

# **Jack-of-all-trades: Social capital, criminal versatility and brokerage in a street gang network**

**by**

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## **Abstract**

This study draws from research on social capital and social network analysis to study the criminal careers of street gang members. The research question tested is whether access to greater social capital, by facilitating access to criminal opportunities, resources and skills, will be associated with criminal versatility. The social dynamics of street gangs and the fact that gang members have been found to be particularly active and versatile offenders provides an ideal framework to study this research question. Data on the criminal careers and social networks of gang members embedded in a large criminal network of 979 gang members and associates active from 2001 to 2008 in a large Canadian city are analyzed. Findings suggest that social capital is associated with criminal versatility. Furthermore, different social network structures in which social capital is embedded are important to understand involvement in offences requiring different skills and resources.

**Keywords:** Versatility, social capital, social network analysis, gangs, criminal careers

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# Table of Contents

Approval.....	iii
Partial Copyright Licence .....	iv
Abstract.....	v
Acknowledgements .....	vi
Table of Contents.....	vii
List of Tables.....	ix
List of Figures.....	x
<b>1. Introduction .....</b>	<b>1</b>
<b>2. Literature review .....</b>	<b>4</b>
2.1. Crime theories and the versatility/specialization debate.....	4
2.2. Operationalization and measures of versatility.....	7
2.3. Social capital, crime theories, and versatility.....	11
2.4. Access to social capital in legitimate and criminal networks.....	13
2.5. Social capital in the creation of criminal capital.....	17
2.6. Jack-of-all-trades in the cafeteria: Versatility and social capital in street gangs .....	19
2.7. Current study.....	21
<b>3. Data and methodology .....</b>	<b>23</b>
3.1. Background.....	23
3.2. Data used in this study .....	24
3.2.1. Network selection.....	24
3.3. Haitian street gang members.....	27
3.3.1. Membership and associates.....	27
3.4. Dependent variable .....	30
3.5. Independent variables .....	30
3.5.1. Network measures .....	30
3.5.2. Control variables .....	32
3.6. Analytic strategy .....	33
<b>4. Methodological issues in the use of the versatility index.....</b>	<b>35</b>
4.1. Minimum number of offences and the use of categories.....	36
4.1.1. Number of categories used .....	39
4.1.2. Equal probabilities.....	42
4.1.3. The substantive meaning of the versatility index .....	43
4.2. Crime classification and index interpretation in the current study.....	45
4.2.1. Four crime types .....	45
Violent offences .....	45
Unskilled property crimes.....	45
Skilled property offences.....	46
Market crimes .....	46
Excluded offences.....	46
4.2.2. Interpretation of the index with four categories.....	47

4.2.3. Versatility beyond “pure specialization” .....	50
4.3. Statistical modelling of versatility .....	52
4.4. Summary .....	55
<b>5. Versatility, social capital and network structures .....</b>	<b>56</b>
5.1. Descriptive statistics and bivariate analyses .....	56
5.2. Quantile regression .....	58
5.3. Pure specialists .....	64
5.4. Different crimes, different networks .....	68
<b>6. Discussion .....</b>	<b>74</b>
6.1. Brokerage and versatility .....	75
6.2. Theoretical implications of the results .....	77
6.3. Different offences, different social capital? .....	79
6.4. Limitations .....	83
6.4.1. Network selection, completeness and accuracy .....	85
6.4.2. Sample selection, crime categories and versatility index .....	86
6.5. Conclusion .....	88
<b>References .....</b>	<b>92</b>



## List of Tables

Table 1.	Differences between members and associates .....	28
Table 2.	Network measures by ethnicity for members and associates .....	29
Table 3.	Versatility index descriptive statistics using different samples .....	38
Table 4.	Mean versatility by minimum number of arrests .....	39
Table 5.	Regression coefficients and variance explained for simple regression models predicting versatility from offending frequency .....	40
Table 6.	Pearson correlation matrix for types of offences .....	46
Table 7.	Composition of versatility scores .....	50
Table 8.	Probabilities and frequencies of different crime combinations .....	52
Table 9.	Descriptive statistics (n=138) .....	57
Table 10.	Pearson correlations between key variables .....	57
Table 11.	Quantile regression models of versatility .....	58
Table 12.	Characteristics of pure specialists .....	64
Table 13.	Correlations between network measures and involvement in specific offences .....	68

## List of Figures

Figure 1. Network construction .....	25
Figure 2. Network of gang members and associates.....	26
Figure 3. Total number of arrests distribution .....	37
Figure 4. Distribution of versatility index values for 4 and 13 categories.....	41
Figure 5. Least non-zero index score by number of arrests.....	48
Figure 6. Residual plot from OLS regression model of versatility .....	53
Figure 7. Relationship between age and versatility .....	59
Figure 8. Quantile regression and OLS regression coefficients and confidence intervals .....	60
Figure 9. Betweenness centrality coefficients below the 50 <sup>th</sup> quantile .....	62
Figure 10. Betweenness centrality, age and versatility .....	63
Figure 11. Ego networks of violent specialists.....	65
Figure 12. Ego networks of non-violent specialists.....	66
Figure 13. Pure specialists within the gang network.....	67
Figure 14. Market offence involvement in the gang network .....	70
Figure 15. Skilled offence involvement in the gang network .....	71
Figure 16. Violent offence involvement in the gang network .....	72
Figure 17. Unskilled offence involvement in the gang network.....	72

# 1. Introduction

Are “Jack-of-all-trades” *really* masters of none? The figure of speech implies that someone who is proficient in many skills is usually not outstandingly good in any particular task. In some domains, however, acquiring many skills is a skill in and of itself. Crime research has not been able to determine yet if versatile offenders – jack-of-all-trades – should be considered among the cream of the crop. Versatility, however, has been studied extensively by criminologists. In fact, criminal career researchers have consistently found that most offenders tend to be versatile (DeLisi & Piquero, 2011; Piquero, Farrington, & Blumstein, 2007). However, researchers have recently qualified this finding by studying the conditions that foster versatility and specialization in offending. Changes in local life circumstances have been found to alter criminal opportunities and thus affect offending versatility/specialization (McGloin, Sullivan, Piquero, & Pratt, 2007). Moreover, Guerette, Stenius and McGloin (2005) found that specialization is likely to occur when crime opportunities meet offender needs. These authors argued that offending versatility can be understood under a rational choice perspective, where “crime [is] not random, occurring evenly across time and place, but a product of the interaction between the offender and his or her situational environment” (p.79).

In a rare study using social network analysis to study this specific situational environment, McGloin and Piquero (2010) found that redundancy in co-offending networks was predictive of a tendency to specialize because redundant networks “provide access to overlapping skills, knowledge, and opportunities” (p.64). Overall, these studies all point towards the fact that variations in opportunity structures are key to understand offending versatility. Still, while it is known that some offenders are more versatile than others, our understanding of the reasons as to why this happens is rudimentary.

Several problems have plagued the study of versatile offenders. Research on the topic has often been criticized as atheoretical. Moreover, disagreements over operational definitions of offending versatility and its measurements have led some authors to question whether researchers using different methods are in fact studying the same concept. This study provides an in-depth analysis of a widely used measure of criminal versatility—the diversity index. Imported from ecological sciences, the diversity index has been (and continues) to be used by researchers despite concerns regarding its distributional properties and interpretability (Sullivan, McGloin, Ray, & Caudy, 2009). This thesis undertakes an analysis of the many methodological issues associated with the use and interpretation of the diversity index. Furthermore, this study proposes that the use of a strong theoretical framework combined with an operational definition consistent with the research question is crucial in order to solve some of the current disagreements.

This thesis considers criminal versatility under a social capital perspective. Drawing from research on co-offending networks, criminal achievement and criminal careers, this study tests the hypothesis that criminal versatility is associated with access to greater social capital. The availability of social network data allows for a more direct approach in measuring social capital. Moreover, the data available is not limited to co-offending data, but also includes relations that did not necessarily lead to official co-arrests. This is a departure from many studies on co-offending and allows for a better assessment of the available pool of offenders in the “search for a suitable co-offender” (Tremblay, 1993).

This thesis also focuses on the study of social capital and versatility in the context of street gangs. Klein (1995) eloquently stated that gang members’ offending careers could be described as “cafeteria style”—they engage in a little bit of this, a little bit of that. Beyond the versatile nature of gang members, street gangs offer an interesting environment to study social capital. The social nature of street gangs is well described in classic studies in criminology (e.g. Short & Strodtbeck, 1965, Thrasher, 1927, Whyte, 1943). Recent research has reiterated the importance of the social aspects of street gang involvement (e.g. Decker & Van Winkle, 1996, Tremblay, 2011; Venkatesh, 2008). Given that street gangs are rich sources of social capital, both

symbolic and tangible (Moule, Decker, & Pyrooz, 2013) and that gang members have been found to be particularly versatile, they constitute the ideal population for this study.

The thesis is divided into five chapters. Chapter 2 provides an overview of the literature that informs the research question tested. Chapter 3 presents the data and methodology used to study the research question. Chapter 4 provides an in-depth analysis of the operationalization of versatility in this study. Chapter 5 presents results from the analysis of the relationship between social capital, criminal versatility and network structures. Finally, Chapter 6 provides a discussion of these results, limitations of the study and concludes by summarizing the findings of the study and proposes future research considerations.

## **2. Literature review**

### **2.1. Crime theories and the versatility/specialization debate**

Jack-of-all-trades have been studied extensively in criminology. However, criminal specialization has generally received more attention compared to criminal versatility (Mazerolle, Brame, Patternoster, Piquero, & Dean, 2000). According to Mazerolle et al. (2000), the preponderance of specialization research is not surprising given the policy and theoretical implications of such research. Knowing whether or not offenders tend to engage in specific types of crimes is clearly relevant for public policies—should policies be tailored to target offenders who specialized in different crimes? From a theoretical standpoint, the specialization issue has often been thought of as a “critical test” of criminological theories (Mazerolle, et al., 2000, p. 1144).

The versatility/specialization debate has been fuelled by the disagreement in many prominent theories of crime concerning which end of the continuum is the “norm” in criminal careers (Sullivan, McGloin, Pratt, & Piquero, 2006). While some theories predict that most offenders should be versatile (e.g. Gottfredson & Hirschi, 1990), most posit that both specialization and versatility should be expected (e.g., Cohen, 1955; Cornish, & Clarke, 1986; Cloward & Ohlin, 1960).

Gottfredson and Hirshi (1990) presented a rather categorical prediction regarding criminal versatility in their general theory of crime:

“Because both crime and analogous behaviors stem from low self-control [...], they will all be engaged in at a relatively high rate by people with low self-control. Within the domain of crime, then, there will be much versatility among offenders in the criminal acts in which they engage. Research on the versatility of deviant acts supports these predictions in the strongest possible way.” (p. 91)

Gottfredson and Hirschi (1990) argued that the most important predictor of criminal involvement is low self-control. As such, the authors stated that individuals commit crimes because they: 1) provide easy, simple and immediate gratifications, 2) are exciting, and 3) require little skill or planning.

Although they found support for their theory elsewhere, criminal versatility is often used as a case in point by Gottfredson and Hirschi (1990) to show that most crime is generated by low self-control. For the authors, a low self-control conception of criminality “is compatible with the observation that criminal acts require no special capabilities, needs, or motivation; they are, in this sense, available to everyone” (p. 88). However, the authors acknowledge that specialization is also possible. Gottfredson and Hirschi (1990) state that given the bias of individuals with low self-control to seize “obvious opportunities for an easy score” (p.90), there may be an appearance of specialization. This, according to the authors, is an artifact of repeated opportunities and simple convenience.

Gottfredson and Hirschi’s stance on versatility has been used as a counter point in many studies of criminal specialization (e.g. Guerette, et al., 2005; Piquero, Paternoster, Mazerolle, Brame, & Dean, 1999; Sullivan et al, 2006). Although often referred to as the main proponent of the versatility hypothesis, their theory does not completely rule out evidence of specialization, at least in the short term. The notion that repeated opportunities may present themselves to an offender and influence their criminal behaviour is a rare departure from the central argument of *A General Theory of Crime* that criminality is overwhelmingly caused by individual propensities, rather than by external causes. The notion of opportunity is nevertheless a common thread between Gottfredson and Hirschi’s theory and other frameworks that hypothesize the presence of specialization in offender’s careers.

Cloward and Ohlin’s (1960) differential opportunity theory has often been interpreted as predicting specialization in certain types of crimes (e.g., Mazerolle et al., 2000). The notion of opportunity in Cloward and Ohlin’s work is however much different from Gottfredson and Hirschi’s. In *Delinquency and Opportunity*, Cloward and Ohlin (1960) define opportunities, whether legitimate or illegitimate, as implying an individual’s access to “appropriate environments for the acquisition of the values and skills

associated with the performance of a particular role, and he must be supported in the performance of the role once he has learned it” (p.148). For Cloward and Ohlin’s (1960) theory, like for most variants of strain theory, individuals engage in criminal activities because they lack access to legitimate means. Opportunity structures do not only influence criminal involvement, it influences the nature and composition of criminal involvement. For example, Cloward and Ohlin (1960) state that specialization will arise from different illegitimate opportunity structures.

Cornish and Clarke’s (1986) rational choice perspective can be seen as a middle ground between the last two perspectives. For Cloward and Ohlin, external forces dictate the nature of criminal careers; internal forces are the main driver of criminal involvement for Gottfredson and Hirschi. Cornish and Clarke (1986) recognize, like Gottfredson and Hirschi, that criminal involvement serves to fulfill an offender’s needs. However, for Cornish and Clarke criminal involvement is less reactionary—it involves rational decisions and choices that are “constrained [...] by limits of time and ability and the availability of relevant information” (Clarke & Felson, 1993, p.6). The rational choice perspective is a rather natural theoretical framework to study criminal specialization. As Clarke and Felson (1993) state, the explanation of criminal decisions require a crime-specific focus, as different offences “may serve different purposes, but also because the situational context of decision making and the information being handled will vary greatly among offences” (p.6).

Although these theories differ in important ways, their conceptions of versatility and specialization have some common ground. Opportunities are key in Cloward and Ohlin and Cornish and Clarke’s theories. The decision to offend is largely based on whether or not one possesses the skills, motivation and resources to commit a crime. While Gottfredson and Hirschi (1990) state that specialization is unlikely to occur, they do acknowledge that the very nature of individuals with low self-control will lead them to engage in offences that are more convenient for them. In other words, offenders may engage in repetitive behavior if opportunities present themselves easily to the offender.

Contrary to Gottfredson and Hirschi, Cloward and Ohlin argue that different offences require different opportunity structures. They argue that an important caveat for involvement in criminality is the presence of a learning structure and the integration of



different offenders of different age levels. For Gottfredson and Hirschi, this is unlikely to happen given the short-sighted nature of individuals with low self-control. In fact, for these authors, learning criminal skills from mentors is unnecessary given that the “defining features of crime is that it is simple and easy” (p.92).

Despite the insight provided by these theoretical perspectives and others, most research on criminal specialization and versatility has been concerned with finding evidence of one or the other pattern. Guerette et al. (2005) argued that specialization research has generally been geared towards its policy implications, and less towards its theoretical relevance. The authors pointed out that research on offending specialization/versatility has often been atheoretical.

While empirical results have generally shown “some level of specialization amid a great deal of versatility” (Piquero et al., 1999, p. 276), this has not settled the debate. On the one hand, researchers have maintained that findings regarding versatility were due to the aggregation of offences over the life-course, and have demonstrated evidence of specialization in the short term (McGloin, Sullivan, & Piquero, 2009; Sullivan et al., 2006). On the other hand, some have argued that “affirmative evidence of criminal specialization has relied on analyses that were heavy in analytical techniques and statistical significance, but light on substantive meaning” (Delisi, 2003, p.170). Britt (1994) went further in stating that a double standard exists in specialization research. The author pointed out that specialization is often inferred from careers that do not show complete versatility, but that the opposite is rarely stated. Among all these debates, a common point of agreement is that our ability to measure versatility is limited. Many have proposed that the divergence of findings is likely related to the diversity in statistical modelling and operationalization of specialization or versatility (Bursik, 1980; Delisi, 2003; Mazerolle et al., 2000; Osgood & Schreck, 2007; Piquero et al., 1999; Sullivan, et al., 2009)

## **2.2. Operationalization and measures of versatility**

An issue that has fuelled much of the debate in specialization/versatility research concerns the operationalization and measurement of the concept. Sullivan et al. (2009)

reviewed and compared different methods used to measure offending versatility and specialization. They identified four different methods: 1) the forward specialization coefficient, 2) the diversity index, 3) latent class analysis, and 4) the multilevel latent variable approach.

The forward specialization coefficient (FSC) was developed by Farrington (1986). The FSC measures the extent to which consecutive offences in a sample fall in the same category. In other words, the FSC measures consecutive specialization by calculating transition matrices and produces a single summary value of specialization for a sample or sub-samples of cases (Sullivan et al., 2009). Osgood and Schreck (2007) pointed out that early research on specialization focused on offence sequence rather than the composition of entire offender careers. They proposed that a focus on temporarily adjacent offences reduces the precision of the FSC and hinders its interpretability. Moreover, the aggregate nature of the measure is not very useful in contexts where individual correlates of specialization are to be investigated (Osgood & Schreck, 2007).

The diversity index was originally an index used in ecology to measure species diversity in an ecosystem (Agresti & Agresti, 1978). This measure was adapted to the study of criminal careers and indicates the probability that two offences taken at random in a criminal career will fall in the same category (Mazerolle et al., 2000). Compared to the FSC, the diversity produces an individual measure of offending versatility over the entire criminal career. Moreover, it does not take into account the sequence of offences. Given the necessity for individual-based measures, the diversity index has become widely used in criminal career research (Mazerolle et al., 2000; McGloin et al., 2007; McGloin & Piquero, 2010; Piquero et al., 1999; Sullivan et al., 2006).

Sullivan et al. (2009) argued that the diversity index is confounded with offending frequency. The authors however state that “the extent to which this is problematic is not clear” (p.423). Furthermore, Osgood and Schreck (2007) pointed out that the diversity index failed to take into considerations baseline offending patterns. If an offender is to be deemed a “specialist”, the pattern of offences displayed must differ from what would normally be expected in a sample. Sullivan et al. (2009) noted that the diversity index is not informative as to the offence type in which an offender specializes.

This last critique has been improved through the use of latent class analysis and multilevel item-response theory models. Latent class analysis considers the information of the overall sample to identify patterns of responses (Sullivan et al., 2009). This method allows for the identification of clusters of offences using the information available from the overall sample. However, such a method may also confound versatility with offending frequency. Also, Sullivan et al. (2009) underscored that such methods rely on researcher judgment to determine whether specialization is present.

Finally, Osgood and Schreck (2007) used item response theory (IRT) within a multilevel model to measure specialization. The technique uses hierarchical regression to model specialization at level 1 and the influence of covariates at a second level. The first level model is based on IRT which produces a latent indicator of specialization or versatility by considering individual offending frequency and sample base-rates for each offence (Sullivan et al., 2009). While this technique solves many prior critiques of measures of specialization/versatility, it is limited to the identification of specific specialization. For example, Osgood and Schreck (2007) applied the technique to measure specialization in violence.

Sullivan et al. (2009) after comparing the different methods concluded that it is unclear whether different studies using different measures (and even when similar measures are used) are truly studying the same concept. The authors further stated that no measure is “better” than another—they all have flaws and advantages. Sullivan et al. (2009) concluded that in the absence of such consistency, theory should guide the selection of an appropriate method. More importantly they stated that “researchers must be careful to articulate an operational definition and associated rationale as part of the questions guiding their inquiry” (p.438).

It is possible that the atheoretical nature and the measurement problems tied to the study of offending versatility are inter-related—solving one problem would perhaps solve the other. Two recent studies are particularly insightful on that matter.

First, Guerette et al. (2005), recognizing the need for integration of theory, applied a rational choice perspective to the study of criminal versatility and specialization. In applying the theory, the authors classified crimes based on the needs

most likely to be met by specific offences. This type of classification is a clear departure from most research in this area; prior studies either do not differentiate between offences or create clusters of offences (e.g. property, violent, drug, etc.). Guerette et al. (2005) made a distinction between monetary crimes and other property crimes as these crimes fulfill much different needs. The authors found that offenders are likely to reoffend within the same crime category when those categories reflect similar needs.

A contribution of this study is in its operationalization of specialization in relation to the theoretical framework used. Studying specialization as a generic offending pattern can be problematic, especially when cross-study comparisons are used. Tying the notion of specialization to a specific theory gives a clear conceptual meaning to its measure. In this case, specialization was defined as successive repetitions of offences that fulfill specific needs. This is certainly a definition that is consistent with most of research on the topic, but it is a definition that is informed by a clearly laid out rationale and theoretical framework.

Second, McGloin and Piquero (2010) studied criminal versatility from a network perspective. Drawing from research on co-offending, but also from research on social networks in general, the authors provide a framework in which to study versatility. They find that non-redundant networks—that is, networks where co-offenders of offenders are not necessarily connected—leads to offending versatility. Moreover, McGloin and Piquero (2010) found that the relationship holds, even when controlling for the size of the network. They conclude that versatility is not necessarily a function of the size of one's network, but of its structure.

These studies highlight the importance in studying the relationship between an offender and his environment. Guerette et al. (2005) highlighted the fact that various factors may influence an offender's decisions to engage in crime. The authors stressed that understanding the decision making process and the influence of life circumstances are crucial in order to understand specialization and versatility.

McGloin, et al. (2007) also found that life circumstances had an impact on the specialization and versatility of offenders. However, they argued that opportunity structures also played a major role in shaping versatile and specialized careers.

McGloin and Piquero (2010) went further by explaining how opportunity structures arise and how they impact criminal careers. Central to this explanation is the importance of co-offending networks as a source of these opportunities. These findings imply that social networks hold essential resources to foster different opportunities—these resources are embedded in the social capital accessible through social relationships.

### **2.3. Social capital, crime theories, and versatility**

Bourdieu defined social capital as “the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition—or in other words to membership in a group” (Bourdieu, 1986, p.51). Sociologists and criminologists are generally more familiar with Coleman (1988) and Putnam’s (1995) applications of the concept. Coleman (1988) and Putnam (1995) often referred to social capital as a force to unite communities. Social capital allows children to succeed at school, it fosters trustworthiness and efficiency in wholesale diamond markets, and it creates a sense of security within neighborhoods (Coleman, 1988). Although Coleman (1988) did not give an inherent positive value to social capital, Putnam (1995) was unequivocal. According to the author,

“... life is easier in a community blessed with a substantial stock of social capital. In the first place, networks of civic engagement foster sturdy norms of generalized reciprocity and encourage the emergence of social trust. Such networks facilitate coordination and communication, amplify reputations, and thus allow dilemmas of collective action to be resolved.”(Putnam, 1995, p.65)

Portes (1998) contended that Putnam’s view of social capital does not reflect the initial formulation of the concept. According to Portes (1998), Bourdieu’s definition of social capital does not imply that social capital produces either good or bad outcomes—it is neutral and is a resource that can be exploited. In this way, a neutral conception of

social capital is consistent with many processes that make up the foundation of some of the criminological perspective that has been used to explain versatility<sup>1</sup>.

For example, Cloward and Ohlin's (1960) opportunity structures create access to both illegitimate and legitimate means. Whether one engages in criminal activities or not depends on the availability and accessibility of different opportunity structures. Similarly, rational choice theory stipulates that offenders make decisions to engage in criminal events based on the availability of information and resources necessary to engage in the offence. Both theories imply that offenders have at their disposition a more or less latent structure of resources or opportunities.

The natural extension of these two theories to social capital is no accident. While the first emphasizes causes of criminal involvement to be external to the offender, the second emphasizes the internal conditions that lead to the decision to be involved in crime. Social capital, in a way, is embedded exactly in the intercept of both theories. Social capital is neither purely external, nor is it purely individual; it is both.

Tremblay (1993, p.18) stated that criminologists tend to either oversocialize or undersocialize crime. The author proposed that criminal career research, while very informative, focuses on the individual to such an extent that its environment is largely ignored. With regard to specialization, Tremblay (1993) argued that the definition of specialization as the repetition of similar "rather vague" crime activities provides a very limited view of the offender. He stated: "A very different definition could be provided, however, based on the ability of a given offender to build a viable or complex network of crime-relevant contacts and co-offenders" (p. 19).

In a way Tremblay's statement illuminates the link between Gottfredson and Hirschi's notion of self-control and the other two theories. If criminal involvement relies

<sup>1</sup> It is necessary to point out that Coleman (1988), but especially Putnam (1995), discussed social capital at the community level. Putnam's reference to "America's declining social capital" was meant to stress the importance of community cohesiveness in fostering informal social control. Bourdieu (1986) discussed social capital as a resource embedded in social networks (i.e. communities, society, etc.), but stressed the fact that access to social capital was individually determined. Hence, for Bourdieu (1986; and Lin, 2001), social capital is treated as an individual resource.

on both opportunity structures and individual rational decisions, the ability to build the networks necessary to access these opportunities, information and skills must be variable. Gottfredson and Hirschi (1990) claimed that low self-control may cause an individual to engage in criminality because the nature of crime provides easy and immediate gratification. Morselli and Tremblay (2004) showed that for certain types of offences low self-control is actually associated with increases in criminal earnings. However, for offences requiring sustained criminal partnerships like drug trafficking, low self-control hinders the exploitation of effective network structures.

Perhaps the common denominator between these theories is the bidirectional relationship between an individual and his environment, the connection being mediated by an offender's network. Bourdieu's description of the function of social capital seemingly integrates at the same time the rational (rational choice), individual (self-control) and environmental (opportunity structures) components that have been exported from these theories of crime to explain the development of criminal careers. Bourdieu states:

“there are some goods and services to which economic capital gives immediate access, without secondary costs; others can be obtained only by virtue of a social capital of relationships (or social obligations) which cannot act instantaneously, at the appropriate moment, unless they have been established and maintained for a long time, as if for their own sake, and therefore outside their period of use” (Bourdieu, 1986, p.24).

## **2.4. Access to social capital in legitimate and criminal networks**

Lin (2001) suggested that one's position in a network and the activities in which one engages will be determinant of the level of social capital. Lin, like Bourdieu, viewed social capital as a neutral resource used by actors for purposive actions. According to Lin, access to social capital is explained by four propositions: 1) the strength of position, 2) the strength of strong ties, 3) the strength of weak ties, and 4) the strength of location.

The strength of position proposition refers to the “initial” social structure. This structure ensures greater access to social capital for those who have favourable positions. Depending on the context, one's initial position can be ascribed (or inherited,

through an individual's parents for example) or attained (through an individual's actions). Regardless of the nature of a position of origin, individuals who are in strong positions will have access to others in strong positions, thus having a multiplicative effect on their means to access social capital. In the criminal context, the strength of position proposition was explored by Morselli (2005) in his analysis of Howard Marks, an Oxford student-turned-international drug smuggler. Marks was able to enjoy a large network of wholesalers and importers from his days at Oxford. This solid base of contacts was instrumental in acquiring the most important investors later in his criminal career (Morselli, 2005). Marks' initial position in the network enabled him to build relationships with other important actors in the drug trade, and by extension granted him with even more access to social capital.

The strength of strong ties proposition stipulates that the social capital accessed through individuals connected by strong ties (e.g., friendship, kinship) is less risky and more likely to yield positive benefits (Lin, 2001). Coleman (1988) maintained that closure in networks—that is networks where actors know most others-- ensures trusting relations. Moreover, the idea of closure brings about the idea of reputation in a network. Coleman (1988) stated that without a certain level of closure, it would be difficult to form a lasting reputation in a network. In the criminal context, Anderson (1999) explained how tight groups of friends in disadvantaged neighborhoods can become involved in the drug trade. The author stated that a “drug organizer” will approach the group's “main man” (the natural leader of the group). This individual will gain tremendous power within the group as he “distributes opportunities to his boys” (p.115). Anderson (1999) explained that in no time this tight group of friends becomes a hub of power in the community.

Burt (1992) called this phenomenon “redundancy by cohesion”. Not only does everybody have direct access to everybody else but everybody is strongly connected. This combination ensures the greatest level of trust in the network. In the criminal context, there are some advantages of such structures. Erikson (1981) in her study of secret societies found that consideration of risks often translated into recruitment of new members within established networks of trusted relationships. Erikson (1981) argued that this selective recruitment leads to redundant network structures that serve two security purposes. First, it protects secret societies from attacks from within (e.g.



treason, snitching, etc.). The dense web of strong ties enables members in the society to quickly detect odd behaviours from other members. Second, it creates resiliency from external attacks. In a redundant network, the removal of one member does not effectively lead to the collapse of the network as individuals have other means to reach other members in the network.

Burt (1992) called this second phenomenon “redundancy by structural equivalence”. While trust emerges from strong ties between individuals, it can also emerge through repeated relationships between individuals who share strong ties with a common individual, but are not initially strongly attached to one another. A common example would be the relationship a brother might develop with his brother-in-law. Erikson (1981) stated that in secret societies “the excitement and comradeship of shared risk can lead to stronger and stronger affiliation with the secret society and with other members” (pp.201-202).

Morselli (2009) stressed that this consideration for security is in part where the criminal network diverges from legitimate networks. Legitimate networks are not concerned with concealment and have the leisure to strictly focus on efficiency. For Morselli (2009) resiliency in criminal networks resides on a balance of security and efficiency. As Morselli (2005) pointed out in his analysis of Marks’ career, strong ties were crucial for the start-up of the operation. But it is through his access to weak ties that Marks really became a “successful” drug smuggler. This is reflected in Lin’s (2001) third theoretical proposition for access to social capital: the strength-of-weak ties.

The strength of weak ties proposition is a direct importation of Granovetter’s work. Granovetter (1973) showed how individuals on the job market were more likely to find employment through acquaintances, rather than close friends or family members. This finding led the sociologist to develop the strength of weak ties theory. Granovetter (1973) concluded that information about opportunities (employment-related or other) is likely to be redundant in strong tie networks. Weak ties consist of relationships between individuals who have little overlap between their respective networks. According to Granovetter, this enables access to novel and unique information, which gives an advantage to those possessing many weak ties over those with closed strong tie networks.

In the criminal context, Descormiers and Morselli (2011) found that groups of rival allegiances cooperated sometimes, especially with regards to business opportunities. The authors found that there was a strong “us versus them” mentality when it came to relations between groups affiliated along Bloods and Crips lines. However, Descormiers and Morselli (2011) found that some individuals understood the opportunities afforded by crossing rivalry lines. One of the gang members interviewed stated that if one wanted to deal cocaine, he necessarily would need to reach out to a rival Latino gang. In the gang context, cooperating with the enemy can carry some risk. As such, reaching out to the enemy may produce a source of unique social capital. In a way, inter-rivalry ties can be conceived as the ultimate weak ties in street gangs.

Strength-of-location is the fourth proposition (Lin, 2001). Although compatible with the strength of weak ties idea, this proposition refers to one’s access to bridges in a network. This proposition imports Burt’s (1992) notion of structural holes. Burt (1992) argued that social capital can be acquired when positioned near structural holes of networks. A structural hole consists of any location of a network where two actors or groups of actors are not connected to one another (Burt, 2004). Brokers—individuals who bridge structural holes—are conferred positional advantages in a network. . These individuals have more efficient and less redundant networks and have greater access to information, opportunities and skills (Burt, 1992; 2000; 2004). In a criminal context, McGloin and Piquero (2010) have shown that non-redundant networks allowed offenders to access many different crime opportunities, thus leading to versatility. Similarly, Morselli and Tremblay (2004) showed that effective network structures lead to higher criminal earnings.

Social capital is highly dependent on the structure of networks (Burt, 2004). In the criminal context higher social capital has been consistently associated with greater and more attractive criminal opportunities (Descormiers, Bouchard, & Corrado, 2011; Morselli, & Tremblay, 2004; Nguyen, & Bouchard, 2013). However, as Bourdieu (1986) points out, social capital only refers to resources an individual can mobilize. While the ability to mobilize resources can be observed in the network size and structure, the nature of the resources one can mobilize is perhaps equally important. Sometimes knowing the right people can be equally or more important as knowing many people.

## **2.5. Social capital in the creation of criminal capital**

The crucial aspect of social capital in the criminal context emerges because resources, skills and opportunities can only be accessed through personal relationships. There are no crime diplomas or job listings in the criminal world. Social relationships are the only channels through which an offender can acquire what McCarthy and Hagan (1995) termed “criminal capital”.

Coleman’s theory of social capital states that social capital is crucial in creating human capital. Human capital, he maintained, refers to knowledge, education and skills one possess (Coleman, 1988). In the context of criminal activity, McCarthy and Hagan (1995) called criminal capital “the knowledge and technical skills that can facilitate successful criminal activity” (p.66). The authors stated that this type of capital can only be acquired through embeddedness in criminal networks. Social capital in the criminal world thus serves the creation of criminal capital.

The idea that criminal endeavours may require specific skills is unfounded according to Gottfredson and Hirschi (1990). However, examples given so far have shown that such enterprises as drug trafficking do require the establishment of a sustained network of accomplices, be it only to access resources. Research has shown that drug trafficking is not the only criminal activity that requires specific skills and opportunity structures. For example, Sutherland (1937) described the complexity of professional theft. According to the author, the “profession of theft” requires very specific skills and knowledge. Tremblay (2011) also showed that crimes like pimping require significant resources. He quoted one of the gang members in his study as saying “Pimping is a surveillance business that takes all your time and requires specific dispositions. You don’t just improvise yourself as a pimp.” (Author’s translation, p.131).

Cloward and Ohlin (1960) have discussed the idea of tutelage available through illegitimate opportunity structures. Research on criminal achievement has found that offenders reported higher illegal earnings when they were tied to mentors (Morselli, Tremblay, & McCarthy, 2006). Bouchard and Nguyen (2010) found that ties to experienced offenders afforded younger offenders more sophisticated opportunities and greater protection in cannabis cultivation enterprises. Beyond illegal earnings and cost

avoidance, ties to older and more experienced co-offenders appear to be crucial to involvement in some criminal activities in general. Sarnecki (2001) found that in co-offending networks, drug-related crimes were usually committed with older offenders. In fact, a willingness to cooperate in criminal careers has been associated with criminal achievement in certain types of crimes, but most notably, for offenders involved in drug-related crimes (McCarthy & Hagan, 2001).

Research on co-offending has argued for a better consideration of the social nature of crime. Warr (1996) found that co-offending groups, despite their short-lived and unstable nature described in prior research (e.g., Reiss & Farrington, 1991), were important in order to understand crime instigation, and the offending patterns of offenders. Although Warr (1996) found that although offenders were generally versatile, co-offending groups tended to be specialized. This particular finding suggests that offenders constrained to only a few co-offending groups may be more specialized than those who have access to a greater pool of co-offenders.

Sarnecki (2001) found that the unstable nature of co-offending networks is reminiscent of Granovetter's (1973) strength of weak ties concept. A recurrent finding in co-offender research is that co-offender ties are rarely used more than once (Reiss & Farrington, 1991; Sarnecki, 2001; Warr 1996; 2002). Sarnecki (2001) argued that when offenders actively seek crime opportunities, weak ties may grant them with access to criminal opportunities. However, the author stated that most criminal offences observed in his sample occurred spontaneously.

Nevertheless, these structures last and may be used by offenders to reach out to a co-offender. Moreover, many studies on co-offending networks relied on official co-arrests to assess the connectivity in a network. Warr (1996, p.22) noted: "the number of accomplices that offenders know, in other words, is greater than the number with whom they actually collaborate during the commission of offences". Offenders, especially juvenile offender, are embedded in social networks that extend far beyond co-offending relationships. For example, Haynie (2001) found that density in friendship networks was an important mediator of the association between delinquent peers and delinquency. Wright and Decker (1994) also explained that even when offenders have a preference

for a specific criminal activity, many often engaged in more risky and/or less profitable crimes simply because a friend requested their help.

Social capital, be it through ties to mentors, older offenders, co-offending or friendship networks, appears to be central to a complete understanding of criminal involvement. Whether it be because it grants access to opportunities, enables the search for suitable co-offenders, or even allows for easy immediate outlets for criminal involvement, greater access to social capital is likely to increase the accessibility to diverse criminal ventures. As McGloin and Piquero (2010) point out, access to unique opportunities in a social network is likely to translate into a versatile criminal career.

The intersection of the social nature of crime and criminal versatility quite naturally lead to the study of street gangs. The inherent group nature of gangs and the claims that gang members are particularly active and versatile offenders (e.g., Decker, Melde, & Pyrooz, 2013) provides a natural context to study the relationship between social capital and versatility.

## **2.6. Jack-of-all-trades in the cafeteria: Versatility and social capital in street gangs**

Klein (1995) used the term “cafeteria style” to describe the offending careers of gang members. The author mentioned that gangs generally lack the basic organization to sustain complex criminal activity. While most gang research states that gangs are loosely organized groups (Klein & Maxson, 2006), organization, even at low levels, has important repercussions for the individual offending behaviours of gang members (Decker, Katz, & Webb, 2008). Bouchard and Spindler (2010) have found that organization of the gang has impacts on the pool of available offenders and may facilitate crime by providing a more efficient, structured-for-crime environment than what is available to non-gang offenders. Similarly, Decker and Van Winkle (1996) contended that while crime is generally not committed by the gang per se, the social environment surrounding the gang facilitates involvement in different crimes. The social nature of gangs, to put it in Klein’s words, shapes the menu of the offence “cafeteria” from which offenders choose to engage in a little bit of this, a little bit of that (Klein, 1995).

Beyond organizational features of gangs, the culture that is associated with this phenomenon also poses restrictions to the availability of resources. Many gang researchers have described the code of conducts that prevails within gangs, which constrains individual behaviour. Matsuda, Melde, Taylor, Freng and Esbensen (2012) found that gang members ascribe to a “code of the street” that regulates their behaviours and justifies the use of violence to attain respect or enact retaliation for wrongs (real or perceived). Decker and Van Winkle (1996), through ethnographic research, depicted an “us versus them” mentality, where loyalty to your fellow gang members is crucial and transgressions are severely punished. Associating with rival gangs, disrespecting another member of your gang and engaging in activities that may hinder the gang's reputation or their business relationships are among common rules that are usually punished by violence in gangs, or at least this is the belief (Decker & Van Winkle, 1996; Venkatesh, 2008).

Despite these rules and the apparent risks of engaging in certain activities or associate with certain individuals, many researchers including Decker and Van Winkle (1996), have noted that gang members transgress these rules if they need to. Venkatesh (2008) describes gangs in Chicago in the late 1980s as being particularly well organized, with members acting as employees having well-defined job descriptions, and leaders ensuring discipline for transgressions and controlling their members' activities. Even in this somewhat highly structured setting, uncharacteristic of most gangs, gang members, highly ranked or not, transgress their gang rules and engage in activities as the opportunities arise. They hustle counterfeit products, they run prostitution rings, they extort local businesses, they cooperate with rival gangs to fulfil demands from drug customers, or when conflicts may scare customers. This entrepreneurial quality of certain gang members is also reflected in Descormiers and Morselli' s (2011) research on Crips and Bloods in Montreal, as they noted that “proximity favors [inter-rivalry] relations in the context of drugs and arms trade” (p.12). They found that although some members are categorical when it comes to associating with rival gangs (“Everything that's Blue, we clean up” [p.10]), some members considered collaborations with rival gangs if they perceived that it would improve their financial situation. Moreover, while Decker and Van Winkle (1996) argued that hostile views of rival gangs are indeed present in gang member's account of the life in a gang, Decker and Curry (2002)

maintained that gangs are not especially effective in regulating their members' behaviours. Gangs typically lack the structure to enforce rules against transgressions of their members (Decker, 2001). Arguably, gangs foster interesting dynamics that may create divergent opportunities for members, and thus, according to criminal career research, versatility or specialization may emerge.

## **2.7. Current study**

The current study applies a social capital perspective to the study of criminal versatility in the street gang context. Gangs provide an ideal setting to study how social capital may be tied to criminal versatility. First, gang members appear to be a particularly versatile group of offenders. Second, the inherent group nature of street gangs, but also the constraints and dynamics known to be central to the gang life, provide different aspects of social capital. Criminal opportunities in gang networks are likely to be influenced by symbolic sources of social capital (e.g. prestige, leadership) and tangible sources of social capital (e.g. contacts in the drug and prostitution business). While exploring the relationship between criminal versatility and social capital is the primary objective, methodological issues with the measure of versatility requires an in-depth analysis of the diversity index as a secondary objective<sup>2</sup>.

The primary objective of the current study is to explore whether greater social capital is associated with criminal versatility. This study attempts to improve on prior research by following the lead from two recent papers on the topic: 1) Guerette et al. (2005), and 2) McGloin and Piquero (2010).

Following Guerette et al. (2005), the current study attempts to apply a theoretical framework to the study of criminal versatility. Bourdieu's concept of social capital will be used to explain how criminal versatility emerges. Criminological theories have been criticized as moving back and forth from oversocialized to undersocialized explanations of crime (Tremblay, 1993). As discussed above, theories of crimes tend to favor individually-based or environmentally-based causes of crime. Yet, even in theories

<sup>2</sup> To avoid confusion, the term versatility index will be used for the remainder of this thesis

focusing heavily on individual causes of crime, environmental influences can never be dismissed and vice-versa. Social capital is neither a purely individual nor a purely environmental characteristic—it is a characteristic of both.

Greater social capital has been associated with access to opportunities, skills, and information in both legitimate and illegitimate enterprises. The rationale behind the primary objective is that greater social capital will be associated with greater access to criminal resources, knowledgeable co-offenders, and information about criminal opportunities. Access to greater social capital may thus enable offenders to engage in a variety of crimes that require different skills and resources.

Following McGloin and Piquero (2010), the current study examines criminal versatility from a social network analysis perspective. While social capital has been measured in many different ways, social network analysis enables a more direct operationalization of the concept. Nevertheless, there exist many different ways to measure access to social capital in a network.

An assumption behind the hypothesis tested in this study is that different types of crimes require *unique* social capital. Hence, a combination of many types of crime will require diverse sources of social capital. Granovetter (1973) explained that unique information and opportunities were better accessed through weak ties. Betweenness centrality measures whether the extent to which an individual is found on the path between two unconnected individuals (Freeman, 1977). Brokerage in networks grants access to diverse and non-redundant information from different unconnected part of the network (Burt, 1992; 2005). In this study, it is hypothesized that being a broker in the network, given the potential variety of social capital accessed by these individuals, will be associated with criminal versatility.



### **3. Data and methodology**

The following sections describe the data used in this study and the measures used in subsequent analyses. The first part illustrates the construction of the social network. The second part explains the decision to focus on known gang members. The third section outlines the network measures and other variables used in this study. Finally, the fourth section introduces the analytic strategy used.

#### **3.1. Background**

The data used for this study were collected as part of a larger project examining the victimization trajectories in the criminal underworld surrounding Haitian street gang members in a large Canadian city. The researchers were interested in uncovering relationships between victims and offenders over their offending careers, and the criminal relationships they build over this period. Rather than focusing on the victimization events themselves, the research centered on the networks and criminal careers of both victims and offenders within the criminal universe of Haitian street gangs. The focus on Haitian street gang members was motivated by important waves of immigration that started in the late 1980s and continued throughout the 1990s (Tremblay, Charest, Charette, Bouchard, Tremblay-Faulkner, & Beaudoin, 2011).

The original data collected by the research team consisted of a large network of offenders and their relations known to police between 1993 and 2008. Ties between individuals were defined by combining two pieces of information: 1) instances of formal co-arrests (1993-2008) and, 2) instances of simultaneous presence during identity checks (2001-2008).

A snowball network sampling strategy was performed to narrow the focus of the study to the social-criminal world around a “core” of gang members known to police. A total of 405 individuals of Haitian origins and identified by police as affiliated with street

gangs were chosen as a starting point. All the individuals who were co-arrested or suspected of a crime with these 405 individuals were added to the database, creating a much larger network of 2787 individuals. These 2787 individuals formed a part of the criminal universe in which these initial 405 gang members were embedded.

## **3.2. Data used in this study**

The initial network allowed for the analysis of the co-offending networks of 2787 individuals between 1993 and 2008. However, information regarding ties that were not specifically due to arrests were only collected for the 2001-2008 period. A decision was made to remove from the network individuals who were only active before 2001. Given the incompleteness of social network information for individuals prior to 2001, it would have biased the results of the analyses by over-emphasizing data from the most recent cohorts.

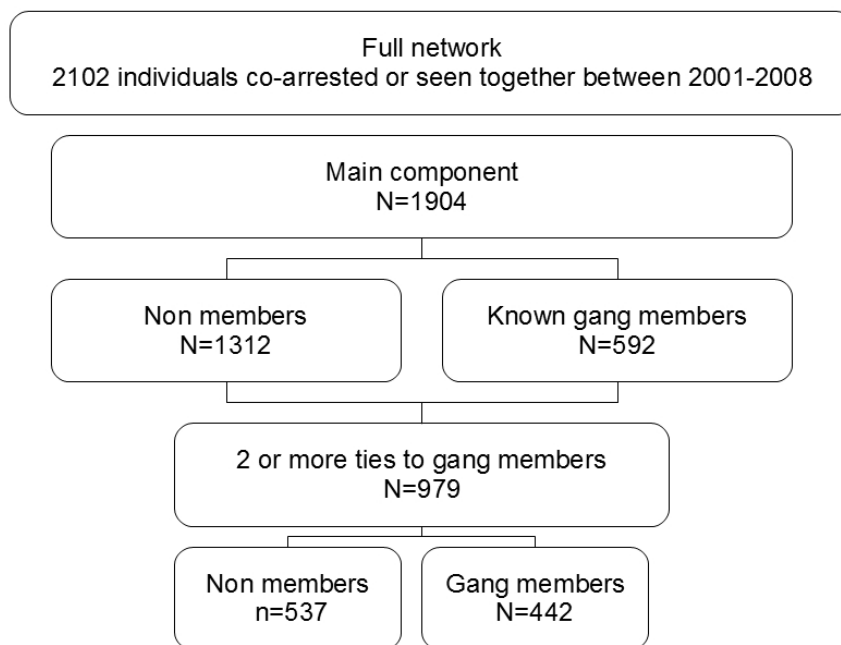
Another option could have been to simply ignore ties that were not co-arrests and analyze the entire co-arrest network from 1993 to 2008. However, a strict focus on co-arrests would restrict our understanding of the social-criminal interactions among gang members to those rare instances when they are arrested for a crime. The knowledge of ties beyond co-arrests expands the information available on each individual to instances where they successfully avoided arrest (or were simply seen “hanging out”). This way, the analyses are not limited to the pool of prior co-offenders, but rather to the pool of potential co-offenders. This is a significant departure from other studies on co-offending networks.

### **3.2.1. Network selection**

The full network includes substantial noise it might be preferable to get rid of. Given the focus on gang members, it is important that the network include contacts that are relevant to their criminal activity. Many ties that may have been collected by the police might have been with acquaintances who have very little to do with criminal involvement. The selection of the network to be analyzed thus reflects the focus of this study on the criminal relationships of street gang members.

Figure 1 explains the different decisions made to reconstruct the criminal network. After the removal of individuals only active prior to 2001, the full network contained 2102 individuals. A large number (n=198) of these individuals were not related to the principal component of the network. These individuals were either interconnected in small isolated clusters or simply not tied to anyone and were removed from the network. These individuals were inter-related in small components surrounding, but not connecting to anyone in the main component of the network.

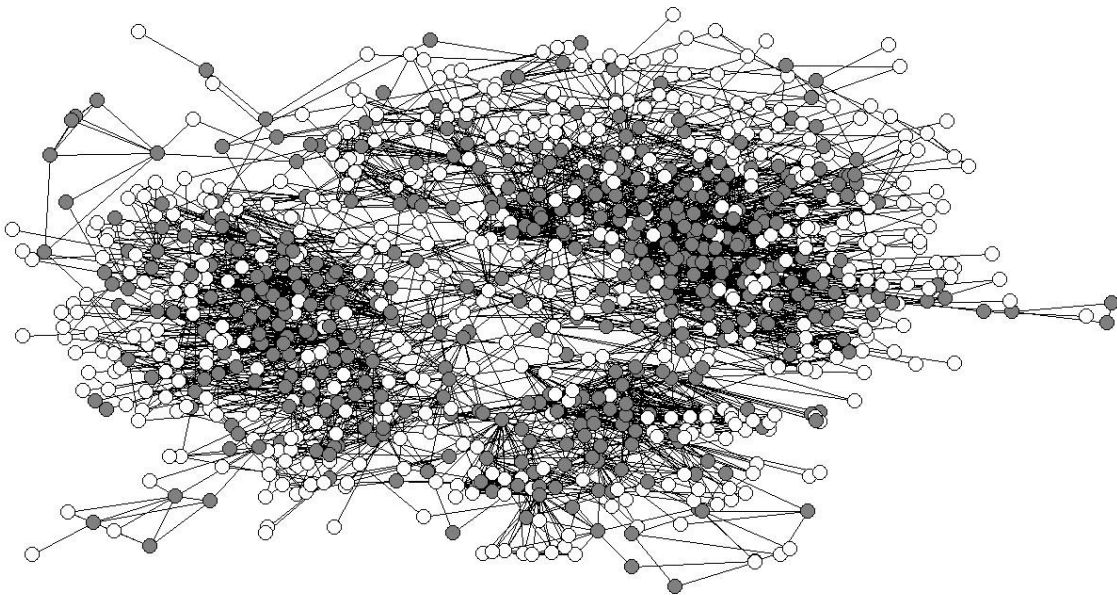
**Figure 1. Network construction**



This network of 1904 individuals included 592 gang members identified through police information. The exact information used by police to attribute gang membership is unclear. It is likely that this information was based on the judgement of the police officer at the scene of an event. However, police identified individuals as either members or associates, which indicates that membership was likely attributed when sufficient information was available. In order to ensure that the network studied consisted of active gang members and their associates, network information was used to identify

individuals that were truly connected to gang members. The 592 gang members were used as a starting point and the network was “re-centered” around those gang members who had at least 2 ties (median for the 1904 network) to other gang members. This procedure ensured that 1) gang membership was not overestimated, and 2) important actors that were not identified as gang members were not removed. All gang members that were not tied to at least 2 other gang members were removed. In total, 442 gang members were selected by that procedure. Other individuals (who were not identified as members) who add 2 or more ties to gang members were kept in order to account for underestimation of gang membership. This procedure added 537 gang member associates to the network, for a total network size of 979.

**Figure 2** *Network of gang members and associates*



Grey nodes=Gang members, White nodes= Associates

Figure 2 shows the network of 979 gang members and associates. Gang members are identified by grey nodes and associates by white nodes. Gang members appear to be more central and concentrated in clusters, while associates are found on the periphery and in-between clusters. Still, some associates are quite central in the network which suggests that the official membership measure may not be completely accurate. However, the inclusion of associates in the network gives a more realistic overview of the network.

### **3.3. Haitian street gang members**

While many different sub-groups of street gangs co-exist in this Canadian city, the decision to focus on Haitian street gang members was motivated by the scope of the original study but also because of the available information on the formation and reproduction of these gangs.

Tremblay (2011) provided an ethnography of one of the leaders of a major Haitian street gang in this city in the 1980s through 1990s. His description of the life of Beauvoir Jean enables a rare insight in the structure, rivalries and criminal involvement of street gangs. The inner-working of street gangs is something that is often ignored in gang research (e.g. Short & Hughes, 2006). Having access to a wealth of knowledge on the structure of Haitian street gangs enables the study of gangs in their environmental context.

#### **3.3.1. *Membership and associates***

An important sampling consideration is whether associates of gang members should be included in the sample. On the one hand, there are several reasons why associates may be included in the analysis. Gang membership is a concept that is notoriously hard to systematically define. Defining the boundaries of membership has often been contentious in gang research. The network perspective may offer a viable alternative to police denominated and self-report methods of identifying membership. If we are to assume that gang members form distinct groups, it should also be assumed that associations among gang members are more likely to be detected than their associations with non-gang members. Thus, analyzing gang members' social networks may prove to be a more practical tool to establish gang membership, or perhaps of more practical importance, gang co-membership. Including individuals with ties to gang members formally identified by law enforcement may avoid underestimation of gang membership and may enable the identification of members who are better at avoiding detection. Conversely, examining gang members' social networks may also help avoid overestimation of gang membership. While police may label an individual as a gang member, his/her network ties may tell a different story.

On the other hand, many reasons might justify removing associates from the analysis given the scope and research decisions of the original project and the information available about gang membership. The original project focused primarily on Haitian gang members. Members of non-Haitian street gangs may be underrepresented in the network, and the size and completeness of their networks may be negatively affected. Moreover, given the focus on Haitian street gang members, less information is available about non-Haitian individuals which may limit the identification of gang membership. Table 1 shows the differences between the two groups on key indicators.

**Table 1. Differences between members and associates**

	Gang members (n=261)	Associates (n=192)
Proportions	%	%
White	3.8	14.6
Black	90.4	75.5
Other	5.7	9.9
2 arrests	26.1	37.5
3 arrests	19.5	24.0
4 or more arrests	54.8	38.5
Mean (SD)		
Degree- Gang network**	11.25 (8.03)	4.79 (3.65)
Betweenness- Gang network**	3852.08 (5758.49)	920.83 (2617.65)
Degree- Full network**	13.21 (9.33)	6.11 (4.16)
Betweenness- Gang network**	16986.72 (25087.15)	5056.83 (10177.92)

\*\*p<0.01

Based on the differences identified in table 1, a decision was made to focus on individuals identified as gang members. The information available regarding network size (degree centrality) of both groups indicate that networks of gang members are on average larger much larger than those of associates. It could be argued that the networks of associates may have been reduced by the decision to keep only those associates with 2 or more ties to gang members. However, the significant differences between centrality measures of members and associates in the full network, in which no manipulations were made, indicate that the discrepancy is not an artefact of the

manipulation of the network. Similar differences are observed for betweenness centrality, which refers to the extent to which an individual is a broker in the network.

Although these differences may indicate that gang members have in general larger networks and are more likely to be brokers compared to gang associates, further analyses indicate that there is a strong possibility that this difference is an artefact of data collection. The ethnicity composition of the associate sample also hints at the fact that this difference may be related to the Haitian street gang member focus of the original project. In fact when looking at the differences between network measures of Blacks and non-Blacks (Table 2), we see that non-Blacks are less central than Blacks for both members and associates, although only significantly so for associates. Although these differences may not be an artefact of data collection and might reflect the reality of street gangs in this particular city, the evidence points towards a bias towards Haitian gang members in the data collection. However, given the small number of non-Black gang members and the fact that none of the differences were statistically significant, these cases will be kept for the analysis.

**Table 2. Network measures by ethnicity for members and associates**

	Members		Associates	
	Black (n=236)	Non-Black (n=25)	Black (n=145)	Non-Black (n=47)
Degree-Gang network	11.42 (8.30)	9.64 (4.70)	5.02 (3.88)	4.06 (2.73)†
Betweenness-Gang network	4027.63 (5948.39)	2194.87(3100.11)	1149.00 (2955.75)	216.87 (657.00)*
Degree-Full network	13.37 (9.57)	11.68 (6.57)	6.50 (4.44)	4.91 (2.88)**
Betweenness-Full network	17649.08 (25787.40)	10734.03 (16177.85)	6136.28 (11362.57)	1726.61 (3309.95)*

† p<0.1, \*p<0.05, \*\*p<0.01

While analyses regarding the relationship between versatility and social capital will focus on street gang members, it would be a mistake to ignore associates in the network for the computation of network measures. While their individual information may be negatively biased, associates are still important in the overall connectivity of known gang members in the network. These individuals enrich the social capital of the

gang members with whom they associate. In fact, they may bring in the network resources and capital that is unique and foreign to Haitian gang members.

### **3.4. Dependent variable**

The dependent variable used in this study is the versatility index. The index calculates the probability that two offences picked at random from an offender's criminal career will fall in the same category of offences (Mazerolle et al., 2000). Subtracting this probability from 1, this index indicates complete specialization with a score of 0 and versatility as the score approaches 1. The maximum value of the diversity index varies according to the number of crime categories and is calculated with the following formula:

$$(Number\ of\ categories-1)/Number\ of\ categories$$

The use of the diversity index is particularly relevant in the study of criminal career as it allows characterization of an individual's tendency towards offending versatility (McGloin et al., 2007; Piquero et al., 1999; Sullivan et al., 2009). An inherent problem of many measures of offending versatility is that they are influenced by offending frequency (McGloin et al., 2009). The problems associated with the measure of versatility led to an in-depth analysis of the properties and interpretation of the index discussed in the following chapter.

### **3.5. Independent variables**

#### **3.5.1. *Network measures***

The primary network measure used in this study is Freeman's betweenness centrality. Betweenness centrality is defined as the extent to which an actor is found on the shortest path between unconnected actors (Freeman, 1977). Individuals with high betweenness centrality score are able to control the flow of information between unconnected individuals and are able to reach different regions of the overall network. Social capital in networks has often been measured using Burt's structural holes measures. However, Borgatti, Jones and Everett (1998) maintain that when information



about the entire network is available, centrality measures such as betweenness centrality are richer measures than structural hole measures (e.g., effective size, constraint). Betweenness centrality measures a node's position in the network by considering every node in the network, whereas structural hole measures are based on ego-networks (Borgatti et al., 1998).

Secondary analyses consider four additional network measures: 1) degree centrality, 2) effective size, 3) constraint, and 4) coreness. Degree centrality simply refers to the size of an ego's network. High centrality in a network indicates "where the action is" (Wasserman, & Faust, 1994, p.179). In other words, high degree centrality indicates high visibility in the network.

While having many contacts in a network may be reflective of one's importance, redundancy of ties greatly limits the access to unique information and the ability of an ego to control information flow in a network (Burt, 1992). Differential access to social capital implies positional advantages in a network (Bourdieu, 1986; Burt, 2000). According to Burt (1992; 2004), positional advantages appear when one is taking advantages of structural holes. Structural holes are found in a network whenever two individuals or groups are not connected to one another (Burt, 1992). Bridging this gap confers positional advantages to the individual occupying this structural hole, as it grants access to different information and opportunities (Burt, 2004). Social capital, created by proximity to structural holes, is thus acquired by this mechanism known as "brokerage" (Burt, 1992; 2004; 2005). Brokerage reflects social capital in the sense that "networks that span structural holes provide broad and early access to, and entrepreneurial control over, information" (Burt, 2000, p. 347).

Two measures were used to measure access to structural holes. Effective size of a network refers to degree centrality minus the redundancy of ties (Burt, 1992). In other words, effective size refers to an ego's access to alters that are not connected to one another. Morselli and Tremblay (2004) argued that effective size of a network was more important than the simple size of this network in predicting criminal achievement. A related measure that was proposed by Burt (1992) is network constraint. While similar to effective size in that it is a measure of network redundancy, constraint considers the

“network time”<sup>3</sup> invested in constrained individuals (Burt, 1992, p.55). Network constraint differs from effective size in that it is less related to degree centrality, and more related to network efficiency. In other words, low constraint indicates that a larger proportion of an ego’s alters are themselves low on constraint. Since network constraint is a proportion, changes in alters’ constraints will be less impacted in larger ego-networks (i.e. because each alter is has smaller weight), than it will be in smaller ego-networks. Still, egos with small or large networks will receive similar low constraint scores if all their ties are themselves low on constraints. Comparatively, given that small networks can never achieve an effective size larger than their degree centrality, it is likely that larger networks will be associated with larger effective sizes as well. Constraint is thus more reflective of strategic access to opportunities from structural perspective, whereas effective size reflects access to opportunities through the sheer volume of contacts.

The final measure used is the measure of coreness. Coreness measures the extent to which an individual is found at the core of a network rather than on its periphery (Borgatti & Everett, 1999), a measure that is especially suitable for research on gang networks (Bouchard & Konarski, in press). The measure estimates the coreness values for all pairs of nodes in a network and gives high values when most ties of an ego are found close to the center of the network, and low values when most ties are found in the periphery. This measure indicates to what extent an individual is in the “thick of things”. Individuals close to the core of the network are thus crucial to the structure of the overall network.

All measures were computed using UCINET version 6.392 (Borgatti, Everett, & Freeman, 2002).

### **3.5.2. Control variables**

The main analysis includes three control variables. First, age was used as a control in regression models. Given the cross-sectional nature of the data, age was

<sup>3</sup> In a non-valued network, network time simply refers to the proportion of all ego’s contacts an alter represents

coded as a gang member's age at the end of the study period (2008). The relationship between age and criminal involvement is well known in criminology. Furthermore, given the inclusion of gang members from a wide age range, it was crucial to control for this effect. Second, further analyses revealed a quadratic effect of age on versatility. Regression models thus included age squared in order to control for this effect.

Third, total arrests were entered as a control in the models. The relationship between offending frequency and versatility has been a source of concern for critiques of the use of the versatility index (Sullivan et al., 2009). The following chapter looks at the relationship in detail. However it is important to note that this variable does not necessarily refer to the number of arrests used to compute the versatility score. As will be demonstrated in the following chapter, some offences were excluded for the purpose of measuring versatility. Total arrests include all arrests recorded for an offender between 2001 and 2008. It is important to control for the total official contacts with police in this study as it may have an influence on offender's networks. A gang member arrested frequently will most likely draw more attention from law enforcement, even if those arrests are minor probation violations.

An additional measure was used in secondary analyses. The proportion of arrests was used to measure the extent to which contacts with police were through official arrests or informal contacts. It was measured by dividing the total number of arrests by the total number of contacts (arrests and informal contacts). A high value on this measure indicates that most contacts between a gang member and law enforcement were made through formal arrests.

### **3.6. Analytic strategy**

Issues regarding the modeling of the versatility index were identified early in the process of conducting the study. It became clear that a thorough analysis of the nature and interpretability of the versatility index was necessary prior to testing the main hypothesis. Results are thus divided into two chapters. Chapter 4 explores the properties of the versatility index and provides solutions in order to model the relationship between social capital and versatility. Chapter 5 presents the results for

these analyses. The statistical techniques used in Chapter 5 and the reasons that motivated those decisions are described in detail in Chapter 4. Still, an overview of the analytic strategy is presented here.

Prior studies (e.g., Sullivan et al., 2006) have recognized the difficulties associated with the modeling of the versatility index. The use of the versatility index as a dependent variable has been found to violate key assumptions of OLS regression, most notably homoscedasticity and non-normality of residuals. For reasons explained in Chapter 4, the decision was made to use a novel technique that has only recently been used in criminology (Delisi, Beaver, Wright, Wright, Vaughn, & Trulson, 2011)—quantile regression. Quantile regression (Koenker & Bassetts, 1978) does not assume a specific distribution of residuals and is not restricted to estimations of conditional means (like most OLS regression models). The technique enables modeling of dependent variables at different quantiles, or levels, which emerged as crucial after analyses described in Chapter 4. The technique and the rationale for its use are explained in more details in Chapter 4.

## **4. Methodological issues in the use of the versatility index**

There is substantial debate on what is the best approach to measure criminal versatility or specialization. Sullivan et al. (2009) have said that the disagreement regarding which measure is best to use has led some to question whether researchers are actually studying the same concept from one study to another. In this study, it was crucial to have an individual-based measure of versatility. The versatility index has been the most widely used individual measure of criminal versatility and specialization (Sullivan et al., 2009). While concerns have been raised regarding the distributional properties of the index and its interpretability (Osgood & Schreck, 2007; Sullivan et al., 2009), the measure has been and continues to be used in criminal career research.

This study attempts to contribute to research on criminal versatility by undertaking an in-depth analysis of the distributional properties and interpretability issues linked to many key decisions made by researchers using this index. Since its importation from ecological sciences to the study of criminal versatility (Mazerolle et al., 2000; Piquero et al., 1999), no studies have considered the impact of different research decisions on the validity and interpretability of the index. Early in the process of conducting this study observations raised concerns that need to be addressed prior to using the measure to test the main research question.

This chapter presents the results of these analyses. First, different crucial research decisions are analyzed in relation to their impact on the distributional properties of the index and its interpretability. Second, the decisions regarding crime classifications and the interpretability unique to the theoretical framework used in this study are discussed. Third, issues related to statistical modeling of the index are considered and the analyses to be used in the following chapter are explained

## **4.1. Minimum number of offences and the use of categories**

The versatility index measures the probability that two offences taken at random in an individual's career will fall in the same category (Mazerolle et al., 2000). Thus, the versatility index can only be calculated for individuals with at least two offences. While using individuals with 2 or more offences might be appealing when dealing with relatively small sample sizes as is the case in this study, the ability to quantify versatility (or specialization) when only two data points are available is very limited. Moreover, it should be noted that allowing cases with a number of arrests lower than the number of categories used is also not advised; it would be impossible to have a perfect versatility score if it is impossible to have at least one offence in each category.

Despite those considerations, prior research using the versatility index has often included individuals with 2 offences in their analyses (Piquero et al., 1999; Sullivan et al., 2006), even when using multiple categories of crimes (e.g., Sullivan et al. (2006) use 10 crime categories). It can be shown that using cases with lower numbers of offences creates a bias towards specialization, especially when the minimum number of arrests does not reach the number of categories used. Some have argued that the versatility found using the index is confounded with offending frequency (e.g., Sullivan et al., 2009). The effect appears to be highly contingent on the number of categories used, but also on the assumption that the probability of committing a crime of each type is equal.

**Figure 3. Total number of arrests distribution**

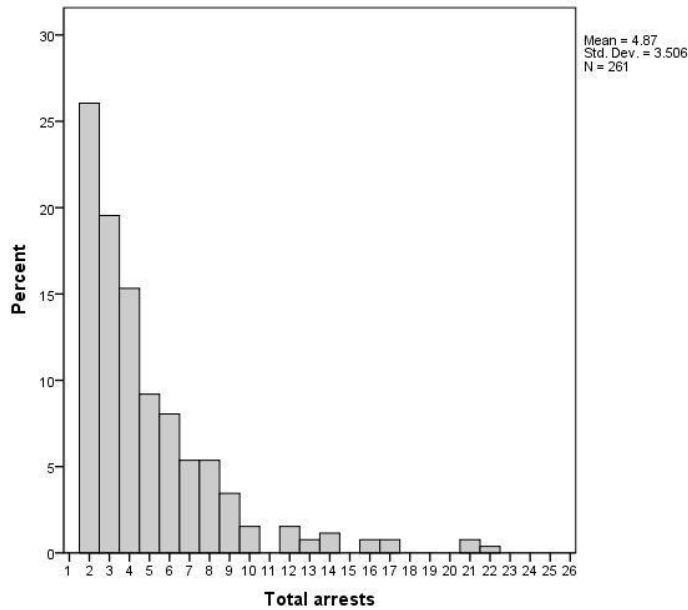


Figure 3 shows the distribution of the total number of arrests for cases with two or more arrests in this sample. Not surprisingly, a large proportion of cases have only 2 arrests (26%). The percentage of cases decreases exponentially as the number of arrests increases. This implies that, as mentioned above, removing cases with a low number of arrests will significantly reduce the sample size for the analysis. Another consideration is that removing a large number of cases will hinder the generalizability of the results. Choosing the cut-off value of arrests to include should not be based solely on methodological considerations, but this decision should also be guided by internal and external validity considerations.

Table 3 illustrates the impact of different sample selection decisions on the versatility index distribution. Mean versatility scores appear to increase as the minimum number of offences increases. However this increase is not dramatic. This is surprising when considering the discrepancies in the number of cases with values of 0 on the index at each cut-off value. Respectively, 18.4, 11.4 and 7.7% of cases can be found at 0 when including individuals with 2, 3 and 4 arrests.

**Table 3. Versatility index descriptive statistics using different samples**

Arrests	Sample size	Mean versatility	Mode (n)	Minimum (n)	Maximum (n)
2 +	261	0.41	0.50 (51)	0.00 (48)	0.75 (1)
3 +	193	0.44	0.44 (40)	0.00 (22)	0.75 (1)
4 +	142	0.47	0.63 (17)	0.00 (11)	0.75 (1)
5 +	102	0.49	0.61 (8)	0.00 (5)	0.72 (3)
6 +	78	0.50	0.61 (8)	0.00 (3)	0.72 (2)

However, for cases with only 2 or 3 arrests, the downward impact on the mean of values of 0 is offset by other clusters of values. The only possible values when only 2 arrests are considered are 0 and 0.5. With three arrests, only three possible values exist: 0, 0.44 and 0.67. Table 3 reports the mode values and the number of cases found at the modal value. The clustering of cases at 0.5 is not uniquely caused by cases with 2 arrests, but they account for 46 out of 51 total cases with values of 0.5. Similarly, cases with 3 arrests account for 35 of the 40 cases with values of 0.44. It is also interesting to note that of the 51 cases with 3 arrests; only 9.8% (5 cases) have the highest possible value of 0.67. This highest possible value however should not be confused with the theoretically highest possible value of the index, when calculated using four categories, of 0.75.

These observations point to two things: 1) the inadequacy of measures of central tendencies with these cases, and 2) the inherent weight towards specialization cases with only 2 or 3 arrests have. At two arrests, the index is reduced to a dichotomous indicator of specialization. The maximum value possible for two arrests is 0.5. When compared to the theoretical maximum value of 0.75, one could argue that a value of 0.5 shows a tendency to be versatile as it crosses the mid-point of the maximum possible range (0.375). Although it will be demonstrated below that using the 0.75 value as a comparison point may be inadequate, it shows that including many cases that cannot reach the maximum value of 0.75 necessarily leads to a bias towards specialization if one relies on measures of central tendencies in both bivariate and multivariate statistical analyses. This finding is likely to be unchanged for large sample sizes. Given the usual Poisson distribution of count data, the lowest values will most likely have the highest



frequencies. Hence, the influence of cases with a low number of arrests will be much larger than those with higher number of arrests.

#### **4.1.1. Number of categories used**

Sullivan et al. (2006) argued that “aggregation [into crime types] may actually bias the findings towards specialization because the ‘target’ for repeat offending is much larger than a specific crime, such as auto theft” (p.208). As these authors were interested in identifying specialization, they opted for what they say is a more “conservative” (p.222) approach to identifying specialization. The authors thus use 10 categories (burglary, business robbery, personal robbery, assault, theft, auto theft, forgery, fraud, drug crimes, and rape). They state that the maximum theoretical value from this index is 0.90.

In the sample used for this thesis, it can be demonstrated that Sullivan et al. (2006) are right in assuming that using aggregate categories will lead to a bias towards specialization. Table 4 presents the mean versatility values for two different ways of calculating the index: 1) using the four categories of crimes involving similar skills<sup>4</sup>, and 2) disaggregating these categories into 13 separate criminal offences (Assault, sexual assault, threats, homicide/attempted homicide, burglary, robbery, theft, fraud, fencing, kidnapping, drug trafficking, misdemeanour, and prostitution).

**Table 4. Mean versatility by minimum number of arrests**

<b>Arrests</b>	<b>Mean versatility (SD) (4 categories)</b>	<b>Mean versatility (SD) (13 categories)</b>
2 +	0.41 (0.22)	0.54 (0.21)
3 +	0.44 (0.20)	0.59 (0.18)
4 +	0.47 (0.19)	0.63 (0.16)
5 +	0.49 (0.17)	0.66 (0.15)
6 +	0.50 (0.17)	0.67 (0.15)

<sup>4</sup> These categories will be explained in detail later on in this chapter

While it is true that a versatility index with 13 categories tends to produce larger values on the versatility index, the relationship between versatility in offending frequency is also much greater when using 13 categories. Table 5 presents the standardized betas and R-square for simple linear regression models with versatility (using both measures) as a dependent variable and total number of arrests as an independent variable.

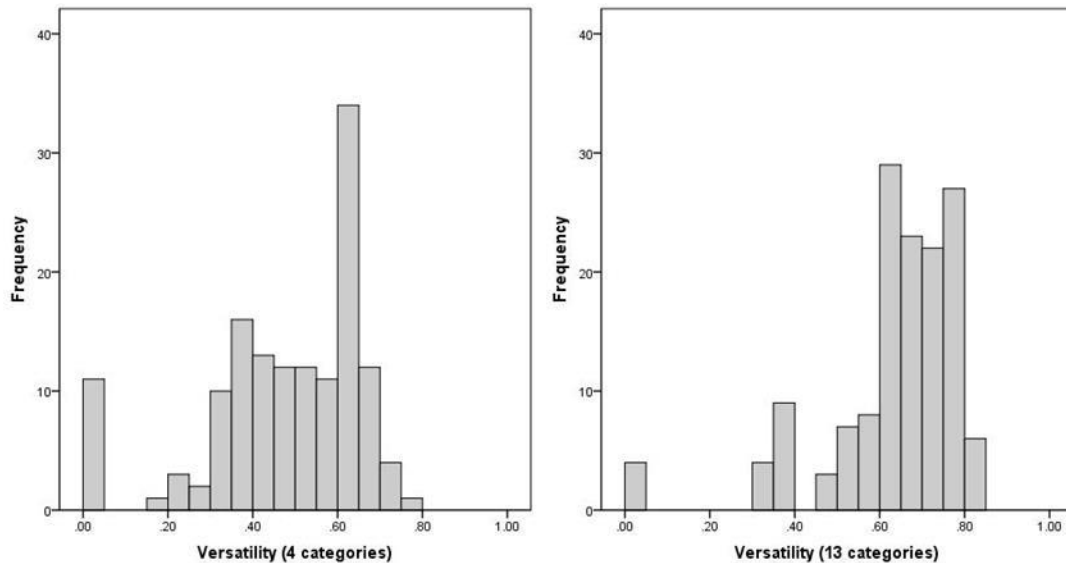
**Table 5. Regression coefficients and variance explained for simple regression models predicting versatility from offending frequency**

Arrests	13 categories		4 categories	
	Std $\beta$	R-squared	Std $\beta$	R-squared
2 +	0.437	0.191**	0.263	0.069**
3 +	0.356	0.127**	0.190	0.036**
4 +	0.260	0.068**	0.111	0.012
5 +	0.176	0.021†	0.072	0.005
6 +	0.127	0.016	-0.006	0.000

†  $p < 0.1$ , \*\* $p < 0.01$

When using 13 categories, offending frequency explains a significant portion of the variance up to 5 or more arrests, compared to 3 or more arrests when using four categories. Moreover, the standardized coefficients are much larger for 13 categories than they are when using 4 categories. When comparing the distribution of versatility scores using 4 or more arrests for both indices (Figure 4), it becomes clear why the coefficients for offending frequency while still large, are not accounting for a large proportion of the variance—there is not much variance to explain in the first place.

**Figure 4. Distribution of versatility index values for 4 and 13 categories**



This effect is likely caused by the fact that in order to get the theoretical maximum value with 13 categories, it is necessary to have committed at least 13 crimes, whereas it only requires 4 offences with 4 categories. Only 10 cases in this sample have committed 13 or more offences. Even for those offenders, they would have to have committed an offence in each of the 13 categories in order to get the theoretical maximum score. While this pattern would undoubtedly point to extreme versatility, at high numbers of offences the departure from a high score of versatility is unlikely, even in cases where it seems obvious that a versatile pattern is present. For example, in staying with the case of 13 offences, if 10 offences are committed in one category and the other 3 offences are committed in different categories; this would result in a score of 0.40.

It appears clear that using four categories favors specialization, whereas using 13 categories favors versatility. Just as Sullivan et al. (2006) favored an approach that was more likely to yield versatility in order to study specialization, it could be said that in the present study, where versatility is the topic of interest, the same rationale could be used. If we wish to discriminate between truly versatile offenders and others, it may be wise to use four categories instead of 13. However, a final issue regarding the

interpretability of the versatility index should be explored: the assumption that all types of crime are likely to be committed in the sample.

#### **4.1.2. Equal probabilities**

It is to be expected that certain crimes occur with much less frequency than others.. Sullivan et al.'s (2006) argument in using 10 categories was that specialization identified by the index will leave little doubt regarding whether or not an offender is a specialist. They state that since the "target" is much smaller when using more categories the likelihood of finding specialization is much less likely. In using 10 categories, they establish that the maximum theoretical value of the index is 0.90. While mathematically correct, this is not a realistic benchmark given the offence frequency distribution provided. The authors compute versatility indices for offenses committing within a month and for offenses committed over 36 months. For 75% of their monthly sample, the maximum value possible is 0.75 (less than 5 arrests). Nevertheless, this benchmark could be attainable for most of the sample over 36 months, but only under specific circumstances. This is where considerations of the probability that a case will commit 10 different crimes become important.

While the authors do not provide statistics regarding the distribution of the total number of offences in the different types, examining the offence types used in their study is useful. Sullivan et al. (2006) compute their versatility index using arrests for: burglary, business robbery, personal robbery, assault, theft, auto theft, forgery, fraud, drug crimes, and rape. Arguably, rape, forgery and fraud are not as common as thefts, assaults or drug crimes. Because the authors do not provide statistics about the frequency of those crimes, it is impossible to know for sure. Moreover, it is perhaps more likely those offenders will commit combinations of subtypes of robbery rather than a personal robbery, a rape, and a fraud. Yet, an offender with 3 arrests for business robbery, personal robbery and burglary would be considered as versatile.

Mazerolle et al. (2000) point out that there is no agreed upon typology of crimes. As such studies using the versatility index have often calculated the index without categorizing offences (Mazerolle et al., 2000; McGloin et al., 2007; Sullivan et al., 2006; Sullivan et al. 2009). As was demonstrated above this is not the best approach

methodologically. It could also be argued that the substantive meaning of the index is difficult to interpret in these circumstances.

#### **4.1.3. *The substantive meaning of the versatility index***

Most studies using the versatility index have relied only on the relationship between the index and a limited number of covariates. Very few studies have considered the substantive meaning of different values of versatility. This thesis constitutes a rare attempt at deconstructing the versatility index and analyzing its behaviour. Examining how the index behaves under different circumstances (at low and high number of offences, by aggregating or not aggregating offences, etc.) is crucial in order to understand exactly what it is we are trying to predict.

Although it is rarely discussed in these terms, the versatility index is essentially an index of qualitative variation (IQV; Agresti & Agresti, 1978). As such its purpose is to “[describe] the dispersion of the population over a number of nominal categories” (Agresti & Agresti, 1978, p.204). Typically, IQVs are used to measure the heterogeneity of a population in terms of ethnicity or religious affiliation. As is the case for crime types, there is not a single adequate classification scheme for ethnicity. Generally, ethnicity will be divided into more or less broad categories depending on the population studied or the specific research questions investigated.

Considering the use of an IQV to measure the ethnic diversity of a specific region provides a good analogy to explain the necessity to classify crimes into types that make sense both for the sample studied and the research question studied. Technically, there could be an infinite number of ethnicity categories that could be used. In most cases, however, including all possible categories is unnecessary. For example, a researcher might be interested in studying the impact of segregation in African Canadian communities. An IQV could be used to compare the levels of segregation between different neighborhoods in which there are only two dominant groups: Caucasians and African Canadians. In this case, it would amount to a simple proportion. However, perhaps these communities have large Latino communities as well. In that case an IQV using three categories could be used.

The use of a third category significantly changes the meaning of the IQV. A high value of an index of ethnic diversity indicates heterogeneity. A low value indicates the domination of a single group. Generally, when combined with descriptive statistics, it is easy to identify which group is dominating. Where the interpretation can become murky is in the mid-values of the index. Such a value would indicate that two groups co-exist in majority in a community. While this may be interesting to the researcher, it would perhaps be difficult to interpret if Latino and African Canadian communities have similar characteristics with regard to the research question (e.g., income inequality). The index would give similar values for African Canadian/Latino dominated communities, Caucasian/African Canadian dominated communities and Caucasian/Latino dominated communities. It is possible that using three categories in this case provides more complete information than, say combining Latino/African Canadian in a single category. However, depending on the question of interest, it is possible that using three categories would only blur the relationship investigated. In the ethnicity example with three categories it is relatively easy to look at contrasts, especially because the IQVs are measured at a group level, hence, generally only a few IQVs are used. When measuring offending versatility, the communities are analogue to criminal careers; ethnicities are analogue to types of crime. However, the same principles apply, but in this case it is much more difficult to assess the adequacy of each versatility measure—even more so when using a large number of categories.

It is perhaps necessary at this point to state the obvious: Using an index of *qualitative variation* implies that the categories used vary qualitatively from one another! The manner in which they vary is only relevant to the specific research question for which the index is calculated. What is certain is that one should be careful to interpret and compare versatility scores where individual offences, as opposed to categories, are used. Is there a meaningful difference between an offender that has committed only burglaries and offender who has split his career between burglaries and thefts? And is an offender as versatile if he commits 5 assaults and 5 auto thefts? It is argued in the present case that maybe there is a meaningful difference, maybe not—it depends on the research question.

## 4.2. Crime classification and index interpretation in the current study

In this section, the rationale for categorizing offences into four categories and the decisions to remove certain offences from the calculation of versatility is explained. The focus of the present study is on an offender's capacity to gain access to different criminal opportunities and learn different skills through network determinants of social capital. The inclusion and categorization of different offences will reflect this focus.

### 4.2.1. *Four crime types*

The four crime types used in this study have been grouped together because they require similar skills and opportunities. Although not necessarily on a continuum, the first two categories reflect crimes that do not require much preparation, skills or sustained criminal relationships, whereas the last two categories do.

**Violent offences** include assaults, threats, kidnapping/confinement, sexual assaults, and homicides/attempted homicides. This category is perhaps the most homogenous of all in terms of necessary planning and required skills. Sexual assaults and homicides/attempted homicides would perhaps be more suited in a "skilled" violence category but their rarity (4 sexual assaults, 3 homicides and 23 attempted homicides) would make this category superfluous. Moreover, it is impossible to assess with the available data whether attempted homicides were planned in advance or occurred in the heat of the moment (the latter is probably more likely). Nevertheless, these crimes generally do not require any specific skills, at least compared to the other crime categories.

**Unskilled property crimes** include theft, burglary (breaking and entering), and personal robbery. These offences require a limited amount of skills. They also generally require little planning. To some extent personal robberies constitute a step above simple theft, but only to the extent that violence is involved and a weapon is used. What characterizes these offences as a whole is that they do not require specific skills and do not require one to know specific co-offenders. They could very well be committed with co-offenders who happen to be available at the moment of the offence.

What is common to the last two types of crime is a notion of trust and access to resources—commodities that take time to acquire. Moreover, they might necessitate that gang members “prove themselves” to other members which may necessitate involvement in prior criminal activities before gang members are “entrusted” to be involved in market crimes and skilled offences.

**Skilled property offences** include motor vehicle theft, fraud, business robberies and fencing. These offences require specific skills (e.g., motor vehicle theft, fraud), reliable co-offenders (e.g., business robberies) and trading partners (e.g., fencing).

**Market crimes** include drug trafficking, prostitution offences, and loan sharking. These offences require access to product (e.g., drug trafficking), clients (e.g., prostitution), employees and capital (e.g., loan sharking).

**Excluded offences.** The decision was made to remove three types of offences: Drug possession, weapon-related offences, and status offences. Those offences were hard to categorize in terms of their necessary skills or resources. Many studies include an “other” category, but in the context of studying versatility, such a category would have likely only inflated versatility scores and made the interpretation more difficult. Moreover, there is no substantive meaning in having an “other” category specialist.

**Table 6.** *Pearson correlation matrix for types of offences*

	Unskilled	Skilled	Market	Violence
Unskilled	1			
Skilled	0.023	1		
Market	-0.147†	-0.121	1	
Violence	-0.051	0.015	-0.123	1

† p<0.1

An interesting fact about these categories is that they are not significantly correlated to one another (Table 6). This indicates that on average, involvement in one type of offence is not correlated to involvement in another (although involvement in



market offences is generally negatively related to involvement in other types of offences but only marginally significantly so).

These categories allow for a better interpretation of the versatility index for the purposes of the present study compared to an index using all crime types as described above. Moreover, this index has the desirable property of not being significantly correlated with offending frequency ( $r=0.111$ ,  $p=0.182$ ) while the 13 categories index was significantly correlated to offending frequency ( $r=0.261$ ,  $p<0.001$ ). It is also interesting to note that the two indices are themselves highly correlated ( $r=0.703$ ,  $p<0.001$ ).

Methodologically, the four category index is superior in that all cases can theoretically reach the maximum value of the index (0.75). The weak correlation with offending frequency is also a desirable characteristic of this index. In terms of the substantive meaning of the index, it is much more suitable in order to answer the research questions of the present study. The more manageable number of categories will allow a more in depth analysis of offenders' criminal careers, a step rarely taken in prior studies of versatility/specialization.

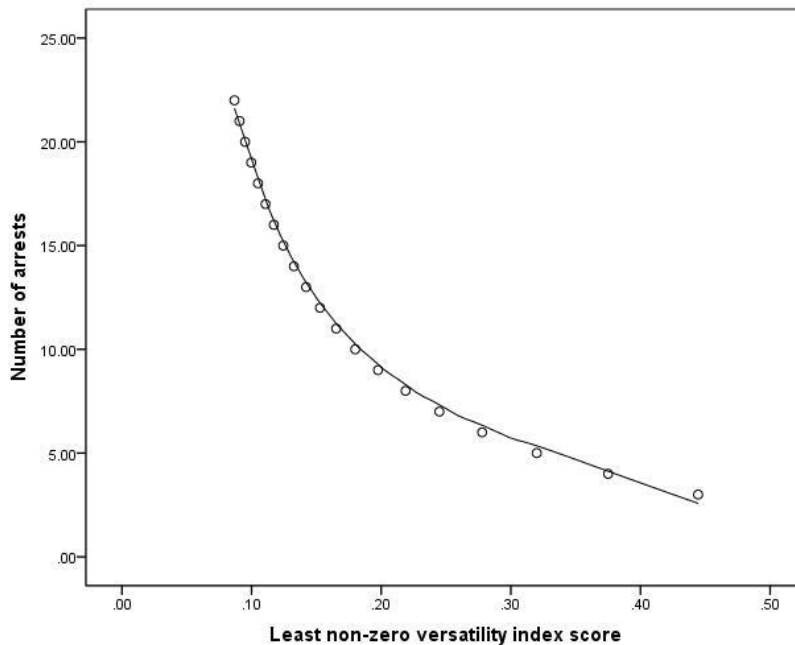
#### **4.2.2. Interpretation of the index with four categories**

It could be argued that beyond the perfect score of 0 on the versatility index, scores between cases become much more difficult to compare. At 0, all crimes committed fall within the same category. Now, even at 4 offences, this indicates persisting repetitions of behaviour, despite consequences of prior arrests. The confidence associated with the appropriate qualification of an offender as a "specialist" is much greater, even for only 4 arrests, than it is for the qualification of an offender as "versatile".

Moreover, scores above zero are not necessarily continuous. The continuous nature of the measure is only truly achieved for cases with large numbers of arrests. For example, an offender with 4 arrests can receive a score of 0, 0.37, 0.5, 0.63, and 0.75. Similarly, for five arrests, six scores are possible (0, 0.32, 0.52, 0.56, 0.64, and 0.72). The difficulty occurs when it comes to comparing individuals with different numbers of

arrests. For example, offender A has 4 arrests in total with 3 in one category and 1 in another, offender B has 5 arrests in total with 4 in one category and 1 in another, and finally offender C has 6 arrests with 5 in one category and 1 in another. Respectively, the three offenders would score 0.37, 0.32, and 0.28 on the versatility index. Although these offenders commit different numbers of crimes, they still have similar patterns of offences. Yet, they would have very different versatility scores. While a control variable for the total number of arrests can be included in a regression model, it is unclear what kind of relationship exists between frequency of offending and the versatility index. Figure 5 plots the relationship between the number of offences and the versatility index score for the least non-zero versatility score possible.

**Figure 5. Least non-zero index score by number of arrests**



This index refers to careers of  $n$  offences with  $(n-1)$  offences in one category and 1 offence in a second category. Similarly shaped curves can be estimated with  $(n-2)$  in one category and 1 in two other categories respectively, and with  $(n-3)$  in one category and 1 in three other categories. For lower values of versatility, the relationship seems to follow this curve. However, it is very difficult to recreate such a clear relationship with higher values of versatility.

“Perfect” versatility implies that an equal number of crimes are found in each category. A minor problem arises when the number of arrests is not divisible by 4 (or in more general terms, by the number of categories). The maximum value of versatility is only possible for multiples of 4. When a high number of arrests are considered, the value tends towards 0.75. However, at smaller number of arrests, such as 5 or 6, the maximum value possible is 0.72. This difference is not dramatic but it illustrates the instability of the index at higher measures of versatility. This maximum value is attained by spreading the arrests somewhat equally across four categories. Another peculiar phenomenon arises when two or more crime categories have the same number of crimes. If the number of crimes is split somewhat equally across two categories, the versatility index tends towards 0.5, with values of 0.48 possible for cases with an odd number of arrests. If the number of crimes is somewhat evenly spread in three categories, the versatility index tends toward 0.67.

Given the sample at hand, with most cases having 4, 5, 6 or 7 arrests, these observations imply that the versatility index can hardly be considered a continuous variable. If it is assumed that the probability of committing any crime is the same for each type of crime, only a few scenarios are possible:

- Pure specialization (versatility=0)
- Perfect versatility (versatility=0.72-0.75)
- Evenly split in two types (versatility=0.48-0.5)
- Evenly split in three types (versatility=0.63-0.67)
- Non-pure specialists (0.38-0.25)

Other values are possible since some offenders have more than 7 offences. However, the scores from these individuals should not deviate very far from these scores. The categories above are useful moving forward because they illustrate groups for which the versatility index might be appropriate and groups for which it might not be. Table 7 illustrates every possible combination of categories for individuals with 4 to 7 arrests and their corresponding scores on the versatility index. The dark grey areas represent the non-pure specialists and the perfect versatile groups. The light grey areas represent those evenly split in two or three types.

**Table 7. Composition of versatility scores**

Arrests	Versatility scores								
	0.25-0.38	0.41-0.44	0.45-0.50	0.48-0.50	0.56-0.61	0.61	0.63-0.67	0.67-0.68	0.72-0.75
7	6-1	5-2	5-1-1	4-3	4-2-1	4-1-1-1	3-2-2	3-2-1-1	2-2-2-1
6	5-1	4-2	4-1-1	3-3	3-2-1		2-2-2	3-1-1-1	2-2-1-1
5	4-1			3-2	3-1-1		2-2-1		2-1-1-1
4	3-1			2-2			2-1-1		1-1-1-1

This table makes it easy to understand the strong tendency of individuals to cluster in versatility. It also highlights the difficulties of comparing individuals with different number of arrests. For example, an individual with 5 arrests with a 3-1-1 pattern will have the same score as an individual with 7 arrests and a 4-1-1-1. Added to the difficulty of comparing scores between individuals with different numbers of crimes is the difficulty of comparing careers with different numbers of crime categories.

### **4.2.3. Versatility beyond “pure specialization”**

Pure specialists are relatively rare in this sample (7.7%), while versatile offenders are in abundance. As such, perhaps these offenders are merely exceptions and it should not be surprising that they behave differently from the majority of cases. Alternatively, it could be argued that beyond the perfect score of 0 on the versatility index, the versatility index becomes a far less consistent indicator. At 0, all crimes committed fall within the same category. Suppose that a pure specialist commits a fifth crime, in a different category. Suddenly, this offender has a score of 0.32. Modeling the increase in a dependent variable that leaps from one value to another would not be so problematic if it were consistent, but this is not the case with the versatility index. If the same offender commits the same offence he initially “specialized” in as his 6<sup>th</sup> offence, his versatility score decreases to 0.28; if the 6<sup>th</sup> offence is in the same category as the 5<sup>th</sup>, his score increases to 0.45. If this 6<sup>th</sup> offence happens to be in a different category from the other, his versatility score increases to 0.51. Confidence in the appropriate qualification of an offender as a “specialist” is much greater, even for only 4 arrests, than it is for the qualification of an offender as “versatile”.

The example above highlights the difficulty in modeling the versatility index once the scores moves away from the lowest versatility values. However, in order to move beyond 0.5 on the diversity index implies that the offender has committed an offence in at least 3 different categories. Similarly, to reach the highest level of versatility, an offender will have committed a crime in all 4 categories. Just as pure specialists are rare, it can be demonstrated that a high versatility index score can be almost as rare. By considering the distribution of offences in the four categories, it becomes clear that having at least one crime in each of the four categories is a relatively rare phenomenon. Table 8 breaks down the different probabilities in the sample including gang members with 4 or more arrests for each category and the different combinations of categories possible.

An important point highlighted in this table is the rarity of two types of offences: Skilled property crimes and market offences. This is not surprising given that these offences involve greater skills and/or access to drugs, prostitutes and clients. These crimes are perhaps the ones for which greater social capital might be most beneficial. Moreover, it is interesting to note that those crimes are rarely found on their own or in combination with one another. Skilled and market offences are combined in 21% of cases, but no case has only skilled and market offences. Only one gang member is a pure specialist for each type of crime. On the other hand, they are often combined with violent and unskilled property crimes. These observations also point to the fact that having the highest versatility score is contingent on being involved in both skilled and organized crime, which, as demonstrated, is a rather rare occurrence.

In contrast, violence might be inflating versatility for certain offenders. Individually, violence is by far the most common category. It is also often found with all three other types of offences. Unskilled property crimes are also found in combination with all other types of offences, but, most commonly, in combination with violence. This categorization entails that most offenders who score above 0.5 on the index will either have committed a skilled property offence or a market offence (or both). Note that a combination of all four categories is also a relatively rare occurrence (11%).

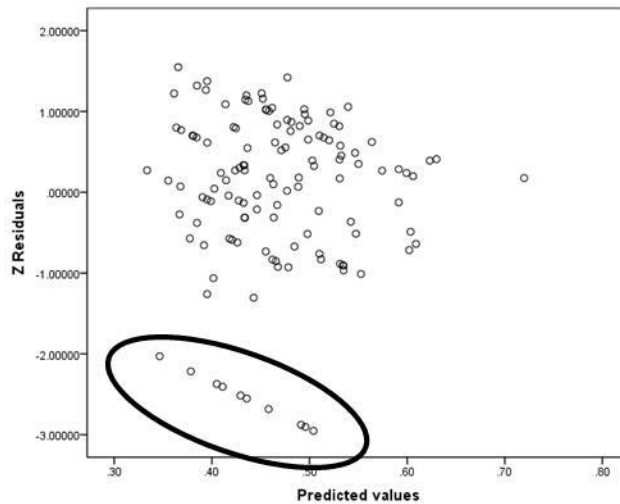
**Table 8. Probabilities and frequencies of different crime combinations**

Categories and combinations	Probability (including categories)	Frequency (exact combination)
Violent	0.93	8
Unskilled	0.68	1
Skilled	0.53	1
Market	0.46	1
Violent+Unskilled	0.62	23
Violent+Skilled	0.49	13
Violent+Market	0.42	12
Skilled+Unskilled	0.35	2
Skilled+Market	0.21	0
Unskilled+Market	0.29	2
Violent+Unskilled+Skilled	0.32	29
Violent+Unskilled+Market	0.25	20
Violent+Skilled+Market	0.19	11
Skilled+Unskilled+Market	0.13	3
Only one category	0.08	
Only two categories	0.37	
Only three categories	0.44	
All four categories	0.11	

### **4.3. Statistical modelling of versatility**

A problem that is left to overcome is the clustering of values of zero. Preliminary OLS regression analyses showed that these cases may be problematic. An examination of residuals revealed the presence of heteroskedasticity and highlights additional difficulties in modelling the versatility index. Figure 6 presents a scatter plot of predicted values plotted against normalized residuals.

**Figure 6. Residual plot from OLS regression model of versatility**



This plot highlights three problems that arise when using a standard OLS regression modeling strategy. First, the presence of parallel lines indicates a clustering of cases around certain values (Searle, 1988). While this in itself is not especially problematic, the clustering of cases around the value of 0 appears to be influencing the results. The cluster of cases at the bottom of the graph are caused by individuals who are pure specialists—that is, all their offences fall in the same category. These cases fall two standard deviations below the mean of residuals. These cases are also mostly responsible for violating the assumption of normality of residuals.

Second, a violation of the homoscedasticity assumption is noticeable. The variance appears to decrease for larger predicted values. Heteroskedasticity does not have an influence on the coefficient; rather it may influence the estimation of standard errors. Using bootstrapped standard errors may ensure that adequate standard errors are estimated, but this phenomenon is worth exploring further as it may not be a strictly statistical artifact.

Third, Figure 6 highlights an important aspect of the versatility index that may be problematic in testing the main hypothesis. As mentioned earlier, parallel lines in the residual plot indicate the high frequency of specific values of the outcome variable. It was demonstrated above that at lower levels of arrests, the versatility index is more

discrete than it is continuous. While this problem is partially solved by using only cases with four or more arrests, there still remains some clustering around specific values of the index. Using 4 or more arrests, 13 cases have a value of 0.38 and 15 cases have values of 0.63. This could be an issue as the ability of the regression model to correctly predict these values is quite variable. This indicates that perhaps not all cases with those scores are similar. In other words, the clustering around these values might be an artifact of the construction of the index and may group together very different criminal careers.

The difficulties in modeling the versatility index have been recognized by prior researchers. A multitude of statistical techniques have been used. For example, Sullivan et al. (2006) employ probit and truncated regressions models (specifically, they use a Cragg specification on a Tobit regression model). The probit model estimates the probability of having a value greater than 0 and the truncated model estimates mean versatility beyond zero. They found that for almost all their models, the effect of their independent variables is much larger and, in general, only statistically significant in the probit models compared to the truncated models.

However, these models are still conditional mean models. Recently, DeLisi et al. (2011) have used simultaneous quantile regression models as an alternative technique to study offending specialization. While the authors do not use a versatility index, they use quantile regression to model proportions of specific offences over the total number of offences. Proportions are in a way “censored” as they can only take a value between 0 and 1. The versatility index behaves in a similar way.

Whereas traditional regression models change in the conditional mean of the dependent variable associated with changes in the independent variables, quantile regression models changes in *conditional quantiles* (Koenker & Bassett, 1978; Hao & Naiman, 2007). In other words, rather than predicting the mean value of the dependent variable at different values of independent variables, quantile regression models predict the value of the dependent variable at specific quantiles for different values of independent variables. This technique is especially useful when assumption of OLS regression, such as heteroskedasticity and non-normal distributions, are violated. In this context, this technique will be useful in order to model whether the independent



variables have varying predictive value at different levels of versatility. As was demonstrated above, this will be particularly useful in assessing the impact of cases at values of zero.

#### **4.4. Summary**

This chapter has given an overview of the difficulties both in terms of statistical modelling of versatility and substantive interpretation of the index. The categories used to calculate the index described in this chapter ensure that versatile offenders in this study will reflect offenders who have engaged in crimes that reflect a broad array of skills. This index was created specifically for the purposes of this study. It reflects, as this type of index should, qualitative variation in the acquired skills and criminal opportunities between offenders. This chapter also proposes the use of a novel statistical analysis to overcome the methodological hurdles associate with modeling the versatility index. The next chapter presents the results of the quantile regression models.

## **5. Versatility, social capital and network structures**

The research question investigated in this chapter is whether greater social capital is associated with versatility. The main hypothesis of this thesis is that high network brokerage will be associated with access to greater skills and criminal opportunities which will translate into a tendency towards versatility. Quantile regression is used to test the main hypothesis. The first section presents bivariate analysis and the results of the quantile regression models.

The second section explores the special case of “pure specialists”—those who only commit one type of offence. As observed previously, versatility indices values of 0 are the most easily interpretable. The analyses undertaken in this section suggest that different offence types may yield different network structures. The third section examines different measures of social capital and their association with versatility but also with involvement in different crimes

### **5.1. Descriptive statistics and bivariate analyses**

Table 9 presents the descriptive statistics for the sample (n=138) used for the analysis in this chapter. Overall, the sample does not show a tendency towards either versatility or specialization. A score of 0.48 implies that the average member of this sample will have committed two types of crimes.

**Table 9. Descriptive statistics (n=138)**

	Statistic	Minimum	Maximum
<b>Mean (SD)</b>			
Versatility	0.48 (0.18)	0.00	0.75
Number of arrests	16.21 (8.56)	4	50
Age (in 2008)	24.97 (4.66)	15	38
Betweenness-Gang network (BetGNW)	0.85 (1.28)	0.00	10.39
Betweenness-Full network (BetFull)	0.77 (1.13)	0.00	9.01
<b>Mean (SD, Median)</b>			
Unskilled property	1.60 (1.70, 1)	0	9
Skilled property	1.10 (1.63, 1)	0	10
Violent	3.42 (2.62, 3)	0	17
Market	0.74 (1.00, 0)	0	5

Table 10 reports the correlations between variables used in the analyses below. Two measures of betweenness centrality are displayed in Table 10. The first is taken from the full network of 2102 cases (BetFull), while the second was measured using only the gang and associate network (BetGNW). It appears that betweenness in the gang network is more strongly correlated to versatility than in the full network. However, both correlation coefficients are positive and significant. The high correlation between the two measures suggests that the sampling decisions taken in the construction of the network do not seem to affect brokerage measures for the gang members in this sample.

**Table 10. Pearson correlations between key variables**

	Versatility	Arrests	Age	BetGNW
<b>Arrests</b>	0.149†			
<b>Age</b>	-0.223*	-0.078		
<b>BetGNW</b>	0.209*	0.213*	0.039	
<b>BetFull</b>	0.177*	0.230*	0.103	0.967*

† p<0.1, \*p<0.05

A negative, statistically significant correlation between age and versatility can be observed. Older gang members appear to be less versatile than younger gang members. Finally, total number of arrests is positively associated with versatility, but only marginally significantly ( $p=0.088$ ).

## 5.2. Quantile regression

Table 11 reports estimates and bootstrapped standard errors from the quantile regression model at the 5<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup> (median), 75<sup>th</sup> and 95<sup>th</sup> quantiles. All variables were standardized so that the intercept reflects the conditional quantile value of versatility. The different quantiles chosen reflect different regions in the distribution of versatility. For example, the coefficients of model 1 reflect changes in the dependent variable for the lowest scores of versatility, many of which are scores of 0. Similarly, the coefficients in model 5 reflect the changes in the dependent variables for extreme scores of versatility.

**Table 11. Quantile regression models of versatility**

	Model 1	Model 2	Model 3	Model 4	Model 5
<b>Quantile</b>	5	25	50	75	95
	B(BSE)	B(BSE)	B(BSE)	B(BSE)	B(BSE)
<b>Intercept</b>	0.08(0.07)	0.35(0.03)**	0.50(0.02)**	0.59(0.02)**	0.66(0.02)**
<b>Age</b>	-0.01(0.06)	-0.07(0.02)**	-0.07(0.02)**	-0.05(0.01)**	-0.03(0.01) †
<b>Age (squared)</b>	0.03(0.03)	0.04(0.01)**	0.02(0.01)	0.01(0.01)	0.00(0.01)
<b>Total arrests</b>	0.06(0.05)	0.01(0.02)	0.02(0.02)	0.00(0.01)	0.00(0.02)
<b>BetGNW</b>	0.07(0.02)**	0.04(0.01)**	0.02(0.02)	0.02(0.01)	0.02(0.02)

† $p<0.1$ , \*\*  $p<0.01$

Overall, these results indicate that beyond the 25<sup>th</sup> quantile betweenness centrality is no longer a significant predictor of versatility. It appears that brokerage positions might be necessary to engage in more than one type of crime. However, beyond the 25<sup>th</sup> quantile brokerage does not seem to matter anymore. Scores below 0.5 generally indicate careers in which only two types of offences are committed. These

findings suggest that betweenness centrality is perhaps more a necessity for individuals who want to engage in more than one type of crime.

The relationship between age and versatility shows a significant non-linear effect at the 25<sup>th</sup> quantile. However this effect becomes insignificant at other quantiles. The relationship between age and versatility is negative for all quantiles, although not significantly different from 0 at the 5<sup>th</sup> quantile and only marginally significant at the 95<sup>th</sup> quantile. It is possible that this effect is created by the wide range of ages of cases clustered at 0.38 and a few older individuals with high versatility scores. The plot of this relationship shows support for this explanation (Figure 7). Without the few older gang members on the right of the plot, the relationship between age and versatility appears to be a clear negative linear relationship.

**Figure 7. Relationship between age and versatility**

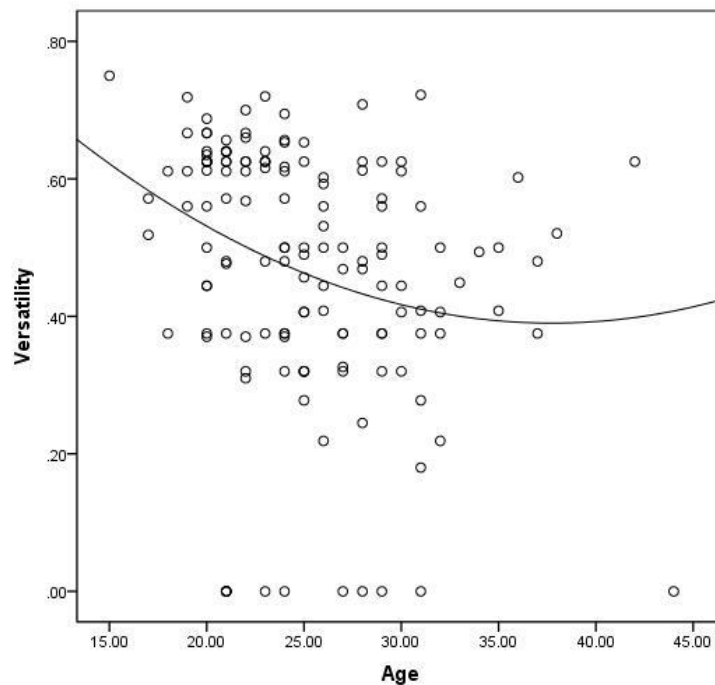
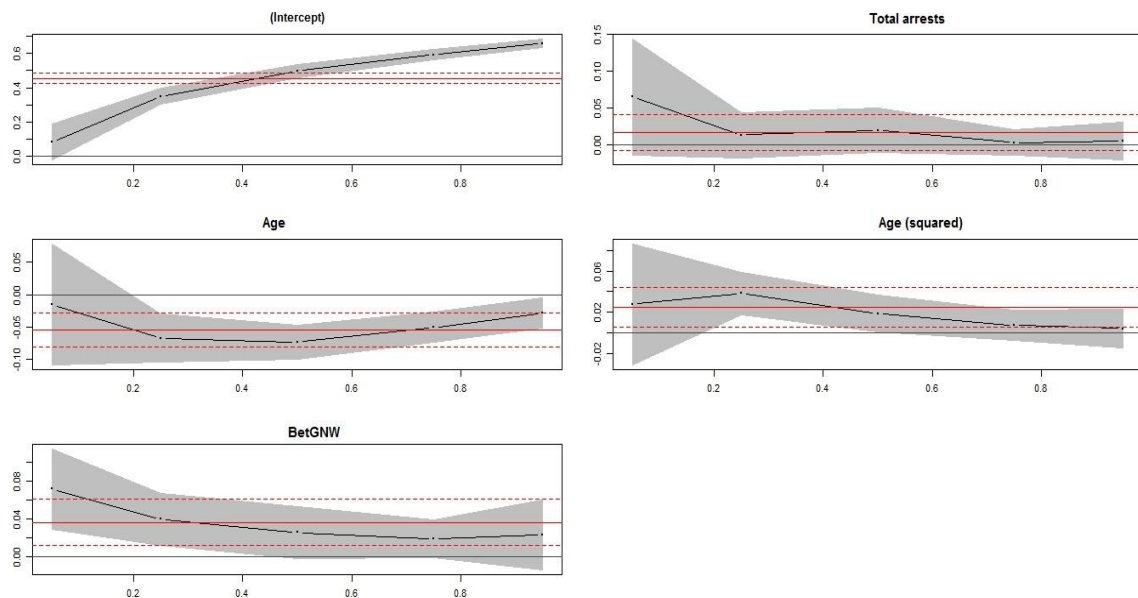


Figure 8 provides further explication regarding this relationship. This figure illustrates the confidence intervals and regression coefficients estimated at different quantiles of the versatility index distribution. The long broken lines indicate changes from one quantile to another, and the shaded area indicates the confidence intervals

around each coefficients. The straight horizontal line indicates the OLS regression coefficient (estimated using the conditional mean), and the dotted horizontal lines indicates its standard errors. A second horizontal line indicates 0. It can be seen that the high variability of age at the lowest quantile explains the non-significant results. It also illustrates that the large significant effect of age at the 25<sup>th</sup> quantile gradually decreases as versatility increases until it becomes close to zero for the most versatile offenders. Similarly, Figure 8 shows a much larger uncertainty around the coefficient of betweenness centrality at the highest quantile.

**Figure 8. Quantile regression and OLS regression coefficients and confidence intervals**

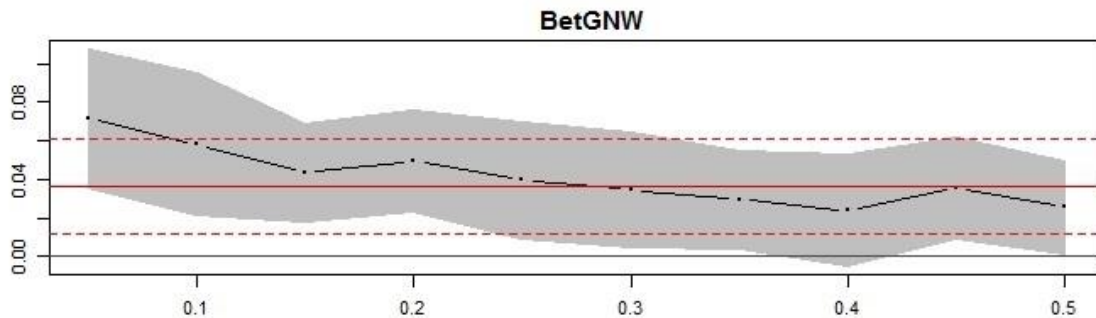


Overall these results indicate that brokerage is important in order to engage in more than two types of crimes. It can be said that low brokerage may be a better predictor of specialization than it is a predictor of high versatility. However, the non-significance of brokerage at the median indicates that at least for some individuals who engage in at least two types of crime. The intercept at the 25<sup>th</sup> quantile was 0.38. In the previous chapter, it was observed that scores below 0.38 were generally obtained when all crimes but one fell into the same category. It could be argued that at the 25<sup>th</sup> quantile of versatility gang members are still relatively specialized, although not to the same

extent as those with a versatility index of 0. Still, the qualitative difference between those cases is perhaps not very meaningful. The results do suggest that those individuals who have a tendency to favor one type of crime are less in brokerage positions than those who extend their criminal activities to more than two types.

Yet, those results are not conclusive regarding individuals who engage in only two types of offences. Results at the 25<sup>th</sup> quantile indicate that brokerage is key to moving beyond specialization or quasi-specialization (an offender with for example 5 offences in one category and 1 offence in another). However, some gang members past the 25<sup>th</sup> quantile only engage in 2 offences as well, although they have a more evenly distributed career (4 offences in one category and 2 offences in another). Similarly, some offenders close to the 25<sup>th</sup> quantile commit 3 types of offences although one type clearly contains a majority of offences. Figure 9 illustrates how the relationship between versatility and betweenness centrality changes at the lowest quartile. The coefficient follows a downward trend that remains statistically significant until it approaches the 40<sup>th</sup> quantile. At this level of versatility the relationship is no longer significant, but at the 45<sup>th</sup> quantile, the relationship becomes significant again before becoming non-significant again at the 50<sup>th</sup> quantile. It would be easy to dismiss this as a statistical artifact. However, changes at these specific locations are closely associated with a peculiar behavior of the versatility index. The 35<sup>th</sup>, 40<sup>th</sup>, 45<sup>th</sup> and 50<sup>th</sup> quantile of the versatility index correspond respectively to values of 0.41, 0.46, 0.48, and 0.50. As was demonstrated in the last chapter, values between 0.41 and 0.44 indicate under most circumstances in this sample, the distribution of crimes into two different types with a preference for one type. Values between 0.45 and 0.50 can include both careers with 3 types of crime with a clear majority falling in one type (5-1-1) and careers with 2 types of crime evenly split into two categories. The value of 0.48 is a peculiar one as it indicates careers where crimes cannot be evenly split into two categories (4-3).

**Figure 9. Betweenness centrality coefficients below the 50<sup>th</sup> quantile**

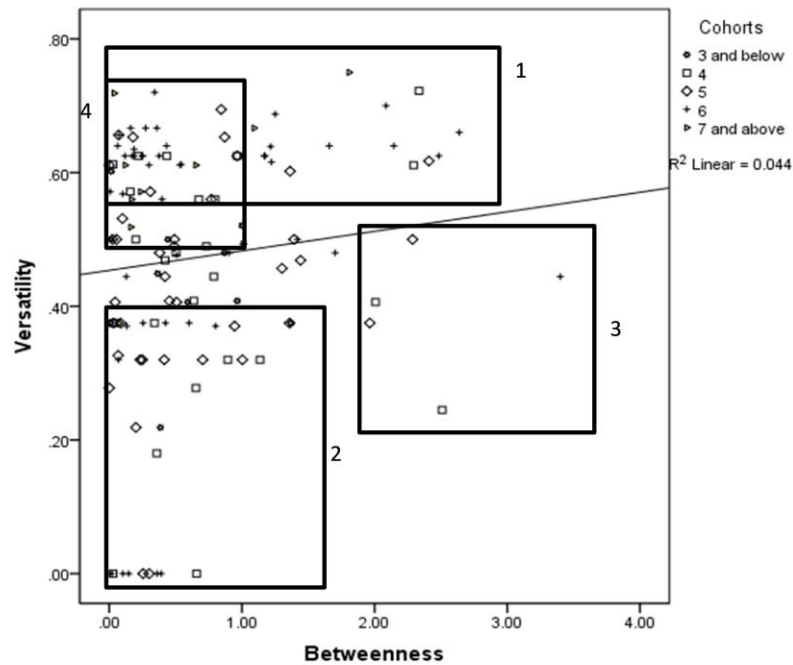


Although there may not be any substantive interpretation to be made from this peculiar finding, it illustrates some of the odd behavior the versatility index can display. With a much larger sample, it is possible that such behaviour may influence the interpretation of the findings. Overall, these observations suggests that there might be a difference between individuals who engage in only two types of offences or less compared to three or four types. In a way, this lends support for the hypothesis that brokerage leads to greater criminal opportunities. In this case, brokerage seems to be able to differentiate between most gang members who engage in two or more offences. However, the perfect combination of two types of offences does not lead to a statistically significant relationship

Figure 10 displays the complexity of the relationship between versatility and betweenness centrality. The four sections highlighted display results that deserve further attention. Section 1 includes the most versatile offenders in the sample. This section of the graph illustrates what the quantile regression models found at higher quartiles of versatility. Being highly versatile in this sample is not necessarily linked to a particular pattern of brokerage. It can be seen that offender can be just as low on brokerage as they can be high for highly versatile individuals. The same cannot be said for individuals at lower levels of versatility. Section 2 shows that most offenders low on versatility also happen to be the lowest on brokerage.



**Figure 10. Betweenness centrality, age and versatility**



As the regression models at lower quartiles showed, this trend is much more pronounced at versatility scores of 0. Still, some cases with lower versatility scores also happen to be brokers in the network although, as can be seen in section 3 of the graph, these cases appear to be few in numbers. When sections 2, 3 and the right part of section 1 are considered there appears to be some support for the hypothesis that higher brokerage predicts versatility. However, it could be argued that one group of cases (section 4) is responsible for the blurred relationship at the highest levels of versatility.

Figure 10 also provides some information regarding the age cohort of each case. As predicted by the regression models, older individuals tend to be found at lower levels of versatility, while younger individuals are found at higher levels of versatility. However, some older offenders can be found with high versatility scores, and some younger offenders are found at low levels of versatility. For example, most of the 6<sup>th</sup> and 7<sup>th</sup> cohorts can be found in section 1, but a few can be found in section 2 and 3. However, offenders from the 5<sup>th</sup>, 4<sup>th</sup> and 3<sup>rd</sup> cohorts, while mostly found in section 2, are found in all sections of the network—at all levels of versatility and at all levels of betweenness.

What figure 10 indicates is that something seems to happen at the midpoint of the versatility index. The relationship between versatility and brokerage appears to be clear below this midpoint: individuals who are more central in the network, and who occupy positions of brokerage, tend to be less specialized. However, beyond the midpoint of versatility, the relationship becomes much more difficult to discern. Although statistical significance is achieved, these analyses clearly show that there is more to the story. However, it was demonstrated in the last chapter that using a well-defined and theoretically meaningful measure of versatility may enable further investigations to supplement the results found above.

### 5.3. Pure specialists

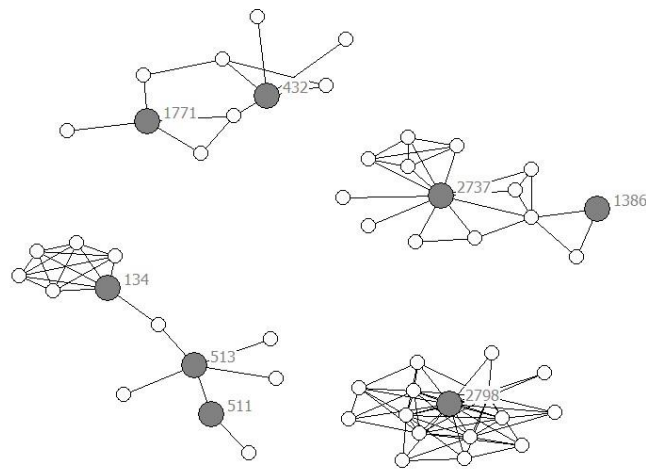
The clearest crime pattern possible in this study is the one associated with pure specialists. Eleven pure specialists can be identified in this sample. Table 12 describes those cases. These individuals are for the most part violent offenders, are below the full sample median (0.43) and mean (0.85) betweenness centrality and degree centrality (full sample median=10, mean=12), and have less arrests than the average offender in the full sample (mean= 7, median=6). Specialists include both younger and older gang members. However, one case differs drastically from the others—case #65.

**Table 12. Characteristics of pure specialists**

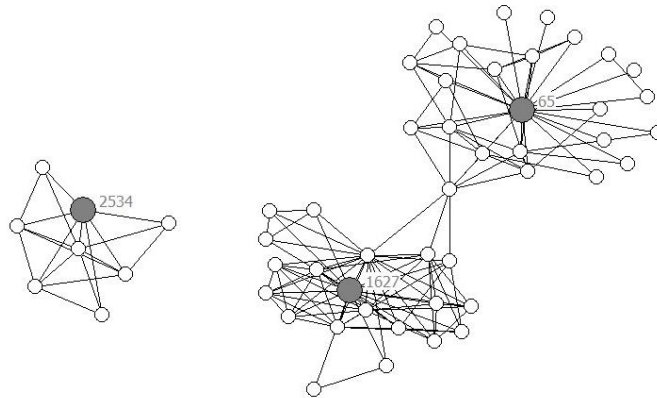
ID	Age	Type	Crimes	Degree	Betweenness
65	29	Market	4	23	2.95
134	21	Violent	6	6	0.10
432	27	Violent	12	5	0.30
511	28	Violent	6	2	0.03
513	21	Violent	5	5	0.39
1386	44	Violent	4	2	0.00
1627	21	Unskilled	4	19	0.36
1771	23	Violent	5	4	0.15
2534	21	Skilled	4	7	0.02
2737	31	Violent	4	11	0.66
2798	24	Violent	4	15	0.26

This individual is one of the better connected individuals in the sample and has one of the highest betweenness centrality score in this sample. The organized crime specialization of this individual makes him quite unique amongst specialists. In fact, the number of arrests for organized crimes for this individual makes him unique in the full sample—only one other gang member has more arrests for organized crime. Moreover, this individual is amongst the few members of the sample to have been arrested for prostitution-related crimes. Table 12 shows two other non-violent specialists. Case 1627 was only arrested for unskilled property offences, while case 2534 was only arrested for skilled property offences.

**Figure 11. Ego networks of violent specialists**



**Figure 12. Ego networks of non-violent specialists**



While both offenders have the same age, their ego networks appear to have different structures. Figure 11 maps the ego networks of violent specialists and Figure 12 maps the ego networks of non-violent specialists. The skilled property crime specialist has a lower number of contacts and has a rather closed ego network, which contributes to a low betweenness centrality score. The unskilled property specialist has a much larger network and a much larger betweenness centrality score compared to case 2534. The size of the network of Case 1627, while being amongst the largest in the sample, is rather redundant. This is especially salient when compared to Case 65's ego network. With only 4 more ties, Case 65's brokerage is much greater than Case 1627's.

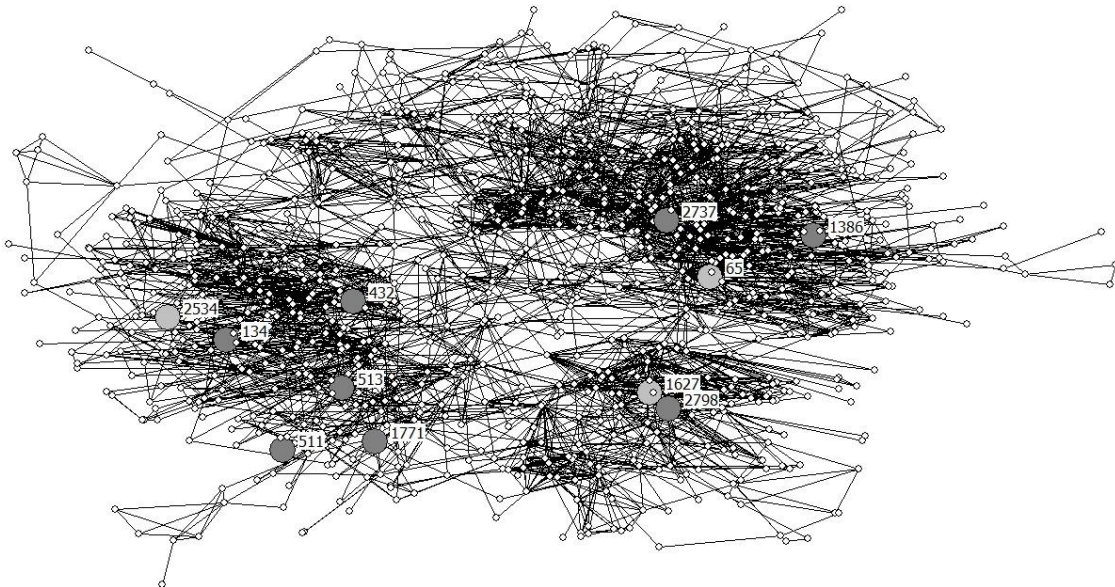
While those are only three examples, they illustrate different structural properties that may be interesting to explore further. Different crimes may be associated with network structures. Brokerage is used here as a measure of social capital since it is hypothesized that access to opportunities and other co-offenders will be greater from individuals bridging structural holes. The idea is that versatility will be fostered by maximizing access to unique opportunities. However, while this might be necessary in order to operate a prostitution ring (case 65), it may not be as important in order to steal motor vehicles (Case 2534) or be involved in thefts and muggings (Case 1627). In the later cases, trust and closeness or simply the availability of co-offenders may be

necessary. Comparing those cases' ego networks to violent specialists' further highlights possible differences in network structures of different types of crime. Violence specialists present a variety of ego networks. However, notwithstanding two cases with relatively large but dense networks, most violent offenders have small and linear networks.

While ego networks are informative of the immediate entourage of a gang member, it is important to consider where this entourage fits in the overall network. Figure 13 highlights pure specialists within the full gang network.

The importance of case 65 is even more obvious when considering the overall network. This figure also illustrates how density in the network is clustered in different sections of the network. It also noticeable that most violent specialists are found on the periphery of these clusters, sometimes falling between clusters (e.g., Cases 1771 and 423).

**Figure 13. Pure specialists within the gang network**



The examination of networks and careers of pure specialists highlights an important aspect of the relationship between the structural properties of networks and criminal careers: Different types of offences may lead to different types of networks.

This may explain the difficulty in modeling versatility. Offending versatility implies that an offender has engaged in a variety of different offences. If there are indeed differences in the network structures for different types of offences, as was shown for specialists' offenders, it may be difficult to identify a unique network measure that might characterize versatile offenders. This might explain why versatile offenders, more so than specialists, are found at all levels of betweenness centrality. A closer look at the different types of offences may be necessary in order to untangle this relationship.

## 5.4. Different crimes, different networks

The analysis of pure specialists showed that different types of criminal involvement may foster different networks. Table 13 reports the correlations between different types of network measures and involvement in certain offences. Each offence was dichotomized above its median.

**Table 13.** *Correlations between network measures and involvement in specific offences*

	Versatility	Market (>=1)	Skilled(>1)	Unskilled(>1)	Violence (>3)
Market	0.404**				
Skilled	0.256**	-0.033			
Unskilled	0.328**	-0.243**	0.009		
Violence	-0.331**	-0.165†	0.061	-0.094	
All arrests	0.149†	0.034	0.308**	0.219*	0.384**
Proportion arrests	-0.079	0.016	0.185*	0.024	0.048
Degree (Full)	0.246**	0.125	0.030	0.225**	0.018
Degree (Gang)	0.259**	0.140	0.030	0.221**	0.000
BetFull	0.177*	0.056	0.080	0.183*	0.112
BetGNW	0.209*	0.065	0.097	0.201*	0.102
Constraint	-0.144†	-0.145†	-0.014	-0.027	0.003
Effective size	0.246**	0.072	0.054	0.258**	0.068
Coreness	0.229**	0.210*	0.064	0.175*	-0.013

† p<0.1, \*p<0.05, \*\*p<0.01 (2-tailed)

The table shows that involvement above the median value of violence is negatively correlated with versatility. Given that the majority of pure specialists discussed above were violent specialists, this should not be surprising. Also, given the distribution of offences, having 3 offences in any category is likely to lead to lower versatility. The correlations between types of offences reflect the observation made in the prior chapter. Involvement in market offences is negatively related to all other offences. However, market offences are not significantly related to the total number of arrests, contrary to all other types of crime.

Correlations with proportion of arrest are only significant for skilled offences. This variable was calculated by dividing the number of arrests by the number of contacts with police. This significant relationship may suggest that skilled offenders are not detected as often by police. It indicates that these offenders are less often seen by police or they are only seen when they are arrested.

The table also shows that regardless of which network measure is used, all measures are significantly correlated with versatility. However, when looking at how those measures correlate with specific crime types, different measures correlate with different types of crime.

Market offences are positively related to coreness. This indicates that involvement in market offences is perhaps more about knowing the “right” people than it is about knowing a large number of people. Indeed, degree centrality, while positively correlated with involvement in market offences, is not statistically significant. Moreover, coreness indicates an ego’s tendency to be “in the thick of things”. Market offences appear to be crucial to the structure of the network. Figure 14 illustrates those nodes who are involved in market offences. Although some nodes are found on the outside of the network, most individuals involved in market offences are found near or at the center of clusters. Despite being in those highly clustered regions of the network, offenders who engage in market offences are not constrained in the network, as shown by the negative but marginally significant relationship with network constraint.

**Figure 14. Market offence involvement in the gang network**

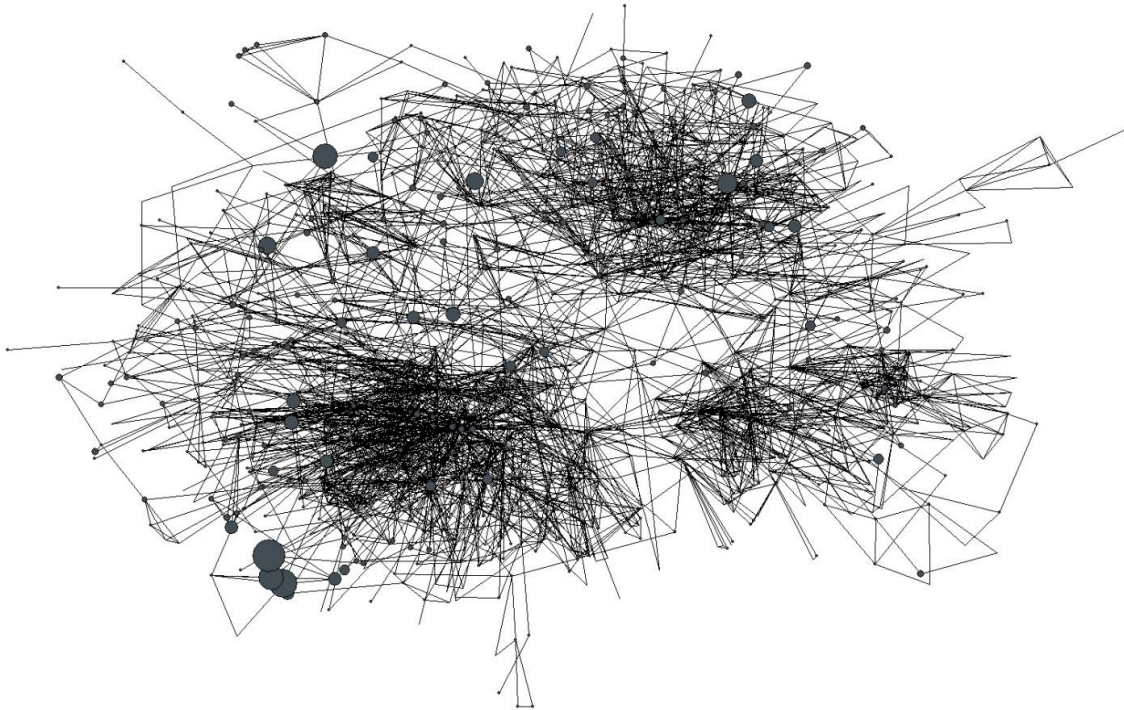


Node sizes indicate frequency of involvement.

Surprisingly, there does not seem to be any network correlates to skilled offences. The location of these offenders in the network however contrasts with those of market offenders (Figure 15).



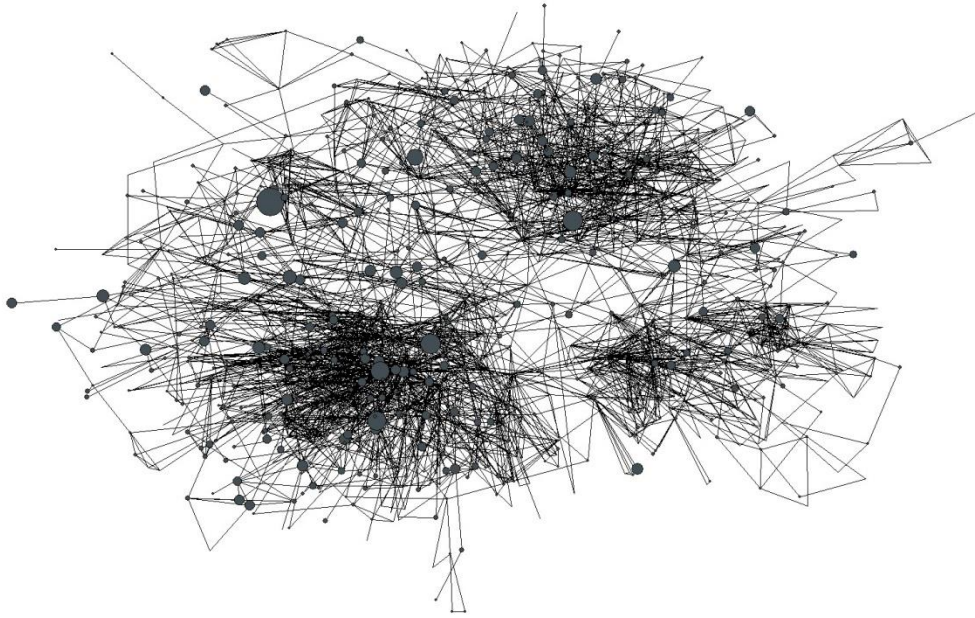
**Figure 15. Skilled offence involvement in the gang network**



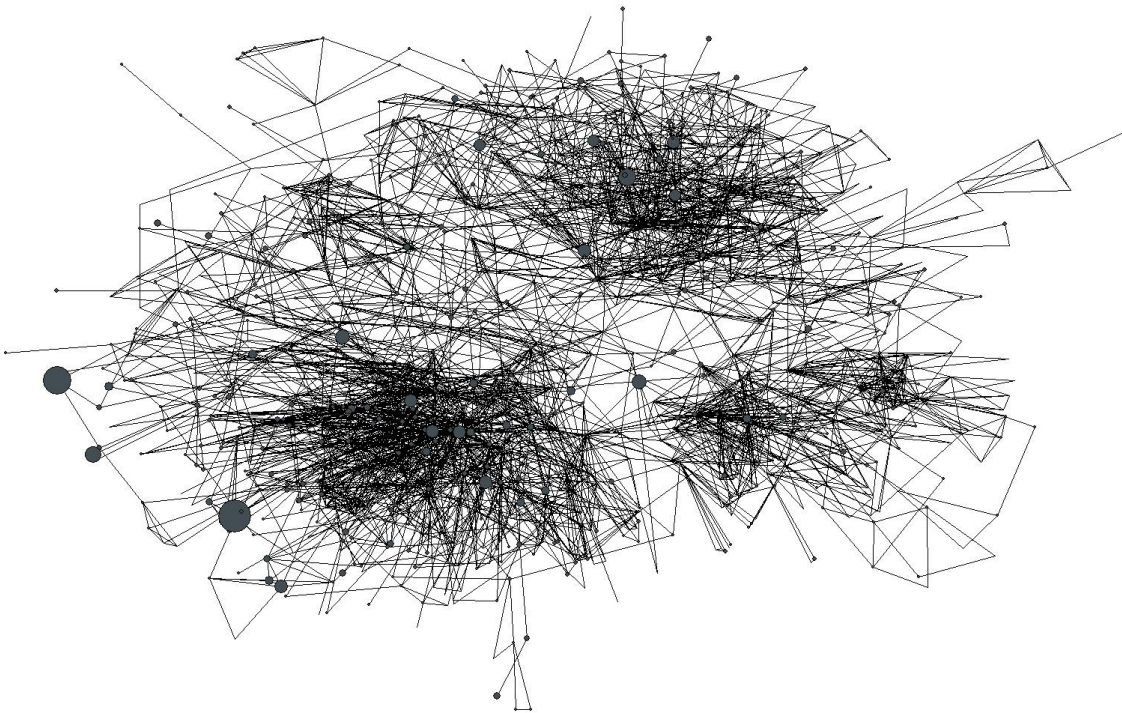
The most frequent offenders in this category (larger nodes) are notably on the periphery of the network. However, skilled offenders can be found close to clusters as well (top). There seems to be a special quality to this kind of offence. The observations made from the network combined with the high proportion of arrests may suggest that these type offenders are more fringe members of gangs.

Conversely, violence is everywhere in the network (Figure 16). Most individuals engage in violence, and even for those who engage in violence more than most, there does not seem to be a pattern in the network for these individuals. Violence in the careers of gang members literally appears to be the norm. For the study of criminal careers, violence may simply blur out otherwise specialized careers.

**Figure 16.** *Violent offence involvement in the gang network*



**Figure 17.** *Unskilled offence involvement in the gang network*



Finally, while both are different subsets of property crimes, skilled and unskilled property crimes show quite different patterns. In fact unskilled offender networks are closer to those who engage in market offences. Like market offenders, coreness is positively related to unskilled offences (Figure 17). However, the difference for unskilled property offenders is that they may get to the right people because they know more people: Unskilled property offences are positively related to all other measures of centrality and tend to have efficient networks as shown by the positive correlation with effective size. Moreover, unskilled property offences are the only offences to positively correlate with betweenness centrality. In fact it could be argued that the relationship between versatility and betweenness centrality is contingent on involvement in unskilled offences.

Although it was hypothesized that high betweenness may grant access to opportunities and skills, it turns out that being a broker in the network is highly correlated with involvement in unskilled offences. It is possible that involvement in burglaries and thefts may in fact form the basis of early connections for gang members. Although it is impossible to state with much certainty given the cross-sectional nature of the study, unskilled offences as a type of offence that does not require any skills, may be an easy way to “get into” crime and start constructing a network of co-offenders. If we are to assume that these crimes are committed in the early years of a gang member’s career, it is possible that the network ties these crimes serve to build are not observed in this network for older offenders.

## 6. Discussion

The main objective of this study was to examine the relationship between criminal versatility and social capital. This thesis attempted to contribute to research on criminal careers by testing theoretical predictions regarding versatility. Many prominent crime theories predict that availability of criminal opportunities; relevant information and skills are important determinants of the makeup of criminal careers. Although generally studied in legitimate contexts, research has consistently shown that access to greater social capital facilitates unique access to opportunities and novel information. Rather than relying on any specific criminological theories, this study chose to focus on a common aspect of those theories: the interplay between the individual and its environment. While theories of crime tend to favor individual-based or environmental-based explanations, a social capital perspective considers both explanations at the same time. In other words, social capital is at the junction of individual and environmental explanations of crime. Moreover, the availability of social network data for this study provided an ideal context to measure social capital and test its impact on the criminal careers of gang-involved offenders.

The hypothesis of this study was that access to greater social capital is associated with access to diverse criminal opportunities and resources. This access to a variety of opportunities should translate into a more versatile portfolio of criminal experiences. However, early analyses revealed significant difficulties in testing this relationship.

A major difficulty was related to the measurement of versatility and the interpretation of this measure. Given the nature of the available data, the use of the versatility index was necessary. As an individual measure of versatility, the index has been used in many recent studies on the topic (e.g., Piquero et al., 1999; Sullivan et al., 2006), especially given its seemingly straightforward interpretation. However, early analyses revealed many different issues regarding the distributional properties and the

interpretability of the versatility index. Given a gap in the literature on the use of this index in criminology, a secondary objective of this study was to examine the properties of the index and how different decisions in the computation of the index influence its interpretation.

A second difficulty was related to the measurement of social capital. As described by Lin (2001), there are many ways to measure social capital, depending on the context and the expected return generated by investment in social capital. The hypothesis called for access to *unique* social capital. The rationale behind the hypothesis is that diverse criminal involvement will be fostered by access to diverse opportunities. According to Burt (1992), unique opportunities are more easily accessed if individuals have ties to individuals that do not necessarily know one another. This idea is reflected in the measure of betweenness centrality. However, the ability to predict versatility was somewhat limited using this operationalization of social capital. Moreover, many different network measures appear to be correlated with versatility. Breaking down the versatility index into its different components allowed some insight into the relationship between versatility and social capital. The results show that there is a clear relationship between network structure and versatility. Furthermore, analyses showed that different offences are associated with different network properties.

The following sections review the main findings of the thesis. The first section reviews the findings pertaining to the relationship between network brokerage and versatility. The second section discusses the findings regarding other measures of social capital and the different network properties of different offences. The third section concludes this chapter by discussing other possible sources of social capital and proposes future research considerations.

## **6.1. Brokerage and versatility**

This study found that brokerage was positively associated with versatility, but only at lower levels of versatility. A different way to interpret this finding is to say that low brokerage is associated with a tendency to specialize. The quantile regression models show that beyond the 45<sup>th</sup> quantile of versatility, brokerage was not significantly

predictive of versatility. Versatility scores below the 45<sup>th</sup> quantile generally indicate that offenders have only committed 2 types of offences. These results show that the tendency to specialize is associated with low brokerage only for individuals who engage in two or fewer offences. The relationship between versatility and betweenness centrality is less clear for those who engage in 3 or more offences.

These results appear to show support for the hypothesis. Burt (1992; 2005) argues that individuals who are in brokerage positions in a network have access to more unique opportunities and more information. Individuals who specialize in one type of offence are lower on betweenness centrality than individuals who engage in more than one type of offence. This relationship extends to individuals who, despite engaging in more than one type of crime, clearly specialize in a single type of offence. These individuals may be more constrained in the criminal opportunities available to them. This finding is consistent with McGloin and Piquero (2010), who found that network redundancy lead to offending specialization. While betweenness centrality is not strictly a measure of redundancy, individuals low on betweenness centrality are generally embedded in dense networks or are found on the periphery of the network (Freeman, 1977; Wasserman & Faust, 1994).

The absence of a significant relationship beyond the 45<sup>th</sup> quantile may be another indication of the difficulty in modeling versatility. As mentioned in Chapter 4 the versatility index becomes very difficult to interpret when more than 2 categories are involved, especially with regard to its relationship to offending frequency. The increase in offending frequency when only 2 categories are involved is easy to understand. A gang member committing 7 assaults and 1 theft will necessarily get a lower versatility score than a gang member who commits 3 assaults and 1 theft. While it could be argued that both are violence specialists, the first offender shows a much clearer tendency to specialize. Offending frequency with only two categories does not influence the interpretation of the index, it only allows for discrimination between “true” specialists, and those with a tendency to specialize. This reinforces the finding that specialization is associated with low brokerage.

Chapter 4 also showed that offending frequency does not necessarily allow for a better identification of offenders who are “truly versatile”. For example, an offender with

an offence pattern of 3-3-3 would score 0.67 (just as an offender with a 10-10-10 offence pattern would). As soon as a third category is involved, most offenders (i.e. those who have a lower number of offences) will score above 0.50. Recall Figure 4 in chapter 4, where the lowest non-zero versatility values were plotted against the number of arrests. This plot showed the relationship when n-1 offences fell in one category and 1 offence fell in another. If n-2 offences fall in one category and the two remaining fall in 2 different categories, it takes at least 8 offences for such a crime pattern to fall below the 0.5 value. Only 30% of the sample used for the analyses in Chapter 5 committed 8 or more offences. Similarly, if n-3 fall in one category, 2 offences fall in one category and the remaining falls in a third category (e.g., 4-2-1), a score below 0.5 is attainable for offenders with 10 or more offences (11% of the sample). Hence for most of the sample, committing only one offence in one other category would necessarily lead them to fall at or above the 0.5 threshold. At 5 offences, an offender with a crime pattern 3-1-1 would be 0.11 points above an offender with a pattern 3-2. These observations may account for the difficulty in seeing a relationship past the 45<sup>th</sup> quantile.

Overall, the observations made in Chapter 4 and those above suggest that the versatility index is not a very efficient operationalization of criminal versatility. The analyses undertaken in this thesis rely mostly on an index using only 4 categories. It is possible that some of the difficulties identified are magnified by the use of such a small number of crime types, but some analyses of an index using 13 categories showed other issues regarding the interpretability of such a measure. Perhaps the issues observed in this study would have been more difficult to see with 13 categories. Given the analyses undertaken in Chapter 4, it is more likely that the interpretability issues using 13 categories are even more serious.

## **6.2. Theoretical implications of the results**

Guerette et al. (2005) argued that criminal specialization/versatility research has usually focused on the policy relevance of such research at the detriment of its theoretical value. Others have argued that in some instances, the desire to show evidence of specialization or versatility has trumped substantive interpretations of such patterns. The approach taken in this study was to consider versatility as the involvement

in multiple types of crimes that vary in the resources they require. While taking such an approach in the end did not lead to a better interpretation of the index itself, it allowed for an in-depth analysis of the behavior of the index by considering the impact of the inclusion of offences that are less common, such as skilled property offences and market offences.

Another advantage of this approach was that it allowed for the analysis of qualitatively different offences. Gottfredson and Hirschi (1990) argued that little differences exist from one offence to another, which is why offenders tend to be more versatile. They argued that most offenders engage in crime impulsively; the notion that offenders may learn special skills and engage in structured criminal activities is not supported by prior research. Analyses in Chapter 4 revealed that the most common crimes involved little skill and planning. Nonetheless, offences that require a certain amount of planning or sustained criminal relationships, although less common, are not rare in this sample. Also, involvement in skilled and market offences is usually found in combination with crimes that would better suit Gottfredson and Hirschi's low self-control propensity (violent and unskilled offences).

It was not an objective of this study to test Gottfredson and Hirschi's theory but as major proponents of the idea that most offenders are versatile, it is interesting to analyze the results in light of their conception of crime. Although specialists are not rare in this sample, a majority of offenders *are* versatile. Moreover, as mentioned above, the most common offences are ones that do not require specific skills or resources. Still, 46% engaged in at least one market offence and 53% engaged in at least one skilled offence. This suggests that all offences may not be as easily accessible.

It could be argued that some support for Gottfredson and Hirschi's theory can be inferred from the finding that most pure specialists are violent specialists. However, violence is pervasive in the sample. In fact, only 10 out of 138 individuals have not committed a violent offence. It should not be surprising to see that violence is the norm in a sample of gang-involved offenders. Still, those who only engage in violence are amongst the lowest in betweenness centrality. The analysis of pure specialists showed that those who specialize in violence have for the most part smaller networks. Of the 8 violence specialists, 6 gang members had 6 contacts or less (the other two had 11 and



15 contacts). Although only 3 non-violent pure specialists were identified, the difference between those and the violent group is notable. The market specialist had 23 contacts, the unskilled property specialist had 19 contacts and the skilled property crime specialist had 7 contacts. Considering that the average degree centrality in the sample is 12 and the median is 10, it is interesting to note that most violent specialists have much smaller networks compared to the average gang member and compared to the market and unskilled property specialists. Perhaps the violent nature of these individuals makes them less desirable to associate with. Although testing this hypothesis is beyond the scope of this study, it shows that the specialist or versatile nature of a criminal career is perhaps less important to study than the makeup of a criminal career itself.

### **6.3. Different offences, different social capital?**

The assumption behind the main hypothesis is that some offences require different skills or resources. In fact, it could be argued that skilled property offences require specific skills and planning while market offences require sustained criminal relationships. Comparatively, violent and unskilled offences do not necessarily require any elaborate planning or specific skills; they can be spontaneous and improvised. If different offences require different resources, it stands to reason that different offences may require different sources of social capital. Betweenness centrality considers the structure of the whole networks, not simply an ego's network. Burt's notion of structural hole is more closely tied to ego-networks (Borgatti et al., 1998).

Further analyses showed that different network properties are associated with involvement in different offences. Betweenness centrality was only significantly correlated to unskilled property offences. In fact, it was observed in the previous chapter that the correlation between versatility and betweenness centrality is almost as high as it is for involvement in unskilled offences. Involvement in unskilled property crimes was also associated with larger networks, and more efficient networks (i.e., greater effective size).

This finding may indicate a socializing function of unskilled property crimes especially for younger gang members. Decker and Van Winkle (1996) described the

activities of young gang members (average 16.9 years old) as generally spontaneous and involving little planning. The gang members they interviewed were frequently involved in vandalism, minor thefts and burglaries. The authors describe involvement in minor thefts by gang members:

“Most minor thefts seem to be spur-of-the-moment actions involving a group of members who just happen to be hanging out together when someone (or many of them) decide to steal something” (Decker & Van Winkle, 1996, p.132).

Thefts, burglaries, and personal robberies may not require skills and specific resources, but prior research has shown that those offences generally involve co-offenders. Sarnecki (2001), Reiss and Farrington (1991), and Warr (2002) have observed that minor property crimes such as thefts, burglaries and muggings are most often committed with co-offenders, especially for younger offenders. Wright et al. (1994) showed that the decision to commit burglaries was often triggered when associates “asked to lend a hand” or presented them with “good opportunities” (p. 54).

The “social” aspect of unskilled property crimes may explain why this crime type is correlated with betweenness centrality. As Borgatti et al. (1998) pointed out, betweenness centrality is tied to social capital in that brokers can control and exploit the flow of information between two unconnected individuals. As such, social capital accessed through betweenness centrality may be more important when knowledge about criminal opportunities is required. In a way, betweenness centrality may facilitate the “search for a suitable co-offender” (Tremblay, 1993), a condition that appears to be crucial for involvement in minor property crimes (Decker & Van Winkle, 1996; Wright & Decker, 1994). This may also explain why involvement in unskilled property crimes is the only crime type significantly correlated with degree centrality.

There appears to be no distinguishable network property associated with involvement in skilled offences. The only notable difference between skilled offences and other types is that it is the only crime type significantly correlated to proportion of arrests. A high proportion of arrests indicate that most contacts police have had with these individuals are through official arrests, rather than through identity controls or other informal contacts. It is possible that some of these individuals are simply not good at

avoiding arrests. Perhaps a more likely explanation is that these individuals are better at avoiding overall attention from law enforcement. The latter explanation is reinforced by the fact that offenders heavily involved in skilled offences tended to be found at the periphery of the overall network.

Skilled offences may require more time investment and more planning. Pyrooz, Sweeten, and Piquero (2013) found that embeddedness in gangs constrained one's involvement in other social networks. The results in this study show that skilled offences are not common offences of individuals central in the gang network. It is possible that skilled offenders become less embedded in gang networks. Indeed, analyses showed that those involved in skilled offences were more often found at the periphery of the network. This may explain why those offenders are in general better known to police through formal arrests than through other contacts.

Another explanation could be that skilled offences require contacts that are embedded in legitimate enterprises. Offenders may be re-selling vehicles and trading stolen merchandise using legitimate businesses (e.g., car dealerships, pawn shops, etc.). This may allow them to go under the radar of law enforcement. Kleemans and de Poot (2008) explain how individuals with certain expertise may not be seen as important from a law enforcement perspective, but can quickly develop networks that depend on their skills. Although these authors are more interested in crimes such as drug trafficking, it is possible that such a phenomenon occurs with individuals involved in motor vehicle theft, fencing and fraud. Moreover it could be that skilled offences do not necessarily require a large amount of social capital. The specific skills required to be involved in those crimes are perhaps more likely to be obtained in a large network. However, a single connection to a more experienced co-offender may be sufficient to learn the tricks of the trade.

Another crime type that does not seem to have a particular link to the network structure is violent offences. Violent offences are found everywhere in the network. An interesting finding however is in the relationship between violent offences and market offences. While violent and market offences are often found in a gang member's criminal career, involvement in violent offences more than the median level is negatively related to market offences. On the one hand, Levitt and Venkatesh (2000) found that

gang violence negatively impacted revenues linked to drug selling. On the other hand, violence has been found to have great instrumental value in gangs (e.g., Decker, 1996; Klein, 1971; 1995). Involvement in violence may be a by-product of gang membership, but too much violence may hinder gang members' opportunities to be involved in profitable illegal activities. This is perhaps what explains why violence specialists have smaller networks and are low in brokerage.

Finally, market offences are positively correlated with the measure of coreness and negatively related to the measure of constraint. On the surface, market offences appear to have similar network characteristics to unskilled property crimes. Involvement in market offences is characterized by a concentration in the core of the network, much like unskilled property crimes. However, differences between those offences on other network measures suggest coreness associated with unskilled property crimes may be attained differently compared to coreness associated with market offences. One such key difference is with regard to each crime type's relationship with network redundancy. Unskilled property crimes are positively correlated with higher effective size, while market offences are not. However, market offences are correlated with low constraint, while unskilled offences are not. While both measure an aspect of network redundancy, effective size is closely associated with the network's size while constraint depends both on an ego's network size and their non-redundant alters' network size (Burt, 1992). Larger networks are likely to have more non-redundant ties. Since involvement in unskilled property crimes is correlated with network size, these offenders achieve non-redundancy through larger networks. Low constraint is calculated by considering the proportional constraint each ego's alters have on ego. Moreover, it considers constraint on alters. Thus low constraint is not directly tied to network size. Low constraint indicates that most of ego's connections are themselves low in constraint. Unskilled offenders thus achieve network efficiency and coreness through network size while market offenders are efficient through more strategic ties.

Although these findings are tentative and more research is needed in order to explore the network structures of different criminal activities, these results show that strictly studying versatility, at least in relation to social networks, may provide a misleading and superficial picture of criminal careers. Lin (2001) pointed out that different ways to access to social capital exist and the social network structures that

facilitate its access differ depending on the expected return on investment in social capital. This study provides support for Lin's theory in the context of criminal involvement of gang associated offenders.

## **6.4. Limitations**

The results should be interpreted in light of the limitations of this study. First and foremost, the cross-sectional nature of the study should be considered. Research on criminal careers can be credited with great advances in the longitudinal study of criminal behaviour (see Delisi & Piquero, 2011). Social network analysis in criminology is still relatively rare (Papachristos, 2011) and longitudinal network data even more. The inability to model the evolution of network structures and social capital over time makes it impossible to impute causality to the relationship between versatility, different criminal involvement and social capital. The analysis of the impact of age on versatility allows for a better understanding and interpretation of the results.

McGloin et al. (2009) have shown that while offenders show a tendency to "aggregate to versatility" (p.244), they also do tend to specialize in the short term. This idea is consistent with the hypothesis tested. It is argued that brokerage will lead to new opportunities and access to different skills. The inability to model this change in brokerage over time is a great limitation in order to assess whether or not brokerage leads to versatility. The only relationship that can be clearly modelled here is the co-occurrence of accumulated brokerage and accumulated versatility; a causal relationship cannot be demonstrated with the data at hand.

It is possible that what is being observed in this study is this aggregation to versatility discussed by McGloin et al. (2009). Many gang members in this sample were in their late teenage years at the beginning of the study period. It is possible that their involvement in crimes such as drug trafficking or motor vehicle theft occurred in their later years. Skilled offences require specific skills (e.g., motor vehicle theft, fraud), reliable co-offenders (e.g., holdups) and trading partners (e.g., fencing). Market crimes require access to product (e.g., drug trafficking), clients (e.g., prostitution), employees

and capital (e.g., loan sharking). What is common to those crimes is a notion of trust and access to resources—commodities that take time to acquire.

The cross-sectional nature of the data limits the interpretation of the order in which offenders engage in these offences. If skilled and market offences require the accumulation of resources, it is possible that gang members may engage in violent and unskilled offences before engaging in more “advanced” offences. While the data available does not allow for an analysis of the order of offences, the findings of this study show some support for such an explanation. It was demonstrated that skilled and market offences are rarely found in pure specialists’ careers and are generally found in combination with unskilled and violent offences. Yet, it is not uncommon to find market offences or skilled offences combined with only one other type of offence (violent or unskilled). However, further analyses show younger offenders who engage in market or skilled offences are generally involved in both violent and unskilled offences as well. Yet, it is not rare to find older offenders who have engaged in market or skilled offences but in only one other type of crime.

It stands to reason that a gradation in the severity of crime should be expected in a criminal career. However, little is known about the gradation in the complexity of criminal involvement over a criminal career. Gottfredson and Hirschi (1990) argued that most offenders engage in easy and convenient criminal activities. The findings of this study suggest that overall they might be correct about this assertion with one major caveat; most offenders eventually commit a more “advanced” offence. Wright and Decker (1994) observed that offenders were almost complacent in their involvement in burglaries. Some offenders stated that they did not want to be involved in other crimes because the returns from their crimes were sufficient for their needs and involvement in other offences was associated with uncertainty and risks. McGloin et al. (2007) in studying why offenders may engage in short-term specialization showed that life circumstances, positive (e.g., marriage) or negative (e.g., drug use), fostered changes from specialization to versatility (or vice-versa). The authors found that both propensity (e.g., criminal motivations) and opportunities (e.g., situational contexts) were important in shaping criminal careers. This study focused and found support for the latter (i.e., through the study of social capital in networks), but found at least some support for the former explanation (i.e., through the violent nature of specialists).

The data available in for this study do not allow a clear conclusion on whether gang members “aggregate to versatility”, although it is argued that it is likely the case. Somewhat related to the cross-sectional limitation is the inclusion of individuals at different stages of their criminal careers. For younger offenders, it is possible that a large portion of their criminal career is covered in the 2001-2008 study period. However, older offenders may have been active prior to 2001. As such it is possible that these offenders engaged in other types of offences prior to 2001, but those are not included in the versatility index. The results showed that younger offenders generally had scores above 0.5, indicating that most of them had committed at least 3 types of offences. Conversely, older gang members were generally found with scores below 0.5, although some were found among the most versatile offenders. This explains the curvilinear relationship between versatility and age.

#### **6.4.1. *Network selection, completeness and accuracy***

Another limitation related to the study period is with regard to the size and completeness of networks. Older offenders may have had contacts to individuals who are no longer active in 2001. Moreover, ties between offenders who are still active in 2001 but co-offended prior to 2001 may be missing. As such the size and interconnectedness of older offenders may be underestimated compared to younger offenders.

Beyond the masking due to the study period, other factors may have influenced available network information. First, an inherent limitation to the study of social networks is that it is virtually impossible to possess complete social networks. This is especially the case in this study as individuals from the sample were included because they were detected by police. Many individuals may have gone undetected or under-detected because of reasons such as specific investigation strategies that may target specific neighborhoods, groups or individuals. Moreover, some individuals may be simply better at avoiding detection. In any case, undetected or under-detected individuals may be key players in a network, especially if they are particularly well connected. The data used however included contacts from police that are not co-arrests. It is highly unlikely that a particularly well connected individual will be entirely missed by law enforcement. The use of police contacts to supplement contacts through co-arrests is still subject to certain

biases with regard to police work, but such an approach enables researchers to get a better understanding of an individual's importance in a larger criminal network. Moreover, it allows for a better assessment of the potential resources at the disposition of an offender rather than simply the extent of the network linked to "failed" partnerships.

This is in and of itself one of the strengths of this study compared to prior studies on co-offending. Tremblay (1993) argued that official co-offending data is not sufficient to understand how criminal embeddedness and social ties influence criminal careers. He argues that the study of co-offending should not be limited to "official" co-offenders (i.e., arrested together), but should be extended to "all those offenders he must rely on before, during and after the crime event in order to make the contemplated crime possible or worthwhile" (Tremblay, 1993, p.20). Warr (1996; 2002) and later Sarnecki (2001) found support for Tremblay's insight. For example, Warr (1996) found that the number of co-offenders known to an offender is far greater than the number with which he will actually co-offend. Studying the network of a co-offender beyond official co-arrestees is crucial in assessing the impact of access to skills and information regarding criminal opportunities on criminal behaviour.

Another limitation may be related to the decisions made in selecting the network. The decisions described in chapter 3 may have influenced the networks of individual offenders. Removing some individuals from the network might have decreased the network size and influenced the betweenness centrality of some individuals. However, different tests shown in Chapters 3 and 5 suggest that overall the differences were not important.

#### **6.4.2. *Sample selection, crime categories and versatility index***

The final set of limitations refers to the decisions taken regarding the measures used in this study and the sample used for the analysis. A limitation is related to the exclusion of gang associates from the sample. Given the focus of the original study, and the possible bias towards Haitian street gang members both in terms of their networks and offending information, it was deemed essential to focus on gang members only. Analyses in Chapter 3 supported such a decision. Still, given the notorious difficulty in identifying gang members, it is possible that some associates were actually gang



members and some gang members were more fringe gang members. A future research avenue would be to consider the differences in the network structures between gang members and associates.

Also, the use of the versatility index and the difficulties identified in this study led to a considerable reduction of sample size. As demonstrated in Chapter 4, limiting the sample to offenders with 4 or more arrests while reducing the sample substantively, allowed for a better interpretation of the versatility index. However, this criterion may have created a bias toward offenders who are more likely to be arrested. Moreover, the loss of sample size may have hindered statistical power.

Another limitation related to the use of the versatility index is the categorization of offences. The approach was to create categories that were consistent with a social capital theoretical framework. Analyses in Chapter 4 showed the difficulties associated with the interpretation of an index without categories. Although it is argued that the approach taken here is better, the categorization used could be disputed. Principal component analysis was considered but early results indicated some inadequacy of the data for such a method. A chief concern was the inclusion of categories with lower frequencies. Stable principal component analysis models were obtained only after the removal of several crime categories.

Crime categories were thus constructed by combining crimes that involve tangible skills and resources (i.e., skilled offences) and sustained criminal relationships (i.e., market offences). The remaining crimes included offences for which specific skills or sustained relationships were not necessary. Given the limited information about the context of the offence, it is possible that offences classified as “unskilled” involved considerable sophistication, whereas some “skilled” offences might have been purely spontaneous. A good example of such ambiguity is motor vehicle theft. Although the decision was to classify those offences as skilled offences, motor vehicle theft can occur in as a spontaneous event. Moreover, motor vehicle theft may have simply been for the purpose of “joy riding”, or it could have been for the purpose of re-selling. However, it was found that motor vehicle theft was highly correlated with fencing in the sample ( $r=0.501$ ). Similar considerations motivated the classification of muggings in unskilled property crimes, whereas holdups were classified in skilled offences. While muggings

were significantly correlated with thefts ( $r=0.177$ ) and burglaries ( $r=0.155$ ), holdups were only correlated to thefts ( $r=0.142$ ,  $p=0.045$ ) and weakly correlated to burglaries ( $r=0.047$ ,  $p=0.282$ ). Moreover, holdups appeared to be much more serious offences as they were correlated to attempted homicides ( $r=0.122$ ,  $p=0.070$ ), and assaults ( $r=0.103$ ,  $p=0.112$ ). These results combined with the fact that muggings and holdups were weakly correlated ( $r=0.03$ ,  $p=0.386$ ) motivated the current classification. Although these observations support the classification, it is possible that a different classification may have yielded different results, especially for the analyses of specific offence types. While holdups, fencing, fraud and motor vehicle theft are “more advanced” offences and all, to some extent, require skills, they may not require the same skills. Although prior social network analysis studies are informative regarding the link between skill acquisition and network structures, it is not anticipated that skills of different nature will be associated with different networks. Still this assumption would need to be tested in future research. Another future research consideration would be to observe the network structures associated with the involvement in specific offences.

## **6.5. Conclusion**

The main hypothesis tested in this thesis was that access to social capital is associated with criminal versatility. Despite some limitations, this study was able to show that social capital is indeed associated with versatility. While the findings do suggest a relationship between social capital and versatility, this relationship appears to be more complicated than first anticipated. Still, the results show that low brokerage was associated with a tendency to specialize in a street gang network. These results are consistent with McGloin and Piquero (2010) who have found that redundancy in social network ties was negatively related to versatility.

This thesis contributes to improve measurement issues in the study of criminal careers. The analysis of the versatility index and problems related to its use demonstrate that this measure should be used with caution. Moreover, the interpretation of versatility or specialization in future studies should be based on strong theoretical foundations. Also, the rationale behind each decision regarding the computation of the index (i.e. categorizing crimes, including a certain minimum number of offences, etc.)

should be informed by theory and the data at hand. A better assessment of the different decisions will enhance clarity of interpretation and ensure that researchers are indeed studying the same concepts.

While many have argued that research on crime typologies has generally been unsuccessful, future research should investigate the likelihood that different crime types will be found in the same careers. Even without such typologies available, analyses of these patterns within samples used in criminal career research may be useful in informing crime categorization.

Perhaps the most important finding regarding versatility is that its identification should not be the end goal of any research, regardless of the theoretical inclination. The results regarding the different offence types clearly show that versatility is only the tip of the iceberg; the most interesting, and perhaps most relevant to theoretical explanations of crime, is hidden within the aggregate nature of the index. Debates regarding whether short term specialization exists, or whether offenders are engaging in crimes haphazardly necessarily producing versatile careers has perhaps led researchers to forget why the study of criminal specialization or versatile is important in the first place: the policy and theoretical implications of such finding.

The versatility index was originally used to measure species variation in an ecosystem. Such indices are used to give an aggregate measure for a population, but once such information is known, research should seek to understand *why* these aggregate measures differ from one ecosystem to another, or in the cases of criminal versatility, from one offender to another. It is doubtful that criminology would be the field it is today if the study of crime had not evolved from the examination of city-wide crime rates. Recent research on criminal versatility and specialization has moved beyond etiological examinations and the analysis of the impact of socio-economic characteristics. This study follows those attempts at understanding *why* some offenders engage in a variety of offences while others show a tendency to specialize. Furthermore this study goes further in exploring the composition of those versatile and specialized criminal careers. Future research should seek to explore more in depth the content of criminal careers, rather than simply an aggregate property.

Another contribution of this thesis is the application of social network analysis to the study of criminal careers. Co-offender research has stressed the importance from criminologists to pay more attention to the social nature of crime. The availability of social network data, and criminology's awakening to its potential is likely to lead to a greater focus on the social aspect of crime.

A return to a focus on socialization and group context is especially crucial to the field of gang research. This study focused on street gang networks to explore the link between social capital and versatility. Gang research has moved away from its ethnographic traditions where the social contexts of gang involvement and gang crime were thoroughly investigated. Large-scale longitudinal data collections and nation-wide program evaluations have generated much of the data used in the study of street gangs in the last couple of decades. These recent efforts constitute a crucial departure from classical studies of street gangs in that their data collection assumes (in fact seeks) independence of observations. Gang-related delinquency, to state the obvious, is not independent; its very description implies interdependence.

Recent research has started to acknowledge the advantages of a social network perspective to study street gangs. This thesis follows this trend. The results in this study show that different network structure foster different opportunities in street gangs. Prior ethnographic work has discussed at length the symbolic and tangible sources of reputation and power in street gangs. This thesis only brushes the surface in how a social network perspective may enable researchers to study different sources of social capital in the street gang context, and in the criminal context in general. For example, ties to veteran gang members may be important determinant of criminal careers. Future research should consider other types of relationship as well, such as family ties, ties to organized crime, inter and intra-gang ties, etc. While prior research has shown that most gang members are versatile, this research shows that it does not mean that these individuals are similar in *how* they are versatile, and the paths they have taken to reach this level of versatility. Obviously, future research would gain tremendously by analyzing longitudinal patterns in network structures and its impact on criminal career.

In sum, although there is still much work to be done towards the understanding of criminal careers, this study was able to answer the initial question of state at the outset

of this thesis. The findings of this study suggest that in the context of street gangs, Jack-of-all-trades are *not necessarily* masters of none. Jack-of-all-trades appear to possess a crucial skill that allows them to be proficient in many tasks: the ability to mobilize social capital.

## References

- Agresti, A., & Agresti, B. (1978). Statistical analysis of qualitative variation. *Sociological Methodology, 9*, 204-237.
- Anderson, E. (1999). *Code of the street*. New York, NY: Norton.
- Borgatti, S. P., & Everett, M. G. (1999). Models of core/periphery structures. *Social Networks, 21*, 375-395.
- Borgatti, S. P., Everett, M. G., & Freeman, L. C. (2002). *Ucinet VI*.
- Borgatti, S. P., Jones, C., & Everett, M. G. (1998). Network measures of social capital. *Connections, 21*(2), 27-36.
- Bouchard, M., & Konarski, R. (In press). Assessing the core membership of a youth gang from its co-offending network. In C. Morselli (Ed.). *Crime and Networks*. Criminology and Justice Series. New York: Routledge.
- Bouchard, M., & Nguyen, H. (2010). Is it who you know or how many that counts? Criminal networks and cost avoidance in a sample of young offenders. *Justice Quarterly, 27*(1), 130-158.
- Bouchard, M., & Spindler, A. (2010). Groups, gangs and delinquency: Does organization matter? *Journal of Criminal Justice, 38*(5), 921-933.
- Bourdieu, P. (1986). The forms of capital. In Richardson, J. (Ed.). *Handbook of theory and researcher for the sociology of education*. New York, NY: Greenwood Press.
- Britt, C. L. (1994). *Versatility*. In T. Hirschi and M. Gottfredson (Eds.) *The generality of deviance*. New Brunswick, NJ: Transaction.
- Bursik, R. J. (1980). The dynamics of specialization in juvenile offences. *Social Forces, 58*, 851-864.
- Burt, R. (1992). *Structural holes: The social structure of competition*. Boston, MA: Harvard University Press.
- Burt, R. (2000). The network structure of social capital. *Research in Organizational Behaviors, 33*, 345-423.
- Burt, R. (2004). Structural holes and good ideas. *American Journal of Sociology, 110*(2), 349-399.

- Burt, R. (2005). *Brokerage and closure: An introduction to social capital*. New York, NY: Oxford University Press.
- Clarke, R. V., & Felson, M. (1993). *Routine activity and rational choice: Advances in criminological theory*. New Brunswick, NJ: Transaction.
- Cloward, R. A., & Ohlin, L. E. (1960). *Delinquency and opportunity*. New York, NY: The Free Press.
- Cohen, A. K. (1955). *Delinquent boys: The culture of the gang*. Glencoe, IL: Free Press of Glencoe.
- Coleman, J. (1988). Social capital in the creation of human capital. *American Journal of Sociology*, 94, S95-S120.
- Cornish, D. B., & Clarke, R. V. (1986). *The reasoning criminal: Rational choice perspective on offending*. New York, NY: Springer.
- Decker, S. H. (1996). Collective and normative features of gang violence. *Justice Quarterly*, 13(2), 243-264.
- Decker, S. H. (2001). The impact of organizational features on gang activities and relationships. In M. Klein., H.-J. Kerner, C. Maxson, and E. Weitekamp (Eds.). *The eurogang paradox: Street gangs and youth groups in the U. S. and Europe.*, Dordrecht: Kluwer Academic Publisher.
- Decker, S. H., & Curry, D. (2002). Gangs, gang homicides, and gang loyalty: Organized crimes or disorganized criminals. *Journal of Criminal Justice*, 30(4), 343-352.
- Decker, S. H., Katz, C. M., & Webb, V. J. (2008). Understanding the black box of gang organization: Implications for involvement in violent crime, drug sales, and violent victimization. *Crime & Delinquency*, 54(1), 153-172.
- Decker, S. H., Melde, C., Pyrooz, D. C. (2013). What do we know about gangs and gang members and where do we go from here?. *Justice Quarterly*, 30(3), 369-402.
- Decker, S. H., & Van Winkle, B. (1996). *Life in the gang: Family, friends and violence*. Cambridge, MA: Cambridge University Press.
- DeLisi, M. (2003). The imprisoned non-violent drug offender: Specialized martyr or versatile career criminal? *American Journal of Criminal Justice*, 27, 167-182.
- DeLisi, M., Beaver, K. M., Wright, K. A., Wright, J. P., Vaughn, M. G., & Trulson, C. R. (2011). Criminal specialization revisited: A simultaneous quantile regression approach. *American Journal of Criminal Justice*, 36(2), 73-92.
- DeLisi, M. & Piquero, A. (2011). New frontiers in criminal career research, 2000-2011: A state-of-the- art review. *Journal of Criminal Justice*, 39(4), 289-301.

- Descormiers, K., Bouchard, M., & Corrado, R. (2011). Strain, social capital, and access to lucrative crime opportunities. *International Journal of Child, Youth and Family Studies*, 1-2, 83-98.
- Descormiers, K., & Morselli, C. (2011). Alliances, conflicts, and contradictions in Montreal's street gang landscape. *International Criminal Justice Review*, August (2011), 1-18.
- Erickson, B. H. (1981). Secret societies and social structure. *Social Forces*, 60(1), 188-210.
- Farrington, D. P. (1986). Age and crime. In M. Tonry and N. Morris (Eds.) *Crime and justice: A review of research*. Chicago, IL, University of Chicago Press.
- Freeman, L. C. (1977). A set of measures of centrality based on betweenness. *Sociometry*, 40, 35-41.
- Gottfredson, M. R., & Hirschi, T. (1990). *A general theory of crime*. Stanford, CA: Stanford University Press.
- Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology*, 78(6), 1360-1380.
- Guerette, R., Stenius, V., & McGloin, J. (2005). Understanding offence specialization and versatility: A reapplication of the rational choice perspective. *Journal of Criminal Justice*, 33(1), 77-87.
- Hao, L., & Naiman, D. Q. (2007). *Quantile regression: Quantitative applications in the social sciences*. Thousand Oaks, CA: Sage.
- Haynie, D. L. (2001). Delinquent peers revisited: Does network structure matter? . *American Journal of Sociology*, 106(4), 1013-1057.
- Kleemans, E. R., & de Poot, C. J. (2008). Criminal careers in organized crime and social opportunity structure. *European Journal of Criminology*, 5(1), 69-98.
- Klein, M. W. (1971). *Street gangs and street workers*. Englewood Cliffs, NJ: Prentice-Hall.
- Klein, M. W (1995). *The American street gang*. New York, NY: Oxford University Press.
- Klein, M. W, & Maxson, C. M. (2006). *Street gang patterns and policies*. New York, NY: Oxford University Press.
- Koenker, R., & Bassett, G. (1978). Regression quantiles. *Econometrica*, 46(1), 33-50.
- Levitt, S., & Venkatesh, S. (2000). An economic analysis of a drug-selling gang's finances. *The Quarterly Journal of Economics*, 115(3), 755-789.



- Lin, N. (2001). *Social capital: A theory of social structure and action*. Cambridge: Cambridge University Press.
- Matsuda, K., Melde, C., Taylor, T., Freng, A., & Esbensen, F.-A. (2012). Gang membership and adherence to the "Code of the street". *Justice Quarterly*, 30(3), 440-468.
- Mazzerolle, P., Brame, R., Paternoster, R., Piquero, A., & Dean, C. (2000). Onset age, persistence, and offending versatility: Comparisons across gender. *Criminology*, 38(4), 1143-1172.
- McCarthy, B., & Hagan, J. (1995). Getting into street crime: The structure and process of criminal embeddedness. *Social Science Research*, 24(1), 63-95.
- McCarthy, B., & Hagan, J. (2001). When crime pays: Capital, competence, and criminal success. *Social Forces*, 79(3), 1035-1059.
- McGloin, J., & Piquero, A. (2010). On the relationship between co-offending network redundancy and offending versatility. *Journal of Research in Crime and Delinquency*, 47(1), 63-90.
- McGloin, J., Sullivan, C., & Piquero, A. (2009). Aggregating to versatility? *British Journal of Criminology*, 49(2), 243-264.
- McGloin, J., Sullivan, C., Piquero, A., & Pratt, T. (2007). Local life circumstances and offending specialization/versatility: Comparing opportunity and propensity models. *Journal of Research in Crime and Delinquency*, 44(3), 321-346.
- Morselli, C. (2005). *Contacts, opportunities, and criminal enterprise*. Toronto, ON: University of Toronto Press.
- Morselli, C. (2009). *Inside criminal networks*. New York: Springer.
- Morselli, C., & Tremblay, P. (2004). Criminal achievement, offender networks and the benefits of low self-control. *Criminology*, 42(3), 773-804.
- Morselli, C., Tremblay, P., & McCarthy, B. (2006). Mentors and criminal achievement. *Criminology*, 44(1), 17-43.
- Moule, R. K., Decker, S. H., & Pyrooz, D. C. (2013). Social capital, the life-course, and gangs. In C. L. Gibson, and M. D. Krohn (Eds.) *Handbook of life-course criminology*. New York, NY: Springer.
- Nguyen, H., & Bouchard, M. (2013). Need, connections, or competence? Criminal achievement among adolescent offenders. *Justice Quarterly*, 30, 44-83.
- Osgood, D. W., & Schreck, C. (2007). A new method for studying the extent, stability, and predictors of individual specialization in violence. *Criminology*, 45(2), 273-312.

- Papachristos, A. V. (2011). The coming of a networked criminology. In J. Macdonald (Ed.) *Measuring crime and criminality*. Piscataway, NJ: Transactions.
- Piquero, A., Farrington, D., & Blumstein, A. (2007). *Key issues in criminal career research: New analyses of the Cambridge study in delinquent development*. New York: Cambridge University Press.
- Piquero, A., Paternoster, R., Mazerolle, P., Brame, R., & Dean, C. W. (1999). Onset age offence specialization. *Journal of Research in Crime and Delinquency*, 36(3), 275-299.
- Portes, A. (1998). Social capital: Its origin and applications in modern sociology. *Annual Review of Sociology*, 24, 1-24.
- Putnam, R. (1995). Bowling alone: America's declining social capital. *Journal of Democracy*, 6(1), 65-78.
- Pyrooz, D. C., Sweeten, G., & Piquero, A. R. (2013). Continuity and change in gang membership and gang embeddedness. *Journal of Research in Crime and Delinquency*, 50(2), 239-271.
- Reiss, A. J., & Farrington, D. P. (1991). Advancing knowledge about co-offending: Results from a prospective longitudinal survey of London males. *Journal of Criminal Law & Criminology*, 82(2), 360-395.
- Sarnecki, J. (2001). *Delinquent networks*. Cambridge, MA: Cambridge University Press.
- Searle, S. R. (1988). Parallel lines in residual plots. *The American Statistician*, 42(3), 211-211.
- Short, J. F., & Hughes, L. A. (2006). *Studying youth gangs*. Lanham, MD: Altamira.
- Short, J. F., & Strodtbeck, F. L. (1965). *Group processes and gang delinquency*. Chicago, IL: University of Chicago Press.
- Sullivan, C., McGloin, J., Pratt, T., & Piquero, A. (2006). Rethinking the 'norm' of offender generality: Investigating specialization in the short-term, *Criminology*, 44(1), 199-233.
- Sullivan, C., McGloin, J., Ray, J., & Caudy, M. (2009). Detecting specialization in offending: Comparing analytic approaches. *Journal of Quantitative Criminology*, 25, 419-441.
- Sutherland, E. (1937). *The professional thief*. Chicago, IL: University of Chicago Press.
- Thrasher, F. (1927). *The gang*. Chicago, IL: University of Chicago Press.
- Tremblay, P. (1993). Searching for the suitable co-offender. In R. V. Clarke and M. Felson (Eds.) *Routine activity and rational choice: Advances in criminological theory*. New Brunswick, NJ: Transaction.

- Tremblay, P. (2011). *Beauvoir Jean, Le recit du vétéran*. Montreal: Liber Editions.
- Tremblay, P., Charest, M., Charrette, Y., Bouchard, M., Tremblay-Faulkner, M., & Beaudoin, I. (2011). Les trajectoires de victimisation dans le milieu des gangs de rue haïtiennes. Ministère de la Justice (Québec).
- Venkatesh, S. (2008). *Gang leader for a day: A rogue sociologist takes to the streets*. Toronto, ON: Penguin Publishing.
- Warr, M. (1996). Organization and instigation in delinquent groups. *Criminology*, 34(1), 11-37.
- Warr, M. (2002). *Companions in crime: The social aspects of criminal conduct*. Cambridge, MA: Cambridge University Press.
- Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications*. Cambridge, MA: Cambridge University Press.
- Whyte, W. F. (1943). *Street corner society*. Chicago, IL: University of Chicago Press.
- Wright, R. T., & Decker, S. H. (1994). *Burglars on the job: Streetlife and residential break-ins*. Lebanon, NH: University Press of New England.