Sex and Age Homophily in Co-offending Networks: Opportunity or Preference?

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Abstract

Homophily, the tendency for individuals to associate with similar others, has been demonstrated across a wide range of social relational forms, including co-offending. In fact, one of the most widely cited 'facts' about group crime is that it is typically carried out in homogeneous groups, particularly with respect to age and sex. This finding is often taken as evidence that offenders exhibit a clear *preference* for accomplices who share these social attributes. However, it is also possible that the age and sex homogeneity typically observed in co-offending groups simply reflects chance expectation given the demographic composition of the larger offending network; in other words: *structural opportunity.* In this paper, probability models are applied to distinguish between baseline homophily (the degree of clustering expected by chance alone) and inbreeding homophily (the degree of clustering above and beyond that expected by chance) for more than 10,000 co-offending groups detected by a large UK police force between 2002-2005. The findings provide evidence for inbreeding homophily and indicate that the bias for offending with similar others is most pronounced amongst males and youths in co-offending networks. Implications of these findings for theory and policy are discussed.

Introduction

Interest in examining the structures and characteristics of social networks has gained considerable popularity over the past few decades, also in criminology (Bouchard & Nuygen, 2010; Carrington, 2011; Haynie, 2002; McGloin & Kirke, 2010; Morselli, 2009; Mullins & Wright, 2003; Sarnecki, 2001). Although criminological attention to the network paradigm has increased recently, there are several areas of inquiry that are particularly well suited to network-type analyses which have yet to be fully explored. One of these is the study of joint criminal action, or co-offending.

It is well known that many offenders commit their crimes with others, yet focused studies of co-offending are relatively rare (Andresen & Felson, 2010; Carrington 2002a, 2009; McGloin et al., 2008; Reiss & Farrington, 1991; van Mastrigt & Farrington, 2009, 2011; Warr, 1996) and data constraints have limited most of the existing investigations to outlining its basic prevalence and correlates, particularly among juveniles (Conway & McCord, 2002; McCord & Conway, 2002, 2005; Reiss, 1988; Sarnecki, 1986, 1990, 2001). Theories of co-offending are also rare (Felson, 2003; McCarthy et al, 1998; Tremblay, 1993; Weerman, 2003). More than two decades ago, Reiss (1988:117) argued that "understanding co-offending is central to understanding the etiology of crime and the effects of intervention strategies", but even today key aspects of co-offending, such as the selection of accomplices, is somewhat of a mystery.

Applying network concepts and techniques to the study of group crime has considerable potential with respect to elucidating the formation, composition, and functioning of co-offending groups; information that is central to a better understanding of their impacts. To date, however, only a handful of studies have done so, and most applications have been purely descriptive: either using the concept 'network' itself to identify the nature of the associations among co-offenders (Chattoe & Hamill, 2005; Waring, 2002), or constructing sociograms to portray ties within and between co-offending groups (e.g. Sarnecki, 1986, 1990, 2001). Although increases in the availability of network data and related methodological improvements have evidenced more complex modeling attempts in recent years (e.g., Frank & Carrington 2007; McGloin & Piquero, 2010; Smangs, 2010; Schaefer 2011), studies that apply network concepts and probability models to test hypotheses about co-offending are still far and few between.

The goal of the present study is to contribute to this burgeoning literature by applying the social network concept of 'homophily', the tendency to associate with similar others, to explore alternative theories of the selection of co-offenders. The fact that co-offending networks typically display high levels of homophily, especially for age and sex, is well known (Reiss, 1988; Weerman, 2003). Often, this finding is taken as evidence that offenders exercise a conscious choice when selecting co-offenders and, in doing so, exhibit a clear *preference* for accomplices who share these social attributes (Reiss & Farrington, 1991; Warr, 2002). However, it is also possible that the observed homogeneity of co-offending groups is determined not by preference, but by *structural opportunity* and specifically, the underlying demography of the offender pool (Carrington, 2002b).

In order to explore these possibilities, we first outline the descriptive and theoretical literature on homophily and introduce a key distinction between homophily resulting from baseline demography and that which reflects a social inbreeding bias. We then apply this distinction to construct probability models of sex and age homophily using data on more than 10,000 co-offending groups detected by police in a large metropolitan area of England.[i] We conclude with a discussion of our key finding that although inbreeding does appear to drive the selection of co-offenders overall, it does so differentially across age, gender, and co-offending group size.

Homophily in Conventional and Criminal Networks

The term homophily, from 'homo'= self and 'philia'= love, refers to the well demonstrated tendency for human actors to form relational ties with similar others (Blau, 1977; Lazarsfeld & Merton, 1954; Marsden, 1988; McPherson et al., 2001). Popular references to this principle are pervasive, illustrated by Plato's observation that 'similarity begets friendship' and the Gluecks' frequently cited adage that 'birds of a feather flock together' (1950:164). These proverbs have been supported empirically time and again throughout a long history of research in anthropology, social psychology and sociology aimed at examining the patterning of human relationships; the field now formally known as social network analysis. The robust finding that voluntary contact between similar people occurs at a higher rate than among dissimilar people has been demonstrated across a wide range of demographic and social dimensions and in both face-to-face and online communities. Conventional network ties including friendship (Moody, 2001), marriage (Kalmijn, 1998), confiding relationships (Marsden, 1988), business associations (Ruef, 2002), and leisure activities (Huang et al., 2009) all display high levels of homophily on ascriptive characteristics (such as age, sex, and race/ethnicity), attained characteristics (like income, education, professional experience) and psychological characteristics (including attitudes and values). For a review of this extensive literature, see McPherson et al. (2001).

Homophily for the highly visible characteristics of age and sex, the focal points of the current paper, have received particularly widespread research attention. Considerable evidence suggests that even young children recognize the social significance of these attributes as organizational features of society, and tend to form their associations accordingly (Maccoby, 1998; Hagestad & Uhlenberg, 2006). Research on conventional networks consistently shows that sex segregation is most pronounced for non-kin emotional ties like friendship, particularly at younger ages (McPherson et al., 2011). As individuals begin to form romantic relationships and friendships with members of the opposite sex in late adolescence and early adulthood sex segregation diminishes considerably, but classic studies still demonstrate marked gender homophily for close ties amongst both males and females in adulthood; Marsden (1988) found that ties between adults who 'discuss important matters' were only 70% as heterogeneous as expected given the relatively balanced sex distribution of the general population. In comparison to close ties, however, ties that are instrumental in nature appear to be less gender homogeneous, especially in populations with skewed gender distributions. In these contexts, both sexes have been shown to commonly use men as "network routes to accomplish tasks" (McPherson et al., 2001:424).

Patterns of age homogeneity in conventional social networks are more consistent. Many studies show that marriage ties are almost exclusively age-homogeneous, and that non-kin ties ranging from friendship to general associations are also overwhelmingly made with alters in the same general age range. In Marsden's (1988) study of confiding networks mentioned above, age heterogeneity was less than half that expected for non-kin relations, a finding that many subsequent studies have replicated (see Burt, 1991; Hagestad & Uhlenberg, 2006). Although the primacy of age homophily in tie formation is relatively constant across the life-course for most relational forms, some dips in the age-graded nature of network formation have been observed in socio-emotional support networks, where age homogeneity is more pronounced at young and older ages, but dips in middle-age (Burt, 1991).

Although the research on homophily in illicit networks is not nearly as well developed as that for conventional networks, there is growing evidence that similarity on a range of attributes predicts tie formation in criminal and delinquent networks as well.[ii] Strong tendencies toward homophily have been demonstrated in the literature on co-offending in particular (Daly, 2005; Reiss & Farrington 1991; Sarnecki, 2001; Schaefer, 2001; van Mastrigt & Farrington, 2011; Warr, 2002). The descriptive finding that co-offending groups are typically homogeneous with respect to key attributes like age, sex, ethnicity, residence, and criminal experience is so consistent that group homogeneity was recently named as one of eight key characteristics of co-offending identified by Weerman (2003:400).

Patterns of sex and age homogeneity are especially pronounced. Warr (1996) reported that, based on National Survey of Youth data, between 62-90% of delinquent group events involved same-sex co-offenders. Similar figures emerged from the UK Crime and Justice survey in which more than 70% of co-offending incidents committed across a wide range of ages implicated same-sex groups (Budd et al., 2005). In general, whilst both males and females appear to choose co-offenders of the same sex in the majority of cases, "females are more often found in the company of males than vice versa" (Warr, 2002:79). Stated differently, the sex homogeneity observed in most co-offending groups is driven primarily by all-male co-offending (Pettersson, 2005; Reiss, 1988; Reiss & Farrington, 1991; Sarnecki, 2001; Warr, 2002).

Even at the youngest ages, females are less likely than males to offend with same-sex accomplices. In their analysis of Philadelphia juvenile court records, for example, Conway and McCord (2002) reported that whereas 95.5% of males had male co-offenders in their first recorded co-offence, only 80.6% of females had female co-offenders. In older samples even more striking differences are evident. In Carrington's (2002, 2002b) Canadian analyses, 87% of co-offending males compared to only 50% of co-offending females were involved in same-sex incidents. Similar figures emerged using self-report methods in the UK Crime and

Justice Survey (Budd et al., 2005:61); whereas males reported offending almost exclusively with other males, females reported that they had female co-offenders only half of the time (48%). Finally, in his analysis of Crown Court conviction data, Tarling (1993) reported that across age and crime type, a small *majority* of females' co-defendants were male (57%), whereas a small *minority* (10%) of males had female co-defendants. Such findings are often interpreted as evidence that males have a greater preference for same sex accomplices as compared to females (Carrington, 2002b), a point we return to later.

Similar homogeneity patterns have been demonstrated by age. A number of studies have shown that age differences between co-offenders are typically small- one to two years on average- and that there is little overlap between youth and adult criminal networks. Reiss and Farrington (1991:390) found that in the Cambridge Study, 54% of offenders were within one year younger or older than their co-offenders and that only 16% of co-offending pairs had an age differences of five or more years. Warr (1996:24) reported similar findings based on juvenile self-report data, citing an average age difference of less than one year for all co-offences captured in the National Survey of Youth. Recent evidence from the UK Crime and Justice Survey replicates these findings. Across age, more than 75% of incidents involved co-offenders in the same general age range (Budd et al., 2005: 61). These findings consistently suggest that co-offenders are typically selected from amongst one's same age peers. Indeed, in her British self-report study, Shapland (1978:262) reported that very few boys aged 13-14 reported committing offences with a parent or other adult, a finding that led her to conclude that delinquents had "little contact with any adult criminal culture". Of course, there are exceptions to this general rule. In their legendary case study of Sidney's criminal career, Shaw and McKay (1942) observed that "delinquent boys...have contact not only with other delinquents who are their contemporaries but also with older offenders", and more recent evidence illustrates that youths and much older adults do, occasionally, offend together (van Mastrigt & Farrington, 2011).

Although co-offending tends to take place in relatively age-homogeneous groups overall, there is some evidence to suggest that this tendency decreases with age. Recent findings from the UK Crime and Justice survey (Budd et al., 2005: 61) showed that in 83% of incidents reported by 10-15 year olds, all co-offenders were in the same general age range, but that this was the case in only 75% of incidents committed by 16-25 year olds. Sarnecki's Swedish study and Reiss and Farrington's research similarly revealed a "slight tendency for the age difference between actors and their co-offenders…to increase as actors became older" (Sarnecki, 2001:53), findings which are typically explained with reference to the changing constellations of personal networks across the life course (Reiss & Farrington, 1991; Warr, 1993).

Opportunity versus Preference: Theoretical Explanations for Homophily and the Selection of Co-offenders

As the above review shows, it is clear that both conventional and illicit networks display marked patterns of homophily across both age and sex. What is less clear, is what accounts for these patterns and their variation across attributes. Theoretical explanations generally fall into two competing camps: choice-based explanations and opportunity-based explanations (Franz et al., 2010; McPherson & Lovin-Smith, 1987; McPherson et al., 2001).[iii]

Choice-based explanations posit that individuals have a social preference for forming relationships with similar alters because these ties are more psychologically rewarding and/or less energy-intensive than those with formed with dissimilar alters. Social psychologists have long argued that attraction is strongly influenced by perceived similarity. This idea, formalized as the ‘similarity-attraction hypothesis’, has been supported by a large number of both correlational and experimental studies (Huston & Levinger, 1978; Monge & Contractor, 2003; Byrne, 1971; Turner et al., 1987).

According to some theorists, the powerful draw to associate with others like us reflects fundamental processes of social categorization and social comparison, ultimately geared towards the reward of validating one’s own social status and identity (Festinger, 1954; Tajfel & Turner, 1986). Others frame their explanations not in terms of maximization of rewards, but minimization of costs, as sharing a social status is argued to ease understanding and cooperation (Ruef, 2002). According to Mayhew and colleagues (1995: 19-21) differences in social position (e.g., age, race, sex) can act as “energy barriers” to communication and coordinated action. Because humans encode more information about their own social categories’ expected behaviors as compared to others’, they argue, more time and energy must be expended in heterogeneous groups checking for social signals and action, a requirement that makes these types of associations less attractive.

Irrespective of the specific mechanisms identified, choice-based explanations share the common feature of framing the selection of alters as a conscious process which employs socio-cognitive heuristics that maximize the rewards and minimize the costs of social interaction. Such explanations are consistent with theoretical accounts of co-offender selection that argue that the search for co-offenders is purposeful and reflects a process of (bounded) rationality in which the attractiveness of potential co-offenders is weighed (Tremblay, 1993, Weerman, 2003). A number of studies have shown that criminal cooperation is recognized by many offenders as inherently risky; accomplices may be incompetent, dishonest, or quick to save themselves at others’ expense if caught (McCarthy et al., 1998). To the extent that shared social status may ease cooperation and maximize trust as outlined above (see also, von Lampe & Johnasen, 2004), offenders might be expected to limit the risks of co-offending by actively seeking out similar accomplices, a process that could explain the high levels of homogeneity observed in co-offending groups.[iv]

In contrast to choice-based explanations, opportunity-based explanations of homophily argue that affiliations are governed, not by unconstrained choice, but by underlying structural opportunities (Blau, 1977; Franz et al., 2010). According to these theories, it is the baseline distribution of social characteristics in the selection pool that drive tie formation (McPherson et al., 2001). A strict interpretation of the opportunity paradigm would suggest that individuals select at random from the full population in which they are embedded, and that observed patterns of homophily reflect nothing more than the unequal distribution of social characteristics in that population.

Consider, for example, a population in which the gender distribution is highly skewed in favor of males (as is the case in the offending population). Even in the absence of a psychological preference for same-sex ties, males would, as members of the larger subgroup, have a greater probability of coming into contact and forming ties with one another simply by chance. Thus, an observed tendency for males to differentially associate with other males could simply reflect the baseline structural opportunities that bring males into contact with one another more often than with females. Similarly, low levels of female-to-female contact and correspondingly high levels of female-to-male contact could be explained by the relative scarcity of females in the selection pool (see Carrington, 2002b). Another important consideration for opportunity models is the size of the social unit under observation, as larger groupings of individuals would be expected to be more heterogeneous by chance, for the same reasons outlined above (Mayhew et al., 1995).

Critics of strict opportunity explanations like that provided above argue that in large populations, an individual is rarely free to choose alters from the entire pool of potential contacts (Feld, 1982). More tempered versions of the opportunity approach thus propose that structural opportunities have a more local character and that one's choice set is constrained to those individuals within the larger population which whom one comes into regular contact via shared spaces and social foci, such as neighborhoods, schools, and workplaces (e.g., Reskin et al., 1999). As the demography of these local selection pools may differ from that of the larger pool of potential contacts, proponents of these more tempered models argue that baseline demography measured at the population level tells only part of the story. [v] Even according to these more lenient theorists, however, structural opportunity, rather than psychological preference, is seen as the key mechanism driving tie formation.

Opportunity theories thus support an alternative view of co-offender selection; namely, that ties between accomplices are formed relatively spontaneously and involve considerably less forethought and planning than choice-based, rational choice models would suggest. Here, co-offending ties might be expected to form more inadvertently between the offenders present when criminal opportunities arise. According to this hypothesis, homophily should simply reflect the demography of the potential co-offender pool as outlined above.

Felson (1993) argues that routine activities provide frequent opportunities for would-be co-offenders to come together via informal and recurrent meetings at 'offender convergence settings'. Seen from a structural opportunity perspective, these criminogenic social foci would be expected to determine both the possibilities for co-offending to occur, and the selection of potential accomplices.

To recap, two different theoretical explanations have been advanced to explain homophily in conventional social networks: choice and opportunity. Broadly speaking, these two approaches are also evidenced, to a greater or lesser degree, in existing hypotheses regarding the search for co-offenders. Although most scholars, including those cited above, would likely agree that it is a combination of choice and opportunity that governs the selection of co-offenders in practice, current theoretical explanations nonetheless tend to prioritize either structural opportunities or rational choice.

With the exception of one earlier investigation (Carrington 2002b, discussed below), we are not aware of any studies that have empirically pitted these theories against one another in the co-offending context. It is our view that insights regarding the relative import of these factors in the selection of co-offenders would be of considerable theoretical and practical value.

Basic, Baseline, and Inbreeding Homophily

Any attempt to empirically disentangle the effects of structural opportunity and social preference requires a conceptual distinction between three different, but related, measures of homophily: basic homophily, baseline homophily, and inbreeding homophily (Currarrini et al., 2009; McPherson et al., 2001).

Basic homophily is a simple descriptive measure, indicating the fraction of same-type (homogeneous) ties in a network. This basic measure of homophily is the one most commonly reported in the studies of co-offending reviewed above. Whilst informative in relation to constructing a descriptive profile of co-offending networks, measures of basic homophily are of limited value for theory evaluation as they fail to take account of the baseline distribution of social characteristics in the offending population and the size of offending groups, factors that are crucial to opportunity models.

Measures of baseline (also called induced) homophily incorporate this important information to provide probability estimates regarding the degree of clustering expected by chance, given the demography of the potential contact pool and the size of the social group (typically expressed as the frequency or proportion of expected same-type ties). Because this measure of homophily assumes random mixing and no social preference for similar others, it provides a straightforward gauge of the baseline constraints on which structural opportunity theories are built; for if opportunity alone governed the selection of alters, the observed and expected number of homogeneous ties would be equal.

In the co-offending context, estimates of baseline homophily are particularly important because of the known age and gender skew in offending populations. A comparison of observed and expected figures is therefore crucial to any meaningful interpretation of the homogeneity of co-offending groups. This was the point made by Carrington (2002b) in the only study of which we are aware that has attempted to compute baseline homophily figures for co-offending groups. Based on his analysis of sex homogeneity using Canadian UCR2 data, Carrington found that the observed frequency of both all-male and all-female co-offending groups exceed baseline expectation. Moreover, despite the fact that all-male co-offending groups were the norm in descriptive terms, it was all-female groups that displayed the largest differences between observed and expected homogeneity, a finding that led Carrington to conclude that "both males and females prefer to co-offend with members of the same sex, but [contrary to conventional wisdom] the tendency is relatively weak in males and much stronger in females" (2002: 115). By comparing basic and induced homophily measures, Carrington's earlier analysis was able to show that the selection of co-offenders could not be explained by baseline opportunities alone. What his analysis lacked, however, was specificity. In particular, a standardized measure of deviation from expectation that could be meaningfully compared for males and females, and across group size. Inbreeding coefficients offer one such measure (Coleman, 1958; Currarini et al., 2009; McPherson et al., 2001).

Inbreeding homophily refers to the degree of clustering that *cannot* be explained by baseline opportunity structures. Put another way, it is a measure of the difference between the observed probability of same-type ties and the probability expected by a simple model of random assortment, standardized to "capture…how biased a group is compared to how biased it potentially could be" (see Coleman, 1958: 36; Currarini et al., 2009: 1008).

Inbreeding coefficients range between -1 and 1, where 0 = no deviation from baseline. If the observed deviation is in favor of same-type ties, a population is said to exhibit inbreeding bias (1 = total inbreeding), whereas a greater than expected number of out-group ties indicates the opposite (-1 = total outbreeding). Although a handful of studies have recently used inbreeding coefficients to explore racial homophily in friendship ties (Currarini et al., 2009, 2010; Franz et al., 2010), this simple and informative measure of social bias has never, to our knowledge, been applied to criminal networks.

Our use of the term 'social bias' instead of 'choice' or 'preference' is important to note here. Whereas at first glance, inbreeding coefficients appear to provide a direct measure of choice-based homophily in the same way that baseline homophily figures provide a measure of population-based structural opportunity, it is important to recognize that inbreeding patterns can also result from bias in *local* meeting opportunities, or by social structures below the population level, which effectively constrain ones' choices to a subset of the population selection pool. Because the demography of local socio-organizational structures may differ from that of the full population pool, inbreeding bias does not necessarily capture "choice or agency purified of [all] structural factors" (McPherson et al., 2001:419). Instead, it measures the combined social bias for associating with similar others that is produced by preference *and/or* local socio-organizational constraints.[vi] In this sense, measures of inbreeding homophily can be used to refute strict structural opportunity theories but not to support choice-based theories or the more local opportunity-based models independently.

Even so, information on inbreeding bias has the potential to advance knowledge of the formation and composition of co-offending networks considerably, not least because it elevates the discussion of homophily beyond the basic descriptive level typically provided in the extant literature. Tests for inbreeding are also of theoretical value, as even refuting strict opportunity theories can go some way towards a better understanding of accomplice selection processes. Furthermore, if standardized inbreeding measures are computed separately for different offender subgroups (males/females; youths/adults), variations in levels of social bias like those noted by Carrington (2002b) can be explored in more detail. In conventional networks, this information has proven useful in exploring segregation, gatekeeping, and inequality in diverse social systems (Moody, 2001), issues that may be of potential interest for criminal networks as well (e.g., see Steffensmeier & Terrry, 1982).

The Current Study

For all of the reasons outlined above, meaningful discussion regarding the selection of accomplices and the homogeneity of co-offending groups must take as its starting point deviation from baseline expectations. Although information on observed (basic) homophily in co-offending networks is widespread, the baseline and inbreeding measures that are required to interpret these basic findings are lacking. In this study we extend Carrington's (2002b) earlier work by using all three measures of homophily to explore patterns of both age and sex homogeneity in a large collection of UK police data, and performing statistical tests of the significance of any apparent deviations from baseline homophily. In doing so, we attempt a preliminary test of competing opportunity vs. choice-based hypotheses regarding the selection of co-offenders.

Specifically, we test the following research questions: (i) to what extent are co-offending groups homogeneous with respect to sex and age? (ii) to what extent is their homogeneity an indication of inbreeding homophily? (iii) does the magnitude of inbreeding homophily vary across age, sex, or group size?

Hypotheses

In relation to the first research question, given the high levels of observed (basic) homophily reported in the existing co-offending literature, we have good reason to expect that the co-offending groups captured in our data will also demonstrate considerable age and sex homogeneity (*Hypothesis 1*). Moreover, both Carrington's (2002b) earlier analyses and insights from choice-based theories lend support to the hypothesis that these observed patterns of homogeneity are likely to reflect clustering above and beyond what a baseline model would predict. In other words, that co-offending groups will evidence a general tendency towards inbreeding (*Hypothesis 2*).

Even so, some variations by age, sex and group size might be expected on both empirical and theoretical grounds. If Mayhew et al.'s (1995:22) "energy distribution principle" transfers to illicit networks, then inbreeding homophily for both sex and age should increase with increasing group size, as "any increase in heterogeneity with size, or even the same level of heterogeneity at larger sizes, would compound the difficulties in communication and coordination of action" within co-offending groups (*Hypothesis 3*).

With respect to sex, from a choice-based theoretical standpoint one would expect that males, rather than females, would exhibit greater inbreeding. A number of scholars have noted that male offenders often see females as less reliable or competent crime partners (Decker et al., 1993; Pettiway, 1986; Steffensmeier & Terry, 1986). In fact, Steffensmeier (1983:1025) has argued that, "institutional sexism is so consistent and pervasive in the underworld that female access is likely to be limited to those circumstances in which male members of the underworld find females to be useful". On these grounds, a higher degree of male inbreeding would be expected (*Hypothesis 4*).

Finally, we hypothesize that youths will display greater inbreeding homophily as compared to adults (*Hypothesis 5*). This expectation is driven by research which shows that because of their relatively limited mobility, the 'activity spaces' of youths are typically concentrated around local social foci like schools and neighborhoods (Cohen & Felson, 1979; Reiss & Farrington, 1991), whereas adults cast more diverse social and spatial nets. Because the offender convergence settings available to youths are likely to be more homogeneous than those available to adults, similar co-offenders should be more accessible than those who are dissimilar (Felson, 2003; Weerman, 2003). According to this reasoning, local-level opportunities, in addition to choice, could drive youthful inbreeding.

Data and Analytic Methods

Data

The co-offending data analyzed in this study is taken from a large official dataset detailing the full population of notifiable criminal events detected by a large UK police force between March 1, 2002 and February 28, 2005. In total, this data includes information on 105,348 crimes implicating 61,646 different individuals aged 10-74 (for further details, see vanMastrigt & Farrington, 2009). Overall, 30% of offenders were linked to at least one known accomplice during the study period and 10% of offences involved more than one perpetrator. In the current study, we focus on this subpopulation of joint offences and adopt the co-offending group as the main unit of analysis (N= 10,997).

Variables

Co-offending group size: The co-offending groups captured in our data ranged in size from 2 to 20 members, with 2.37 on average (SD=0.87). The current analyses are limited to the 10,946 groups with between 2 and 6 members, as the observed and expected numbers for larger groups were too small for meaningful analysis. This restriction is unlikely to have a substantive impact on our conclusions as less than 1% of all groups (n=51) comprised more than 6 members.

Sex composition: Complete information on the sex of all members was available for 10,942 co-offending groups. These groups were coded using a simple tripartite variable indicating whether the group was all-male, all-female, or mixed-sex. Overall, 68.3% of the co-offending groups comprised exclusively males, 11.5% exclusively females, and 20.2% a mix of both sexes.

Age composition: As Burt (1991) has argued, there is no consensus about the most appropriate coding scheme to capture the social meaning of age. The approach adopted here was to code each co-offending group members' age in relation to the important life stages of youth (<18) and adulthood (≤18), yielding a group composition variable with three levels: all-youth, all-adult, or mixed-age. In total, 10,387 co-offending groups had valid information for this variable: 53.1% of all these groups were all-adult, 29.6% all-youth, and 17.2% mixed-age.

The choice to code age in this manner was taken, in part, to allow a uniform analytic approach to exploring homophily across both age and sex using binomial probability models (see below). This dichotomization also seemed appropriate given the common suggestion in previous research that youth and adult co-offending networks rarely overlap (Reiss & Farrington, 1991; Shapland, 1978). By coding our co-offending groups as all-youth, all-adult, or mixed-age, we are able explore this issue directly by comparing the inbreeding coefficients for each.

Homophily: We use all three homophily measures outlined earlier in our analyses, calculated separately for each subgroup (males, females, youths, adults), and each co-offending-group size. Although formal homophily measures are most often used in the context of dyad-based interactions in populations, they can, with minor modification, also be usefully applied to measure homophily in small interaction cliques such as co-offending groups. The measures developed below are modified versions of those presented by Coleman (1958: 36; see equations 17 and 18) and re-stated by Currarini et al. (2009: 1007-1008).

There are two sexes and two age groups in the population; let a_{in}, $i=1,2$ denote the number of homogeneous co-offending groups of size n composed of individuals of type i, and let a_{3n} denote the number of heterogeneous co-offending groups of size n. Let A_n denote the total number of co-offending groups of size n. Then A_n is $\Sigma a_{in}=a_{1n}+a_{2n}+a_{3n}$.

- **Basic (Observed) Homophily (H)** is the proportion of homogeneous co-offending groups of a given type of individual and a given size:

(Eq. 1) $$H_{in} = \frac{a_{in}}{A_n}$$

For example, of the 8,381 co-offending groups of size 2, 5,649 were all-male; thus basic male 2-group homophily is 0.674.

- In contrast to basic, or observed, homophily, **Baseline (Expected) Homophily (EH)** is computed based on the assumption of random assortment and thus yields *expected* homophily figures. As Coleman (1958) and others (Mayhew et al., 1995; Carrington, 2002b) have pointed out, expected distributions cannot be calculated from simple marginal proportions, as in a contingency table; rather they are based on combinatorics. Because both sex and age were measured as binary variables, the binomial distribution is used to provide the number of co-offending groups of size n and type i that would be expected to form by chance.

Using sex homogeneity as an example, we first determine the proportions p of males and q of females (defined as $1-p$), in the full offender dataset. These proportions represent the baseline, or random, probability of encountering a male (p=.784) or a female (q=.216) in the offending population (for age, p (adult) =.767 and q (youth) =.233). Using these proportions, binomial expansions are then applied to compute the baseline probabilities, denoted by w_{in}, of observing co-offending groups of different compositions i (e.g., all-male, all-female, and mixed-sex groups) under chance expectation for each size n. Specifically, for groups of size n, $w_{1n} = p^n$ is the expected proportion of all-male groups, $w_{2n} = q^n$ is the expected proportion for all-female groups, and $w_{3n} = 1 - (p^n + q^n)$ is the residual proportion of mixed-sex groups.

For example, for 2-groups (co-offending groups of size 2) baseline (expected) male homophily w_{12} is $0.784^2 = 0.615$, baseline female homophily is $0.216^2 = 0.047$, and baseline heterophily is 1 - (0.615 + 0.047) = 0.338. Thus, for 2-groups, the observed male and female homophilies of 0.674 and 0.131 considerably exceed baseline homophily, and, concomitantly, the observed heterophily of 0.195 is considerably less than baseline. The difference between observed and baseline homophily can be tested using the usual χ^2 test, with 1 degree of freedom.[vii]

- The difference between observed homophily and that expected by chance is defined as **Inbreeding homophily (*IH*)**. The raw difference is normalized by dividing by the maximum possible difference, denoted by m_{in}, so that the result ranges between +1 and -1, with a value of 0 when observed and expected homophily are equal (Coleman, 1958: 36, Equations 17 and 18).

However, the maximum possible value in this case is not simply 1 (cf. Currarini et al., 2009: 1008, Definition 6); its calculation is complicated by limitations due to the numbers of male and female participations in co-offending groups of size *n*. For example, there were 8,381 2-groups, of which 5,649 were all-male, 1,100 all-female, and 1,632 mixed-sex. The maximum possible number of all-male groups is not 8,381, or a proportion of 1.0. There were only 12,930 male participations in 2-groups; thus the maximum number of all-male 2-groups is 12,930/2 = 6,465, or a proportion of m_{12} = 0.771 (not 1.0). Similarly, as there were only 3,832 female participations in 2-groups, the maximum possible number of all-female 2-groups is 3,832/2 = 1,916, or a proportion of m_{22} = 0.229. (Note that if all male participations are sex-segregated into all-male groups, then the number of mixed groups is 0, and all female participations must be in all-female groups, so the proportion of all-female *n*-groups m_{2n} is 1 - m_{1n}.)

In cases where observed homophily is *greater than* expected homophily, the inbreeding coefficient is calculated as:

(Eq. 2a) $$IH_{in} = \frac{H_{in} - w_{in}}{m_{in} - w_{in}}$$

In cases where the observed homophily is less than the expected homophily, so that their difference is negative, the maximum value (i.e. of the absolute value) of the difference is simply the expected value itself, so the inbreeding coefficient is:

(Eq. 2b) $$IH_{in} = \frac{H_{in} - w_{in}}{w_{in}}$$

Results

Sex Homogeneity

Table 1 shows values of Basic (observed), Baseline (expected), and Inbreeding Homophily, with chi-square tests of the differences, for male and female co-offending groups, by co-offending group size. Consistent with Hypothesis 1, high levels of basic sex homophily are observed overall: only 20% of co-offending groups are mixed-sex. However, while observed overall male homophily is substantial (68% of all co-offending groups are all-male), observed female homophily is much lower (12% of all co-offending groups).

-Table 1 about here-

Hypothesis 2 posits a general tendency towards inbreeding homophily in co-offending groups. Overall, this hypothesis is supported. Observed homophily exceeds baseline homophily for both sexes, observed heterophily is less than expected, and the differences are statistically significant at $p < .001$. The values of the inbreeding coefficient are substantial: 0.51 for males and 0.44 for females. The value of *IH* for mixed (heterophilous) groups indicates the normalized extent to which observed heterophily exceeds that expected by chance, and thus serves as a (reverse) indicator of non-sex-specific inbreeding homophily: it is also substantial, at -0.48.

The results for Hypothesis 3 are mixed. Consistent with the hypothesis, inbreeding male homophily increases with co-offending group size, from 0.38 for 2-groups to 0.74 for 5-groups — but it decreases to 0.61 for groups of 6 co-offenders. Also consistent with Hypothesis 3, outbreeding heterophily decreases with group size, from -0.42 for 2-groups to -0.65 for 5-groups — although it increases slightly to -0.63 for groups of 6 co-offenders. Contrary to Hypothesis 3, however, female inbreeding homophily does not increase with group size: it decreases from 0.46 for 2-groups to 0.13 for 5-groups and 0 for 6-groups (however, the values for female homophily for 4-groups and greater may be unreliable due to small numbers).

Finally, there is weak overall support for Hypothesis 4, which posits that male inbreeding homophily will be higher than that of females. The overall value for male inbreeding is 0.51, compared with 0.44 for females, and greater inbreeding for males is also evidenced for 3-groups and larger. However, for groups of 2 co-offenders, female inbreeding homophily is higher: 0.46 compared with 0.38 for males.

Age Homogeneity

The results for age are shown in Table 2. As was the case for sex, considerable observed (basic) age homophily is evidenced overall: 53% of all co-offending groups are all-adult, 30% are all-youth, and only 17% are age-heterogeneous. These findings lend further support to Hypothesis 1: co-offending groups tend towards observed homogeneity overall.

-Table 2 about here-

Like the findings for sex, there is also evidence for a general inbreeding tendency by age (Hypothesis 2). The overall value of *IH* for mixed-age co-offending groups is negative and substantial (-0.58, p <.001), as are its values for co-offending groups of each size, implying substantially less heterophily than would be expected by chance. However, almost all of the inbreeding homophily is due to homophily of young offenders, not of adults. Whereas youths' overall inbreeding coefficient is high (*IH* = 0.75), and observed homophily exceeds baseline for youthful co-offending groups of each size (p <.001), adults exhibit a slight and barely significant tendency towards outbreeding overall (*IH* = -0.03, p <.05), and for co-offending groups of sizes 2, 3, and 4. This outbreeding pattern is weak, however, and only significant for 3-groups. Further, for adult 5- and 6-groups, the pattern is reversed and there is evidence of inbreeding, although it is significant only for 5-groups (p <.01). The results for Hypothesis 2 are therefore mixed.

Support for Hypothesis 3, that inbreeding will increase with co-offending group size, is thus also mixed. Consistent with this hypothesis, adult inbreeding does, in fact, increase from -0.02 for 2-groups to a high of 0.40 for 5-groups, although it is lower for both 3- and 4-groups. In contrast, youth inbreeding decreases rather than increases with co-offending group size, from 0.77 for 2-groups to 0.57 for 5-groups — with a slight rise to 0.68 for groups of 6 co-offenders (although here, too, the values for 4-groups and greater should be interpreted with caution due to small numbers). Outbreeding heterophily exhibits similar variability, increasing with offending group size, from -0.62 for 2-groups to -0.45 for 4-groups — but decreasing again for larger co-offending groups, to a value of -0.63 for 6-groups.

Support for Hypothesis 5 is much more consistent: inbreeding homophily is much greater for youth than adults overall (*IH* = 0.75 vs. -0.03), and for co-offending groups of all sizes. For groups with between 2 and 4 co-offenders, youths' *IH* values are all positive and large, indicating a high degree of inbreeding homophily, whereas adults' coefficients are all negative and small, indicating a weak tendency towards outbreeding. Moreover, even in 5- and 6-groups, where both youth and adults exhibit inbreeding, youths' values are considerably higher.

Discussion

Students of co-offending have repeatedly observed sex and age homogeneity in co-offending groups, particularly amongst males and youths (Carrington, 2011: 245). These observations have generally been taken as evidence of a preference for accomplices who are similar to oneself; that is, as evidence of choice-based accomplice selection. However, this conclusion is typically drawn in the absence of information regarding baseline opportunities for homophilous co-offending groups to form, given the demographic distribution of the offending population. The objective of this paper was to explore competing hypotheses regarding the selection of co-offenders by comparing Basic, Baseline, and Inbreeding homophily for different offender subgroups and co-offending group sizes. Specifically, using police data from a large UK metropolitan area, we compared observed age and sex homophily with expectations from a simple probability model in order to compute standardized inbreeding coefficients for males, females, youths and adults.

We found strong evidence of age and sex inbreeding in co-offending groups. Overall, and for each co-offending group size, the observed number of mixed (heterophilous) groups was substantially and significantly lower than the number expected by chance. This is consistent with the findings of other co-offending research (Carrington, 2011:245). However, our conclusions concerning sex-specific homophily differ markedly from those of most other research. Although—consistent with other research—there is far more observed homophily among male than female co-offenders in this population, the difference between male and female homophily is very small, once it is normalized to account for the highly skewed sex ratio in the offending population: 0.51 for males and 0.44 for females. Furthermore, for co-offending groups of size 2—which account for 77% of all co-offending groups in this population—normalized female inbreeding homophily *exceeds* that of males (0.46 versus 0.38), even though the basic observed homophily of females in 2-groups is far lower than that of males. These findings provide support for Carrington's (2002b) argument that the high observed frequency of all-male co-offending groups and low observed frequency of all-female co-offending groups is largely accounted for by the sex ratio of the offending population: that is, by sex-specific opportunity. This calls into question the supposed preference of females to co-offend with males (Sarnecki, 2001; Steffensmeier & Terry 1986), and explanations of female co-offending that highlight the influence of, or coercion by, male associates, especially romantic partners (Fleisher and Krienert, 2004; Haynie et al., 2005; Vandiver, 2006; Warr, 1996). The finding that both males and females were disproportionately involved with same-sex accomplices is more consistent with the idea that criminal networks are highly segregated by gender and that this segregation, whether a result of choice or exclusion, plays an important role in the selection of co-offenders for both sexes (Alarid et al., 1996).

Whereas males and females demonstrated similarly high levels of inbreeding in this study, the findings for age-specific homophily indicate considerable inbreeding differences between youth and adults. Basic observed homophily is much higher for adults than youth (0.53 versus 0.30), but normalized (inbreeding) homophily is far lower for adults than for youth: in fact, for adults, it is *negative* (-0.03): that is, less than expected by chance; whereas for youth it is strongly positive (0.75). Similarly, at each co-offending group size (except groups of size 6, of which there are few), basic observed homophily is greater among adults, but normalized (inbreeding) homophily is far greater among youth. These findings illustrate the importance of using a normalized index of homophily, rather than basic observed proportions, when making comparisons. The high rates of youthful inbreeding observed in this study are consistent with suggestions made in previous research that there is “substantial separation of juvenile from adult networks in the selection of co-offenders” (Reiss & Farrington 1991:390; Sarnecki 2001; Shapland 1978), perhaps due to the restricted activity spaces within which young people operate. However, the finding that adults tend *not* to inbreed was unexpected, and warrants future attention. Investigations based on more fine-grained age categorizations could be useful in shedding light on this result and clarifying whether adult outbreeding can be accounted for by older youths and younger adults offending together.

The variable relationship between homophily and co-offending group size observed in this study also deserves mention. Although we found some support for Mayhew and colleagues’ (1995) energy distribution principle for male co-offending groups and, to a lesser extent, adult groups, the findings for females and youth contradict the proposition that larger groupings should evidence greater inbreeding homophily. While it is possible that the 'energy barriers' discussed by Mayhew et al. operate differently for female and youth co-offending groups, it is likely that these inconsistent results are due, at least in part, to the very small number of female and youthful co-offending groups of larger sizes.

The strong inbreeding tendency observed in this study confirms the fact that "pure availability…does not by itself fully determine or exhaust the search for co-offenders" (Tremblay 1993:25). Our findings thus refute strict opportunity-based theories of co-offender selection. However, in the absence of information on the socio-organizational features of offenders' daily lives (e.g., routine activities, convergence settings, and social foci), our police data do not permit a clear test of local opportunity vs. choice-based theories. The homophily patterns observed here could thus reflect psychological biases that render similar accomplices more 'attractive', structural factors below the population level that make them more readily 'available', or a combination of both (Weerman 2003). Conventional network studies that include information on local meeting opportunities suggest that "both [structure and choice] play an important but partial role, where each reinforces the other" (Kossinets &Watts, 2009:409; Currarini, 2009; Moody, 2001). The key task for future co-offending research will be to determine how these factors interact to produce inbreeding biases in co-offender selection. Answering this question will require data not typically available in official records. [viii]

Supplementing the basic analyses presented here with research using other types of data is important for a number of reasons. First, the homophily findings outlined in this study reflect detected co-offending patterns only, and it is possible that the composition of non-detected co-offending groups may differ. If, for whatever reason, heterogeneous groups are more successful in avoiding capture, inbreeding could be overestimated in this data. Although the high levels of co-offending homogeneity typically observed in self-report studies (e.g., Warr 1996) suggest that any official bias is likely to be small, it would be useful to verify the present inbreeding findings with non-official data.

Second, and more importantly, in addition to lacking details about local mixing opportunities, official data do not include information on many other offender and offence attributes that are likely to be important for accomplice selection. The current study was focused on the two durable, ascriptive characteristics of age and sex (variables readily available in official records). A focus on these traits is valuable in the sense that these characteristics, by virtue of their visibility, are central to one's social identity, and provide easy markers for similarity/dissimilarity in the search for co-offenders. The focus on these characteristics also avoids questions regarding the selection versus influence debate that typically plagues attempts to explore value homophily (Ruef, 2002). Still, there is good reason to believe that less visible traits also play a role in the selection of co-offenders, and perhaps interact with sex and age. In these analyses age and sex have been considered separately. In reality, however, it is likely that individuals consider multiple factors simultaneously when forming social ties (Kalmijn & Vermut 2007). It would thus be desirable if data were collected on a wide range of additional individual traits not typically found in official records (for example, criminal capital, reputation, attitudes, etc). Multivariate analyses could then be used to establish whether homogeneity on age and sex are selected for directly or whether they are, in fact, by-products of selection on other, related, traits. A latent-class approach to random-effects modeling could prove useful in this regard.

It would also be informative if future analyses controlled for characteristics of the criminal incident (e.g., crime type, difficulty, etc) as it is likely that different types of crimes will call for different types of accomplices (Reiss, 1988: 34; Sarnecki, 2004: 43). To the extent that some offences may benefit from a division of labor or specialized skills, heterophily, rather than homophily, might optimize the offending groups' performance as is the case in some conventional innovation and information networks (Granovetter, 1973; Ruef, 2002). Investigating whether age and sex homophily maintain independent significance in the prediction of co-offending, net of other factors, will require multivariate methods designed for network data (Scott & Carrington, 2011). Although the structure of the data used in the current study was not suitable for exponential random graph p^* modeling, this method has been usefully applied to study homophily in other contexts (e.g., Lubbers, 2003) and could be used to advance the study of co-offending in future studies (e.g. Schaefer, 2011).

A third benefit of collecting more in-depth data on co-offending networks is that it would allow for analyses of multiplexity. Some research suggests that co-offenders are often selected from amongst the friends, romantic partners, and acquaintances with which one regularly associates (see Budd et al., 2005). As West (1978:178) eloquently stated, "most teens do not need to befriend somebody to find a 'partner in crime': they already have one". If accomplices are indeed chosen from within one's immediate (conventional) social network, the inbreeding results observed here could simply reflect underlying friendship homophily. With the proper data, it would be straightforward to explore whether individuals' co-offending ties are more or less homophilous than their friendship ties, and thereby determine whether inbreeding homophily in co-offending is a distinct phenomenon.

Finally, an important avenue for future research concerns the practical significance of co-offending homophily. The analyses presented here have focused on the cross-sectional formation of co-offending ties, but another important question is whether homophily encourages the maintenance of co-offending relationships over time. Research on conventional networks suggests that homophily is a strong predictor of relational durability (McPherson et al., 2001; Suitor & Keeton 1997). From an intervention perspective, it would be of value to identify whether the same is true for co-offending ties. Longitudinal network data are exceptionally rare, particularly in criminology but, if collected, they could provide great insight into the ‘meaning’ of homophily for the selection and stability of co-offenders across the criminal career.

Conclusion

In this study, we have demonstrated that deviations from random mixing by age and sex are substantial in co-offending groups of all sizes, but that these deviations are not uniform. Furthermore, we have shown that patterns of normalized inbreeding homophily differ markedly from patterns of basic observed homophily. These findings highlight the importance of exploring null expectations when studying the composition of co-offending groups. Having refuted strict opportunity-based theories of co-offender selection, future research should focus on elucidating the psychological, sociological and local-structural forces that produce inbreeding homophily in co-offending networks. A number of theoretical possibilities have been proposed above, but the true character of co-offender selection remains an empirical question. Our hope is that this study will provide an impetus for additional research aimed at identifying specific accomplice selection mechanisms and exploring their implications for co-offending networks.

Notes

[i] Our use of the term 'group' refers to collectives of two or more individuals who are directly linked through simultaneous joint criminal action. Although some social psychological interpretations of the term 'group' assume a shared identity and some degree of role differentiation (Aronson et al., 2005), no such assumptions are made in the current study.

[ii] Although rarely identified as such explicitly, (delinquent) peer behavioral and value homophily have received the most widespread criminological attention. The fact that friends of juvenile delinquents are themselves much more likely to be delinquent than friends of non-delinquents is one of the most robust findings in criminology. The question of whether this association reflects selection or influence effects is still hotly debated, but there is little disagreement about the existence of the association itself (Cairs & Cairns 1994; Carrington 2011; Glueck & Glueck 1950; Haynie 2002; Matsueda and Anderson 1998; Smangs 2010; Warr 2002).The literature on this topic is vast, but we do not address it here as our interest is in co-offending rather than peer networks, and because social influence effects are not relevant for the stable ascriptive characteristics of age and sex examined in this paper.

[iii] In the case of behavioral homophily and similarity for psychological characteristics like attitudes and values, a third theoretical camp proposes that social influence leads to convergence. Because the current paper is focused on the demographic characteristics of age and sex, which are not subject to change, we limit our attention to theoretical explanations that assume selection.

[iv] It is worth noting that although choice-based explanations are typically applied to explain high levels of homophily, they could also be used to account for instances in which a weighing of costs and benefits leads to the choice of dissimilar alters (heterophily).

[v] Given that these foci are likely to attract socially similar individuals, even greater structural homophily would be expected to emerge through chance meetings at the local-level as compared to the population-level.

[vi] Of course, if detailed information on the demography of localized contact pools were available, this information could be used to compute baseline probabilities instead of using overall population information. In these cases, the presence of inbreeding effects would provide stronger support for choice-based explanations. Unfortunately, this data is difficult to come by, especially for offender populations.

[vii] In some cases, the expected number of homogeneous all-female or all-youth groups was less than 1, violating a key assumption of the Chi-square test. In these situations, a correction was made to in order to permit calculation of the chi-square statistic. This involved increasing the expected count to 1 for that group, while subtracting 0.5 from the counts for each of the other groups. This was done for all-female 5 and 6-groups and all-youth 5 and 6-groups. The results for these co-offending group sizes should be interpreted with caution.

[viii] Our reliance on official data means that we were not able to explore the cognitive, emotional, or instrumental motivations underlying the selection of co-offenders. As a result, our analysis provides a somewhat superficial view of co-offender selection. A proper evaluation of rational-choice vs. opportunity explanations will require more textured information on offenders' motives and methods of accomplice selection.

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Table 1. Basic, Baseline, and Inbreeding Homophily for Males and Females, by Offending Group Size

	Number of Offending Groups					Homophily			
Offending Group Size	Observed	Expected	χ^2	*p* [a]	Max[b]	Basic (observed) *H*	Baseline (expected) *w*	Maximum *M*	Inbreeding *IH*
2									
All Male	5649	5154	47.54	.000	6465	0.674	0.615	0.771	0.378
All Female	1100	394	1265.07	.000	1916	0.131	0.047	0.229	0.464
Mixed	1632	2833	509.14	.000	3832	0.195	0.338	0.457	-0.424
Total	8381	8381							
Number of male participations			12930						
Number of female participations			3832						
3									
All Male	1303	874	210.57	.000	1520	0.719	0.482	0.838	0.664
All Female	125	18	636.06	.000	292	0.069	0.010	0.161	0.391
Mixed	385	921	311.94	.000	877	0.212	0.508	0.484	-0.582
Total	1813	1813							
Number of male participations			4562						
Number of female participations			877						
4									
All Male	372	202	143.07	.000	447	0.698	0.379	0.839	0.694
All Female	32	1[c]	961.00	.000	85	0.060	0.002	0.159	0.369
Mixed	129	330	122.43	.000	343	0.242	0.619	0.644	-0.609
Total	533	533							
Number of male participations			1789						
Number of female participations			343						
5									
All Male	126	49.5	118.23	.000	153	0.741	0.296	0.900	0.736
All Female	2	1[c]	1.00	.317	16	0.012	0.000	0.094	0.128
Mixed	42	119.5	50.26	.000	82	0.247	0.704	0.482	-0.649
Total	170	170							
Number of male participations			768						
Number of female participations			82						

(cont'd)

6									
All Male	27	9.5	32.24	.000	37	0.600	0.232	0.822	0.612
All Female	0	1[c]	1.00	.317	7	0.000	0.000	0.156	0.000
Mixed	18	34.5	7.89	.005	43	0.400	0.768	0.956	-0.628
Total	45	45							
Number of male participations			227						
Number of female participations			43						
All 2-6									
All Male	7477	6289	224.41	.000	8622	0.683	0.575	0.788	0.509
All Female	1259	415	1716.47	.000	2316	0.115	0.038	0.212	0.444
Mixed	2206	4238	974.29	.000	5177	0.202	0.387	0.473	-0.479
Total	10942	10942							
Number of male participations			20276						
Number of female participations			5177						

Note: values in highlighted cells may be unreliable due to low expected numbers
[a] Statistical significance, *df* =1
[b] Maximum possible number of groups
[c] Expected value rounded to 1 to permit chi-square calculation

Table 2. Basic, Baseline, and Inbreeding Homophily for Youths and Adults, by Offending Group Size

	Number of Co-offending Groups					Homophily			
Co-offending Group Size	Observed	Expected	χ^2	*p* [a]	Max[b]	Basic (observed) *H*	Baseline (expected) *w*	Maximum *M*	Inbreeding *IH*
2									
All Youth	2277	434	7826.38	.000	2825	0.286	0.054	0.355	0.771
All Adult	4593	4685	1.81	.179	5141	0.577	0.588	0.645	-0.020
Mixed	1097	2848	1076.55	.000	5651	0.138	0.357	0.709	-0.615
Total	7967	7967							
Number of youth participations			5651						
Number of adult participations			10283						
3									
All Youth	600	19	17766.37	.000	815	0.348	0.011	0.473	0.730
All Adult	683	778	11.60	.001	908	0.396	0.451	0.527	-0.122
Mixed	441	927	254.80	.000	2447	0.256	0.538	1.419	-0.524
Total	1724	1724							
Number of youth participations			2477						
Number of adult participations			2725						
4									
All Youth	147	1[c]	21316.00	.000	233	0.298	0.003	0.473	0.628
All Adult	168	171	0.05	.819	260	0.341	0.346	0.527	-0.028
Mixed	178	321	63.70	.000	932	0.361	0.651	1.890	-0.445
Total	493	493							
Number of youth participations			932						
Number of adult participations			1040						
5									
All Youth	40	1[c]	1521.00	.000	70	0.250	0.001	0.438	0.570
All Adult	61	41.5	9.16	.002	89	0.381	0.265	0.556	0.399
Mixed	59	117.5	29.13	.000	354	0.369	0.734	2.213	-0.498
Total	160	160							
Number of youth participations			354						
Number of adult participations			446						

(cont'd)

6									
All Youth	15	1[c]	196.00	.000	22	0.349	0.000	0.512	0.682
All Adult	12	8.5	1.44	.230	20	0.279	0.204	0.465	0.287
Mixed	16	33.5	9.14	.002	121	0.372	0.796	2.814	-0.628
Total	43	43							
Number of youth participations			137						
Number of adult participations			121						
All 2-6									
All Youth	3079	456	15088.00	.000	3965	0.296	0.044	0.382	0.748
All Adult	5517	5684	4.91	.027	6418	0.531	0.547	0.618	-0.029
Mixed	1791	4247	1420.28	.000	9505	0.172	0.409	0.915	-0.578
Total	10387	10387							
Number of youth participations			9521						
Number of adult participations			14615						

Note: values in highlighted cells may be unreliable due to low expected numbers
[a] Statistical significance, *df* =1
[b] Maximum possible number of groups
[c] Expected value rounded to 1 to permit chi-square calculation