OXFORD

Historical Co-offending Networks: A Social Network Analysis Approach

Grace Di Méo [iD],

*G. Di Méo, University of Southampton, Building 65, Avenue Campus, Highfield Road, Southampton, Hampshire, SO17 1BF, UK; email: dimeo.gea@gmail.com, g.dimeo@soton.ac.uk

Recent decades have witnessed growing use of social network analysis (SNA) to study criminal activities, including that of co-offending. However, few studies have examined co-offending networks within a historical context. This paper focuses on group-based crime in a large English town during the Victorian period, employing SNA methods to examine the prevalence, structure and composition of co-offending relationships. Networks for property, violent and victimless crimes were partitioned to compare co-offending across crime categories. Results indicate that co-offending groups were typically segregated, although there was a loosely-organised community of property crime offenders connected by 'brokers' who collaborated with multiple groups. Evidence also suggests that co-offending was largely characterised by assortative mixing in regard to sex, age and marital status.

KEY WORDS: co-offending, criminal networks, illicit networks, group crime, NetworkX, historical criminology

INTRODUCTION

Social network analysis (SNA) has recently become a popular theoretical and analytical approach among criminologists. Although the benefits of using SNA to examine crime and deviance were highlighted in the early 1900s (Sparrow 1991), concerted efforts to incoporate network analysis measures were not implemented for another decade. SNA allows scholars to assess the impact of social structures and peer influence on criminal behaviour, with the underlying assumption being that criminality is 'predominantly social behaviour [since] most offenders are embedded in a network of friends who break the law' (Warr 1996). Recent research has used SNA to investigate a range of criminal activities, including: street-gang crime (Papachristos 2009; Papachristos et al. 2015); crime syndicates (Campana and Varese 2022; Krajewski et al. 2022); vehicle theft (Chen and Lu 2018); drug trafficking (Morselli and Petit 2007) and terrorism (Krebs 2002).[1]

---

1   For a review of recent literature, see Bouchard and Amirault (2013) and Bouchard and Malm (2016).

Co-offending is another major theme within social network analysis of crime, a suitable approach given the inherently relational nature of co-perpetrated offences. SNA-based studies have developed traditional examinations of group-based crime by not only analysing the structure of co-offending relationships but also demonstrating that crimes which initially appear disconnected may be part of a larger crime network. Scholars have paid considerable attention to juvenile co-offending (Sarnecki 2001; Schaefer 2012), the role of 'recruiters' vs. 'recruits' (McGloin and Nguyen 2012; Englefield and Ariel 2017), the stability/instability and specialization/versatility of accomplice relationships (McGloin et al. 2008; McGloin and Piquero 2010; Lantz and Hutchison 2015) and the issue of homophily/assortative mixing (van Mastrigt and Carrington 2014; Carrington 2015a; 2015b). Such research suggests that, although important nuances exist across different types of crime, co-offending networks are dominated by young males whose offending relationships are short-lasting and characterised by homophily.

Although there is now a wealth of research on group-perpetrated crime utilising SNA methods, few studies have examined co-offending networks within a historical context. At the time of writing, there appear to be no network analyses which consider events prior to the twentieth century. Network criminologists seldom use historical data, although a handful of studies – most focusing on organised crime – use sources from the early- to mid-twentieth century (Mastrobuoni and Patacchini 2012; Hughes 2013; Smith and Papachristos 2016; DellaPosta 2017; Krajewski et al. 2022). Crime historians, meanwhile, have failed to adopt SNA methods; they have also largely neglected the topic of co-offending, although notable exceptions have been offered (Egmond 1993; Davies 1998; 1999; Roodhouse 2013; Shore 2014; Shore 2015; 2018; Pluskota 2015; Chinn 2019; 2020; 2021). These shortcomings cause little to be known regarding the prevalence, organization, or social processes of co-offending in the past.

This article therefore provides the first study of pre-twentieth-century co-offending networks, focusing specifically on group-perpetrated crime occurent over one decade of the Victorian period (1880–90) in a large English town (Cheltenham). Most forms of crime are covered; however, since evidence suggests that co-offending patterns can vary according to crime types (van Mastrigt and Farrington 2009; Bright et al. 2020; 2022), the study distinguishes between acts of property, violent and victimless crime through analysis as separate networks. Three lines of enquiry are pursued: given the lack of historical research on co-offending, the first considers the prevalence and perpetration of co-offending in the late Victorian period; the second explores the structure of co-offending networks, providing comparisons of composition across different types of crime; the final enquiry considers the extent to which co-offending networks were characterised by assortative mixing. The paper begins with a review of existing research on co-offending, thereafter providing an overview of crime and justice in Victorian England. The subsequent section discusses the sources, data and methods used for this research. Research results are then presented before conclusions are made regarding the findings, limitations and implications of the study.

RESEARCH ON CO-OFFENDING

Co-offending has received attention from criminologists for over a century. Early research included Breckenridge and Abbot's study (1912) of the juvenile court in County Cook (Illinois), within which the authors demonstrated the high prevalence of co-offending among delinquent young males. This finding was supported by Shaw and McKay (1931), with evidence indicating that over 80% of the boys in their sample study of the same court two decades later had been charged with one or more co-offences. Meanwhile, Shaw's pioneering *The Jack-Roller* (1930) used ethnographical methods to trace the 'life history' of a Chicagoan juvenile delinquent and assessed the relationship between geography, structural inequality and youth deviance. In doing

so, Shaw attributed the role played by gangs and criminal associations in the onset of delinquency to the 'disorganization' of communities within poor, urban neighbourhoods.

Research on co-offending expanded as the twentieth century progressed. Scholars made greater use of quantitative methods to assess the nature of group delinquency, focusing particularly on the prevalence and instigation of co-offending alongside the backgrounds of those involved. These examinations supported earlier research by demonstrating that co-offending is strongly associated with juveniles, typically decreasing with age; Reiss (1988), for example, claimed that group offending is 'most characteristic of what we think of as juvenile delinquency [and] begins to rise sharply at ages fifteen to seventeen'. Such studies were also vital in developing many key questions discussed within contemporary research on co-offending.

In recent years, co-offending studies have been enriched by SNA methods. Work in this field was influenced by Sarnecki's research (1990; 2001) on juvenile co-offending networks in Sweden, which demonstrated that seemingly detached crimes could be part of a larger crime network. Co-offending networks provide a valuable lens through which to understand crime since they 'embed individuals in criminal lifestyles' and 'provide an opportunity for individuals to learn deviant behaviour [and to] recognize a wider range of criminal opportunities' (Morselli 2014). They can therefore illuminate a range of issues, including: the prevalence of co-offending; the stability and versatility of co-offender relationships; homophily/assortativity and the role of 'recruiters'/'recruits'. Although it is beyond scope to investigate all such themes in one paper, the remainder of this section provides an outline of the key literature – both traditional and SNA-based – related to each.[2]

Prevalence of co-offending remains an important discussion among scholars. Estimates vary, yet studies suggest that approximately 5-25% of crimes are perpetrated by groups (Carrington 2002; van Mastrigt and Farrington 2009; Andresen and Felson 2010; Bright et al. 2022). Studies which use self-reporting (e.g. surveys) as opposed to official data (e.g. court records) typically yield higher co-offending rates: for example, Warr's study on US juveniles (1996) found that 73% of self-reported delinquent acts involved co-offending, whereas Carrington's analysis of official Canadian statistics (2002) revealed that only 12% of cases involved multiple offenders. However, despite finding discrepancies in co-offending rates, most studies agree on two points: first, that co-offending is more prevalent among younger offenders; second, that it is more common within certain offences, especially 'instrumental' crimes such as burglary, robbery and vehicle theft. There also exists some evidence of co-offending being more prevalent among females than males, although the generalizability of this finding remains contested (Tarling 1993; Carrington 2002; 2015b).

Co-offending literature also explores the extent to which accomplice relationships are characterised by stability and/or versatility, namely: whether co-offending relationships are short-lived (unstable) or long-lasting (stable); and whether accomplices commit a range of different crimes together (versatility), or instead focus on specific offences (specialization). Regarding stability, studies suggest that co-offending relationships are generally short-lived, rarely lasting beyond one crime (Reiss and Farrington 1991; Warr 1996; Sarnecki 2001; Grund and Morselli 2017). Indeed, Warr (1996) claims that delinquent groups are 'so short-lived that it makes little sense to even speak of delinquent *groups* at all, at least in any strict sense'. Meanwhile, discussions regarding versatility suggest that partnerships lean more towards specialised than versatile offending (Warr 1996; Grund and Morsell 2017); however, offenders with non-redundant networks (those who find new accomplices) may show more versatility than those with redundant

---

2   Themes excluded from this review include: multiplexity (Smith and Papachristos 2016); the link between social and spatial effects (Schaefer 2012; Chen and Lu 2018); between-group/between-neighbourhood activity (Bastomski et al. 2017); and crime prevention (Frydensberg et al. 2019).

networks (those who re-use accomplices) since they are often exposed to a larger pool of people and therefore a wider range of opportunities, knowledge and skills (McGloin et al. 2008; McGloin and Piquero 2010).

Research has also focused on accomplice selection – in particular, on the presence of homophily (or assortative mixing), which suggests that offenders tend to commit crimes with persons who possess similar characteristics to themselves, whereas heterophilous relationships are characterised by diversity. Homophily has been detected both in traditional and SNA-based studies of co-offending, evidence indicating that co-offenders are often of similar age, sex and/or ethnicity (Reiss 1988; Reiss and Farrington 1991; Warr 1996; Carrington 2002; 2015a; 2015b; Schaefer 2012; Goldsmith and Halsey 2013; van Mastrigt and Carrington 2014). For example, Carrington's study of Canadian co-offending (2015b) demonstrates that same-sex dyads were twice as frequent as mixed-sex pairings while same-age dyads were seven times more likely than mixed-age groups. However, there remains debate over the causes behind homophily in co-offending relationships, scholars being divided between choice-based and opportunity-based explanations: some argue that offenders actively choose offenders who are like themselves (Reiss and Farrington 1991; Warr 1996), whereas others suggest that, instead of preference, homophily reflects the demography and structural opportunities available in an offender's pool of potential accomplices (Carrington 2002; Bouchard and Malm 2016).

Scholars have additionally examined the role of 'recruiters' and 'recruits' – or 'instigators' and 'joiners' – in co-offending relationships. Several studies suggest that group-perpetrated crimes are often instigated by individuals who influence others to participate ('recruiters'), distinguishable from recruits in that they tend to be older and more-experienced offenders who collaborate in more stable, homogeneous groups (Reiss 1988; Reiss and Farrington 1991; Warr 1996; van Mastrigt and Farrington 2010; McGloin and Nguyen 2012; Lantz and Hutchison 2015). Research further suggests that, whilst only a handful of offenders fit the recruiter profile, offenders sometimes switch between the roles of recruiter and recruit across different offences (Warr 1996).

Such discussions have identified key patterns in the formation, maintenance and organization of modern co-offending groups. However, due to a lack of research which addresses co-offending relationships from a historical perspective, it is difficult to ascertain whether such patterns are inherent to group-based crime or if they have changed over time. Criminologists have rarely used sources predating the late-twentieth century; only a handful of studies have used historical co-offending data, yet they provide valuable insight into the structure of history's criminal groups. Several researchers, for example, have examined the extent to which mid-twentieth-century American Mafia groups were hierarchical, integrated organizations (Mastrobuoni and Patacchini 2012; DellaPosta 2017; Krajewski et al. 2022); Hughes' research (2013) on violent crime in mid-nineteenth century Chicago explores cohesiveness in gang networks; and Smith and Papachristos' study (2016) on an organised crime network in Prohibition-era Chicago demonstrates how multiplexity enabled the criminal 'underworld' to connect with legitimate, mainstream society. A shortcoming of these studies, however, is that they focus solely on crimes carried out by crime syndicates and gangs; such offences constitute only a small portion of all crimes committed by co-offenders (Frydensberg et al. 2019), leaving a lack of information on how more common forms of co-offending partnerships were formed and structured.

Crime historians, meanwhile, have paid little attention to co-offending, with only few historical studies placing group-based crime at the forefront of investigation. These contributions typically focus on gang-related activities: Davies has explored the involvement of young males – and sometimes females – in the scuttling gangs of late Victorian Manchester (1998; 1999; 2008); Chinn's research on Birmingham's Peaky Blinders gang uncovers violent conflict, protection rackets and working-class antagonisms in the inter- and post-war years (2019; 2020;

2021); and Egmond has examined banditry in the Dutch provinces during the seventeenth and eighteenth centuries (1993). Additionally, Shore has investigated the 'racecourse wars' – gang conflicts fuelled by horse racing, gambling and protection rackets – of the inter-war period (2014; 2018); Shore has also examined understandings of the 'criminal underworld' in eighteenth- to twentieth-century London in relation to organised crime contexts such as street robberies, swindler (fraudulent) gangs and hooliganism (2015). Moving into the later half of the twentieth century, Roodhouse's research (2013) on black market dealing by producers, traders and professional criminals uncovers organised crime in the underground economy of wartime and post-war Britain.

Offering another important contribution to co-offending studies, Pluskota's examination (2015) of co-offending families in Amsterdam during the years 1897–1902 remains one of the few historical studies to explore more 'everyday' forms of co-offending involving 'ordinary' people. Drawing evidence from Dutch court records, the study offers two key findings: first, that women constituted a significant minority of the co-offending population; second, that courtroom decisions did not reflect class-based biases, with semi-urban (and more affluent) co-offending families being treated no more leniently than their urban (and more working-class) counterparts. However, despite the contributions made thus far by Pluskota and other historians of crime, historical research on co-offending remains patchy, with no studies having employed SNA methods to date.

CRIME AND JUSTICE IN NINETEENTH-CENTURY ENGLAND

Historians of crime in modern England largely agree that recorded crime rates declined during the nineteenth and early-twentieth centuries. Explanations for this decline have reached less consensus. Some scholars argue that decreasing rates reflect changes in legal and governmental practices, including the evolving role played by police officers and/or adjustments in state-level funding (Gatrell 1990; Taylor 1998; Godfrey 2008). Others argue that declining crime rates reflect real changes in human behaviour: in particular, violent crime may have declined because of a 'civilizing process' which encouraged politeness and restraint, thereby impacting the attitudes of both authorities and the broader public (Spierenburg 2001; Carter Wood 2004; Wiener 2004).[3]

Despite evidence of declining prosecution rates, the Victorian period gave rise to sporadic but intense bursts of fear regarding crime and deviance. These so-called 'moral panics' were exacerbated by sensationalist media reporting which played on public anxieties by exaggerating the prevalence of crime. 'Moral panic' over violent street robberies – then referred to as 'garrotting' – serves as a fitting example: although the actual number of street robberies was very low, the high-profile robbery of an MP in 1862, coupled with a fierce press campaign, resulted in widespread public panic (Davis 1980; Sindall 1990). Similarly, the Jack the Ripper murders had been concentrated around London's East End in the summer of 1888, yet press sensationalism provoked nationwide, prolonged panic (Walkowitz 1982).

The Victorian criminal justice system was three-tiered. The Assizes, at the highest level, circulated the country's major towns biannually and were presided over by a judge and jury who handled the most serious indictable offences. Quarter Sessions formed the middle layer of the justice system, meeting quarter-yearly in large towns and cities.[4] In theory, jurors at Quarter Sessions could adjudicate over any crime except treason, but in practice they handled cases of

---

3   The term 'civilizing process' was coined by sociologists Nobert Elias in the 1930s. His theory suggested two factors reduced interpersonal aggression in Europe from the Middle Ages to the modern period: the spread of ideals regarding self-restraint and the growth of state control over criminal justice systems.

4   The Assizes and Quarter Sessions operated until 1971, at which point they were combined into today's Crown Court.

larceny, aggravated violence and general misdemeanours. At the lowest tier, magistrates' courts met on a near-daily basis to deal with summary (non-indictable) offences, poor relief and establishment licenses; they also heard preliminary evidence for indictable offences before remanding to a higher court. Magistrates' courts became an increasingly important instrument of the criminal justice system during the nineteenth century and by the Victorian period were responsible for handling almost 98% of all criminal offences prosecuted in England (Alexander, 1915).

SOURCES, DATA AND METHODS

This article provides one of the first examinations of co-offending networks within a historical context. However, to make the project feasible, numerous boundaries were placed on the study. First, this research focuses on the period 1880–90, a timeframe similar to other examinations of co-offending networks (Sarnecki 1990; Lantz and Hutchison 2015; Englefield and Ariel 2017); longer periods may reduce overlaps in ties between offenders because of generational change, whereas overly short timeframes can provide 'misleading pictures' (Campana and Varese 2022). The starting point of 1880 was selected since most English court records – particularly for magistrates' courts – are exceptionally patchy prior to 1880. Second, the study covers all forms of criminal offences including serious, indictable offences tried at the Assizes and Quarter Sessions but also more minor misdemeanours handled by magistrates; however, civil and regulatory offences are not included.[5]

A geographical boundary was also imposed, the study focusing solely on co-offending in the town of Cheltenham, Gloucestershire. Cheltenham was selected on two accounts, the first being an excellent survival of the town's courtroom and demographic records. The second stems from the town's transitioning socioeconomic climate during the nineteenth century. Although a prosperous spa and leisure town at the start of the century, and remaining significant for upper-class recreations such as pumprooms, seasonal horse racing and concerts, Cheltenham's declining popularity as a holiday destination – the elite starting to prefer coastal and overseas resorts – directly contributed to local hardships. Just an influx of wealthy visitors and residents in the late-eighteenth and early-nineteenth centuries had created working-class employment opportunities in construction, leisure and domestic service, the town's waing popularity from mid-century onwards took these same opportunities away (Hart 1965; Edlin 2003; Seal 2009; Jones 2010). Meanwhile, Cheltenham failed to develop a significant industrial or manufacturing sector to replace its spa-based economy, resulting in record-high unemployment rates (Edlin 2003; Seal 2009). By the late Victorian period, contemporaries were reporting extensively on Cheltenham's socioeconomic problems, including: inadequate poor relief; slum housing; overcrowded workhouses; crime and vice and the effects of a widespread national depression in 1887–88 (Edlin 2003; Seal 2009). Late Victorian Cheltenham was therefore a highly polarised town, juxtaposing its wealthy population in a world of pumprooms, races and prestigious schools with the expanding and increasingly marginalised classes rife with crime, poverty and social division by the end.[6]

It was further decided that this study should distinguish between types of offence Research suggests that co-offending patterns vary according to crime, therefore stressing the need to disaggregate: a study of co-offending in twenty-first-century Sydney, for example, found notable differences in co-offending rates across crime types, noting that 'aggregating co-offending into

---

5   A list of all offences included in the study can be found in Table 1.
6   Court records suggest that, outside of employment, members of Cheltenham's working classes led largely distinct lives from the middling and upper classes. Most offences were committed within the confines of working-class neighbourhood spaces (often public houses, shared housing or the streets) and seldom extended to leisure sites frequented by Cheltenham's wealthy population (such as racecourses, concerts and tourist sites).

broad groups…can omit important nuance about the many sub-categories within such groups' (Bright et al. 2022); another study, highlighting differences across crime types, revealed that co-offending networks may be larger for property crimes than for violence (Bright et al. 2020). As such, the present study partitions co-offending acts on two levels: first, the broader 'crime category' level, which distinguishes between property, violent and victimless crime; second, at the lower 'crime type' level, which classifies cases by specific offence (for example, an assault is recorded as 'assault' for 'crime type' but as 'violent crime' for 'crime category'). As will be demonstrated, both the prevalence and structure of co-offending demonstrate variety across crime categories and – to a lesser extent – across crime types.

This article draws evidence from three source types, the first being archival records from Cheltenham magistrates' court.[7] These records include both court registers and minute books: registers provide basic information on all prosecutions, including the offence type, names of parties involved, verdict and (if applicable) sentence returned; minute books provide accounts of trial proceedings as denoted by court clerks and, although not all prosecutions were recorded, often provide rich descriptions of crimes and their perpetrators. Second, the study uses local newspapers made available online via the British Newspaper Archive (BNA).[8] Nineteenth-century newspapers often reported trial proceedings for the Assizes, Quarter Sessions and magistrates' courts, thereby offering information on co-offences prosecuted at all tiers of the justice system. In order to identify relevant cases, requests were made to the BNA's search function using the terms '"Cheltenham" AND "police court" OR "magistrates"' (for the magistrates' court) and '"Cheltenham" AND "Quarter Sessions" OR "Assizes"' (for the higher tribunals).[9] Results were then filtered for articles printed in the county of Gloucestershire during the research period (1880-90). Newspaper sources served two purposes: first, to provide additional information on the magistrates' court cases which were first identified in court records; second, to provide a record of Cheltenham-based co-offences which were prosecuted at the Quarter Sessions and/or Assizes.

The final sources used for this study were census returns for the years 1881 and 1891. These have been made available online via Ancestry along with the ability to search for individuals by name, address, birthyear, birthplace and/or census year.[10] The Ancestry platform was used to search for all Cheltenham co-offenders identified within court records and newspaper reports, with any relevant results thereafter being cross-referenced to match individuals to their correct census records; in a time and place where the population was relatively low, the use of a matching name and address across both a census return and either a court record or newspaper was considered sufficient evidence to assume that the records belonged to the same individual.[11] The matched census records were then used to glean sociodemographic data invaluable to examining criminals' backgrounds, including information on their occupations, ages, birthplaces, marital statuses and family members.

Information extracted from these sources was used to create a dataset of co-offending in Cheltenham in the years 1880–90. This consisted of three tables, the first being a simple log of all alleged co-offences ($n = 761$) and solo offences ($n = 6,963$) which allegedly occurred in Cheltenham. The second table, the 'nodelist', required a two-step process. First, a list of

---

7   Records for Cheltenham magistrates' court are held at the Gloucestershire Archives in Gloucester, England under the reference PS/CH.

8   The British Newspaper Archive is accessible via: https://www.britishnewspaperarchive.co.uk/. Newspapers examined for this study include *Cheltenham Mercury*, *Cheltenham Chronicle*, *Gloucester Citizen*, and *Gloucestershire Echo*.

9   Magistrates' courts were sometimes referred to as 'police courts' during the nineteenth century.

10   These records can be found at: https://www.ancestry.com/.

11   Cheltenham had a population of approximately 50,000 residents in the years 1881–91 ('GB Historical GIS, Cheltenham District through time', *A Vision of Britain through Time*, University of Portsmouth, http://www.visionofbritain.org.uk/unit/10168284/cube/TOT_POP, accessed 11/01/2023).

all names associated with co-offences was created, including any identifiable information known about suspects. Second, since some offenders were involved in multiple offences and were therefore duplicated in the list, an entity-matching process was undertaken. To match an individual to each of their associated offences, two inclusion criteria were created whereby 1) the suspect's name or alias had to be the same (or very similar) and 2) two or more of the following personal details needed to match: age; address; occupation; known social connections (e.g., family members or colleagues) and/or marital status. This made it possible to create a nodelist which comprised each unique suspected co-offender ($n = 1,537$) along with details of their sociodemographic and offending histories. Imputation was used if details were unknown: for categorical variables, missing entries were recorded as 'not known'; for numerical variables, missing entries were filled simply by taking the average of all other known data points for the variable.

The third table was an 'edgelist' recording links between co-offenders. An edge was recorded between two individuals if they were suspected of having offended together. Edges were binary, signifying whether two individuals had (allegedly) co-offended together rather than the frequency or strength of their interactions. Additionally, since we do not know who initiated the action, edges were recorded as undirected. However, it was possible for two offenders to have multiple edges between them if they were prosecuted for *different* types of crime together; in order to partition networks by crime, all edges were given both a 'crime category' and 'crime type' attribute. As an example, offender X and offender Y could be connected not only by an edge with the attribute 'violent crime' (if they committed one or more violent offences together) but also by an edge with the attribute 'property crime' (for committing one or more property crimes together).

Various analytical methods were required for this study: the first line of enquiry, which focuses on broad, historical co-offending patterns, relied on traditional descriptive statistics whereby *unique offenders* and their *offences* served as the units of analysis; the second and third enquiries, which examine network structure and composition, required SNA-based methods whereby *dyads* (co-offending pairs) were the unit of analysis. Network analytics were performed using Python's NetworkX library, with pre-processing being undertaken using the Pandas and NumPy libraries. NetworkX provides not only considerable flexibility for structuring and analysing network data but also includes visualization capabilities through integration with Matplotlib. The network measures discussed within the study include descriptive properties – such as network size, density, average degree, components and clustering coefficient – as well as measures of assortativity.

HISTORIC CO-OFFENDING PATTERNS

Since relatively little is known about historical co-offending, we may begin by identifying broader patterns of co-offending in Cheltenham during the research period. There were 7,724 prosecutions for offences allegedly committed in Cheltenham during the years 1880-90, 6,993 (90.15%) of solo offending and 761 (9.85%) involving multiple suspects (see Table 1). However, the prevalence of group crime differed across crime categories while alleged victimless and violent offences had relatively low co-offending rates (3.92% and 5.25% respectively), over a quarter of prosecutions for property crimes (28.84%) involved multiple suspects.

Drilling down to the specific offence level, further variation in co-offending rates is indicated. Among property crimes, acts of burglary, wilful damage and theft had particularly high levels of group crime (40.48%, 31.99% and 30.51% respectively) whereas acts of illegal pawning and fraud had much lower rates (0% and 7.62%). Burglary likely had a particularly high co-offending

Table 1. Co-offending rates by crime categories and crime types

Category	Crime	No. all offences	No. solo offences	No. group offences	% cases involving groups
Property crime	Arson	10	8	2	20.00%
	Burglary	42	25	17	40.48%
	Fraud	130	120	10	7.69%
	Illegal pawning	14	14	0	0.00%
	Poaching	41	31	10	24.39%
	Robbery	8	7	1	12.50%
	Theft	1,088	756	332	30.51%
	Wilful damage	397	270	127	31.99%
	All property crimes	**1,730**	**1,231**	**499**	**28.84%**
Victimless crime	Criminal trespass	114	68	46	40.35%
	Disorderliness	47	30	17	36.17%
	Drunkenness	2,639	2,628	11	0.42%
	Gambling	7	6	1	14.29%
	Indecent behaviour	12	12	0	0.00%
	Keeping brothel	8	7	1	12.50%
	Misc. regulatory offences	104	90	14	13.46%
	Obscene language	123	121	2	1.63%
	Perjury	4	4	0	0.00%
	Possession of weapon	17	15	2	11.76%
	Prostitution	5	4	1	20.00%
	Refusing to quit pub	51	44	7	13.73%
	Road obstruction	69	53	16	23.19%
	Vagrancy, begging	740	703	37	5.00%
	Workhouse insubordination	36	35	1	2.78%
	All victimless crimes	**3,976**	**3,820**	**156**	**3.92%**

Table 1. Continued

Category	Crime	No. all offences	No. solo offences	No. group offences	% cases involving groups
Violent crime	Aggravated assault, GBH	15	14	1	6.67%
	Assault	1,801	1,712	89	4.94%
	Cruelty to animals	132	121	11	8.33%
	Manslaughter	3	1	2	66.67%
	Other violent crimes	7	7	0	0.00%
	Rape, sexual assault	23	21	2	8.70%
	Resisting arrest	8	8	0	0.00%
	Rioting	1	0	1	100.00%
	Threats	28	28	0	0.00%
	All violent crimes	**2,018**	**1,912**	**106**	**5.25%**
All crimes	**(All crimes)**	**7,724**	**6,963**	**761**	**9.85%**

rate due to requiring more specific skills, knowledge and equipment compared to other crimes. As for violent crime, if offences which were exceptionally rare are excluded, acts of sexual violence and cruelty to animals had the highest co-offending rates (8.70% and 8.33% respectively). Assault, by far the most common violent crime, had a lower rate of 4.94%. Victimless crimes also showed diversity in the prevalence of group-based crime. Some offences had relatively high co-offending rates; the group-based nature of trespassing (40.35%) is unsurprising given the connection between such offences and acts of burglary and poaching, while co-prosecutions in disorderliness (36.17%) may ensue from group-based activities such as fighting. By contrast, other victimless crimes were almost exclusively solo activities, obscene language and drunkenness having co-offending rates of 1.63% and 0.42% respectively. Historical data from Cheltenham therefore supports the mainstream criminological view that the prevalence of co-offending varies by crime type.

Although co-offending rates differed across crime categories, there were similarities in the sizes of offending groups. Prosecutions for co-offences typically involved 2–3 defendants, with the average number of persons per offence being 2.93 for property crimes, 2.78 for victimless crimes and 2.32 for violent crimes. This evidence resonates with criminological findings that co-offending groups tend to be small, averaging 2–4 members per offence (Reiss 1988; Reiss and Farrington 1991; Warr 1996). There was, however, a marked difference in maximum group size across these categories: the largest co-offending group among property crimes involved 17 suspects – a prosecution for shoplifting against male adolescents; the maximum group size for victimless crimes was 10 persons – a drinking offence by both male and female adults; and the largest group among violent crimes consisted of six men who allegedly assaulted their neighbour.

Studies have also examined the composition of co-offending populations, in particular focusing on the age and/or sex of criminals. In the 1880–90 dataset, over half (56%) of Cheltenham's

co-offenders were under 18.[12] In addition, a linear decline in co-offending is suggested with age: 18.09% were aged 18-30; 11.65% were aged 31–50 and only 3.45% were over 50.[13] As for the sex-crime ratio, most suspects were male (87.66% males vs. 12.23% females), despite women significantly outnumbering men in Cheltenham during the research period (Jones 2010). Female participation in crime was lowest in group contexts; women accounted for 22.89% of solo prosecutions compared to 18.4% of those involving co-offenders. Women's share in group-based crime was largest among violent offending, women having been involved in 36.79%, 20.5% and 13.85% of violent, victimless and property crimes respectively.

Academic discussions of co-offender characteristics seldom address sociodemographic traits other than age and sex. Yet contemporary court, newspaper and census records provide additional information about co-offenders' backgrounds. Evidence indicates that most suspects in this study (67.53%) were unmarried, with only 18.54% having been married and just 0.78% widowed. This finding is unsurprising given the high proportion of juvenile co-offenders, although young adults working in the labouring and domestic service industries – then the most common employment opportunities for Cheltenham's working classes (Hart 1965; Seal 2009) – formed a notable proportion of unmarried co-defendants. Records can also be used to establish whether defendants were native to Cheltenham. Using data from census returns, defendants' birthplaces were classified under the following categories: those born in Cheltenham; those born outside of Cheltenham but within the surrounding county of Gloucestershire; those born elsewhere in England (outside of Gloucestershire); and those born outside of England. Most defendants were 'local', with 60.57% having been born in Cheltenham and a further 13.53% born elsewhere in Gloucestershire. By contrast, only 9.43% of suspects were born elsewhere in England, and only 2.15% were born outside of England, most notably from Ireland, due to mass Irish emigration following the Great Famine of 1845–52 (Tranter 1985).

Descriptive co-offending statistics provide a top-level impression of group-based crime in late Victorian Cheltenham. First, although co-offending was less common than solo offending, property crimes were considerably more likely to involve multiple offenders than acts of violence and, with some exceptions, victimless offences. This disparity is likely due to property crimes having been so-called 'instrumental' offences with specific goals, whilst violent and victimless offences were often sparked by spontaneous tensions between individuals. Offending groups were typically small (2–3 persons) but, on average, were marginally larger among property crimes. Findings also indicate that cases typically involved those who were male, young, unmarried and/or local-born.

THE STRUCTURE OF CO-OFFENDING NETWORKS

The next focus of this paper concerns the structures of property, violent and victimless crime networks. The property crime network was by far the largest, an unsurprising finding given the high prevalence of co-offending among property offences (similarly, see Bright et al., 2020). However, despite being a relatively large network (nodes = 1115; edges = 1853), it should not be considered a *well-connected* one (see Table 2 and Figure 1). Network density is considerably low at 0.003 – meaning that only 0.3% of all possible ties are present – and indicates that there was little cohesion between co-offenders. The average degree was also relatively low, offenders only being directly connected on average to 3.32 others, although the maximum degree was as high as 29 (i.e. one offender was co-prosecuted with

---

12 Note that offenders may have committed offences prior to the research period (1880–90) and therefore have been younger at the onset of offending.
13 The remaining portion of suspects were of unknown age. Figures for 'missing data' have been omitted throughout this section when discussing offenders' sociodemographic traits.

Table 2. Descriptive statistics of co-offending networks for property, violent and victimless crimes

	Property crime	Violent crime	Victimless crime
No. of nodes	1,115	222	382
No. of edges	1,853	184	515
Density	0.003	0.008	0.007
Avg. degree	3.32	1.66	2.7
Min. degree	1	1	1
Max. degree	29	6	13
No. of triangles	2,290	70	464
No. of components	235	87	110
Avg. nodes per component	4.74	2.55	3.47
No. of nodes in largest component	439	9	19
% of nodes in largest component	39.37	4.05	4.97
Global clustering coefficient	0.55	0.32	0.55

29 different individuals). The network appears to have been weakly connected, splitting into hundreds ($n = 235$) of distinct components (groups not connected to others) with an average of just 4.74 nodes per component. There was, however, a large group of nodes (39.37%) which were connected to each other either directly or indirectly within the main component of the network. As discussed later, this component indicates that, although the entire property crime network was sparse, there is some evidence of a sub-community of co-offenders positioned at its core.

With only 222 nodes and 184 edges, the violent crime network was the smallest across the three categories. Density, although higher than that of the property crime network, was again relatively low at 0.008. Average degree was considerably low in this network compared to property and victimless crimes; offenders were on average linked to only 1.66 other individuals, suggesting that violent offenders preferred to co-offend with one or two specific people than to have a wider pool of accomplices. This network also had the lowest global clustering coefficient (0.32), suggesting that the neighbourhoods of individual violent co-offenders were typically less dense than those of other co-offenders. Furthermore, unlike that of property, the violent crime network did not have a large main component; only 4.05% of all nodes fell into the largest component. Most components consisted of only 2–3 nodes and were formed through a single crime event. Evidence therefore suggests that violent co-offences were largely disparate acts, perpetrators typically offending with specific people and rarely overlapping with other offending groups.

The victimless crime network shares properties with those of property and violent crime. Again, this network was characterized by low cohesion, density being just 0.007 (i.e. only 0.7% of all possible ties existed). Network integration, although higher than that found for violent co-offending, was also low, co-offenders being linked to only 2.67 others on average. In addition, the network was largely split into small components (with an average of 2.47 nodes each). Like the violent crime network, there was an absence of a large, central component; again, less than 5% of all nodes comprised the main component. Victimless and violent crime offenders therefore appear more loosely connected and segregated than their property crime counterparts.

Property crime   Violent crime   Victimless crime

Fig. 1 Sociograms for co-offending networks of property crime (left), violent crime (middle) and victimless crime (right).

From this broad perspective, co-offending appears from all crime categories to have been characterized by a general lack of cohesion, integration and connectivity. However, the property crime network stands out in containing a large component which connected a notable portion (almost 40%) of all offenders. This was analyzed alongside the entire property crime network in order to underpin structural differences (Table 3). Three properties emerge when examining this component: first, although high when compared with the whole network, density was still low, only 1.2% of all possible ties being present; second, the average degree between nodes was relatively high at 5.17 (compared to 3.32 for the whole network) and third, the average shortest path length across this component was high at 7.36. Taken together, these properties indicate that co-offenders within this component may have offended with several different accomplices (as characterized by high degree) but that their accomplices did not frequently offend with one another (as characterized by low density). This suggests that the component forms more of a chain-like structure than a clique or clan (which are instead characterized by high density).

In a chain-like structure, network analysis theory suggests that we might expect to find structurally important individuals who acted as 'brokers' between otherwise disconnected or loosely-connected groups (Bichler et al. 2017). Such actors can typically be identified by high betweenness centrality scores since they essentially control the flow of information through the network. Within the context of this study, 'brokers' may have moved between offending groups and acted 'essentially [in] the role of the instigator' (Lantz and Hutchison 2015). Analysis indicates that there were a handful of such individuals in the main component of this study's property crime network: betweenness centrality scores were heavily right-skewed, with most co-offenders receiving low scores and only a small minority receiving particularly high scores (Figure 2). Co-offenders with higher betweenness scores were positioned between multiple offending groups, linking what would otherwise have been disconnected crime activity. As such, evidence suggests that the main component of the property crime network was not a cohesive, tight-knit group of co-offenders but instead a collection of loose, sometimes overlapping, groups woven together by a handful of individuals (probably more persistent offenders) who moved between them.

This structural analysis of co-offending networks in Victorian Cheltenham indicates that violent, property and victimless offences alike were characterized by a lack of cohesion, integration and connectivity among co-offenders. However, there were notable differences across crime categories. Particularly, connections within the victimless and violent co-offending networks were very segregated, with few overlaps existing between co-offending groups. The property

Table 3. Descriptive statistics of main component for property crime network

	Main component	Whole property network
No. of nodes	439	1,115
No. of edges	1,135	1,853
Density	0.012	0.003
Avg. degree	5.17	3.32
Min. degree	1	1
Max. degree	29	29
No. of triangles	1,815	2,290
No. of components	1	235
Avg. nodes per component	439	4.74
No. nodes in largest component	439	439
Global clustering coefficient	0.69	0.55
Diameter	18	0
Avg. shortest path length	7	0
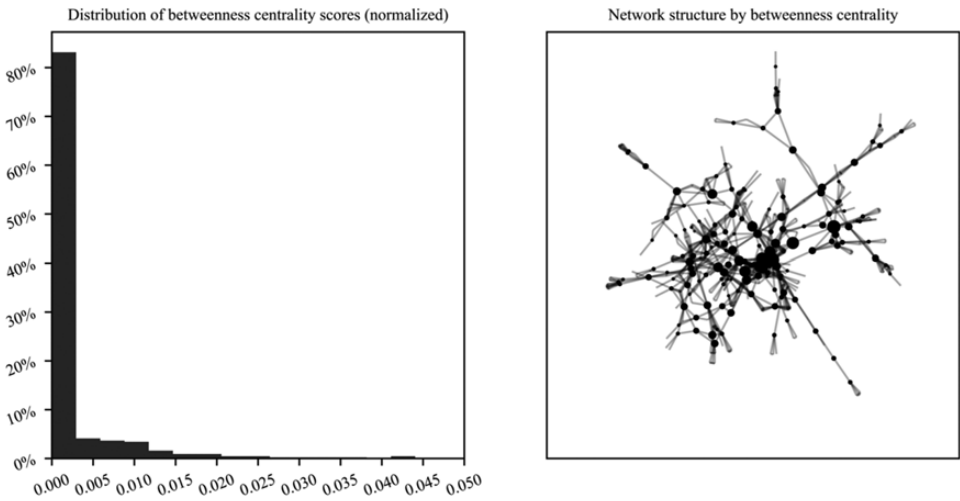
Fig. 2 Betweenness centrality scores for main component of property crime network. The histogram (left) displays the distribution of betweenness centrality scores whereas the sociogram (right) highlights nodes with highest betweenness centrality scores. Betweenness centrality scores have been normalized.

crime network, meanwhile, featured a large component which connected a significant proportion of co-offenders; this was not a cohesive group containing clans or cliques, but can instead be regarded as a loosely-connected community of offenders looped together by 'broker'-like individuals who interacted with multiple criminal groups. The existence of such a component suggests that property co-offenders, as opposed to co-offenders of violent or victimless crimes, were not only more likely to participate in crimes outside of their immediate offending group but also that they formed a more identifiable core of interlinked offenders as a result.

CO-OFFENDING NETWORKS: ASSORTATIVITY

An examination of assortativity may consider the extent to which co-offenders, knowingly or not, selected accomplices like themselves; or whether 'birds of a feather flock together'. In this study, assortativity was compared across different crime networks in relation to four offender traits: birthplace; marital status; age and sex. Assortativity scores represent coefficients ranging from −1 to 1, with −1 representing a completely heterogeneous group ('non-assortative mixing') and 1 a completely homogeneous group ('assortative mixing'). At the top level, results indicate that assortative mixing was present across all three crime category networks, although its strength varied depending on trait (Table 4). Assortative mixing was least pronounced by birthplace (categorized as either Cheltenham, elsewhere in Gloucestershire, elsewhere in England, or outside of England), although scores were similar across crime categories; assortativity coefficients were 0.115, 0.137 and 0.159 for property, violent and victimless crimes respectively.[14] These figures imply a positive but very minor correlation between accomplices' birthplaces, offenders being only marginally more inclined to commit offence with those born in the same area as themselves.

Offenders' marital statuses appear more associated with assortative mixing. Evidence suggests a mild preference among offenders to commit crimes with those who were also single/married/widowed, a tendency evident across each crime category: the marital status assortativity coefficients for victimless, property and violent crime were 0.287, 0.288 and 0.313 respectively. It is unsurprising that assortative mixing by marital status was more pronounced for violence, since many assaults – the most common violent crime – had been perpetrated by married couples when fighting with neighbours. A violent partner may have also influenced their spouse into violence, a process referred to as 'negative assortative mating' wherein the formation of a relationship with a violent individual encourages violence among the other party (Becker 1981).

Researchers have paid considerably more attention to age and have reached broad consensus that offenders tend to select accomplices who are of similar age as themselves (Sarnecki 2001; Carrington 2002; 2015a; 2015b; van Mastrigt and Carrington 2014). Historical evidence from Cheltenham supports this view, assortativity coefficients by birth-year being strong across all crime types. Assortative mixing is especially marked among property crime, its coefficient being 0.502 as compared to 0.398 for both victimless and violent crime. Since juveniles were responsible for most of Cheltenham's alleged property crimes, the tendency towards age homophily among property co-offenders suggests a stronger preference among juveniles to collaborate with other young perpetrators.

Criminological research also suggests that co-offenders tend to commit crimes with those of the same sex (e.g. Carrington, 2002; 2015a; 2015b; Conway and McCord 2002; van Mastrigt and Carrington 2014), possibly due to the building of trust between same-sex accomplices. Historical evidence from Cheltenham again supports this finding: the assortativity coefficients by sex were 0.598 for property, 0.415 for victimless crime and 0.372 for violent crime, suggesting that male offenders showed a moderate preference for male accomplices while female offenders collaborated with other females. Explanations for the diverging rates across crime categories may be explained through context: violent co-offending may have had lower sex assortativity since, as aforementioned, a significant proportion of assaults were perpetrated by married couples; offences falling under the property crime category, meanwhile, were typically acts of shoplifting and vandalism committed by groups of adolescent males.

An examination at the broad crime category level therefore offers two findings: first, that assortative mixing, although present across all traits, was strongest for age and sex; second,

---

14 The categories used for defining birthplaces are outlined on p. 11.

Table 4. Assortativity coefficients across sex, birthyear, marital status and birthplace

Category	Crime	Sex assortativity	Birthyear assortativity	Marital status assortativity	Birthplace assortativity
Property crime	**Burglary**	**-0.011**	**0.439**	**0.554**	**0.096**
	Fraud	0.417	-0.170	-0.063	0.587
	Poaching	1.000	-0.076	0.342	-0.138
	Theft	0.628	0.518	0.316	0.096
	Wilful damage	0.433	0.503	0.160	0.142
	All property crimes	**0.598**	**0.502**	**0.288**	**0.115**
Victimless crime	Criminal trespass	1.000	0.057	0.075	0.055
	Disorderliness	0.702	0.332	0.297	-0.042
	Drunkenness	-0.231	0.171	0.325	0.158
	Misc. regulatory offences	0.482	0.824	0.404	0.077
	Refusal to quit pub	0.005	0.086	0.038	0.015
	Road obstruction	0.327	0.607	0.323	0.051
	Vagrancy, begging	0.565	0.450	0.372	0.341
	All victimless crimes	**0.372**	**0.398**	**0.313**	**0.137**
Violent crime	Assault	0.362	0.376	0.323	0.132
	Cruelty to animals	1.000	0.543	0.125	0.276
	All violent crimes	**0.415**	**0.398**	**0.287**	**0.159**

Note: Only crime networks with >20 nodes have been listed individually.

that it was stronger among property offenders. Drilling down to the specific crime-type level reflects similar assortativity patterns in respect to both findings, although some offences make notable exceptions. Some offences diverged on account of sex assortativity, for example being characterized by complete sex-based homophily since they involved only male perpetrators (e.g. trespass) or only females (e.g. prostitution). Other offences, such as fraud, drunkenness and refusing to quit pubs, diverged in more complex ways and as such warrant further discussion.

Although fraud-based co-offending was characterized by some degree of homophily, assortative mixing appears based on different traits than those found among other property offenders. For instance, while property offenders typically associated most strongly in relation to sex, age and marital status, co-perpetrators of fraudulent crimes do not appear to have shown such preferences: while sex assortativity was relatively high among fraud accomplices (coefficient = 0.417), there was no evidence of assortative mixing by age (−0.170) or marital status (−0.063). However, fraud was the only crime type for which co-offenders showed moderate assortative mixing based on birthplace (coefficient = 0.587), a finding with two potential – but not

mutually exclusive – explanations: first, that perpetrators of fraudulent crimes felt more trust in accomplices whom they knew through local connections; second, that acts of fraud were committed by co-offenders from one jurisdiction but perpetrated in a different town (Cheltenham) to avoid detection.

Acts of drunkenness and refusing to quit pubs, two closely-related offences, also diverge from broader assortativity patterns. While homophilous mixing was moderately strong across most offences, there was a general lack of positive assortativity for both charges: birth-year assortativity coefficients, for example, were 0.171 for the former and 0.086 for the latter; the corresponding figures for birthplace assortativity were 0.158 and 0.015. However, drunkenness was characterized by a slight tendency towards non-assortative mixing in regard to sex (coefficient = −0.231), suggesting that suspects were more often prosecuted in mixed-sex than same-sex groups. This may have resulted either from a real preference among individuals to drink in mixed social groups or, alternatively, of the police to target drinking groups involving both males and females. Sex assortativity aside, evidence suggests that perpetrators of drinking-related offences were relatively neutral when selecting accomplices. This is unsurprising given that such crimes are typically unplanned offences which occur within social settings and are therefore unlikely to involve the organization and/or cautious selection of an offending group.

For the most part, evidence from this historical study of co-offending networks supports criminological findings that offenders typically select individuals like themselves as accomplices. Cheltenham's co-offenders were especially inclined to collaborate with those of the same sex, age and/or marital status as themselves. With some exceptions, assortative mixing was strongest among property crime co-offenders but was also evident between violent co-offenders and those who committed victimless offences. Whether these findings indicate real preference among co-offenders is debatable: offenders may have actively identified accomplices with whom they shared similar traits to foster more-trusted relationships; alternatively their selections may merely reflect the pool of potential candidates within their network, affiliations thereby being guided by underlying structural opportunities within the offending population (Bouchard and Malm 2016).

CONCLUSION

This research aimed to provide a study of co-offending networks within a historical context. Three issues have been addressed: the identification of broad historical patterns in co-offending; the structural properties of co-offending networks; and the tendency of co-offenders towards homophilous/heterogeneous mixing. The first line of enquiry involved examining descriptive statistics on offences and perpetrators, and demonstrated that co-offending rates varied according to crime category: among the Cheltenham-based offences prosecuted during the research period, less than 5% of violent and victimless crimes as opposed to almost a third of property crimes involved multiple suspects. Descriptive statistics also provided an impression of the demographic makeup of Cheltenham's co-offenders, most suspects having been male, young, unmarried and/or born locally.

Subsequent discussions employed SNA methods to examine the structural and compositional properties of co-offending networks. Evidence suggests that the violent and victimless crime networks were incohesive, poorly integrated and loosely-connected structures, indicating that co-offending of this nature in Cheltenham was not a strictly-organized activity involving well-acquainted offenders within a close-knit community; rather, co-offenders appear to have committed crimes within distinct offending groups. Although this finding was partially echoed in property co-offending, the property crime network featured over a third of co-offenders who may have been conntected by 'brokers' participating in crimes across various offending groups

(as opposed to being formed by cliques/clans). The existence of this component suggests that: property crimes were the most likely to have been part of a wider hub of criminal activity as opposed to a distinct offence; and that property crime offenders were more likely than those who committed violent or victimless crimes to look for opportunities and/or skills outside of their immediate groups. In terms of network composition, evidence indicates that offenders typically selected accomplices of similar age, sex and/or marital status to themselves. Assortative mixing was stronger among property crime offenders possibly due to such acts requiring more specialization, but homophily was generally evident across most crime categories.

Several research limitations may impact the findings of this study. First, missing data are especially troubling for social network analyses. As with any study of illicit networks, it is inevitable that the network data in this study do not reflect all criminal activity: many cases may have escaped detection and/or prosecution and it is possible that only a portion of the co-offenders involved in a crime were apprehended (Bichler 2019). Although unavoidable, it is important to note that this shortcoming may render network data incomplete. A second limitation is that this study does not consider the ways in which co-offending networks changed over time; networks are dynamic – not static – phenomena. Although a dynamic approach was avoided due to the complexities associated with modelling network evolution, future attempts to do so may prove valuable: this is particularly pertinent to historical crime networks, given the historians' emphasis on examining continuity and change. Thirdly, these results may not be generalizable. The networks analyzed in this study reflect interactions between specific individuals which occurred at specific times and places. Importantly, Cheltenham was a historically significant town that experienced rising levels of crime, discontent and class division during the research period and was thereby impacted by socioeconomic factors which may not have been felt on a broader, national level. Finally, this study's assessment of assortativity does not consider assortative mixing at the local (dyadic) level. Global assortativity measures aggregate assortativity coefficients and as such may miss nuances which emerge at a lower level (Peel et al. 2018). This study attempts to limit this shortcoming by examining assortativity at both the higher 'crime category' and the lower 'crime type' level, although there may be more variation in assortative mixing beyond the individual offence level.

Notwithstanding these limitations, this study has provided valuable insight into historical co-offending networks. On the one hand, it contributes to criminological research on group-based crime by supporting several key findings, namely: that co-offending is more prevalent among 'instrumental' crimes; that it is dominated by young males; that co-offenders form loose rather than tightly knit networks; and that co-offenders typically share similar demographic traits. On the other, such research contributes to the field of crime history twofold: first, the study provides one of the few in-depth examinations of co-offending in the past; second, it adopts SNA methods to interrogate historical crime networks, an approach which has not yet been incorporated by crime historians. This interdisciplinary study hopes to encourage more historical research – particularly that which uses SNA methods – on co-offending, some potential avenues for future discussions being: evolutions of historical co-offending networks; stability and versatility in co-offending relationships; comparisons of co-offending networks across different periods and/or locations and the identification of key players and/or hubs in co-offending networks.

REFERENCES

Alexander, G. G. (1915), *The Administration of Criminal Justice*. Cambridge University Press.

Andresen, M. A. and Felson, M. (2010), 'The Impact of Co-offending', *British Journal of Criminology*, 50: 66–81. doi: 10.1093/bjc/azp043.

Bastomski, S., Brazil, N. and Papachristos, A. V. (2017), 'Neighborhood Co-offending Networks, Structural Embeddedness, and Violent Crime in Chicago', *Social Networks*, 51: 23–39. doi: 10.1016/j.socnet.2016.12.003.

Becker, G. S. (1981), *A Treatise on the Family*. Harvard University Press.

Bichler, G., Malm, A. and Cooper, T. (2017), 'Drug Supply Networks: A Systematic Review of the Organisational Structure of Illicit Drug Trade', *Crime Science*, 6. doi: 10.1186/s40163-017-0063-3.

Bichler, G. (2019), *Understanding Criminal Networks: A Research Guide*. University of California Press.

Bouchard, M. and Amirault, J. (2013), 'Advances in Research on Illicit Networks', *Global Crime*, 14: 119–22. doi: 10.1080/17440572.2013.801316.

Bouchard, M. and Malm, A. (2016), 'Social Network Analysis and Its Contribution to Research on Crime and Criminal Justice', in *Oxford Handbooks Online*. Oxford University Press.

Breckenridge, S. and Abbott, E. (1912), *The Delinquent Child and the Home*. Charities Publication Committee. Accessed via Internet Archive (https://archive.org/details/cu31924030383214/mode/1up), 08/01/2023.

Bright, D., Whelan, C. and Morselli, C. (2020), 'Understanding the Structure and Composition of Co-offending Networks in Australia', *Trends & Issues in Crime and Criminal Justice*, 597: 1–21.

Bright, D., Whelan, C. and Ouellet, M. (2022), 'Assessing Variation in Co-offending Networks', *Global Crime*, 23: 101–21. doi: 10.1080/17440572.2022.2047654.

Campana, P. and Varese, F. (2022), 'Studying Organised Crime Networks: Data Sources, Boundaries and the Limits of Structural Measures', *Social Networks*, 69: 149–59. doi: 10.1016/j.socnet.2020.03.002.

Carrington, P. (2002), 'Group Crime in Canada', *Canadian Journal of Criminology*, 44: 277–315. doi: 10.3138/cjcrim.44.3.277.

Carrington, P. (2015a), 'The Structure of Age Homophily in Co-offending Groups', *Journal of Contemporary Criminal Justice*, 31: 337–53. doi: 10.1177/1043986214553376.

Carrington, P. (2015b), 'Gender and Age Segregation and Stratification in Criminal Collaborations', *Journal of Quantitative Criminology*, 32: 613–49.

Carter Wood, J. (2004), *Violence and Crime in Nineteenth-century England: The Shadow of Our Refinement*. Routledge.

Chen, P. and Lu, Y. (2018), 'Exploring Co-offending Networks by Considering Geographic Background: An Investigation of Electric Bicycle Thefts in Beijing', *The Professional Geographer*, 70: 73–83. doi: 10.1080/00330124.2017.1325753.

Chinn, C. (2019), *Peaky Blinders: The Real Story: The New True History of Birmingham's Most Notorious Gangs*. John Blake Publishing.

Chinn, C. (2020), *Peaky Blinders: The Legacy: The Real Story of Britain's Most Notorious 1920's Gangs*. John Blake Publishing.

Chinn, C. (2021), *Peaky Blinders: The Aftermath: The Real Story Behind the Next Generation of British Gangsters*. John Blake Publishing.

Conway, K. and McCord, J. (2002), 'A Longtidiuinal Examination of the Relation Between Co-offending with Violent Accomplices and Violent Crime', *Aggressive Behavior*, 28: 97–108. doi: 10.1002/ab.90011.

Davies, A. (1998), 'Young Gangs, Masculinity and Violence in Late Victorian Manchester and Salford', *Journal of Social History*, 3: 349–69 doi: 10.1353/jsh/32.2.349.

Davies, A. (1999), '"These Viragoes are No Less Cruel Than The Lads": Young Women, Gangs and Violence in Late Victorian Manchester and Salford', *British Journal of Criminology*, 9: 72–89. doi: 10.1093/bjc/39.1.72.

Davies, A. (2008), *The Gangs of Manchester: The Story of the Scuttlers, Britain's First Youth Cult*. Milo Press.

Davis, J. (1980), 'The London Garrotting Panic of 1862: A Moral Panic and the Creation of a Criminal Class in Mid-Victorian England', in V. A. C. Gatrell, B. Lenman and G. Parker, eds., *Crime and The Law: The Social History of Crime in Western Europe since 1500*, 190–213. Europa Publications.

DellaPosta, D. (2017), 'Network Closure and Integration in the Mid-20th Century American Mafia', *Social Networks*, 51: 148–57. doi: 10.1016/j.socnet.2016.11.005.

Edlin, R. (2003), 'Attitudes to Poverty and Social Reform in Cheltenham, 1870-1899', *MA thesis*, Univeristy of Gloucestershire.

Egmond, F. (1993), *Underworlds: Organised Crime in the Netherlands, 1650-1800*. Polity Press.

Englefield, A. and Ariel, B. (2017), 'Searching for Influential Actors in Co-offending Networks: The Recruiter', *International Journal of Social Science Studies*, 5: 24. doi: 10.11114/ijsss.v5i5.2351.

Frydensberg, C., Ariel, B. and Bland, M. (2019), 'Targeting the Most Harmful Co-offenders in Denmark: A Social Network Analysis Approach', *Cambridge Journal of Evidence-Based Policing*, 3: 21–36. doi: 10.1007/s41887-019-00035-x.

Gatrell, V. A. C. (1990), 'Crime, Authority and the Policeman-state', in F. M. L. Thompson, ed., *The Cambridge Social History of Britain, 1750-1950*, 243–310. Cambridge University Press.

Godfrey, B. (2008), 'Changing Prosecution Practices and Their Impact on Crime Figures, 1847-1950', *British Journal of Criminology*, 48: 171–89. doi: 10.1093/bjc/azm071.

Goldsmith, A. and Halsey, M. (2013), 'Cousins in Crime: Mobility, Place and Belonging in Indigenous Youth Co-offending', *British Journal of Criminology*, 53: 1157–77. doi: 10.1093/bjc/azt039.

Grund, T. and Morselli, C. (2017), 'Overlapping Crime: Stability and Specialisation of Co-offending Relationships', *Social Networks*, 51: 14–22. doi: 10.1016/j.socnet.2017.03.008.

Hart, G. (1965), *A History of Cheltenham*. Sutton Publishing.

Hughes, L. A. (2013), 'Group Cohesiveness, Gang member Prestige, and Delinquency and Violence in CHICAGO, 1959-1962', *Criminology*, 51: 795–832. doi: 10.1111/1745-9125.12020

Jones, A. (2010), *Cheltenham: A New History*. Carnegie Publishing.

Krajewski, A., DellaPosta, D. and Felmlee, D. (2022), 'Vertical Organisations, Flat Networks: Centrality and Criminal Collaborations in the Italian-American Mafia', *Social Networks*, 12: 127–38. doi: 10.1016/j.socnet.2021.06.001.

Krebs, V. E. (2002), 'Mapping Networks of Terrorist Cells', *Connections*, 24: 43–52.

Lantz, B. and Hutchison, R. (2015), 'Co-offender Ties and The Criminal Career: The Relationship Between Co-offender Group Structure and the Individual Offender', *Journal of Research in Crime and Delinquency*, 52: 658–90. doi: 10.1177/0022427815576754

Mastrobuoni, G. and Patacchini, E. (2012), 'Organized Crime Networks: An Application of Network Analysis Techniques to the American Mafia', *Review of Network Economics*, 11: 1–43. doi: 10.1515/1446-9022.1324.

McGloin, J. M., Sullivan, C., Piquero, A. R. and Bacon, S. (2008), 'Investigating the Stability of Co-offending and Co-offenders Among a Sample of Youthful Offenders', *Criminology*, 46: 155–88. doi: 10.1111/j.1745-9125.2008.00105.x.

McGloin, J. M. and Nguyen, H. (2012), 'It was My Idea: Considering the Instigation of Co-offending', *Criminology*, 50: 463–94. doi: 10.1111/j.1745-9125.2011.00266.x.

McGloin, J. M. and Piquero, R. (2010), 'On the Relationship Between Co-offending Network Redundancy and Offending Versatility', *Journal of Research in Crime and Delinquency*, 47: 63–90. doi: 10.1177/0022427809348905.

Morselli, C. and Petit, K. (2007), 'Law-Enforcement Disruption of a Drug Importation Network', *Global Crime*, 8: 109–30. doi: 10.1080/17440570701362208.

Morselli, C. (2014), *Inside Criminal Networks*. Springer.

Papachristos, A. V. (2009), 'Murder by Structure: Dominance Relations and The Social Structure of Gang Homicide', *American Journal of Sociology*, 115: 74–128.

Papachristos, A. V., Braga, A. A., Piza, E. and Grossman, L. S. (2015), 'The Company You Keep? The Spillover Effects of Gang Membership on Individual Gunshot Victimization in a Co-offending Network', *Criminology*, 53: 624–49. doi: 10.1111/1745-9125.12091

Peel, L., Delvenne, J. and Lambiotte, R. (2018), 'Multiscale Mixing Patterns in Networks', *Proceedings of the National Academy of Sciences*, 115: 4057–62. doi: 10.1073/pnas.1713019115.

Pluskota, M. (2015), 'Criminal Families and the Court: Co-offending in Amsterdam, 1897-1902', *History of the Family*, 20: 270–90. doi: 10.1080/1081602X.2014.1001770.

Reiss, A. J. and Farrington, D. P. (1991), 'Advancing Knowledge About Co-offending: Results from a Prospective Longitudinal Survey of London Males', *Journal of Criminal Law and Criminology*, 82: 360–95. doi: 10.2307/1143811.

Reiss, A. J. (1988), 'Co-offending and Criminal Careers', *Crime and Justice*, 10: 117–70. doi: 10.1086/449145.

Roodhouse, M. (2013), *Black Market Britain: 1939-1955*. Oxford University Press.

Sarnecki, J. (1990), 'Delinquent Networks in Sweden', *Journal of Quantitative Criminology*, 6: 31–50. doi: 10.1007/bf01065288.

Sarnecki, J. (2001), *Delinquent Networks: Youth Co-offending in Stockholm*. Cambridge University Press.

Schaefer, D. R. (2012), 'Youth Co-offending Networks: An Investigation of Social and Spatial Effects', *Social Networks*, 34: 141–9. doi: 10.1016/j.socnet.2011.02.001.

Seal, C. (2009), *Poor Relief and Welfare: A Comparative Study of the Belper and Cheltenham Poor Law Unions, 1780-1914, Ph.D. thesis*, University of Leicester.

Shaw, C. (1930), *The Jack-Roller*. University of Chicago Press. Accessed via Internet Archive (https://archive.org/details/jackroller0000clif), 08/01/2023.

Shaw, C. and McKay, H. (1931), *Social Factors in Juvenile Delinquency: Report on the Causes of Crime*. National Commissio on Law Observance and Enforcement, Washington, D.C.: Government Printing Office.

Shore, H. (2014), 'Rogues of the Racecourse: Racing Men and the Press in Interwar Britain', *Media History*, 20: 352–67. doi: 10.1080/13688804.2014.949417

Shore, H. (2015), *London's Criminal Underworlds, c.1720-1930*. Palgrave Macmillan.

Shore, H. (2018), 'Organised Crime, Criminality and the "Gangster"', in D. Nash and A. Kilday, eds., *Murder and Mayhem: Crime in Twentieth-Century Britain*, 213–42. Palgrave Macmillan.

Sindall, R. (1990), *Street Violence in the Nineteenth Century: Media Panic or Real Danger?* Columbia.

Smith, C. M. and Papachristos, A. V. (2016), 'Trust Thy Crooked Neighbor: Multiplexity in Chicago Organised Crime Networks', *American Sociological Review*, 81: 644–67. doi: 10.1177/0003122416650149

Sparrow, M. K. (1991), 'The Application of Network Analysis to Criminal Intelligence: An Assessment of the Prospects', *Social Networks*, 13: 251–74. doi: 10.1016/0378-8733(91)90008-h.

Spierenburg, P. (2001), 'Violence and The Civilizing Process: Does It Work?', *Crime, History & Societies*, 5: 87–105. doi: 10.4000/chs.740.

Tarling, R. (1993), *Analysing Offending: Data, Models and Interpretations*. H.M.Stationery Office.

Taylor, H. (1998), 'The Politics of Rising Crime Statistics of England and Wales, 1914-1960', *Crime, History & Societies*, 2: 5–28. doi: 10.4000/chs.989.

Tranter, N. L. (1985), *Population and Society, 1750-1940: Contrasts in Population Growth*. Longman.

van Mastrigt, S. B. and Carrington, P. (2014), 'Sex and Age Homophily in Co-offending Networks: Opportunity or Preference?', in C. Morselli ed., *Crime and Networks*, 28–51. Routledge.

van Mastrigt, S. B. and Farrington, D. P. (2009), 'Co-offending, Age, Gender and Crime Type: Implications for Criminal Justice Policy', *British Journal of Criminology*, 49: 552–73. doi: 10.1093/bjc/azp021.

van Mastrigt, S. B. and Farrington, D. P. (2010), 'Prevalence and Characteristics of Co-offending Recruiters', *Justice Quarterly*, 28: 325–59. doi: 10.1080/07418825.2010.482535.

Walkowitz, J. R. (1982), 'Jack the Ripper and The Myth of Violence', *Feminist Studies*, 8: 542–74. doi: 10.2307/3177712.

Warr, M. (1996), 'Organization and Instigation in Delinquent Groups', *Criminology*, 34: 11–37. doi: 10.1111/j.1745-9125.1996.tb01193.x.

Wiener, M. (2004), *Men of Blood: Violence, Manliness and Criminal Justice in Victorian England*. Cambridge University Press.