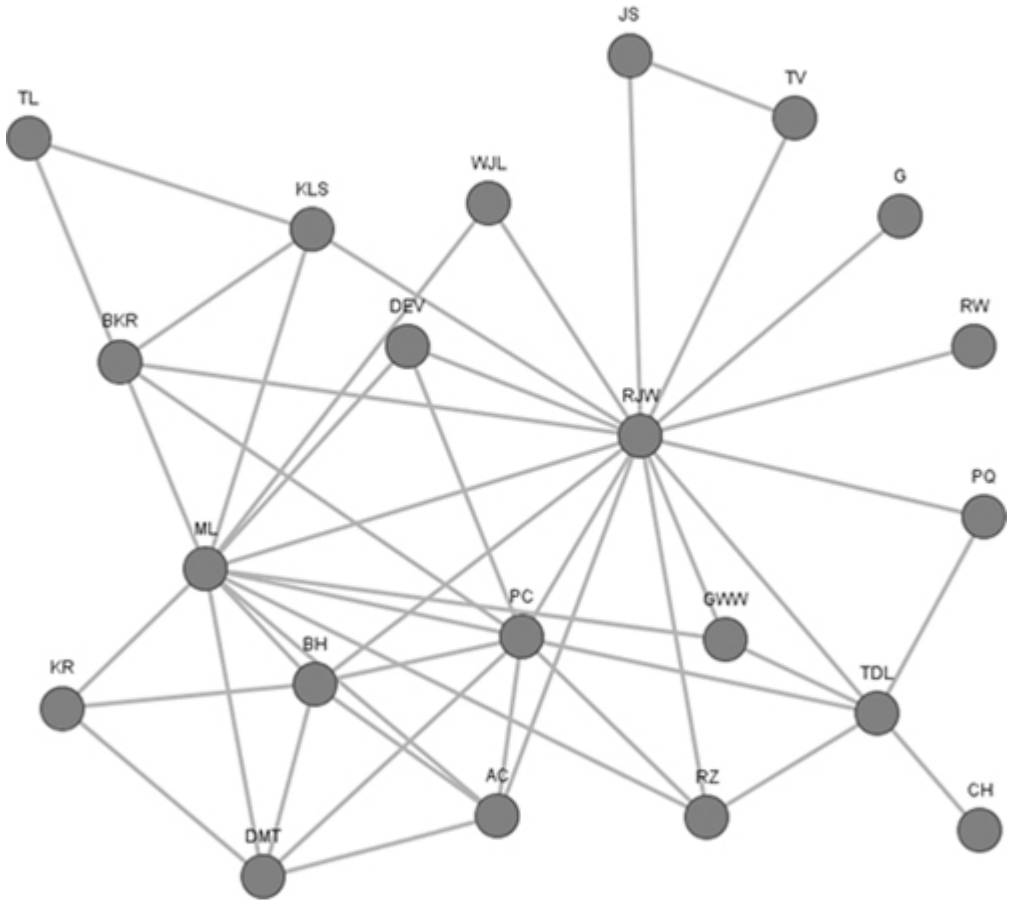

Figure 3.6 Example of a centralised network.

Scale-free networks

Across networks of different types (e.g., connections between webpages, physical structure of the internet, airports connected by flights, some social networks), network structure can be of two main types: *exponential* and *scale-free* (Barabasi & Bonabeau, 2003). Exponential networks are structurally homogenous in that the majority of actors have approximately the same number of links; therefore, the degree distribution of the network forms a bell-shaped curve (see Figure 3.7). The degree distribution is simply a graph of the centrality scores of all actors in the network, for which the degree score is shown on the *y*-axis and the number of nodes with each degree score is displayed on the *x*-axis. No actors in such a network have a very large or very small number of links compared with other actors in the network.

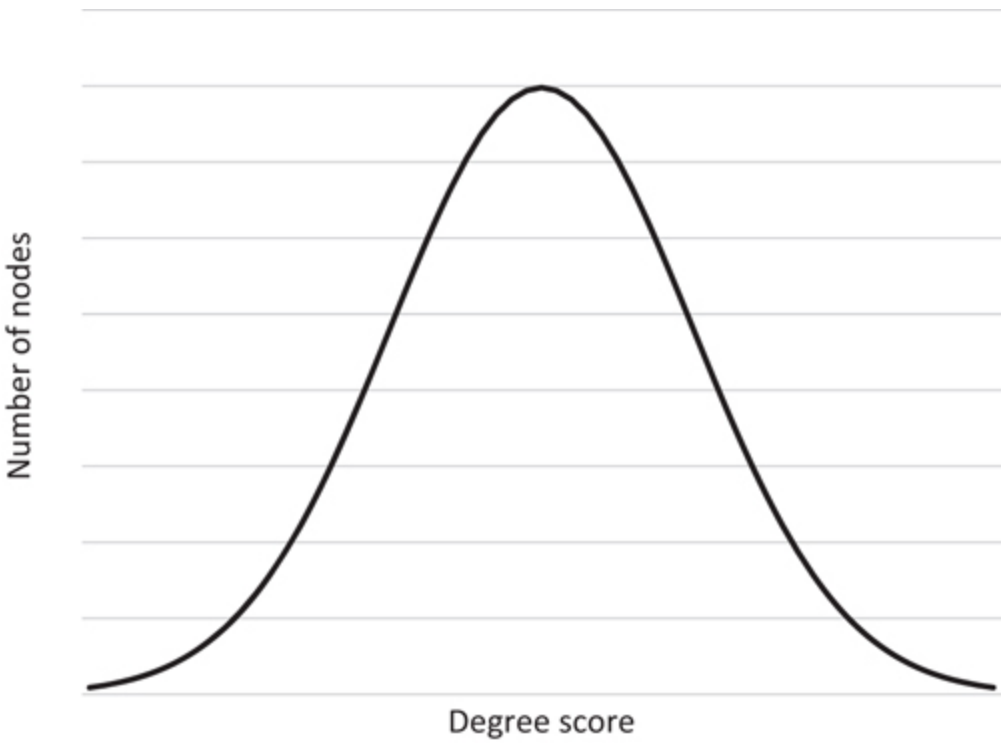

Figure 3.7 Degree distribution in exponential networks.

In scale-free networks, on the other hand, the majority of actors have few links, while a small group of actors have a proportionally very large number of links to other actors in the network. Such actors are high on a metric called *degree centrality* (which we will discuss in more detail later in this chapter) and are sometimes referred to as ‘hubs’ because of the large number of links radiating around them. It is the connectedness of these high-degree actors that maintains connectivity across the entire network and renders such hubs as the glue that holds such networks together (Albert, Jeong, & Barabasi, 2000). The implications of network structure, and in particular, the scale-free–exponential distinction, for the strengths and vulnerabilities of criminal networks will be discussed in more detail in Chapter 5.

While whole-network measures tell us something about the structure of the overall network, SNA can also generate measures that inform us about the relative position of specific actors within the network and can help to identify actors who are very active or influential or those who are positioned as key brokers. In the case of organised criminal groups, these metrics can help to identify individuals who are key to the operation of the group and whose removal can impact the group’s ability to continue engaging in criminal activities.

Node-level measures

Network positioning measures inform us about the relative position of actors in relation to other actors in the network. Centrality measures are the most commonly used and provide an indication of which network actors are more *central* in the network. Measures of positional importance, such as degree centrality and betweenness centrality, are purely ‘structural’ measures in that they indicate the relative importance of an actor based on the actor’s connectivity within the network as a whole. They do not consider other factors such as leadership potential, skills, knowledge, or access to resources (see Robins, 2009). Actors with many connections compared with others may have higher levels of authority, power, or influence in the network (e.g., Bright et al., 2012; Krebs, 2002; Morselli, 2009b). In organised criminal groups, actors who have a proportionally high number of ties to other actors may be very active in the network and involved in many different types of activities and exchanges. Or they may be highly influential and may even direct some of the activities of other actors. This is the type of embedded hierarchy we discussed in the previous chapter.

Degree centrality

Arguably the simplest and most commonly used centrality measure is *degree centrality*. Degree centrality ‘is measured by counting the number of others that are adjacent to an individual and with whom she/he is in direct contact’ (Baron & Tindall, 1993, p. 248). The term *adjacent* in this context means ‘connected to’ or ‘linked to’. In Figure 3.8, Person A can be said to be *adjacent* to Person B. In its simplest form, degree centrality for Actor A is simply a count of the number of actors to whom Actor A is directly connected. Raw degree centrality scores are a count of the number of direct ties an actor has to all other actors in the network. An actor who is connected to five other actors has a raw degree centrality score of five (e.g., in Figure 3.8, Person A has a degree centrality score of 5). *Normalised degree centrality* scores are an alternate way to represent degree centrality scores and indicate the proportion of other network actors to whom an actor is connected. When reporting normalised degree centrality, an actor connected to all five other actors in a network comprising a total of six actors would have a normalised degree centrality score of 1 (meaning that he or she is connected to 100 per cent of network actors, excluding themselves).

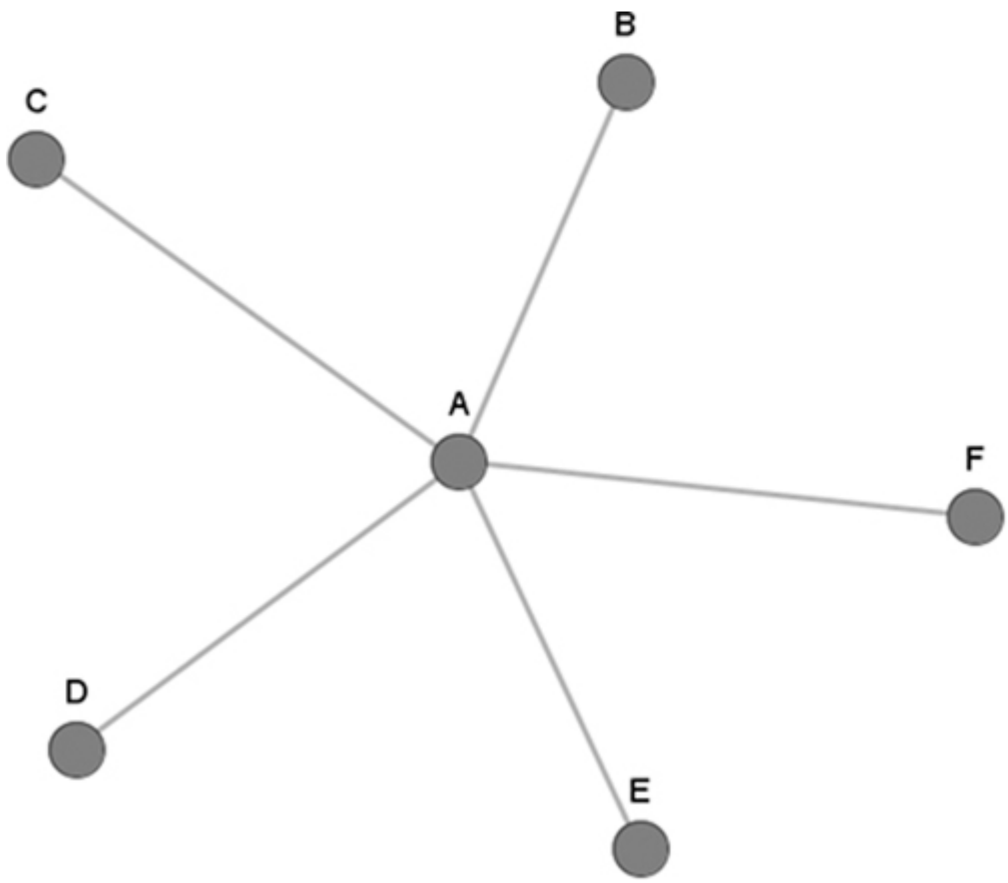

Figure 3.8 Degree centrality in a hub and spoke network

Degree centrality is a way of measuring the quantity of connections that actors have with other actors in the network. High degree centrality relative to other actors can indicate that the actor is a critical structural hub in the network and may indicate that the actor has significant influence or power in the network. It may also indicate that the actor has enhanced access to information or be able to disseminate information more quickly to other actors. Alternately, it may indicate that the actor takes a very active role in the network and is party to many exchanges or activities in the network. However, in criminal contexts, degree centrality also means high visibility, including visibility to law enforcement. As we will explore in Chapter 5, high centrality scores may, therefore, represent a significant vulnerability or weakness (Baker & Faulkner, 1993; Morselli, 2010; Peterson, 1994).

More nuanced centrality scores can be calculated in directed networks. As noted above, directed networks are those networks in which actors are assigned incoming and outgoing ties (e.g., information flows between actors showing the direction of such flows). In such networks, SNA can be used to calculate *indegree centrality* (the number of ties to an actor from other actors in the network) and *outdegree centrality* (the number of ties from an actor to other actors in the network). Indegree and outdegree centrality scores can be used to understand some of the nuance behind undirected degree scores. For example, high indegree centrality may indicate that an actor is in receipt of a lot of information, whereas high outdegree centrality might suggest an actor has significant influence on others in the network or is supplying many other actors with particular resources. Of course, the interpretation of degree, indegree, and outdegree centrality scores depend on the type of ties or relationships on which the network is based. For example, the implications of indegree centrality scores would be very different if the ties were the flows of illicit drugs compared with flows of information about potential law enforcement actions. For example, imagine a network representing an organised criminal group involved in drug trafficking. Calculating undirected degree centrality scores may facilitate the identification of actors with high degree scores, suggesting they are very active in the transfer of drugs through the network. However, if directed centrality scores are used instead, it may be possible to draw conclusions about who is most active in selling the drug to others (high outdegree centrality scores) and which actors are most involved in purchasing illicit drugs from others (high indegree centrality scores).

Betweenness centrality

Actors may be important in a network not because of the number but rather the *quality* of connections they have to others (Bright et al., 2015). Betweenness centrality scores indicate the extent to which an actor lies on the shortest paths between all other pairs of actors in the network. High betweenness centrality scores are indicative of brokerage capacity (Morselli, 2010). Brokers occupy *structural holes* (Burt, 1992) between two otherwise disconnected actors, and operate as a bridge or broker between them. A structural hole is a gap between actors, a potential tie that has not been made between actors (see Burt, 1992). Brokers can be important conduits of information or resources between actors and through the network. Actors with high betweenness centrality scores can act as connectors or brokers between otherwise disconnected actors. Brokers can be considered 'pivotal' in social networks (Morselli, 2010), profiting from others' reliance on the connections they can provide (see Figure 3.5). In organised criminal groups, brokers can be important mediators in the flow of information or resources and can vouch for the trustworthiness of other actors.

In Figure 3.9, actors A, G, and M have high betweenness scores and brokerage capacity. Actor M is a pure broker because Actor M has a high betweenness centrality score but a low degree centrality score. Without Actor M, the two clusters would be disconnected and information and resources required by each cluster could not move across the structural hole that would now exist between the two clusters. Indeed, the social space between the two clusters is a 'structural hole', and is filled in this network by Actor M. Furthermore, if the ties in Figure 3.5 represent communication between actors, actors in one cluster must go through Actor M in order to effectively communicate with all other actors in the other cluster. This places Actor M in a position of (potential) significant control and power within the network. Morselli and Tremblay (2004) found that brokers are the most economically successful actors, and Morselli (2005) found that the brokerage capacity of individuals is highest during the most successful periods of a criminal career. In short, *brokers do better* (Burt, 2005) because they can be highly influential and other network actors come to rely on them.

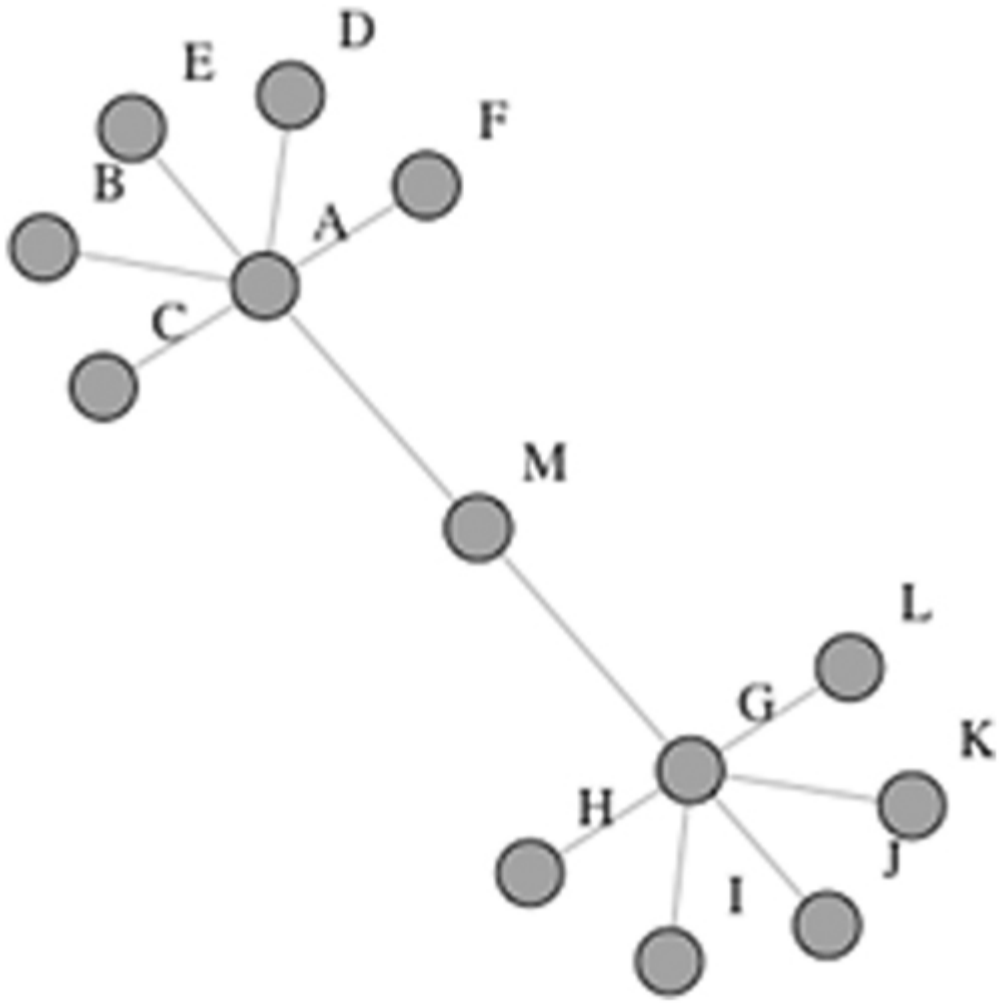

Figure 3.9 Between centrality and brokerage.

Bouchard (2020) cautions against overinterpreting betweenness scores. He notes that an actor who is positioned in a brokerage role may not have the personal capacities and characteristics to take full advantage of their network position. It is important to note that simply being positioned between other actors does not convert directly into advantages. An actor who is positioned in such a way would need to be able to behave in ways that take advantage of such a position. For example, an actor who is positioned strategically as a conduit for the flow of illicit drugs may be able to use this advantageous position to increase the profits he or she is able to extract from the transactions; however, this demands some strategic thinking and social skills to take full advantage of the opportunity. Furthermore, even though an actor is positioned on many shortest paths between other actors, the actor may be unaware of his or her pivotal position or may not be able to negotiate effectively with others or even manipulate others to ensure he or she is able to utilise the position for his or her own advantage.

According to Morselli (2010), actors in criminal networks balance degree and betweenness centrality. In other words, they balance the extent of their direct and indirect ties with other actors across the network. In an SNA of an outlaw motorcycle group (OMCG), Morselli (2010) found that degree and betweenness were moderately correlated ($r = 0.40$). He also found correlations between degree centrality and arrest ($r = 0.63$), but no such correlations were observed for betweenness centrality. This further supports the notion that degree centrality in criminal networks represents more of a vulnerability than a strength and that betweenness centrality (especially when combined with low degree centrality) can be a strength and represent a strategic position within criminal groups. Calderoni (2013) found that within members of the 'Ndrangheta, individuals who were classified as traffickers and bosses were more directly involved in criminal activities and had higher centrality scores relative to others in the network. In this case, degree centrality was a proxy for how active actors were in the criminal activities of the group. However, actors who were classified as higher in status within the group remained more detached from direct participation in criminal activities (i.

e., lower degree centrality scores), such that actors with moderate status were more central and therefore in more vulnerable positions. Such moderate-status individuals might be more easily replaced if they are arrested, facilitating flexibility and capacity to adapt.

Pure brokers

The trade-off between degree centrality and betweenness centrality can be used to identify those actors within organised criminal groups who are strategically positioned as *pure brokers*. The term pure broker refers to actors who have low degree centrality scores but who have high betweenness centrality scores. Morselli (2010) employed an innovative approach to this by using scatterplots of degree centrality and betweenness centrality in order to identify these pure brokers (see Figure 3.10). In Figure 3.10, degree centrality is indicated on the vertical axis and betweenness centrality on the horizontal axis. To make things comparable, both types of centrality are measured in this case using standardised scores (from 0 to 100). By using a measure of central tendency, such as the mean or median (the dotted lines in the figure), four quadrants are formed. Actors can then be allocated to one of the four quadrants based on their scores on degree centrality and betweenness centrality, respectively. In the bottom left quadrant are actors who are low on both betweenness centrality and degree centrality. These are actors who are not well connected and are not strategically connected. In organised criminal groups, these actors are likely to be somewhat peripheral within the network and, therefore, of low influence and value. They may do menial and relatively unskilled tasks. Actors in the upper left quadrant are low on betweenness centrality and high on degree centrality. These are well connected actors but are not strategically positioned actors. They are likely to be the most active and visible and may be those most likely to be detected by law enforcement agencies. Actors in the upper right quadrant are high on both degree centrality and betweenness centrality. Any advantage these actors accrue from being high on betweenness centrality may be overwhelmed by their high degree centrality scores, rendering them vulnerable to detection by law enforcement. Finally, actors in the bottom right quadrant are those who are low on degree centrality and high on betweenness centrality. Being low on degree centrality means one is less visible but is able to exert significant influence within the network by virtue of being high on betweenness centrality. These are the pure brokers.

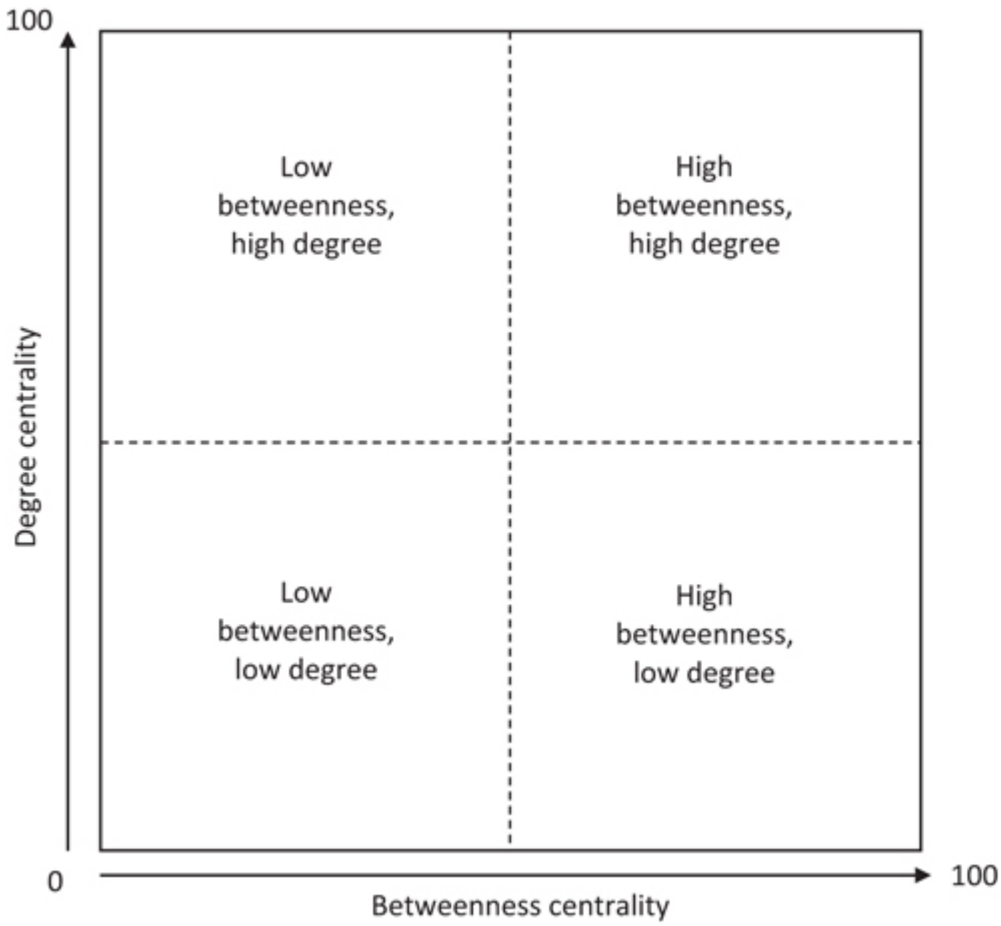

Figure 3.10 Identifying ideal brokers: the four quadrants.

Morselli (2010) found that in an OMCG, two-thirds of network actors fell into the low degree/low betweenness quadrant. Only 10 per cent of this group of actors were arrested, which he suggests may indicate that most actors in this group were relatively minor players. In contrast, those actors in the high degree/high betweenness quadrant (11 per cent of actors) were the most likely to be arrested. The highest proportion of arrests (85 per cent) were among actors in the high degree/low betweenness quadrant, largely comprised of low-ranking OMCG members. The final group, and the most strategically positioned actors, were those with low degree scores and high betweenness scores. Seven per cent of actors are in this group and only a quarter of them were arrested.

In another study of OMCG groups, Morselli (2009a) found that members of the high-ranking Nomad chapter were higher on brokerage compared with other actors. The network actors who scored highest in degree centrality were those who ranked as mid- to low-level members of the Hells Angels organisation. Those with the highest brokerage potential did not hold formal status within the group, suggesting that some of the strengths of the network lie outside the formal structures of the organisation. This again underlines the critical contribution of network perspectives over and above any consideration of formal hierarchy when it exists in organised criminal groups. Actors who were formal Nomad members had relatively low scores on degree centrality and relatively high scores on betweenness centrality. Actors who were members of the 'Rockers' (a group that was subordinate to the Nomad chapter of the Hells Angels) were found to score high in degree centrality and relatively low in betweenness centrality. Nomad prospects – the lowest-ranked Nomads – were located between the elite Nomads and the low-status Rockers in terms of their degree and betweenness scores. Higher-level members of the group were relatively low in their number of direct contacts with others. That is, they were not hands-on participants in the criminal activities and, therefore, were protected from the potential impact of law enforcement interventions.

Finally, there is some evidence from the analysis of multiplex criminal networks that some actors may be pure brokers for some types of ties but not others. Bright et al. (2015) found that some actors within a multiplex network may be in pure brokerage positions for one type of resource exchange only (e.g., the flows of precursor chemicals through the network), but not for other types of resource exchange and not the for the network as a whole. This suggests that brokerage positions and the identification of pure brokers may be more nuanced and that actors may specialise in the provision of specific resources or skills within a network. This explanation is certainly consistent with the notion that crimes that are organised and complex require a certain level of specialisation and division of labour and that this has implications for the structure of criminal networks and the position of actors.

Closeness centrality

Closeness centrality is a measure of the ease with which an actor can connect to or *reach* all other actors in the network. It can be calculated as the inverse of the sum of the shortest paths from an actor to every other actor in the network. Actors with high closeness centrality scores can reach all other nodes in the network in relatively few steps. In the network shown in Figure 3.11, Person C is one step away from Persons B, D, and E and is two steps away from Person A. Person A, on the other hand is one step from Person B, two steps from C, and three steps away from both D and E. Person C's closeness centrality score would be higher than Person A's. Person C is able to contact all other actors in the network in fewer steps compared with Person A. In an organised criminal group, if Person A has information or resources that Person C desires, Person C could ask Person B to ask Person A for that information. Both D and E would need to go through C and B in order to access the information or resources held by A. Actors who are closer to all other actors may be able to be more influential and have easier access to the information and resources held by all other network actors.

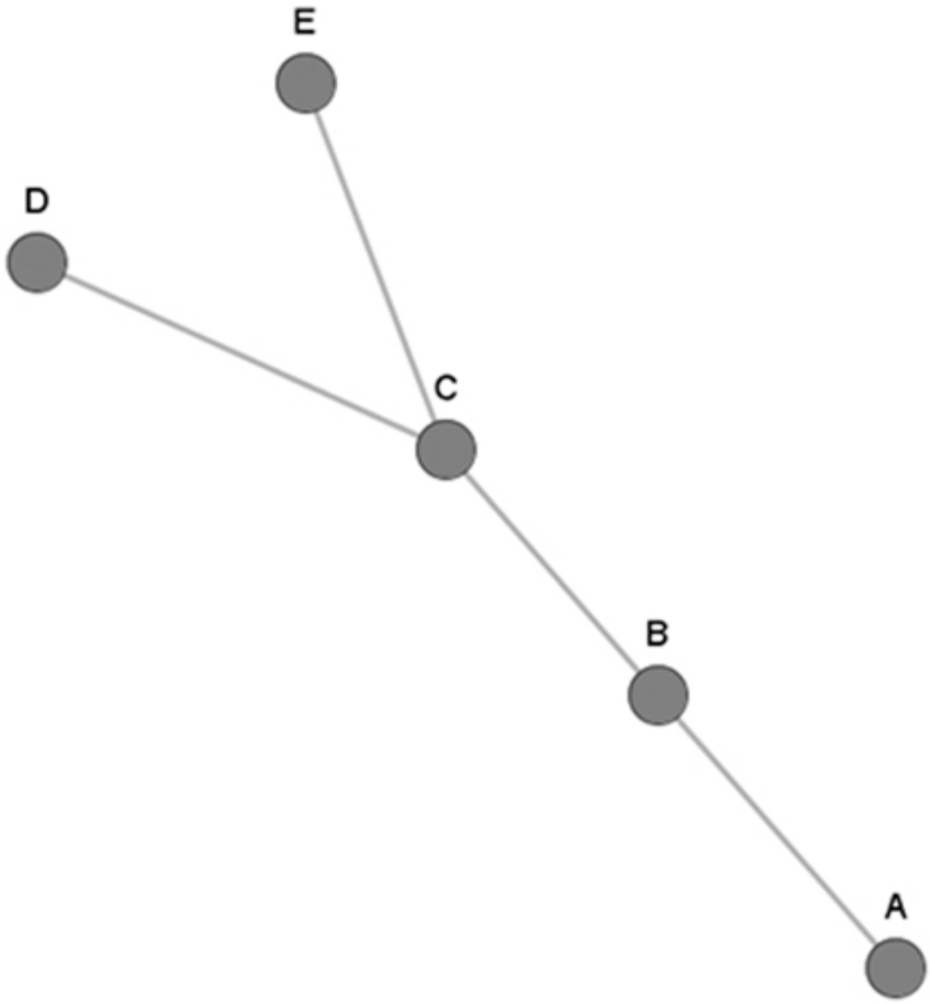

Figure 3.11 Closeness centrality.

Eigenvector centrality

Eigenvector centrality is a reasonably obscure measure and has not been used frequently in the study of organised criminal groups. Nonetheless, we describe it briefly here, as it does have significant potential for our understanding of such groups and the vulnerabilities within them. Eigenvector centrality is a measure of the extent to which an actor is connected to actors in the network who are themselves well-connected (i.e., high degree centrality); therefore, it is a measure of the extent to which an actor is connected to other influential or active members of the network. Actors in a criminal network may benefit from having low direct connectedness to other actors (i.e., low degree centrality) while maintaining a few strategic connections to high degree centrality actors. Actor M in Figure 3.9 would have a relatively high eigenvector centrality score, but a relatively low degree centrality score. Actors high in eigenvector centrality may be useful targets for law enforcement, especially for the collection of intelligence given they are connected to well-connected others (i.e., other active or influential actors in the network).

The SNA metrics discussed to date are structural measures. They consider only the actors' relative network position and do not consider other factors such as personal attributes and characteristics. We discuss these issues next and show how a network perspective on organised criminal groups allows us to consider not only macrolevel factors but also individual-level factors and attributes.

Attributes of actors and ties

When analysing networks using SNA, data can also be collected and analysed on specific attributes or characteristics of both actors and ties. For example, age or gender could be included in analyses as actor attributes. Analyses might then consider the relationship between the centrality of actors and their age or sex (e.g., highly central actors may be more likely to be older). Ties between actors can also have particular attributes, for example it is possible to include a measure of tie strength.

Actor attributes

Actors in a network can have particular characteristics or attributes, such as specific knowledge, skills, or leadership capacity. In organised criminal groups, individuals with specialised skills are needed to conduct some of the tasks required (see for example, Bright & Delaney, 2013; Bright et al., 2012; Morselli & Roy, 2008). For example, in car theft and rebirthing operations, there is a need for skills in stealing cars, such as being able to override electronic security systems (e.g., Morselli, 2010). In methamphetamine manufacture and trafficking networks, organised criminal groups require specialised skills in cooking methamphetamine (e.g., Bright et al., 2012). Cooking is the process of converting precursor chemicals, such as pseudoephedrine, into methamphetamine. Such chemical knowledge and skills are often in short supply, and it may be difficult to replace a methamphetamine cook if they are arrested and imprisoned. SNA can be used in concert with tie attributes and actor attributes. For example, if the aim is to identify key actors in organised criminal groups, one could examine SNA metrics to find, for example, those actors who are well connected and/or those actors who are brokers and pure brokers. These results can be determined using SNA metrics alone and reflect the connectivity of actors within the network. One could also determine which actors play important or specialised roles; for example, those with a high degree of specialisation who are difficult to replace if they are removed.

A limitation of SNA metrics more broadly is that they do not consider actor-level characteristics or attributes (Robins, 2009; Schwartz & Rouselle, 2009). A pure SNA approach that examines patterns of ties between actors ignores an important component of organised criminal groups as social networks. In organised criminal groups, the actors are not simply ‘nodes’ that are all alike. They are humans with a range of characteristics, such as specific skills, knowledge, access to resources, leadership potential, and so on. Actors who are not well connected but who have important skills or knowledge (e.g., how to override car security systems or how to manufacture illicit drugs, such as ecstasy and methamphetamine) or who can access key resources (e.g., precursor chemicals) may be very important to an organised criminal group and the criminal activities they pursue. However, standard SNA may not reveal these actors to be important because such analyses do not consider these specific attributes.

Some scholars have argued that the best way to analyse the structure and operation of organised criminal groups is to combine SNA with information about actors’ skills and resources. Schwartz and Rouselle (2009) formulated a *network capital framework* in which the tangible and intangible attributes of group members is considered along with centrality scores. Using the network capital framework, actors who possess multiple attributes and who share such skills and resources with others in the network contribute more to network capital and are, therefore, more important to the functional success of the group. Actors who have access to resources and who share these resources with others contribute more to network capital. The importance of such actors is both structural and functional. Such actors are functionally important because they facilitate access to resources that are required for the successful completion of the crime commission process. These actors are structurally important because their connectedness is integral to the structural integrity of the network.

The quantum of tangible and intangible attributes possessed by network actors can be quantified using ‘attribute weightings’ (Bright et al., 2015; Schwartz & Rouselle, 2009). Schwartz and Rouselle (2009) suggested the use of two types of weights: one for nodes and one for links. Actor attribute or link weightings can then be combined with actor centrality scores or can be considered separately. In a study of a methamphetamine network, Bright et al. (2015) found that actors who possessed diverse types of resources had more communication with other actors and were more likely to be in brokerage positions. They also found that actors who possessed tangible resources, such as money and drugs, were higher on brokerage than those who did not possess any resources (the result did not hold for intangible resources, such as the transfer and exchange of information). These results suggest that actors are more likely to fill structural holes for exchange of tangible resources as the transfer of these in the network is more critical to the crime commission process and hence to profit. According to Bright et al. (2015, p. 265), ‘The larger the number of tangible and/or intangible resources an actor possesses, and the more the actor shares the resources with other network actors, the greater the weighting applied to that actor.’ Thus, even actors with low scores on positional importance measures, such as degree and betweenness centrality, may contribute significantly to network capital if they have high attribute weightings.

Actor roles

One type of actor attribute data that has been used previously in the study of organised criminal groups is the particular role that actors play within the group. Roles can refer to the specific set of activities that each actor does and often represent a set of knowledge and skills possessed by different actors. Table 3.1 provides an example of different roles and the set of skills and knowledge that each role involves. Previous studies have examined the roles actors play within a network framework by combining role information with more traditional SNA. For example, Natarajan (2000) used wiretap surveillance transcripts to construct a network map of an organised criminal group involved in trafficking cocaine. She identified three main roles: *bosses*, *assistant managers*, and *field workers*. Roles can be considered a proxy for certain combinations of skills and resources. This framework is likely to have been influenced strongly by the law enforcement investigation and by law enforcement conceptualisation of the group, as clearly a hierarchical structure was assumed. In another study, Natarajan (2006) conducted an SNA of a heroin trafficking group, in which she identified four primary roles: *wholesale sellers*; *middlemen* between wholesale dealers and retail dealers; *secretaries* who passed messages to buyers, sellers, and dealers; and *retailers* who purchased drugs from wholesale dealers. Bright et al. (2012) studied a methamphetamine trafficking group in Australia and used degree centrality and betweenness centrality to identify key actors. A role analysis also identified seven distinct roles (see Table 3.1).

Table 3.1 Roles within a methamphetamine manufacture and trafficking network (from Bright et al., 2012)

Role	*Descriptor*	*No.*
Managers	Designated tasks to others and to whom other actors reported. Instructed actors to perform specific tasks, such as obtaining precursor chemicals, supplying the chemicals to clandestine lab managers, receiving supplies of end product from labs, and passing them on to wholesale dealers. Funded some aspects of the manufacture and distribution process (e.g., paying for precursor chemicals).	2
Clandestine laboratory managers	Supervised and coordinated the operation of clandestine lab sites.	3
Wholesale level dealers	Sold methamphetamine in single and multiple kilogram quantities.	7
Resource providers	Obtained chemicals and equipment required for the manufacture of methamphetamine.	8
Specialists	Possessed specialised skills and knowledge in the manufacture of methamphetamine.	2
Workers /labourers	Paid a wage to complete specific tasks that were usually designated by the managers (e.g., transport equipment, remove tablets from foil containers, and make deliveries of drugs, money, messages, or equipment.)	10
Corrupt police officers	Occupied positions as police officers and were paid bribes to behave corruptly (e.g., to tamper with evidence to protect network members from prosecution).	3

Some roles were found to be in low supply, but high in demand. For example, methamphetamine cooks were critical to the manufacture process and were in short supply in the network (there were only two actors who assumed this role). On the other hand, some roles were present in large proportions (i.e., high redundancy). These tended to be roles requiring little to no specialised skill, such as workers or labourers who were paid a wage to undertake menial but often risky tasks, such as transporting equipment between clandestine laboratory sites.

Morselli and Giguere (2006) examined the strategic positioning of actors in a drug importation and trafficking network, and categorised actors as traffickers and nontraffickers. Nontraffickers were actors in legitimate businesses who provided support to the criminal activities of the group (e.g., accountants, lawyers). When nontraffickers were separated into financial and nonfinancial roles, those in financial roles were found to be in strategic positions. Similarly, Calderoni (2012) combined SNA with a task and role analysis of two ’Ndrangheta groups and identified four roles across the two groups: *traffickers*, *buyers*, *brokers*, and *support individuals*. The traffickers were found to have higher centrality scores compared with other roles and played key brokerage roles, connecting the supply and wholesale/retail markets. Mancuso (2013) identified six roles in a Nigerian sex trafficking group: *actors who engaged in direct exploitation*, *intermediaries between victims and madams*, *victims-madams*, *madams*, *traffickers*, *victims*, and *minor roles*. Actors who were madams were found to have the highest degree centrality and betweenness scores. Some madams had high betweenness centrality scores, suggesting that these individuals were key to the network. Overall, the results of these studies suggest that some roles played by actors may be correlated with patterns of degree centrality and betweenness centrality. Nonetheless, use of centrality scores in combination with role/task information and actor attributes can assist in the identification of key actors and the overall structure of the group.

The roles played by network actors can shift and change across time, demonstrating the adaptivity and dynamic nature of networks. For example, Bright and Delaney (2013) collected longitudinal data on a methamphetamine manufacturing and trafficking network across four time periods. Degree and betweenness centrality were found to fluctuate for some actors. For example, in the 1993–94 period, one actor was connected to less than 5 per cent of other actors, while in the 1997–98 period he was connected to almost three-quarters of other actors. In contrast, another actor was connected to over 50 per cent of other actors in the 1992–93 period, but to only 9 per cent of the network in the 1997–98 period. This illustrates that the centre of gravity of organised criminal groups can shift significantly across time. Similarly, the roles played by actors changed over time, often in response to law enforcement intervention and changes in operation or strategy. For example, between the 1991–92 period and the 1993–94 period, there was a decrease in the proportion of actors engaged in the provision of residential premises for the purpose of clandestine laboratories. This was an adaptation to the law enforcement focus on suburban clandestine labs in residential premises and represented a shift to the use of clandestine laboratories located in remote bushland sites. The ‘standover man’ roles emerged only in the final period (1997–98), possibly due to an increase in network size, shift to profit motivation, and emerging problems in ensuring loyalty and compliance.

Just as nodes can have attributes or characteristics, so can ties between actors. We discuss one type of tie attribute relevant to criminal networks: tie strength.

Tie strength

Ties between actors can be weighted by the strength of the relationship between actors. For example, if a tie represents friendship, the weight of the tie can be used to indicate the strength or closeness of the friendship (e.g., a score of 1 may indicate a weak tie and a score of 5 may indicate a strong tie). A tie represents that two actors have contacted each other by phone, and, as is often the case in wiretap information collected on actors within a criminal network (e.g., Natarajan, 2000, 2006), the strength of the tie can indicate the number of times the two actors have talked by phone, meaning more calls within a given time period are represented by greater tie strength (see Figure 3.12). Tie strength can also be combined with information about tie direction. In the case of the phone calls discussed above, if Actor B calls Actor D 20 times, and Actor C calls Actor B 10 times, the tie strength from B to D is greater in magnitude than the tie strength of the link between C and B (as depicted in Figure 3.12). This information can provide important information on the relative importance of actors and dyads within the network and can be used by law enforcement agencies to make decisions regarding intelligence collection and the focus of investigations (see Chapter 7).

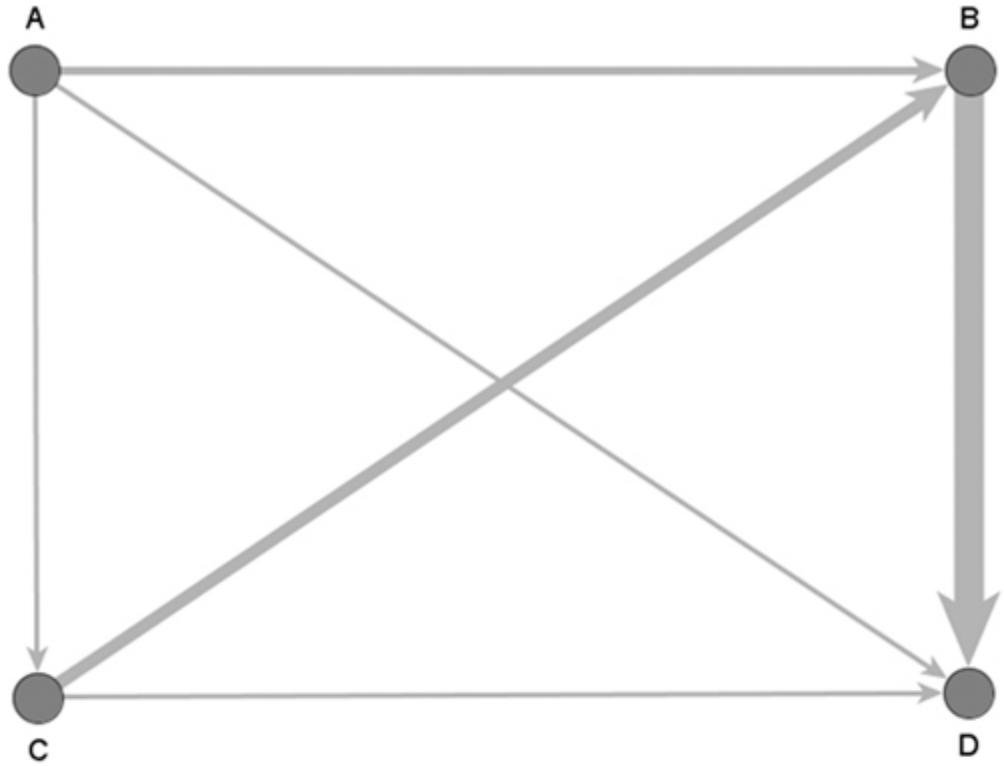

Figure 3.12 Directed edge weights based on the number of phone calls between actors.

Conclusion

This chapter has introduced some basic network concepts as well as SNA measures and metrics. In particular, we provided some introductory information about the structure of networks, whole-network measures, and metrics that can be used to identify key actors within networks. We also discussed actor attributes, such as knowledge and skills, that can be used to complement such metrics and measures. The chapter highlighted the utility of SNA in illuminating the structure and function of organised criminal groups. The network perspective facilitates insights into the structure and operation of criminal groups at several levels, including the level of the group and individual actors within such groups. A network perspective tells us about the overall structure of such groups and how such structure facilitates the illicit activities in which groups engage. Furthermore, a network perspective is flexible enough to also reveal characteristics of individual actors and how such characteristics contribute to the structure and operation of the group as a whole. One particular advantage of the network approach is that no *a priori* assumptions need to be made about the structure of organised criminal groups. Observations about social structure can be made based on the results of the analysis including a consideration of the context in which the organised criminal exists.

In the remainder of Part 1 of this book, we delve deeper into the network perspective on organised criminal groups, building upon some of the details provided in this chapter. In the next chapter, we explore the formation, operation, and evolution of organised criminal groups using a network perspective.

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