Understanding the structure and composition of co-offending networks in Australia

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Acronyms and abbreviations

AICI	Acts intended to cause injury
ANZSOC	Australian and New Zealand Standard Offence Classification
COPS	Computerised Operational Policing System
EDW	Enterprise Data Warehouse
OAGP	Offences against government procedures, government security and government operations
SNA	Social network analysis

Abstract

Much criminal offending is undertaken by two or more individuals acting collaboratively. Therefore, the study of co-offending patterns is critical to improving understanding of crime statistics, theories of crime and criminal careers, and estimating societal harms and the impact of policy interventions. Using techniques from social network analysis, this study uses arrest data for metropolitan Melbourne and Sydney to examine the structure of co-offending networks and whether patterns of co-offending vary according to crime type, number of co-offenders, duration of offending, and offender age and gender. The study also identifies implications for policy and law enforcement practice.

Executive summary

Background

The literature on crime and criminal behaviour has long recognised that much criminal offending is undertaken by two or more individuals, acting collaboratively. Although the true size and impact of co-offending is still not well known, previous research suggests that up to 35 percent of all crime events involve more than one offender (Carrington 2002; Hodgson 2007; van Mastrigt & Carrington 2014; van Mastrigt & Farrington 2009). Research has further demonstrated that co-offending may lead to an escalation in offending, and that co-offending, compared with solo offending, results in more harms to victims, property and society (Carrington 2002; Felson 2003). Therefore, the study of co-offending patterns is critical to developing a comprehensive understanding of crime statistics, theories of crime, criminal careers, estimation of societal harms and the impact of policy interventions, including deterrence, incapacitation and rehabilitation (eg McGloin et al. 2008; Morselli, Grund & Boivin 2015; Zimring 1981).

Analysing co-offending can significantly improve the understanding of offending structures and pathways and can guide the policy and practice of crime prevention and law enforcement (McGloin & Nguyen 2014). Group crime has the potential to further embed individuals in criminal lifestyles and to expand and deepen offending repertoires (Andresen & Felson 2012), offering more opportunities to learn and engage in criminal behaviours. Despite the diverse implications of co-offending for criminal versatility, the design of crime prevention and crime reduction policies, and law enforcement practices, very little research has concentrated on co-offending patterns across different crime types. In Australia, there is a notable lack of research on co-offending. This research project addresses a critical gap in our knowledge: the extent to which the results of co-offending research in other countries, such as the United States or Canada, translate into an Australian context.

Aims and approach

The current study extends previous work on co-offending by analysing the range of crime types committed by individuals and co-offenders across co-offending networks. The project has four main aims:

- to examine co-offending networks across single and multiple crime types (including criminal versatility);
- to examine variations in co-offending across specific crime categories (eg non-sexual violent, sexual violent, acquisitive, drug possession, drug trafficking);

- to determine whether there are differences in duration of co-offending, number of co-offenders, extent of co-offending, structure of co-offending networks and age or gender homophily across different categories of crime; and

- to identify the implications of the various co-offending networks for law enforcement practice, within an intelligence-led framework.

De-identified arrest data were collected for all offences across a five-year period (2011–2015), for the metropolitan areas of both Melbourne and Sydney. We used social network analysis (SNA) to analyse the data. SNA is an established framework that facilitates the analysis of relationships and interdependencies among groups of individuals (Borgatti, Everett & Johnson 2013; Scott 2012; Wasserman & Faust 1994). The use of SNA to examine crime and criminal behaviour, especially group-based crimes, has increased exponentially in the last two decades (Morselli 2009; Papachristos 2011). In this study, SNA was used to explore social structure, criminal versatility, homophily and the duration of co-offending across different crime types.

Results

Overall, rates of co-offending in both the Melbourne and Sydney metropolitan areas were low. In Melbourne, 17 percent of offenders engaged in any co-offending, and six percent of offences involved co-offending. In Sydney, 13 percent of offenders co-offended, and four percent of offences involved co-offending. These rates are lower than estimates in previous overseas studies. Regional variations in data collection and coding and the geographic setting in which data were collected (ie within Melbourne and Sydney central business districts only) are likely to explain some of this variation. We found that property offences involved higher rates of co-offending than violent offences in both Melbourne and Sydney regions. Of offence types, co-offending rates were highest in the offences of robbery/extortion, unlawful entry and homicide. The extent of the variations across crime types highlights the benefits of studying co-offending data in disaggregated form. It suggests that some crimes types are likely to be perceived to be easier, less risky and more profitable than others or, alternatively, that some crime types offer greater opportunities for socially mediated benefits like camaraderie and bonding. This has direct implications for preventing and controlling crime.

In both regions, around 50 percent of offenders in the co-offending network were violent, suggesting that there is a greater access to a range of co-offenders among this crime type than in either market or property offences. (For a description of the categories of crime types, see page 9.) Degree and age assortativity were also strong in both Melbourne and Sydney, suggesting that offenders tend to co-offend with others who also have a large personal network of co-offenders and who are of a similar age. Our findings for gender assortativity were consistent with previous research, suggesting that co-offenders tend to co-offend with others of the same gender except in market-based offences, where mixed-gender groups tend to commit offences. Studying the co-offending network provides useful insights into patterns of co-offending across crime types and the nature and extent of homophily in the network. This information is crucial for devising targeted law enforcement interventions.

Introduction

The literature on crime and criminal behaviour has long recognised that much criminal offending is carried out by two or more individuals, acting collaboratively. Researchers are increasingly placing co-offending at the forefront of the criminological research agenda (eg Bouchard & Konarski 2014; Brantingham et al. 2011; Iwanski & Frank 2014; McGloin et al. 2008; Morselli, Grund & Boivin 2015). Co-offending leads to more interactions with the justice system per person and makes up a greater total number of cases in the justice system (Andresen & Felson 2012) than solo offending. Individuals who engage in co-offending commit a greater number of offences, and these are at more serious levels (Felson 2003; Hindelang 1976; McGloin & Piquero 2009a; Sarnecki 2001; Warr 2002; Zimring 1981). Group crime has the potential to further embed individuals in criminal lifestyles and to expand and deepen offending repertoires (Andresen & Felson 2012; McGloin & Nguyen 2014). For example, co-offending provides more opportunities to learn and engage in criminal behaviours.

In this study, we define 'group crime' as a criminal act that involves the direct and simultaneous actions of at least two people. Studies of group offending show that group sizes typically vary between two and three members (Felson 2003; Lammers 2018; McGloin et al. 2008; Reiss & Farrington 1991; Warr 2002; Weerman 2003).

Analysing co-offending can significantly improve the understanding of offending structures and pathways and can guide the policy and practice of crime prevention and law enforcement.

While there is a significant and growing body of literature on co-offending, there has been no research on co-offending in Australia. Extant research has approached co-offending in different ways. Limited research has concentrated on co-offending patterns across different crime types (Morselli, Grund & Boivin 2015) rather than either specific crimes (eg drug crimes; see Iwanski & Frank 2014) or aggregate crime data. A growing trend has been to use the method of SNA to examine the structures of co-offending networks (eg Bastomski, Brazil & Papachristos 2017; Bouchard & Konarski 2014; Grund & Morselli 2017; Iwanski & Frank 2014; Lantz & Ruback 2017a, 2017b; Morselli, Grund & Boivin 2015; McGloin & Piquero 2009b; Ouellet, Bouchard & Charette 2019). Researchers are using SNA in a variety of ways, examining:

- the internal dynamics and evolution of criminal groups (eg Bright 2015; Bright & Delaney 2013; Bright et al. 2015; Bright et al. 2012; Sierra-Arevalo & Papachristos 2015);
- connections between criminal groups (eg Bright, Hughes & Chalmers 2012; Bright, Whelan & Harris-Hogan 2018; Burcher & Whelan 2015; Kenney 2007; Natarajan 2006);

- applications of SNA as a potential intelligence tool (eg Burcher & Whelan 2018, 2019; Duijn & Klerks 2014; Mullins 2013; Sullivan et al. 2018; van der Hulst 2009); and

- applications of SNA as a law enforcement simulation tool (eg Bright, Greenhill & Levenkova 2014).

The approach has been found to offer significant value in understanding the patterns and implications of co-offending (Bouchard & Konarski 2014; Grund & Morselli 2017; Iwanski & Frank 2014; Morselli, Grund & Boivin 2015). This underpins our decision to use SNA to provide a fuller picture of co-offending in Australia across crime types in the current study.

This introductory section will highlight some of the main trends from the literature on co-offending before outlining the aims of our current study.

Understanding co-offending

Co-offending prevalence

According to Carrington (2002), co-offending incidents account for 24 percent of all crimes—44 percent for young offenders and 20 percent for adults. In a UK study, van Mastrigt and Farrington (2009) found that co-offending was present in a relatively small proportion of offences (approximately 10%) but involved a higher proportion of participations (22%). Carrington (2009) found that burglary, arson, robbery, property damage, theft of a motor vehicle, property offences and theft under $5,000 all have co-offending rates for youth greater than 50 percent. Older studies using relatively small sample sizes tend to report high rates of co-offending, whereas more recent studies using larger sample sizes are somewhat inconsistent regarding prevalence of co-offending (Andresen & Felson 2010). Studies using large numbers of official records suggest that co-offending varies between 10 and 20 percent (Carrington 2002; Hodgson 2007; Stolzenberg & D'Alessio 2008; van Mastrigt & Farrington 2009). Estimates in the extant literature indicate that the percentage of individuals taking part in co-offending varies between 20 and 45 percent (Morselli, Grund & Boivin 2015); co-offending itself varies between 10 and 20 percent across crime events (Hodgson 2007; Stolzenberg & D'Alessio 2008; van Mastrigt & Farrington 2009). One of the factors underpinning such variations is that co-offending is defined and measured in different ways (Andresen & Felson 2010; van Mastrigt & Farrington 2009). This highlights the need for further research to improve understanding of the prevalence of co-offending in different contexts.

Reasons for co-offending

Individuals may choose to co-offend for several reasons. Weerman (2003) identifies three in particular:

- The decision to co-offend is formed as part of a social learning process via differential association or by social or peer pressure (McCluskey & Wardle 1999; Shaw & McKay 1931; Sutherland 1947; Warr 1996).
- Co-offending may be driven by an underlying personality trait, such as low self-control, which then determines self-selection into groups based on such shared attributes.
- Individuals may expect co-offending to be easier, less risky and more profitable than solo offending (Weerman 2003). Co-offending removes or reduces fears and offers the feeling of anonymity and diffused responsibility (Alarid, Burton & Hochstetler 2009; note that Tillyer & Tillyer 2015 found that co-offending was riskier and less profitable than solo offending).

Therefore, co-offending can be driven by social factors and pressures, an individual's personality traits and the perceived benefits and rewards of acting in concert. Other co-offending studies suggest that trust among potential offenders is highly influential on the willingness to participate in a group crime (Alarid, Burton & Hochstetler 2009; Charette & Papachristos 2017; McCarthy et al. 1998; Tremblay 1993), as are camaraderie, loyalty (Alarid, Burton & Hochstetler 2009) and personal circumstances such as poverty or the need for money for a friend (Alarid, Burton & Hochstetler 2009; Hochstetler 2001; McCarthy, Hagan & Cohen 1998). Risk averse offenders have also been swayed to cooperate by assurances of competency or expertise from accomplices (Alarid, Burton & Hochstetler 2009; Lantz & Ruback 2017b; McGloin & Nguyen 2012). Likewise, younger, inexperienced offenders rely on co-offenders to compensate for this inexperience (Lantz & Ruback 2017b). Lantz and Ruback (2017b) found that most burglary offenders begin with co-offending; however, as they gain more experience, co-offending decreases with each additional offence committed. The pooling of resources and expected financial rewards do not, on their own, capture the complexity of group dynamics or the reasons for co-offending.

Impact of co-offending

Research has further demonstrated that co-offending may lead to an escalation in offending and that co-offending produces more harms to victims, property and society at large than solo offending (Carrington 2002; Felson 2003; Lantz 2019b, 2018; Lantz & Hutchison 2015; McGloin & Piquero 2009a; Tillyer & Tillyer 2019). Sub-factors within the makeup of co-offending also contribute to an escalation in offending. Scholars widely agree that an increase in a co-offending group size is accompanied by an escalation in offending, leaning towards more violent offences (Lantz 2019b, 2018; McGloin & Piquero 2009a; Tillyer & Tillyer 2019). Gender is identified as another sub-factor; co-offending groups consisting of mostly males are found to commit more violent offences than female co-offending groups (Lantz 2019b). Co-offending not only leads to an escalation in offending; it also draws out the length of group crime sprees and increases the offence span of individual offenders (Lantz & Hutchison 2015).

Co-offending has direct implications for our understanding of crime, the development of effective crime prevention and crime reduction policies, and law enforcement responses. Incapacitation is far less effective if, for example, only one co-offender is incarcerated; other co-offenders are able to continue to commit crime, perhaps after finding a replacement for the incarcerated co-offender (Reiss 1988). McCord and Conway (2002) argue that analyses of crime rates over time should incorporate co-offending patterns, and recidivism rates should incorporate interpretations of individual differences. These should be the explicit targets of sophisticated intervention strategies. Indeed, Andresen and Felson (2010) argue that:

- Co-offending should be considered in calculations of the effects of prison and rehabilitation.

- Harms to victims and offenders are not always proportional, because some crimes involve more than one offender.

- Co-offending may lead to longer term participation in crime than solo offending.

Crime types

Co-offending rates have been shown to vary by crime types (Andresen & Felson 2012; van Mastrigt & Farrington 2009). In early work on co-offending, sample sizes were too small to examine differentiation by crime types. Reiss (1988) found that some crimes (eg burglary and robbery) are more likely to involve co-offenders. Andresen and Felson (2010) found that co-participation rates were as high as 74 percent for burglary for youth offenders. Andresen and Felson (2012) found that crime participation rates were highest for homicide (58%), commercial burglary (52%), armed robbery (51%), other burglary (49%) and robbery (47%). Reiss (1988) found that half of all burglaries were committed by co-offenders, and 67 percent of offenders commit burglary with two or more people. Morselli, Grund and Boivin (2015) found that co-offending was more likely for market and property crimes than for violent crimes. Of co-offenders, 60 percent were involved in property crimes (compared with 34% of solo offenders), 42 percent in market crimes (25% for solo offenders) and 45 percent in violent crimes (52% for solo offenders). Similarly, arrest rates of co-offenders also vary by crime type (Lantz 2019a; Terranova, Vandiver & Stafford 2019). Burglary and homicide offences were more likely to lead to an arrest of co-offending groups than individual offenders (Lantz 2019a; Terranova, Vandiver & Stafford 2019). Additionally, for these two offences, as the group increased in size, so too did the likelihood of arrest (Lantz 2019a).

Some types of crime are more likely to be associated with co-offending, perhaps because those who co-offend are simply exposed to more varied opportunities. With more exposure and opportunity come the learning of more skills and the making of more deviant social contacts. For example, non-violent offenders who first co-offend with a violent accomplice have an increased risk of committing subsequent violent crimes (Conway & McCord 2002; McGloin & Piquero 2009a).

The network paradigm: Co-offending networks

Co-offending networks are groups of offenders who have committed crimes together (Reiss 1988). Sarnecki (2001, 1990) analysed data on crime events in Sweden to create sociograms (diagrams of actors and the ties connecting them) which show that apparently unrelated crimes could actually be part of larger co-offending networks. Analysing co-offending networks investigates the theoretical assumption that interactions and relations between various actors affect crime; this provides a more nuanced picture of the crimes studied than traditional quantitative analyses which assume that individuals are not connected to one another (Sarnecki 2001). In turn, network perspectives on the formation, composition and functioning of groups can provide important guidance for law enforcement interventions (McGloin & Nguyen 2014).

Much of contemporary research on co-offending is integrated with the study of criminal networks and the use of SNA as an analytic tool (eg Bastomski, Brazil & Papachristos 2017; Bouchard & Konarski 2014; Iwanski & Frank 2014; Lantz & Ruback 2017a, 2017b; McGloin & Piquero 2009b; Morselli, Grund & Boivin 2015; Ouellet, Bouchard & Charette 2019). SNA is an approach that focuses on the relationships or ties between a given set of actors, or nodes, and the implications of these ties for nodes and the network as a whole. Analysing the structural components of the core network, such as individual level density and the roles of individuals within networks, as well as other factors such as the size of a co-offending network and its stability, can generate useful insights into patterns and processes of co-offending and the structure of the criminal activity under consideration that may not be easily discovered at first glance (Morselli, Grund & Boivin 2015; Morselli & Roy 2008).

Research on co-offending networks has used cross-sectional analysis to examine co-offending networks at a specific point in time, and temporal analyses to examine changes in the co-offending network across time. Cross-sectional analysis can be undertaken at different 'levels' of the network. For example, McGloin and Nguyen (2014) examined the overall structure of co-offending networks (network-level analysis) and also described individual characteristics of actors within the network (node-level analysis). Bouchard and Konarski (2014) conducted analyses of the core and periphery of the network (group-level analysis) and explored the positioning of individual actors within the network (node-level analysis). One previous study (Iwanski & Frank 2014) analysed a co-offending network across time (temporal analysis) to reveal changes in network structure and in the positioning of individual actors within the network. Few have examined co-offending across crime types, which have been found to show significant variation in market, property and violence-based offences (Morselli, Grund & Boivin 2015).

The current study

The current study extends previous work on co-offending by analysing the range of crime types committed by individuals and co-offenders across co-offending networks. The project has four main aims:

- to examine co-offending networks across single and multiple crime types (including criminal versatility);

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- to determine whether there are differences in duration of co-offending, number of co-offenders, extent of co-offending, structure of co-offending networks and age or gender homophily across different categories of crime; and

- to identify the implications of the various co-offending networks for law enforcement practice, within an intelligence-led framework.

Collectively, the project contributes to the scholarly understanding of co-offending, especially in the context of multiple crime types. Our results have several implications for policy and practice that we discuss in this report.

Data and method

The project received ethics approval from the University of New South Wales (Panel B: Arts, Humanities and Law, approval #HC16141). De-identified data were collected for all offences across a five-year period (2011–2015) for the metropolitan areas of Melbourne and Sydney. Data were provided by Victoria Police and the New South Wales Police Force, respectively. Approval from NSW Police was provided on 8 September 2016, and Victoria Police on 10 November 2016. It took some time for police to provide the data in the requested form. The data are for all recorded crime events and all persons associated with each crime event across the two metropolitan areas. Being 'associated' means that police records indicate that the individuals were arrested with respect to the same incident or event (for example, three people charged in relation to a robbery). Given that we had person identifiers, we were able to determine whether an individual committed more than one crime in the data collection period. Of course, we do not know whether the individuals committed crimes outside the data collection period.

Data

Melbourne

Data were collected from all Local Government Areas within the two regions that make up the Melbourne metropolitan area (Southern Metro and North-Western Metro). The following 'person data' were sought for each 'event' listed in the police database: date of arrest, charges, location, date of birth, gender and legal actions. Victoria Police de-identified the data before providing them to us. All names were removed from the dataset and replaced with unique numeric or alphanumeric identifiers by the respective police agencies. These unique codes allowed us to identify individuals within the dataset and track multiple mentions of the same individual in the dataset. 'Event numbers' were used to match individuals to events (ie arrests). When two or more individuals are involved in the same crime event, we assume them to be co-offenders. The method allows for the translation of event and person data into an undirected, weighted co-offending network (more detail below). The weight or strength of ties between co-offenders is dependent on the number of times they are observed to co-offend together; the more a pair of offenders co-offend, the stronger their co-offending tie.

Sydney

Data were collected from the NSW Police Force Computerised Operational Policing System (COPS), via the Enterprise Data Warehouse (EDW). Records were extracted on 15 June 2017. The dataset includes selected information on all persons charged—that is, issued with a Court Attendance Notice—in relation to offences occurring in one of three NSW Police Force Metropolitan regions (Central, North West and South West) between 2011 and 2015. Data were included where any one of the charge date, incident start or end date or event reported date was between 2011 and 2015, and where the record is classified as involving an 'event'. A COPS 'event' consists of one or more 'Incidents' that are related to the same unique occurrence (ie that are part of a course of conduct) and: are committed by the same person or group of persons; are part of actions committed simultaneously or in sequence over a short period of time or which come to light as a result of an investigation; are part of interrelated actions, that is, where one action leads to the other or where one is the consequence of the other(s); or that involve the same action(s) repeated over a long period of time against the same victim(s) but only come to the attention of the police at the one point in time.

COPS generates unique reference numbers for data, based on whether a record is classified as an 'event' or an 'Incident', that is, whether it is part of a broader course of conduct involving the same person or a group of persons. COPS also generates a unique reference number for each individual. These reference numbers link different individuals involved in the same event, whom we assume to be co-offenders.

Data analysis

Four main data cleaning procedures prepared the data for analyses. Firstly, we removed offenders who had erroneous year of birth entries (eg individuals who had two dates of birth in the dataset which were more than two years apart, or individuals who had inexplicably low or high birth dates). Secondly, where individuals faced multiple charges for the same incident (which we identified based on the date of that incident and the COPS reference number and event number), we removed the less serious offences. Thus, for incidents where individuals were charged with more than one offence, only the most serious offence was retained. Seriousness was determined using the National Offence Index, which provides seriousness scores for all crimes listed in the Australian and New Zealand Standard Offence Classification (ANZSOC) codes (Australian Bureau of Statistics 2018). Thirdly, we examined cases where the same unique incident could have multiple charge dates associated with it: incidents where there was more than one offender, and the offenders were charged on different dates. For these incidents, we retained the earliest charge date (this only occurred in the Victorian dataset). Fourthly, consistent with previous research that sets a threshold for co-offending group size (eg Grund & Morselli 2017), we removed events involving 12 or more co-offenders, because these had the potential to impact unduly on the analyses of the overall network.

Next, all offence types were classified into one of 16 ANZSOC divisions (Australian Bureau of Statistics 2011). We refer to these as 'crime types' throughout this report (see Table 1). ANZSOC provides a uniform national framework for classifying offences across Australia and New Zealand for statistical purposes.

Table 1: Crime types (based on ANZSOC Classification)	
1	Homicide
2	Acts intended to cause injury (AICI)
3	Sexual assault and related offences
4	Dangerous or negligent acts endangering persons
5	Abduction, harassment and other offences against the person
6	Robbery, extortion and related offences
7	Unlawful entry with intent/burglary, break and enter
8	Theft and related offences
9	Fraud, deception and related offences
10	Illicit drug offences
11	Prohibited and regulated weapons and explosives offences
12	Property damage and environmental pollution
13	Public order offences
14	Traffic and vehicle regulatory offences
15	Offences against government procedures, government security and government operations (OAGP)
16	Miscellaneous offences

We then subjected the data to further categorisation. The 16 divisions were organised into four overarching crime categories used in previous research on co-offending networks (Morselli, Grund & Boivin 2015):

• violent—crimes against the person (eg assault, murder, attempted murder);

• property—crimes against property (eg malicious damage, break and enter);

• market crimes—crimes committed within illicit markets (eg drug trafficking, prostitution); and

• other—crimes that did not fit within the above three categories (eg traffic violations).

All data were analysed using the R software package with the SNA module (R Core Team 2012). This software enables the measurement of a number of SNA metrics, including network density, degree centrality of actors, betweenness centrality of actors, network diameter, the size and number of network components, and assortativity based on gender, degree and age (see Borgatti, Everett & Johnson 2013). The network was a bipartite network, in which persons were connected to events. The bipartite network was transposed to create a one-mode network, consisting of individuals connected together through their arrest at the same events. Further, for each of the three overarching crime categories, individuals are included if they were arrested for that offence category across the data collection period.

Definitions:

- *Network density* is a measure of the extent of interconnectedness of the network. Formally, it is the proportion of potential ties between all network actors that are actually formed in the network. Density is sensitive to network size; generally, larger networks will be less dense than smaller networks.

- *Degree centrality* is a measure of the number of other network actors to which any one actor is linked. It is generally considered to be a measure of the power or influence of network actors.

- *Betweenness centrality* is a measure of the extent to which an actor is strategically positioned on the shortest paths between all other actors in the network. High betweenness centrality actors are considered to be brokers.

- *Network diameter* is a measure of the shortest path between the two most distant nodes in the network. It can be considered a proxy for how long it might take information to get from one end of the network to the other.

- A *network component* is a complete, connected set of actors, where no actor is disconnected. A network may be made up of one or more components.

- *Assortativity* is a network measure of 'homophily', the notion that 'birds of a feather flock together.' It is a measure of the extent to which actors with similar attributes (eg same age, same gender, same degree score) tend to be connected. Homophily refers to the tendency of human actors to form relational ties with similar others (eg Blau 1977). Homophily for age and gender has received much attention, including in the field of co-offending. Research on age homophily has found that age differences between co-offenders tend to be small (eg Budd, Sharp & Mayhew 2005; Reiss & Farrington 1991). Males and females appear to choose co-offenders of the same gender in the majority of cases, although gender homophily appears to be driven mainly by male co-offending (Conway & McCord 2002; Pettersson 2003; Reiss & Farrington 1991; Warr 2002).

There were two key data preparation and extraction stages, following previous work by Brantingham et al. (2011). Firstly, every tie (or edge) in the network either links an offender to an event, or links two offenders with one another, showing that two offenders have committed a crime or multiple crimes together. Individuals who are arrested for involvement in the same incident are assumed to have a co-offending relationship. Edges were given a weight (or strength) according to the number of offences each pair of offenders committed together. Secondly, once we determined who was involved in particular crime events, we constructed a co-offending network inclusive of two matrices that link co-offenders in the same crime events. The strength of the link between any two offenders reflects the number of offences in which they were both involved—the number of times they have reoffended together. Edges also represent the type of offence committed by the pair. Networks were further classified by offence type. Only violent, property and market offences were included (ie all 'other' offence types, such as traffic offences, were excluded).

Each actor in the network had the following attribute information: date of birth, gender, and offence categories in which they have participated (although some of this information was missing for some actors). The networks only include individuals who had at least one co-offence.

Finally, offenders were classified into categories using the classification scheme developed by Morselli, Grund and Boivin (2015): core, periphery and mass. Core offenders are those with the top five percent of ties (ie top 5% by degree centrality). The periphery includes all offenders who are not in the core but who have at least one co-offence with a member of the core. Mass refers to all offenders who are not in the core and did not co-offend with core members.

It is important to note that one of our initial aims for the project was to explore potential cross-jurisdictional variations in co-offending network structure and patterns of co-offending. However, we found that the data sets from the two jurisdictions were collected in very different ways, and the data used to determine co-offending relationships varied. We therefore concluded that it would not be feasible to make meaningful comparisons between the data sets. We return to this and other limitations later in this report.

Results

Results are presented separately for Melbourne and Sydney.

Melbourne metropolitan area

After cleaning the data and removing all 'other' (eg traffic) offences from the data set, we were left with 102,261 offenders, of whom 78,399 (77%) were male and 23,862 (23%) were female.

Table 2 shows that the sample committed a total of 216,211 offences across the entire time period, of which 12,329 (6%) involved co-offending. The largest proportion of co-offending occurred for market-based offences and property offences (both 7%), followed by violent offences (4%). The table also demonstrates that the majority of co-offending involved property crime (46%), followed by violent crime (31%) and market-based crime (23%).

Table 2: Proportion of offences that involve co-offending			
	Offences (*n*)	Co-offending (*n*)	%
Violent	97,272	3,830	3.9
Property	80,327	5,719	7.1
Market	38,612	2,780	7.1
Total	216,211	12,329	5.7

Table 3 shows that 25 percent of offenders aged 18–25 were co-offenders. The proportion declined as age increased. Of offenders aged 26 and over, 14 percent committed crimes with one or more co-offenders. Overall, 17 percent of the total number of offenders committed crimes in which they co-offended with others.

Table 3: Offenders and co-offenders by age			
Age	Offenders (*n*)	Co-offenders (*n*)	Co-offenders (%)
18–25	32,093	8,017	24.9
26–35	30,193	5,216	17.2
36–45	22,397	2,829	12.6
46–89	17,578	1,551	8.8
Total	102,261	17,613	17.2

Table 4 shows that property and market offences overall had higher rates of co-offending (19% and 18% respectively), compared with violent offending.

Table 4: Offenders by offence types		
Offence type	Offenders *n* (%)	Co-offenders *n* (%)
Violent	60,174 (47.3)	6,839 (11.4)
Property	40,863 (32.1)	7,572 (18.5)
Market	26,156 (20.6)	4,781 (18.3)

To reiterate: the largest proportion of offenders (48%) committed at least one violent crime, followed by those who committed property crime (32%) and market-based crimes (21%). The largest proportion of co-offenders were those who had committed at least one property crime (19%), followed by market-based crime (18%) and violent crime (11%).

Tables 5 and 6 show the proportion of offenders within each offence type who had co-offenders. Note that such co-offending might occur across multiple crime types. For example, an offender who commits a robbery/extortion offence might also co-offend with others in theft and illicit drug offences. The individual would be classified as a co-offender for the purposes of the above calculations.

Forty-three percent of offenders charged with robbery and extortion offences engaged in co-offending. In contrast, only six percent of offenders charged with sexual assault engaged in any co-offending. Results suggest that estimates of the extent of co-offending that aggregate across crime types will miss the nuances of co-offending across crime types and overlook higher prevalence of co-offending among some groups of offenders.

Table 5: Offenders who engage in any co-offending as proportion of total by ANZSOC codes[a]	
Offence type	Proportion of total who were co-offenders (%)
Robbery, extortion	43
Unlawful entry	35
Homicide	28
Theft and related	18
Illicit drug offences	18
Fraud, deception	17
Acts intended to cause injury	12
Public order offences	9
Prohibited and regulated firearms	8
Property damage	8
Dangerous or negligent acts	7
Sexual assault	6
Abduction, harassment	6
Offences against government	3

a: Traffic and vehicular offences removed

Table 6: Proportion of offences that involve co-offending	
	Proportion of total who were co-offenders (%)
Violent	11
Property	26
Market	18
Other	10

Figure 1 demonstrates that, across all offence types, most offences (around 80%) involved only two co-offenders. Around 10 percent of offences involved three offenders. Crimes involving four or more co-offenders were rare.

Figure 1: Number of co-offenders per offence (%)
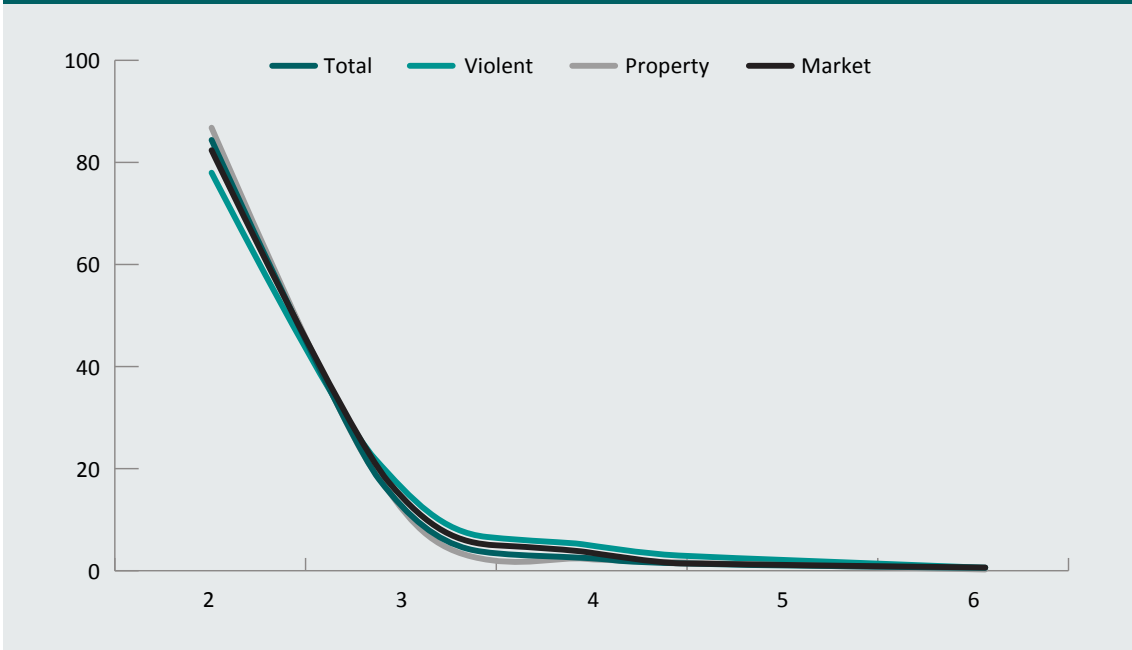
Table 7 displays the proportion of actors in the core, periphery and mass by demographic and other categories. Co-offenders in the core committed the largest average number of offences (6.64), followed by those in the periphery (5.88) and the mass (3.65). Violent and property co-offenders made up the largest number of co-offenders in each of the core, periphery, and mass. Violent co-offenders were just under half (49%) of co-offenders in the core. For co-offenders in the core, the average number of unique co-offenders was five. In the periphery, the average was two, with an average of one for the mass. This finding appears to show that offenders in the core have a larger network of potential co-offenders.

| Table 7: Co-offender network			
	Core	Periphery	Mass
Male (%)	84	74	75
Age (%)			
18–25	53	51	44
26–35	29	30	3
36–45	14	14	16
46–89	4	5	10
Offences (*n*)	6.64	5.88	3.65
Offence type (%)			
Violent	49	37	38
Property	31	40	37
Market	20	23	25
Unique co-offenders (*n*)	5.07	2.02	1.34

Table 8 shows:

- There is a larger network of co-offenders with property offences (7,572) compared with violent (6,839) and market offences (4,781).

- For property offences, there is a longer distance for network, and clustering is lower. Clustering is the extent to which network actors are interconnected. High clustering indicates that many of the actors are connected with each other. Low clustering suggests that relatively few actors are connected.

- All offence types had a small component size (2–3 actors on average).

- Degree assortativity was very strong across all offence types. This indicates that offenders tend to co-offend with others who have the same number of unique co-offenders. (We note that the interpretation of degree assortativity is biased by the transformation of a two-mode network into a one-mode network.)

- Gender assortativity is moderate for violent and property networks. This suggests that co-offenders with at least one violent offence tend to co-offend with those of the same gender. It was, however, negative for market-based offences, denoting a weak tendency for market offenders to co-offend with either male or female co-offenders.

- Age group assortativity is strong across all offence types, indicating a strong tendency to co-offend with others in the same age group.

| Table 8: Network (co-offenders only)				
	Total	**Violent**	**Property**	**Market**
Nodes (*n*)	21,034	6,839	7,572	4,781
Edges (*n*)	18,011	5,733	5,608	3,555
Density	0.0003	0.001	0.001	0.002
Average distance	21.1	1.34	3.32	1.24
Diameter	58	9	14	6
Cluster coefficient	0.65	0.88	0.63	0.83
Degree centrality	0.001	0.001	0.002	0.001
Betweenness centrality	0.002	0.00001	0.001	0
Number of components	7,195	2,724	2,936	1,972
Mean size components	80.03	2.5	2.58	2.42
Degree assortativity	0.65	0.89	0.65	0.8
Gender assortativity	0.13	0.22	0.16	−0.02
Age group assortativity	0.48	0.45	0.51	0.49

Note: For a description of these metrics, see Borgatti, Everett & Johnson (2013)

Figure 2 shows the proportion of offenders who committed solo offences only—that is, offenders who never co-offended over the time period, alongside co-offenders. For example, 62 percent of offenders charged with homicide were never charged with an offence involving a co-offender over the time period. Abduction, robbery and unlawful entry were least likely (less than half) to involve solo offending only. Co-offending was highest among robbery, extortion and related offences and unlawful entry or break and enter offences. Co-offending was next highest in homicide and theft, fraud and deception offences and illicit drug offences.
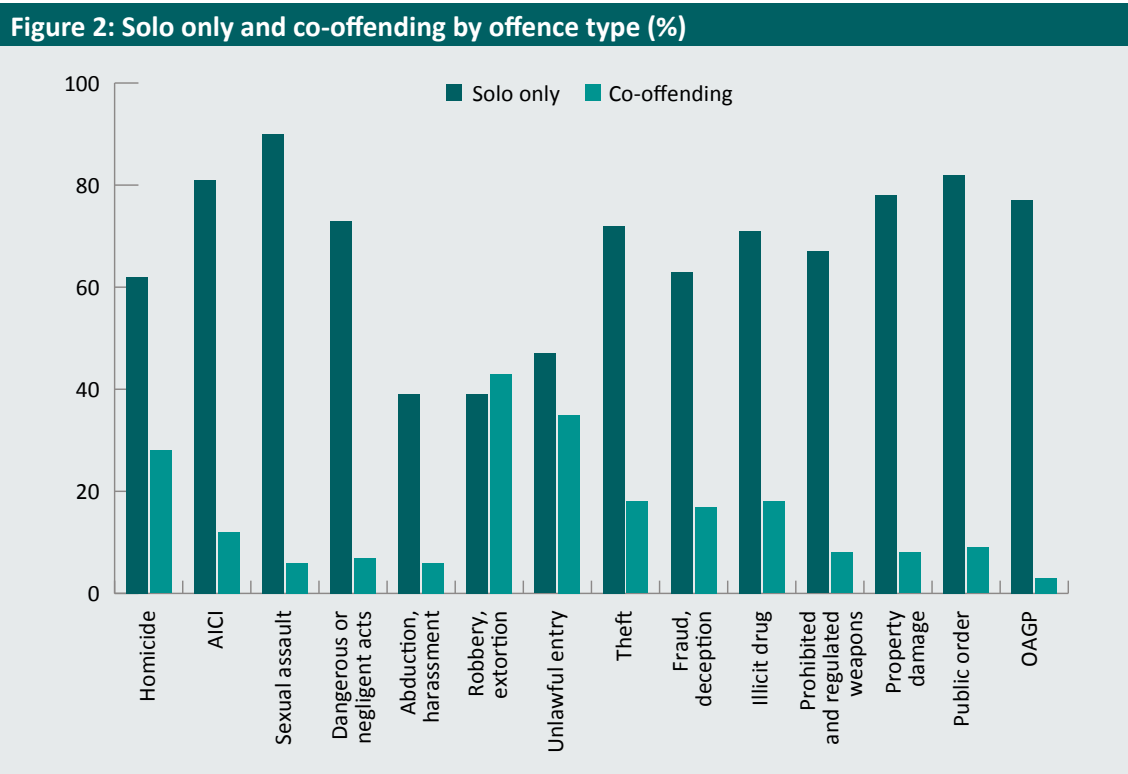
Figure 2: Solo only and co-offending by offence type (%)

Note: AICI=acts intended to cause injury; OAGP=offences against government procedures, government security and government operations

Figure 3 shows degree centrality for co-offenders by type of offence. It displays the average number of co-offenders for offenders charged with a particular crime type, for all offenders and all co-offenders. Overall, the results were fairly uniform across offence types (range=1.79–2.37). Offenders charged with homicide, dangerous or negligent acts, robbery, unlawful entry and public order offences were highest by degree centrality, with an average degree of 2 or above. Over the 5-year period, these offenders co-offended with at least two others.
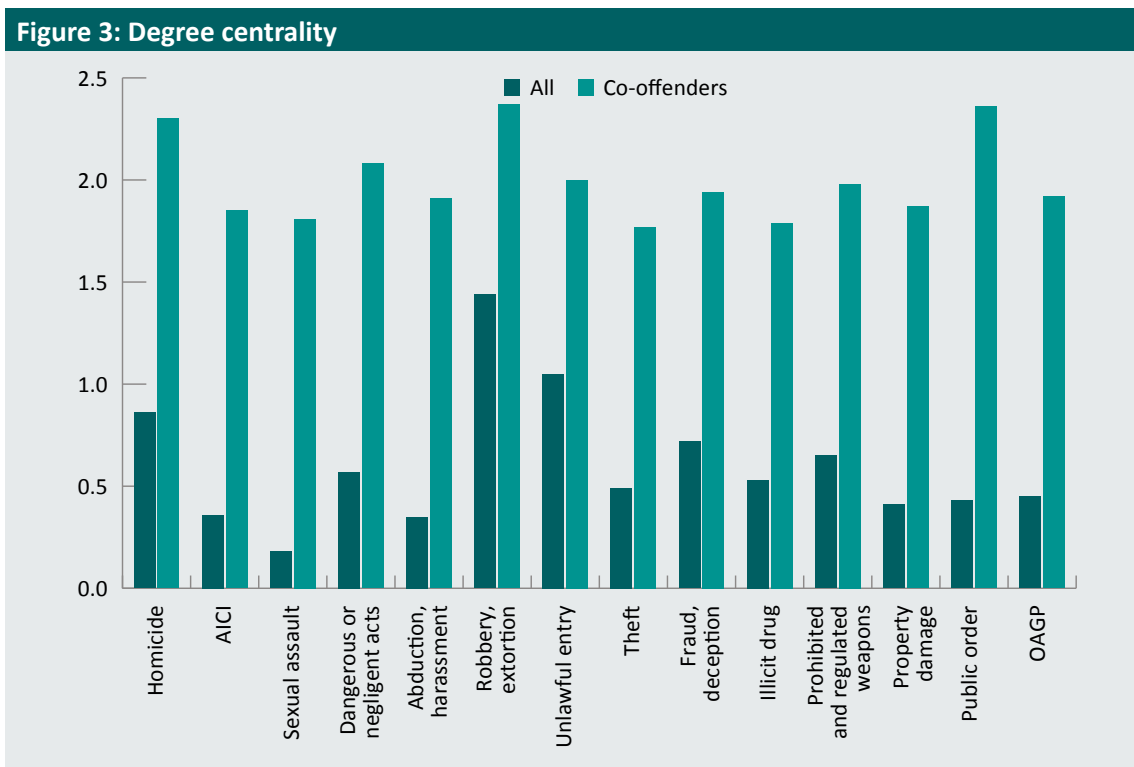
Figure 3: Degree centrality

Note: AICI=acts intended to cause injury; OAGP=offences against government procedures, government security and government operations

Figure 4 shows that the core, periphery and mass are dominated by AICIs, theft and illicit drug offences. Public order offences are more prominent in the core than in periphery and mass, while the reverse is somewhat true for theft and related offences. OAGPs are fairly evenly represented in the core, periphery and mass.

Figure 4: Network structure by offence type (%)

Note: AICI=acts intended to cause injury; OAGP=offences against government procedures, government security and government operations

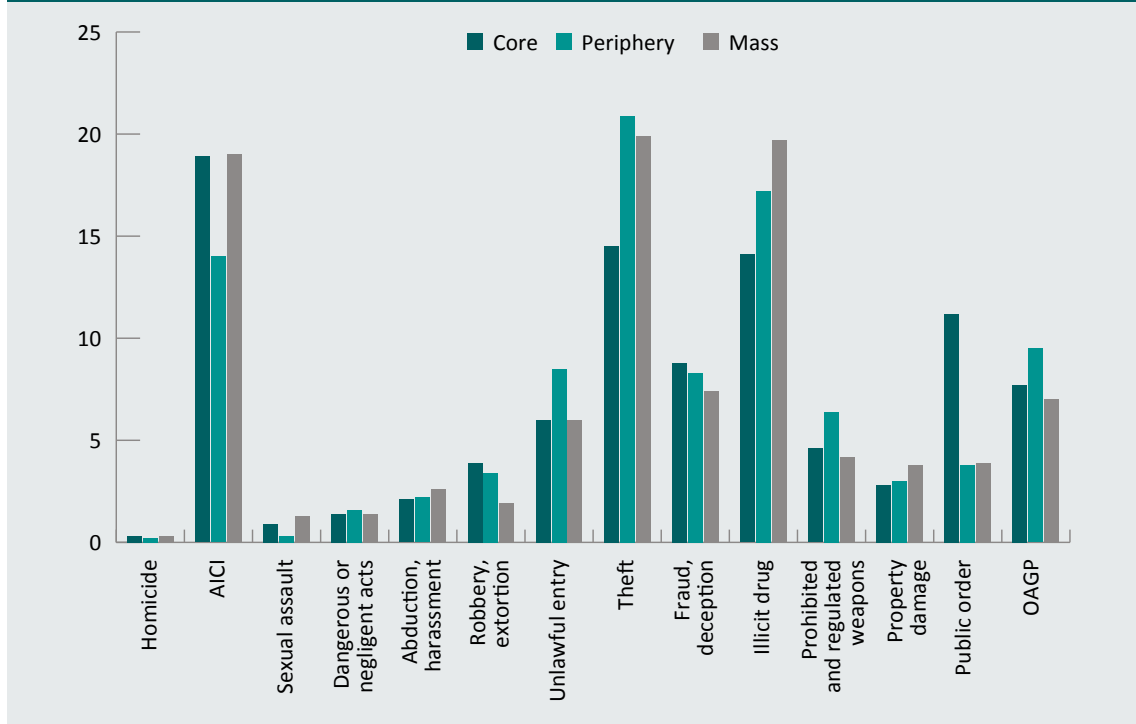The following figures provide a visual map of all offences in the dataset (Figure 5), followed by maps for each crime type: violent offences (Figure 6), property offences (Figure 7), and market offences (Figure 8). Node size represents the number of offences, node colour the offender's gender, and edge labels the number of co-arrests between offenders. The network maps are provided to give an overall 'bird's eye view' of the structure of co-offending networks in Melbourne.

Figure 5: Network map showing all offences
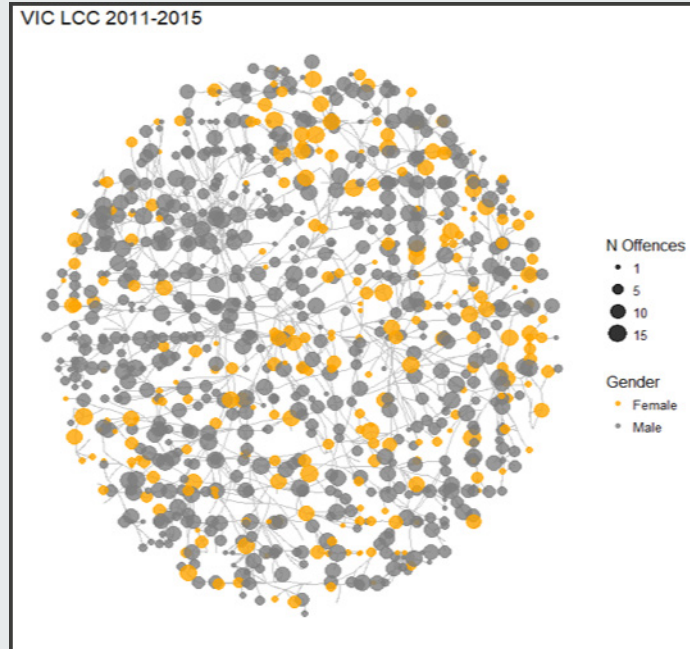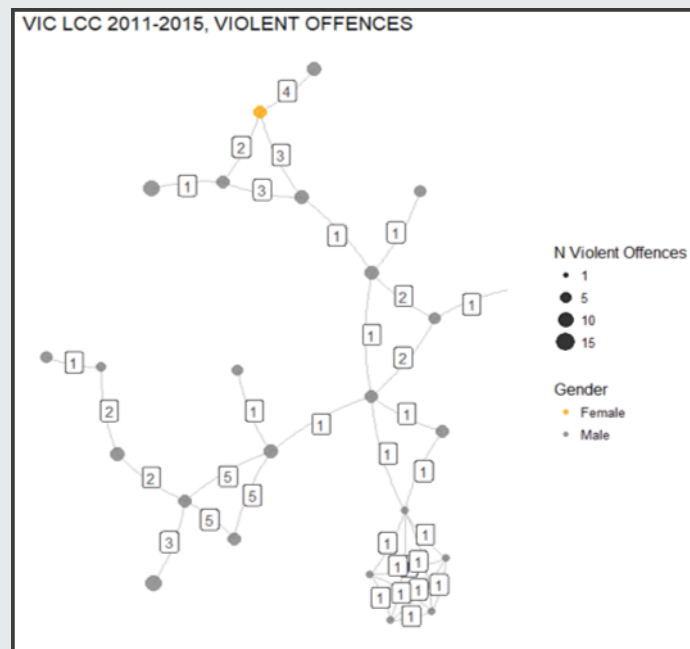

Figure 6: Network map showing violent offences
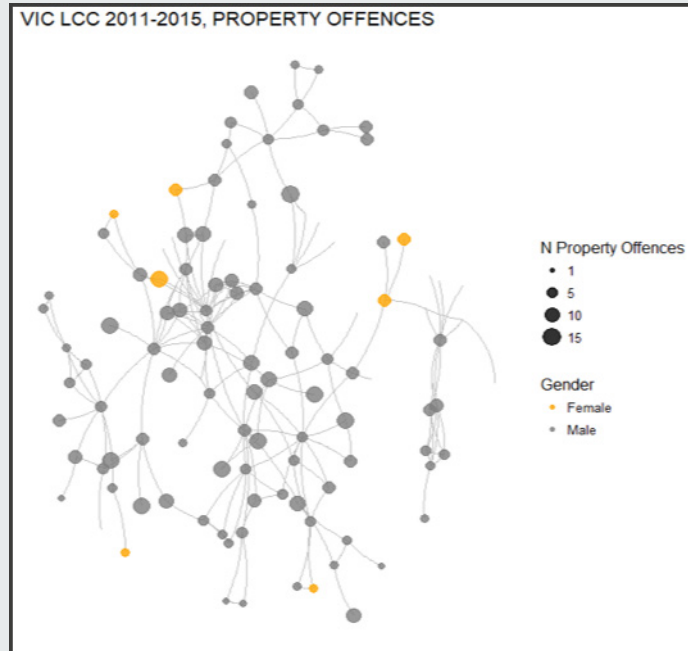
Figure 7: Network map showing all property offences

VIC LCC 2011-2015, PROPERTY OFFENCES

Figure 8: Network map showing market-based offences
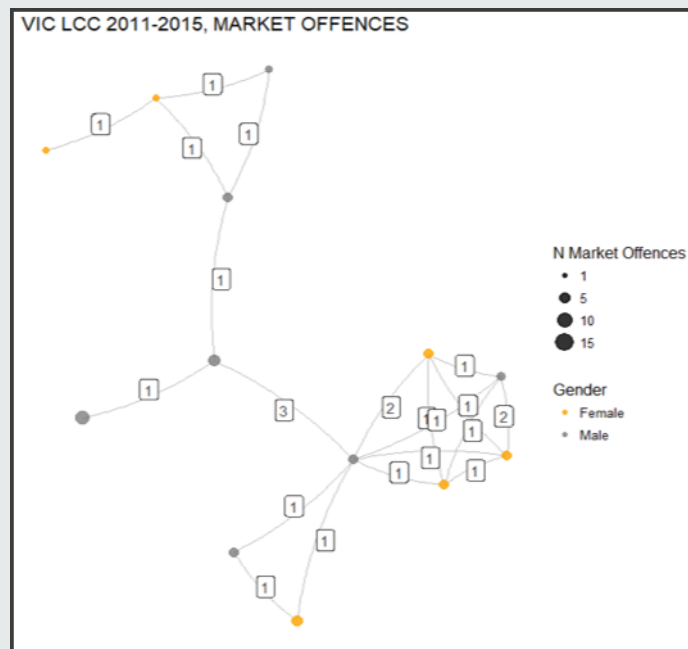
VIC LCC 2011-2015, MARKET OFFENCES

Sydney metropolitan area

After cleaning the data and removing all 'other' (eg traffic) offences from the data set, we had 96,781 offenders, of whom 78,781 (81%) were male and 18,000 (19%) were female. The majority of offending involved violent crime (49%), followed by property crime (29%) and market-based crimes (23%).

Across the entire time period, offenders in the sample committed a total of 157,787 offences, of which 6,874 (4%) involved co-offending. Table 9 shows that the largest co-offending occurred for property offences (6%), followed by violent offences (4%) and market-based offences (3%).

Table 9: Proportion of offences that involve co-offending			
	Offences (*n*)	Co-offending (*n*)	%
Violent	76,802	2,819	3.6
Property	45,067	2,923	6.4
Market	35,918	1,132	3.2
Total	**157,787**	**6,874**	**4.4**

Table 10 shows that, of offenders aged 18–25, 19 percent engaged in co-offending. By aggregating the results for offenders aged 26 and above, we determined that 11 percent of this group engaged in co-offending.

Table 10: Offenders and co-offenders by age			
Age	Offenders (*n*)	Co-offenders (*n*)	Co-offenders (%)
18–25	29,738	5,499	18.5
26–35	29,449	3,996	13.6
36–45	21,478	2,084	10.0
46–89	16,116	1,116	6.9
Total	**96,781**	**12,695**	**13.1**

Overall, 13 percent of the total number of offenders were co-offenders.

Table 11 shows that property offences overall showed higher rates of co-offending than violent and market-based offending.

Table 11: Offenders and co-offenders by offence type		
Offence type	Offenders *n* (%)	Co-offenders *n* (%)
Violent	59,663 (52.0)	6,139 (10.3)
Property	26,368 (22.9)	4,623 (17.5)
Market	28,656 (24.9)	2,505 (8.7)

Table 11 demonstrates that most offenders had committed at least one violent crime (52%), followed by those who committed at least one market crime (25%) and those who had committed at least one property crime (23%). The largest proportion of co-offenders were those with at least one property crime (18%), followed by those with at least one violent crime (10%) and those with at least one market-based crime (9%).

Table 12: Offenders who engage in any co-offending as a proportion of total by ANZSOC codes[a]	
Offence type	Proportion of total who were co-offenders (%)
Robbery, extortion	43
Unlawful entry	31
Homicide	29
Public order offences	24
Theft and related	15
Fraud, deception	13
Abduction, harassment	11
Illicit drug offences	9
Acts intended to cause injury	7
Prohibited and regulated firearms	6
Property damage	6
Miscellaneous	5
Sexual assault	4
Offences against government	3
Dangerous or negligent acts	2

a: Traffic and vehicular offences removed

Tables 12 and 13 present the proportion of co-offending across offence types, showing that some categories had a much greater proportion of co-offenders than others. For example, 43 percent of offenders charged with robbery and extortion were co-offenders, as were 31 percent of those charged with unlawful entry and 29 percent of those charged with homicide. Of the top six, all except homicide and public order offences were acquisitive and profit generating crimes.

Table 13: Proportion of offences that involve co-offending	
	Proportion of total who were co-offenders (%)
Violent	10
Property	24
Market	9
Other	11

Table 14 shows that co-offenders committed a larger average number of offences (3.26) than solo offenders only (1.74). Over 40 percent (43%) of offenders aged 18–25 engaged in co-offending. Of solo offenders, a little more than half (56%) engaged in any violent offending, 19 percent engaged in property offending, and 25 percent engaged in any market offending. For co-offenders, 47 percent engaged in any violent offences, 32 percent engaged in any property offences, and 21 percent engaged in any market offences. Co-offenders were more likely to be younger, although this evens out in the 26–35 age bracket.

Table 14: Offender characteristics by solo offenders and co-offenders		
	Core	Periphery
Age (%)		
18–25	29	43
26–35	30	32
36–45	23	17
46–89	18	9
Number of offences	1.74	3.26
Offence type (%)		
Violent	56	47
Property	19	32
Market	25	21

Figure 9 demonstrates that, across all offence types, most co-offending (around 80%) involved only two co-offenders. Approximately 10 percent of offences involved three offenders. Crimes involving four or more co-offenders were rare.

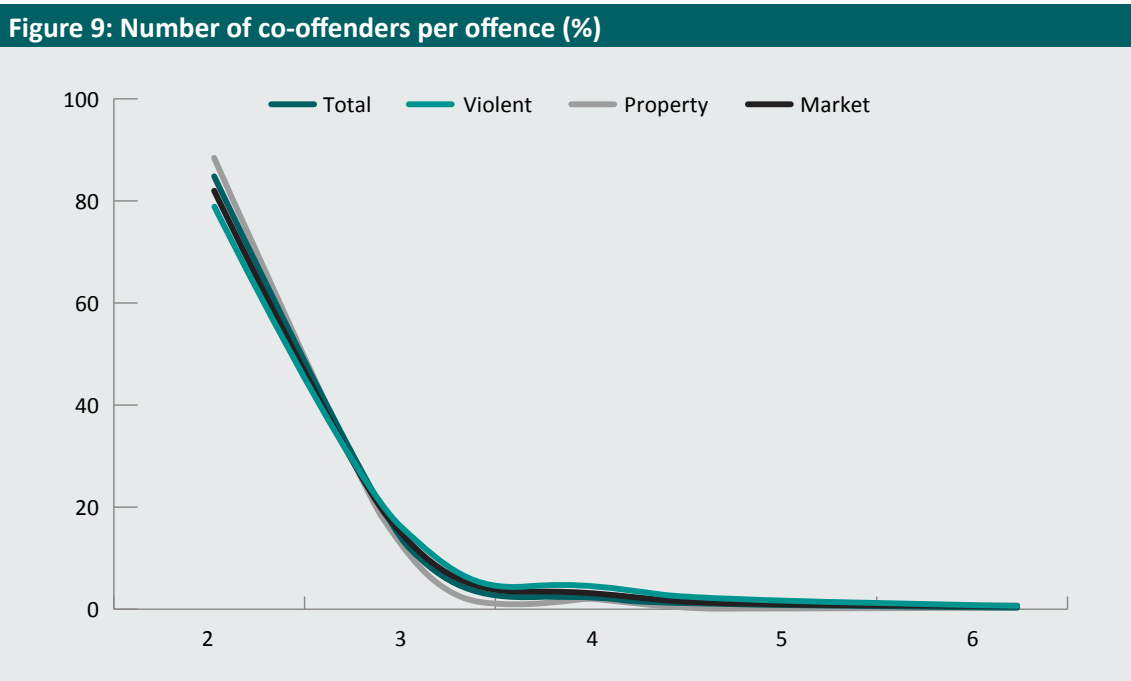**Figure 9: Number of co-offenders per offence (%)**

Table 15 shows the network position for co-offenders only. Violent and property co-offenders were the largest number of co-offenders in each of the core, periphery, and mass. Violent co-offenders were just over half (51%) of co-offenders in the core. Co-offenders in the core had an average of 5.2 unique co-offenders, compared with an average of 2.1 unique co-offenders in the periphery and an average of 1 unique co-offender in the mass.

| Table 15: Co-offender network position			
	Core	Periphery	Mass
Male (%)	86	84	77
Age (%)			
18–25	49	54	42
26–35	32	20	31
36–45	12	11	17
46–89	7	4	9
Number of offences	2.87	3.14	2.61
Offence type (%)			
Violent	51	46	47
Property	22	37	33
Market	27	18	21
Number of unique co-offenders	5.20	2.10	1.31

Table 16 shows:

- There is a larger network of co-offenders with violent offenders (6,139), compared with property (4,623) and market offences (2,505).

- For property offenders, there is a longer distance for network, and the clustering is lower than in violent and market-based offences.

- All offence types had a small component size (2–3 actors on average).

- Degree assortativity was very strong across all offence types, indicating that offenders tend to co-offend with others who have the same number of unique co-offenders.

- Gender assortativity is moderate for violent and property networks. This suggests that co-offenders with at least one violent offence tend to co-offend with those of the same gender. It was, however, negative for market-based offences, denoting a weak tendency for market offenders to co-offend with either male or female co-offenders.

- Age group assortativity is strong across all offence types, indicating a strong tendency to co-offend with others in the same age group.

Table 16: Network (co-offenders only)

	Total	Violent	Property	Market
Nodes (*n*)	14,746	6,139	4,623	2,505
Edges (*n*)	11,754	4,818	3,162	2,044
Density	0.0001	0.0003	0.0003	0.001
Average distance	1.81	1.24	1.42	1.06
Diameter	11	5	8	3
Cluster coefficient	0.8	0.89	0.73	0.97
Degree centrality	0.001	0.002	0.001	0.004
Betweenness centrality	0	0.00001	0	0
Number of components	5,790	2,562	1,927	1,061
Mean size components	2.55	2.4	2.4	2.36
Degree assortativity	0.82	0.87	0.76	0.98
Gender assortativity	0.19	0.24	0.24	0.05
Age group assortativity	0.47	0.48	0.49	0.42

Note: For a description of these metrics, see Borgatti, Everett & Johnson (2013)

Figure 10 shows the proportion of offenders who committed solo offences only—that is, offenders who never co-offended over the time period, alongside co-offenders. For example, 67 percent of offenders charged with homicide were never charged with an offence involving a co-offender over the time period. Abduction, robbery and unlawful entry were the least likely (less than half) to involve solo offending only. Co-offending was highest among robbery, extortion and related offences, unlawful entry or break and enter offences and homicide.
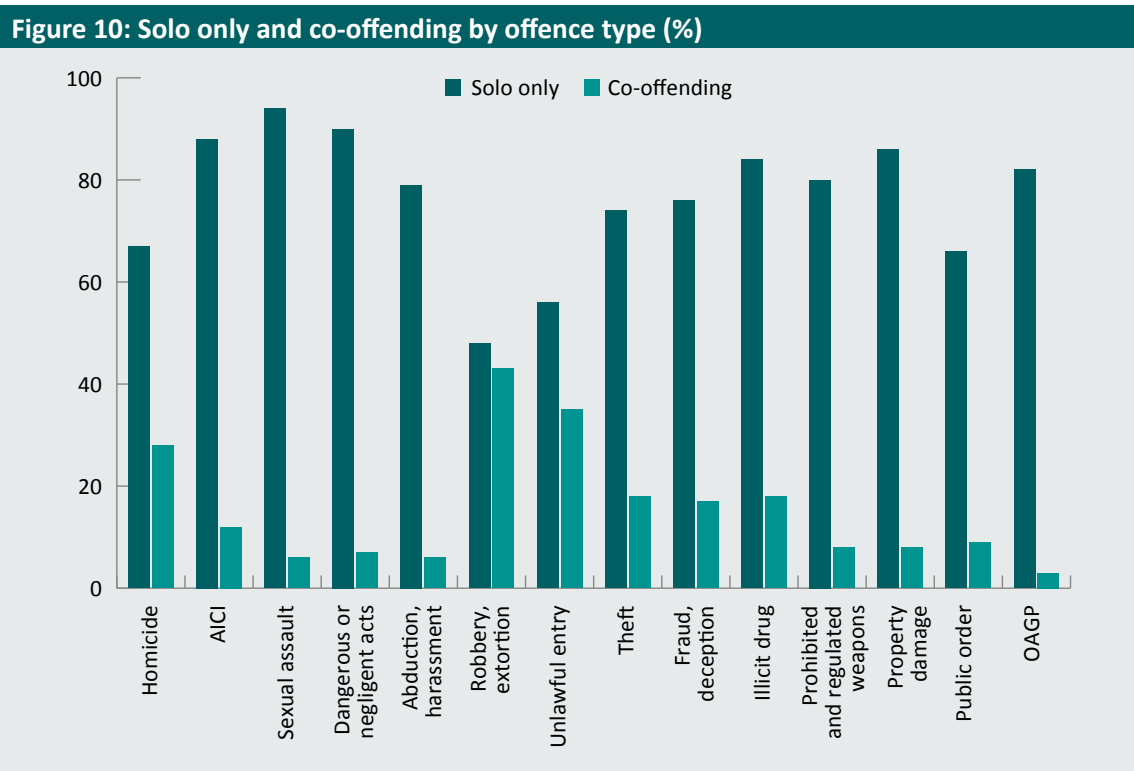
Figure 10: Solo only and co-offending by offence type (%)

Note: AICI=acts intended to cause injury; OAGP=offences against government procedures, government security and government operations

Figure 11 shows degree centrality for co-offenders by type of offence. It displays the average number of co-offenders for offenders charged with a particular crime type, for all offenders and all co-offenders. Overall, the results were fairly uniform across offence types (range=1.51–2.38). Offenders charged with homicide, dangerous or negligent acts, robbery, unlawful entry and public order offences were highest by degree centrality, with an average degree of 2 or above.
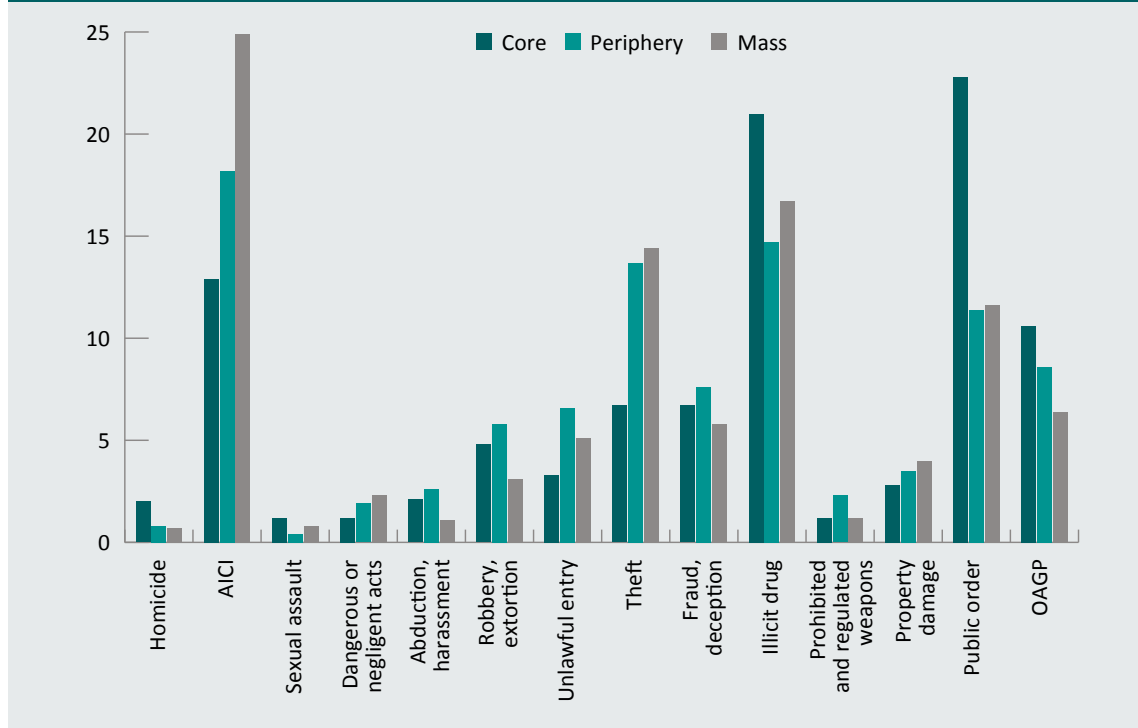
Figure 11: Degree centrality
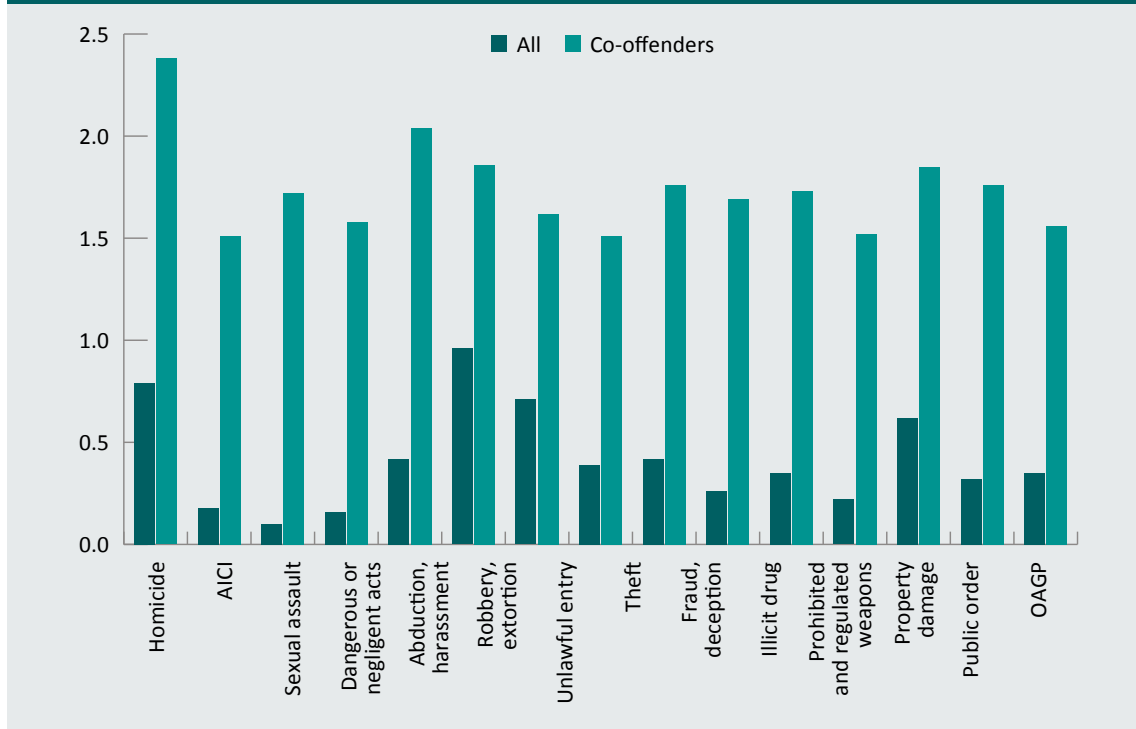
Note: AICI=acts intended to cause injury; OAGP=offences against government procedures, government security and government operations

Figure 12 shows that the core, periphery and mass are dominated by AICIs, illicit drug offences and theft and related offences. Public order offences are more prominent in the core than in the periphery and mass. OAGPs also feature slightly more in the core, followed by the periphery and mass.

Figure 12: Network structure by offence type (%)

Note: AICI=acts intended to cause injury; OAGP=offences against government procedures, government security and government operations

The following figures provide a visual map of all offences in the dataset (Figure 13), followed by maps for each crime type: violent offences (Figure 14), property offences (Figure 15), and market offences (Figure 16). As with Melbourne data, the network maps are provided to give an overall 'bird's eye view' of the structure of co-offending networks in Sydney.

Figure 13: Network map showing all offences
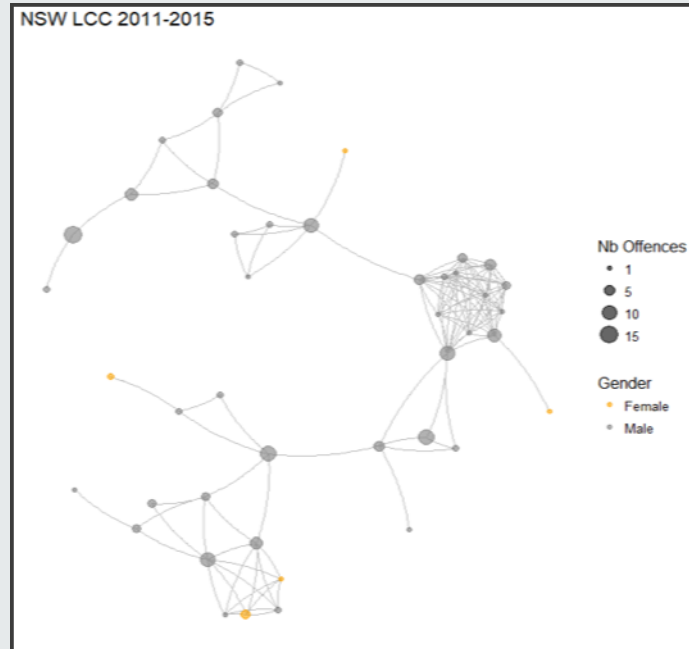

NSW LCC 2011-2015

Figure 14: Network map showing violent offences
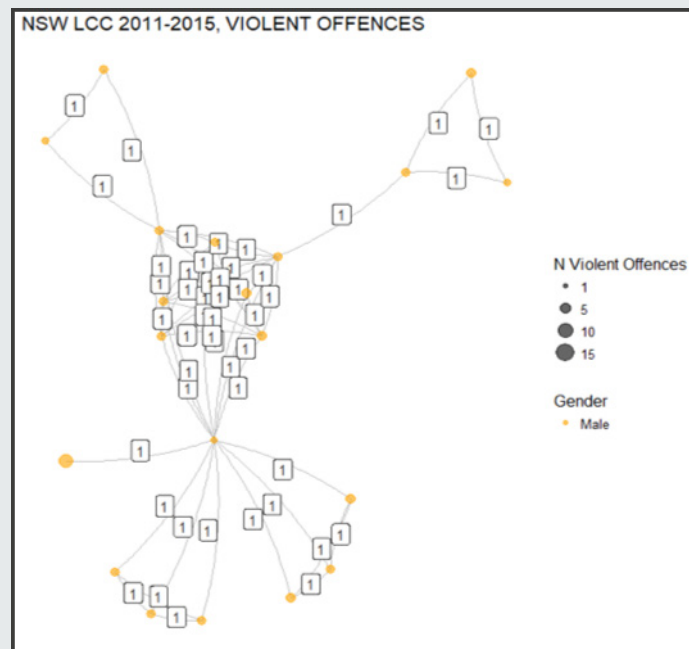

NSW LCC 2011-2015, VIOLENT OFFENCES

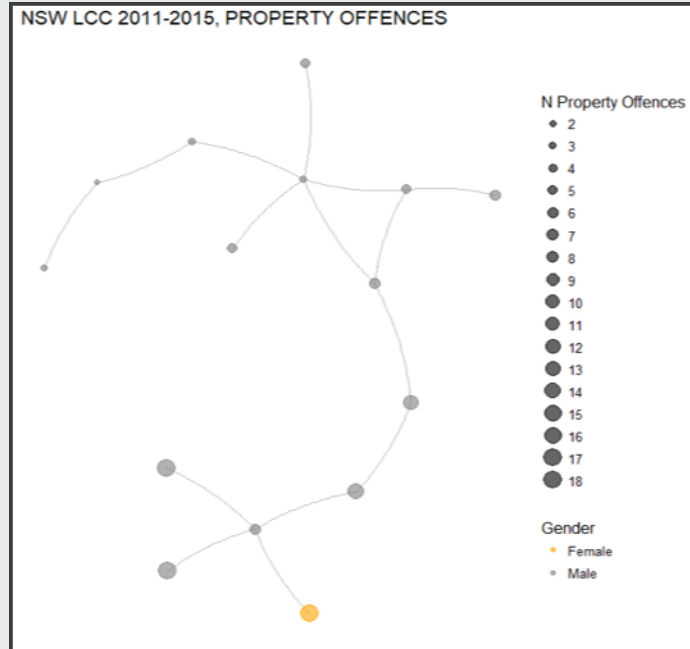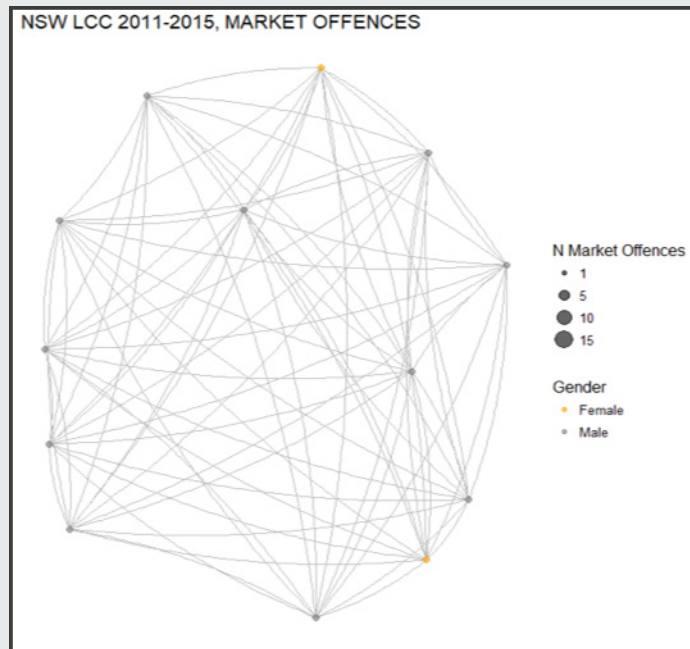**Figure 15: Network map showing property offences**

Figure 16: Network map showing market-based offences

Discussion and conclusion

This project does not seek to compare results for Melbourne and Sydney. Differences in data collection, coding and management across the two police agencies mean that it is not meaningful to make comparisons. However, including data from two metropolitan areas does enhance the generalisability of the results. To this end, we are interested in the consistencies across the two cities.

Table 17: Summary of results		
	Melbourne	**Sydney**
Proportion of co-offenders (%)	17.2	13.1
Property (% co-offenders)	18.5	17.5
Market (% co-offenders)	18.3	8.7
Violent (% co-offenders)	11.4	10.3
Offences (% co-offenders)	5.7	4.4

Co-offending prevalence

In the Melbourne metropolitan area, 17 percent of offenders engaged in any co-offending, and six percent of offences involved co-offending. In the crime categories, seven percent of market and property offences involved co-offending, while only four percent of violent offences involved co-offending. Of property offenders, 19 percent were co-offenders; of market offenders, 18 percent were co-offenders; and of violent offenders, 11.4 percent were co-offenders.

More than 25 percent of the following offences involved co-offending: robbery and extortion (43%), unlawful entry (35%) and homicide (20%). In terms of the overall network of co-offenders, the majority of offences in the core were violence (49%), followed by property (31%) and market offences (20%).

In the Sydney metropolitan area, 13 percent of offenders co-offended, and four percent of offences involved co-offending. For property offences, six percent involved co-offending, while only four percent of violent offences and three percent of market offences involved co-offending. Of property offenders, 18 percent were co-offenders, while 10 percent of violent offenders and nine percent of market offenders were co-offenders. Of offence types, more than 25 percent of the following offences involved co-offending: robbery/extortion (43%), unlawful entry (31%) and homicide (29%). In terms of the co-offending network, the majority of offences in the core were violence (51%), followed by market (27%) and property (22%).

Overall, rates of co-offending were low—somewhat lower than estimates in previous studies (eg Andresen & Felson 2012; Morselli, Grund & Boivin 2015). The restriction to violent, market and property offences may explain this. These low co-offending rates do not provide support for the group hazard hypothesis, which suggests that those involved in co-offending are apprehended at higher rates than individual offenders and are thus overrepresented within official arrest data (Erickson 1973). However, it should be noted that more recent studies using large sample sizes, like the current study, have produced divergent estimates of the prevalence of co-offending (eg van Mastrigt & Farrington 2009), as Andresen and Felson (2012) discussed.

This is the first study of co-offending to use Australian data. Although we did not expect differences in the nature and prevalence of co-offending across countries such as Australia, the United Kingdom, the United States and Canada, it is possible that differences in data collection, coding and management may account for many of the variations measured by researchers in different jurisdictions. In the current study, differences in data collection methods between NSW and Victorian police agencies possibly explain the differences we found between those states—especially the divergence in the recording of offenders against particular offence occasions. Because we used this connection to determine co-offending, the different practices used in each state for connecting offenders and offences probably influenced some of the differences. A further relevant factor, addressed below, is the geographical setting in which data were collected within each jurisdiction.

Impact of co-offending

Despite the small prevalence rates—which we identified as likely to partly reflect the nature of the data sample—the study of co-offending is important because of the burden such offending places on resources in the criminal justice system. Co-offending has been shown to lead to increased recidivism and a trend towards more serious offences, both as members of co-offending groups and as individuals, for those who co-offend (Carrington 2002; Felson 2003; Lantz 2019b, 2018; Lantz & Hutchison 2015; McGloin & Piquero 2009a; Tillyer & Tillyer 2019). The findings of Lantz and Hutchison (2015) suggest that individuals who belong to a co-offending group are more likely to commit burglary offences at a higher rate than those who offend alone. Additionally, research into property crime shows that co-offenders commonly repeat the offending at the same location (Lantz & Ruback 2017b). If a repeat offence at the same location did not involve either the original offender nor a co-offender, known associates of the original offender were involved (Lantz & Ruback 2017b).

Further, every offence involving co-offenders costs the criminal justice system more than solo offending. For example, if one person steals a motor vehicle, the social costs include the victimisation and insurance costs, plus the costs incurred to the criminal justice system of arresting, prosecuting and sentencing that one individual. If four individuals steal one car together, the social costs include the same victimisation and insurance costs, plus an approximate fourfold increase in costs to the criminal justice system. Although the great majority of co-offending involves no more than two offenders, co-offending does occur with larger numbers (see Figures 1 and 9).

Crime types

The current study reinforces earlier research (eg Lantz 2019a; Terranova, Vandiver & Stafford 2019; van Mastrigt & Farrington 2009), suggesting that co-offending should be studied in disaggregated form rather than as a total across all crime types. Some crime types, mainly acquisitive crimes such as burglary and robbery, are more strongly associated with co-offending. Law enforcement should consider collecting and reporting co-offending data in disaggregated form as part of regular statistical summaries of crime. Policymakers should consider the costs, including victimisation costs, of co-offending, compared with solo offending, and the relative burdens placed on the criminal justice system. Policies could be directed toward reducing co-offending; for example, they could focus on prevention in convergence settings, such as prisons, and on interventions that seek to enhance the positive pro-social influences of peers and associates.

Results suggest that an underlying trait such as low self-control or impulsivity is unlikely to account completely for co-offending across crime types. If that were the case, we would expect co-offending prevalence to be more or less evenly distributed across crime types, instead of finding different prevalence rates of co-offending across crime types and categories.

Our results across different crime types suggest two primary mechanisms that may account for co-offending. Firstly, for some types of crime, offenders may perceive co-offending to be easier, less risky and more profitable. Secondly, offenders may gain some other socially mediated benefit from co-offending: shared responsibility for criminal behaviour, diminished feelings of personal responsibility, or increased camaraderie and bonding. These socially mediated effects may be stronger for some types of crime, such as robbery and burglary, and weaker for crimes such as interpersonal violence (including sexual assault).

Networks of co-offenders

The study of co-offending networks offers a more in-depth view of co-offending. In the core of the co-offending networks in both Melbourne and Sydney, most individuals had committed a violent crime. Such individuals made up approximately half of offenders in the core in both metropolitan areas. This finding suggests that individuals who had committed violent offences had a larger personal network of co-offenders. Such individuals may have easier access to a range of potential co-offenders, presumably across crime types. Similarly, Lantz and Hutchison (2015) found that highly connected individuals had committed more offences and, as their network grew, so did the total number of offences committed.

In the co-offending networks for both Melbourne and Sydney, degree assortativity was strong, suggesting that offenders tend to offend with others who have a similar number of unique co-offenders. Age assortativity was also strong in both data sets, which supports other research (Budd, Sharp & Mayhew 2005; Reiss & Farrington 1991; Sarnecki 2001; Warr 1996) showing that offenders tend to co-offend with others of approximately the same age or age group. Findings for gender assortativity across both cities suggest that offenders tend to co-offend with others of the same gender when committing violent offences. However, results for both Melbourne and Sydney suggest that there is a tendency for market-based offences to be committed by mixed-gender groups (males and females co-offending).

Policy implications

The findings of this study offer a number of significant benefits for law enforcement agencies and policymakers.

The results of our study confirm the position taken by previous researchers, that studying co-offending is critical for understanding crime and determining prevention and intervention strategies. Reasons include:

- We cannot accurately calculate the incidence of crime and its impact without considering co-offending. Harms to victims are not always proportional, because some crimes involve more than one offender.

- The financial burden on the criminal justice system is greater when crimes involve more than one offender, intercepted by police and moving through the courts and correctional processes.

- Co-offending may lead to longer criminal careers, compared with solo offending.

Our results suggest that police agencies should collect data on co-offending as a matter of course, to inform their understanding of crime patterns within their jurisdiction. Such data collection and analysis should be conducted at the level of crime type, in order to facilitate a clear picture of co-offending versus solo offending and to assist with the implementation of responsive policing strategies.

Our results suggest that policymakers focus on offender convergence settings—those settings in which offenders find suitable co-offenders. These include bars, parks and prisons. Determining convergence settings enables the development and enactment of policies which divert individuals from such settings or reduce their attractiveness.

Desistance efforts within prisons and in the community should take account of co-offending and the pro-criminal influences of co-offending partners. Perhaps the social influence of such partners could be positively engaged, to motivate co-offenders to seek and attend treatment and rehabilitation programs. The mechanisms of mutual support that make co-offending attractive also offer opportunities for targeted policy interventions.

Limitations

The study suffered from a number of limitations. The first is the issue of data quality. Police agencies collect data for a particular set of operational purposes that do not always coincide with the requirements of researchers. In our case, the data were used to connect offenders with particular offences, and this necessitated making assumptions about which offenders co-participated in offences. In doing so, we may have unwittingly underestimated or overestimated the extent of co-offending. The effect of these assumptions may also have varied between jurisdictions, because of the different nature of the data in each state. Nationally consistent practices for recording crime data would improve the validity and reliability of comparisons between jurisdictions.

We selected a particular geographical area as a boundary for data collection. It is highly likely that at least some co-offending was not captured because it took place outside our artificial boundaries (eg in a neighbouring local area command). We chose to collect data within a set time frame of five years, so only co-offending that occurred within that time period was captured. It is likely that significantly more co-offending would be included had we extended this time frame (eg to 10 years). Further research could extend the geographical boundaries and the time frame of this study, which would require working with a very large data set involving several million crime events.

We used particular definitions and operationalisations of crime types and classifications. Had we used alternative methods of aggregating and classifying crime types, we may have gathered a different set of results. Generalisability to other cities, regions and countries is not known. Attention on the broader Australian context might have produced a better understanding of any variations in co-offending across jurisdictions. Because we examined multiple crime types, offenders could have been involved in co-offending in more than one type of crime over time. This means that we did not examine co-offending that occurred for specific offence types. Finally, we used crime seriousness definitions to determine the most serious offence in order to classify offenders to a crime type. We used a dominant method for doing so, but different results might, of course, have emerged through an alternative methodology.

Despite these limitations, this study makes an important contribution to our understanding of co-offending, particularly co-offending across crime types and classifications. Results suggest that researchers should disaggregate data on co-offending by crime types to reveal the nuances of co-offending behaviours.

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