

**Serial Sex Offenders' Environmental
Consistency and Crime Site Selection
Across Series**

by

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Dissertation Submitted In Partial Fulfillment of the
Requirements for the Degree of
Doctor of Philosophy

in the
School of Criminology
Faculty of Arts and Social Sciences

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SIMON FRASER UNIVERSITY

Summer 2014

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Abstract

Crime linkage analysis constitutes a potential tool to help investigators prioritize suspects in cases of serial crimes. While crime linkage has been a burgeoning field of research for the last decade or so, a still scarce amount of research limits our knowledge on environmental consistency among serial sex offenders. Furthermore, methodological issues characterize previous studies on consistency. The current dissertation departs from previous studies in the crime linkage field by building on research coming from the criminal career field in order to move forward research on serial sex offenders' environmental consistency and crime site selection. To this end, it is organized into three separate but related empirical studies.

The first study examined consistency for specific geographic and environmental factors using various coefficients, two of them taken from the criminal career literature. While a high level of consistency was found, some environmental aspects of the crime showed better consistency than others, making them more valuable for crime linkage analysis. Findings also indicated on the bias associated with each coefficient and the potential contribution of coefficients from for criminal career field when measuring offenders' consistency. In the second study, environmental consistency was further explored using a crime-event approach. More specifically, crime sites used by serial sex offenders were investigated across series to examine for their stability. Distinct and recurrent crimes sites used across series were identified, indicating that serial sex offenders operate over limited environments. In addition, preliminary data suggesting that a connection exists between the victim encounter site selected and the offender's series progression was provided. More specifically, the use of sites known to "attract" potential victims decreased over series and offenders became more risk-taking in regard to sites selected to encounter their victims. In the third study, heterogeneity among serial sex offenders, with regard to offending frequency and duration, was assessed. Findings indicated that different crime series patterns were present, such patterns significantly influencing offenders' levels of consistency. Taken together, the results of these three studies highlighted heterogeneity of serial sex offenders' crime series patterns while demonstrating the relationship and stability between their past and future environmental behaviors.

Keywords: crime linkage; environmental consistency; criminal career; crime sites; serial offenders; sex offenders

Acknowledgements

I would like to express all my gratitude to the many people that, directly or indirectly, helped and supported me throughout my doctoral studies. First, I would like to thank the Vanier Canada Graduate Scholarships program and the School of criminology at SFU for their much appreciate financial support. I would also like to thank the members of my supervisory committee (Drs. Eric Beauregard, Garth Davies, Don Read, and Gabrielle Salfati) for accepting to be part this journey, and for taking the time to read my dissertation and provide me with valuable feedbacks and constructive comments. More specifically, I would like to thank my senior supervisor, Dr. Eric Beauregard, for his incredible support throughout this long and full-on process. Thanks for your always balanced approach as a supervisor, for being patient and encouraging when I needed it, while always challenging me. It means a lot that you were the first one to help me get started with my master's thesis at Udm and ended up as my senior supervisor at the doctoral level at SFU. I will be forever thankful for your guidance and support.

Thanks to the Faculty, professors and administrative staff at SFU who helped me throughout this journey. More specifically, I would like to thank Dr. Simon Verdun-Jones and Dr. Raymond Corrado for giving me the opportunity to work for them as a research assistant when I first moved to British Columbia, at a time where there were some uncertainties about my career and my future. What started as a research assistant position at SFU became an opportunity to appreciate academia and the definite push I needed to start my doctoral studies at the School of Criminology. I would like to extend my thanks to Dr. Pratibha Reebye who always made me feel like I was a good project manager... and a good mom.

I would also like to thank my friends, whether in Montreal, Vancouver, Los Angeles or Sydney, who were always there for me. Les *Brunettes*, thanks for still being by my side after all these years apart. The same goes for you Marie; thank you for always encouraging me and making me feel that what I was doing was extraordinary. Stacy, thank you for your continuous input, psychological and academic support, and for always taking the time to revise my writing and help me improving my English, especially when we started our doctoral studies. B.Sc. and M.Sc. at Udm, Ph.D. at SFU; we are academic soul mates it seems. I'm sure our paths will cross again at some point.

Karine, I am glad that I got to meet a friend like you. Thank you for the good laughs, for always listening and being there when I needed to let the steam out a bit, and thank you for sharing this *Ph.D. mama* experience with me. Martin, thank you for your ecstatic sense of humor; those nights out with you and Karine helped to keep some social life happening during the Ph.D. journey. Jesse, our almost instant friendship after I moved to Vancouver was important in many ways. Thanks for always making me feel that I belonged.

À ma famille, mes parents, merci pour votre soutien constant, pour m'avoir épaulé et encouragé à déménager à Vancouver, même si cela signifiait que je serais loin de vous pour un nombre d'années incertain. Merci aussi d'avoir accepté mes décisions de vie jusqu'à présent, et de m'avoir supportée dans ce périple des études doctorales qui viennent, plus souvent qu'autrement, avec des hauts et des bas et la tête toujours pleine et pensive. Merci aussi de n'avoir jamais mis de pression quant à un potentiel retour. Le temps fait bien les choses... À mon grand-papa et ma grand-maman, une petite pensée pour vous là-haut qui avez toujours eu le don de me faire sentir spéciale et fière de moi. Ma petite grand-maman, je garde très fièrement ce manuel de criminologie que tu as rédigé pour le Professeur Denis Szabo il y a de cela plus de 50 ans.

À mon amoureux, ami, collègue, père de mes enfants: je ne serais probablement pas là où je suis si ce n'était de toi, de ton support inconditionnel, de ton aide, de ta force. Merci d'avoir encore et toujours cru en moi et en mes capacités, même si j'en doutais moi-même parfois. Merci d'avoir su constamment me pousser à me dépasser, à devenir meilleure, tout en sachant m'épauler et me dire d'arrêter quelques instants et prendre le temps. Merci d'être une source d'inspiration constante et de faire partie de ma vie depuis près de 10 ans. Il s'en est passé bien des choses depuis cette première rencontre à Pinel, mais tu es toujours là. À mon petit mais déjà grand garçon Émile (mon « bébé Ph.D. ») et à la petite puce qui arrivera sous peu, vous êtes ce que j'ai accompli de mieux et une des meilleures choses qui me soient arrivées. Vous me forcez à rester bien ancrée, balancée et à relativiser bien des choses; vous m'aidez à devenir une meilleure personne.

Although not easy, full of unknowns and compromises, it is still possible to find some balance between academia and motherhood: the joy, rewards, accomplishments, and growth outweigh the other parts.

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1. Introduction

1.1. Police Investigations and Investigation Techniques

Crimes are generally committed by a few chronic and persistent offenders (Braga, 2011; Piquero, Farrington, & Blumstein, 2003). Consequently, these offenders and the offenses they are responsible for tend to create issues and challenges for law enforcement. Understanding where, when, how, against whom, and by whom serial sex crimes are committed therefore, seems even more important. This is especially true for serial sex offenders for which a connection between the offender and the victim rarely exists (Rossmo, 2000). As such, police investigators often need to rely on different techniques to help in suspect prioritization for these specific crimes.

Suspect prioritization is a central component of criminal investigations. Prioritization is pivotal to ensure practical efficiency (e.g., narrowing the sometime overwhelming number of potential suspects) while reducing the direct and collateral costs associated with an investigation (e.g., length of investigation, number of police officers working on the case). In the absence of a confession, an eyewitness or forensic and physical evidence, other methods must be used to assist police investigators in identifying potential suspects. Over the past decades, detailed information about offenders' behaviors has been relied upon to facilitate investigation and apprehension efforts. Prior studies conducted have mainly focused on two broad techniques to solve cases by supporting and assisting investigators in prioritizing suspects: offender profiling and crime linkage analysis. Despite the fact that offender profiling and crime linkage may carry some value for criminal investigations, scholars and researchers have overlooked these two procedures (Snook, Wright, House, & Alison, 2006). The scarcity of empirical studies examining the validity of offender profiling and crime linkage analysis thus raises some doubts about their value for police investigations as effective investigative tools.

1.1.1. *From Offender Profiling to Crime Linkage*

Offender Profiling in the Context of Criminal Investigations. While criminal profiling has been around for many years as an investigative procedure, it only emerged as a research area in the last two decades or so (Dowden, Bennell, & Bloomfield, 2007). Although different definitions have been proposed over the years, the one proposed by Douglas and colleagues (1986) is the one most widely relied on by scholars. According to these authors, profiling refers to a technique for identifying an individual's major personality, behavioral, and demographic characteristics based upon analysis of the crimes he or she has committed (Douglas, Ressler, Burgess, & Hartman, 1986). Therefore, it is argued that, by looking at the characteristics of a crime scene, the offender's behaviors, personality traits, and sociodemographic background can be inferred. Such inference, known as the homology assumption, will later on help investigators to draw a profile of the presumed author of the crime, ultimately allowing to narrow down the pool of potential suspects, and facilitates police apprehension efforts. This homology assumption, however, has raised concerns from researchers and academics. Among others, several researchers in the field have criticized the fact that the majority of papers published on offender profiling are thought-pieces often aimed at presenting success stories disclosed by law enforcement agencies. The positive reputation of offender profiling appears, in fact, to be the result of its large exposure in media circles (e.g., TV series/shows, films) rather than based on empirical evidence (Alison, Goodwill, Almond, van den Heuvel, & Winter, 2010; Beauregard, Lussier, & Proulx, 2007a; Dowden et al., 2007; Wilson, Lincoln, & Kocsis, 1997).

In the last decade or so, however, researchers have started to test the predictive value of offender profiling (e.g., Alison, Bennell, Ormerod, & Mokros, 2002; Kocsis, 2006; Mokros & Alison, 2002; Snook, Cullen, Bennell, Taylor, & Gendreau, 2008; Wilson et al., 1997). Central to these empirical investigations has been the personality-behavior association (i.e., homology assumption). To date, findings have shown either partial or little evidence supporting the association between crime scene actions and the offender's background characteristics across different crime types (Beauregard, Lussier, & Proulx, 2007b; Mokros & Alison, 2002; Woodhams & Toye, 2007). This has led researchers to look for other type of information in order to help in the prioritization and apprehension of suspects. As such, researchers have recently moved away from the

personality-behavior association and started to look more closely at the behavior-behavior association, central to the crime linkage analysis, to identify and prioritize suspects during criminal investigations.

Behavioral Consistency and Crime Linkage. The behavior-behavior association has generated interest from researchers in what is now known as behavioral crime linkage analysis. Crime linkage involves the identification of behavioral similarities between offences of the same nature to help identify the individual responsible for the crime being investigated. More specifically, crime linkage, with the use of police databases, helps to determine if a crime for which the offender is not yet known (i.e., unsolved case) can be associated with a previous crime for which the offender is already known (i.e., solved case) (Woodhams, Hollin, & Bull, 2007). Therefore, it is assumed that the offender will likely have previously committed the same crime type in a similar fashion; these similarities between the current and previous crimes helping in the identification of the offender. In crime linkage studies, offenders who have committed two or more crimes of the same type are usually referred to as serial offenders. Following the same logic, offences of the same type committed by the same offender are known as a (crime) series. Crime linkage is said to help police investigations in numerous ways. The two most important advantages raised by scholars relate to (1) building the case; and (2) reducing the costs associated with the investigation (Woodhams, Hollin et al., 2007). On one hand, crime linkage analysis has been said to allow the gathering of information from different “linked” crimes (i.e., when two or more crimes are determined to have been committed by the same offender) to potentially increase the factual evidence against an offender. On the other hand, crime linkage can help in reducing the direct and collateral costs associated with an investigation by allowing the crimes committed by the same offender to be investigated simultaneously rather than individually.

Crime linkage relies on two central assumptions drawn from personality psychology: (a) behavioral consistency; and (b) behavioral distinctiveness (also known as behavioral differentiation or variability) (Melnik, Bennell, Gauthier, Gauthier, 2011; Tonkin, Grant, & Bond, 2008). The consistency assumption, as outlined by Canter (1994, p. 347), refers to the idea that “the way an offender carries out one crime on one occasion will have some characteristic similarities to the way he or she carries out

crimes on other occasions.” More specifically, behavioral consistency, as it applies to crime linkage, implies stability over the same type of crime committed by an offender. The behavioral distinctiveness assumption refers to the idea that not only offenders must behave consistently from one crime to another but they must also exhibit a relatively high level of behavioral uniqueness in their crime commission compare to other serial offenders committing the same crime type. Hence, if offenders are committing multiple offences of the same crime type in a consistent manner, but that all offenders committing this type of crime are doing it in a similar fashion, it becomes impossible to link crimes to a common offender. The extent to which these two basic assumptions are valid can help to determine the degree to which it is possible to discriminate between crimes committed by different offenders, a process commonly known as behavioral discrimination (Melnik et al., 2011). In a more proactive way, the extent to which patterns of offending are diverse or specialized indicates on the feasibility of preventing a certain type of crime by targeting a certain type of offender (Nieuwebeerta, Blokland, Piquero, & Sweeten, 2011).

In addition to the obvious implications and debate over the accuracy and validity of such assumptions, however, crime linkage implies some questionable presumptions. As explained above, the idea behind crime linkage (at least in a reactive manner) is to link a yet unsolved crime to another solved crime in the hope of identifying a common perpetrator. It is thus assumed that offenders have a criminal history and are already “in the system” or known to Police. Moreover, not only does it assume that the offender responsible for the crime will likely have a criminal history, the offender is also thought of having recidivated for the same type of crime. In addition, this offender is also thought of having executed the crime in a similar way than crimes, of the same type, the offender may have previously committed. Offenders are thus assumed not only to be recidivists, at some point, but also to be “specialized” in the type of crime committed and the way they committed it. Taken together, these three points suggest that for crime linkage to be effective, offenders need to be previously charged for (or convicted), persistent, and specialized in a specific crime type.

1.1.2. Prior Studies and Empirical Findings on Crime Linkage

Considering its importance, relatively little has been published on the process, validity, and effectiveness of crime linkage. In order to determine if offending behaviors can be used reliably to link crimes, it is crucial to establish if behavioral consistency and distinctiveness exist among offenders. So far, empirical studies have been conducted on a limited set of criminal behaviors, often the most extreme forms of crime. Indeed, the focus of most crime linkage studies has been on violent crimes, such as:

- sexual offences (e.g., Sjöstedt, Långström, Sturidsson, & Grann, 2004; Woodhams, Grant, & Price, 2007; Woodhams, Hollin, & Bull, 2008);
- sexual assault (e.g., Davies, 1992; Grubin, Kelly, & Brunson, 2001; Harbers, Deslauriers-Varin, Beauregard, & van der Kemp, 2012; Lundrigan, Czarnomski, & Wilson, 2010);
- rape (Davies, Wittebrood, & Jackson, 1997; Santtila, Junkkila, & Sandnabba, 2005; Woodhams & Labuschagne, 2012 a, b);
- homicide (e.g., Bateman & Salfati, 2007; Melnyk et al., 2011; Salfati & Bateman, 2005; Santtila, Pakkanen, Zappal, Bosco, Valkama, & Mokros, 2008; Sorochinski & Salfati, 2010); as well as
- sexual homicide (e.g., Schlesinger, Kassen, Mesa, Pinizzotto, 2010).

The growing popularity of crime linkage analysis, however, has led some researchers to explore the utility of crime linkage and test the validity of its assumptions with a wider range of crime types, such as:

- burglary (e.g., Bennell & Canter, 2002; Bennell & Jones, 2005; Bernasco, 2008; Markson, Woodhams, & Bond, 2010; Melnyk et al., 2011; Tonkin, Santtila, & Bull, 2012; Woodhams & Toye, 2007);
- car theft (e.g., Tonkin et al., 2008); and
- arson (Ellingwood, Mugford, Bennell, Melnyk, & Fritzon, 2013; Santtila, Fritzon, & Tamelander, 2004).

Most studies conducted so far have focused on the distinctiveness assumption and the possibility to accurately distinguish between linked and unlinked pairs of crimes. Using different methodological and analytical strategies, all seem to agree: offences committed by the same offender show greater similarity than crimes committed by different offenders (e.g., Beutler, Hinton, Crago, & Collier, 1995; Lundrigan et al., 2010; Santtila et al., 2005; Sjöstedt et al., 2004). Prior studies also revealed that it is possible to successfully distinguish between linked and unlinked crimes based on the offender's

behaviors displayed at the crime scene (Bennell & Canter, 2002; Bennell & Jones, 2005; Grubin et al., 2001; Lundrigan et al., 2010; Markson et al., 2010; Melnyk et al., 2011; Santtila et al., 2004; Santtila et al., 2005; Tonkin et al., 2008; Tonkin, Woodhams, Bull, Bond, & Palmer, 2011; Woodhams & Toye, 2007). Testing for the linking accuracy, most studies have used receiver operating characteristics (ROC) analyses and results showed that moderate levels of linking accuracy were achieved (see Bennell, Mugford, Ellingwood, & Woodhams, 2013 for a review).

A more limited number of studies have specifically focused on testing the behavioral consistency assumption. So far, these empirical studies have shown evidence that offenders commit crimes in a relatively consistent manner across successive offences. Such evidence has been reported for the modus operandi of crimes such as burglary (e.g., Bernasco, 2008; Bennell & Canter, 2002; Bennell & Jones, 2005; Goodwill & Alison, 2006; Yokota & Canter, 2004), arson (e.g., Santtila et al., 2004), robbery (e.g., Woodhams & Toye, 2007), and sexual assault (e.g., Grubin et al., 2001; Santtila et al., 2005). The level of consistency displayed by offenders, however, widely fluctuates throughout the studies. The unstable levels of behavioral consistency found appear to be partially due to the diversity of variables and behaviors investigated by previous studies, as well as the methodology used to investigate consistency.

Mainly, two analytical strategies were used in past studies to test for the behavioral consistency assumption. First, a few studies (e.g., Bateman & Salfati, 2007; Schlesinger et al., 2010) have investigated behavioral consistency by measuring specific single behaviors (e.g., rare behaviors) among offences, a procedure that is also known as the signature approach. As defined by Hazelwood & Warren (2003, p. 597), the signature is the “calling card” of an offender and is viewed as “a highly individualized and unique combination of habitual aspects of offending behavior derived from the fantasy and motive for a series of crime perpetrated by a single offender.” This analytical strategy was used exclusively in empirical studies looking at behavioral consistency among serial (sexual) homicides and serial sexual crimes. Different behaviors were looked at, such as the nature of the sexual acts performed, the victim’s mutilations or injuries, the presence of “trophies” or “souvenirs” taken from the victim by the offender, as well as the use of weapon or ligature to control the victim. This analytical procedure,

however, was found to be less reliable than others as signature behaviors are likely to be rare and hardly identifiable for very frequent crimes (e.g., burglary, arson) (Bennell & Canter, 2002; Canter, 2000; Schlesinger et al., 2010; Sorochinski & Salfati, 2010).

A more common analytical strategy used in crime linkage studies was to measure similarities between themes or domains of behaviors (e.g., Bennell & Canter, 2002; Davies, 1992; Grubin et al., 2001; Santtila et al., 2004; Santtila et al., 2005; Woodhams & Toye, 2007; Woodhams, Grant et al., 2007). The idea behind this procedure is that consistency in offense behaviors is more likely to be expressed through the common themes underlying different combinations of actions rather than through single salient actions. Using different statistical techniques to regroup behaviors under specific themes, these studies have mostly looked at violence used and victim's injuries, escape behaviors, control behaviors, planning behaviors, target selection choices, victim-offender interaction behaviors, body disposal, and type of (sexual) behaviors committed. It is also noteworthy that studies have included different single behavior to form their grouping of behaviors, even when using what appears to be, at first, the same theme. In combining behaviors under themes or domains, however, methodological issues arise. Indeed, by measuring themes or groups of behaviors, rather than individual behaviors, one can expect to find more behavioral consistency. For example, an offender can use a gun to control the victim(s) in one of the crimes selected while binding the victim(s) in another one. Nonetheless, behavioral consistency would still be found among these serial crimes for the "weapon" theme, even if some would argue that using a gun or using ligature to control the victim are two different ways of offending. The validity of the theme-based approach was recently questioned (e.g., Ellingwood et al., 2013) and the value and necessity of looking at a wider range of specific behaviors (rather than groups or themes of behaviors) for behavioral and crime linkage purposes, that are not necessarily rare or "signature" behaviors, have been put forward (e.g., Harbers et al., 2012).

In order to compare and quantify the degree of similarities existing between crimes committed by the same offender, prior studies have used different similarity coefficients. Similarity coefficients usually range from 0 to 1, with 1 indicating a total similarity between the crimes that were compared. The vast majority of studies to date have used Jaccard's similarity coefficient (e.g., Bennell & Canter, 2002; Bennell et al.,

2013; Markson et al., 2010; Tonkin et al., 2008; Woodhams et al., 2008; Woodhams & Toye, 2007). This coefficient has the advantage of not taking into account joint non-occurrence (i.e., if a behavior is absent in two crimes) which is an important aspect for crime linkage studies as police data are not always complete and the absence of a certain behavior in a crime report does not necessarily mean that this behavior did not occur (Tonkin et al., 2008). Other coefficients have been proposed and used, such as the taxonomic similarity index (e.g., Woodhams, Grant et al., 2007) and, more recently, the simple matching index (Ellingwood et al., 2013). While these two newly proposed coefficients might have outperformed Jaccard's under specific circumstances, studies have not found significant support for the use of one of these coefficients over Jaccard's (e.g., Bennell, Gauthier, Gauthier, Melnyk, & Musolino, 2010; Ellingwood et al., 2013; Melnyk et al., 2011).

The somewhat unstable levels of offenders' consistency level found might also be related to the wide range of behaviors examined in prior studies as well as the time-period that elapsed between linked offences selected for the investigation (temporal proximity). Indeed, not all behaviors have shown high consistency and certain behaviors seemed to be temporally more stable and less susceptible to situational influence (Alison et al., 2010). For example, when looking at grouping of behaviors, it appears that behaviors related to target selection, planning of the offense, and control of the victim, were committed more consistently by offenders throughout series of crimes (Bateman & Salfati, 2007; Bennell & Canter, 2002; Woodhams & Toye, 2007). Researchers suggested that themes of behaviors where higher consistency was found were those less dependent on situational factors and/or on victim's reaction and behaviors, such as the level of violence used (Bennell & Canter, 2002; Davies, 1992; Markson et al., 2010; Salfati, 2003; Sorochinski & Salfati, 2010). For example, crime switching could be found in situations where offenders are unable to successfully perform their initial cognitive script and reach their goal and had to adapt to the situation. Sorochinski and Salfati (2010) also suggested that these behavioral changes were attributable to the offenders' experiential learning and adaptation to commit their crime more successfully.

Environmental Consistency and Sex Offending. In recent years, the notion of consistency has been applied to geographic and spatial behaviors, which can be seen as less situation-dependent. For example, Bennell and Jones (2005) argued

that the location chosen to commit a crime is a decision that the offender has control over and is less dependent on the situation. As such, geographic and spatial behaviors as well as crime site selection should present a higher level of consistency comparatively to other traditional modus operandi behaviors. More specifically, two behaviors have mostly been investigated in prior studies: the intercrime distance, conceptualized as the distance between offense locations, and the temporal proximity, conceptualized as the time elapsed between two offenses. In other words, these two behaviors provide indication on the dispersion, in time and space, of the offender's crimes (Tonkin et al., 2011). So far, study findings show that these aspects of a crime, in fact, outperformed more traditional modus operandi behaviors (e.g., Bernasco, 2008; Goodwill & Alison, 2006; Markson et al., 2010; Tonkin et al., 2011).

Most of the research on geographic and spatial consistency, on one hand, has looked at the offender's journey to crime (i.e., offender's mobility and distance travelled to commit an offense). Much less research has focused on the environmental characteristics of sites where crimes most likely take place. More specifically, the environmental decision-making and crime site selection of serial offenders across their series remains unclear. On the other hand, studies analyzing the offender decision-making process related to the location of the crime have mostly been carried out for property crimes such as burglary (e.g., Bernasco & Nieuwebeerta, 2005; Clare, Fernandez, & Morgan, 2009; Coupe & Blake, 2006; Nee & Meenaghan, 2006; Wright, Logie, & Decker, 1995) and robbery (e.g., Bernasco & Block, 2009; Bernasco, Block, & Ruiters, 2013; Petrosino & Brensilber, 2003). Recent studies have also investigated target selection and spatial choices of rioters (e.g., Baudains, Braithwaite, & Johnson, 2013; Martin, McCarthy, & McPhail, 2009). These previous studies have provided evidence that the selection of locations to commit crimes is not random and "irrational" but rather controlled and based on the available information and internal cost-benefit calculation of the offender. Not much is known, however, when it comes to person-oriented offenses such as sex crimes. Still, prior research shows that, while the environmental decision and selection of the site might be influenced by dynamic factors, serial offenders often use the same geographic and ecological space and tend to pattern themselves geographically (e.g., Beauregard, Proulx, Rossmo, Leclerc, & Allaire, 2007; Canter, 2000; LeBeau, 1987). For example, in a recent study, Lundrigan, Czarnomski,

and Wilson (2010) examined the consistency displayed by serial sex offenders in regard to the time of the crime, crime location, and characteristics of the crime site selected — what they referred to as environmental consistency. Their results indicated that these offenders showed a high environmental consistency level across crime series, suggesting that serial offenders are not randomly selecting environments to commit their crimes. In other words, whatever might be influencing the timing of the offense and the offense location of these offenders is also influencing the timing and location of their following offenses.

Different explanations have been put forward to explain why serial offenders would become consistent in the way they commit crimes of the same type. Investigating behavioral consistency of serial sex offenders, for example, Woodhams and Labuschagne (2012b) reinstate the role of the offenders' sexual fantasies in the consistent selection of their victims, offense locations, and modus operandi behaviors (e.g., methods of approach, methods to control the victim, sexual behaviors). Driven by these sexual fantasies, offenders will then tend to repeat the same crime in a similar fashion. For the most part, however, researchers have used a more "rational" approach and suggested that offenders are decision-makers who will act in a consistent fashion based on their knowledge and experience (e.g., Beauregard & Leclerc, 2007; Beauregard, Rossmo, & Proulx, 2007; Bernasco, Block, & Ruiters, 2013; Lundrigan et al., 2010). After successive and successful crime commissions, an offender becomes more familiar with cues associated with good or successful targets, locations or environments to find a target and commit a crime. These cues then become part of a fixed knowledge structure or schemas (also known as scripts) that will influence the commission of future offending behaviors. As such, as offenders learn from their previous experiences, they might try to commit a crime in a different way or at a different place during the first few offenses, in order to determine what strategy works best for successfully achieving their goal (e.g., Cusson, 1993; Rossmo, 2000; Sorochinski & Salfati, 2010). Once a successful strategy has been determined, the offender can then start to reproduce it when committing successive crimes, which leads to the consistent use of specific behaviors or offense sites (Lundrigan et al., 2010).

More specifically into consistency of offense site selection, Canter (2000) suggested that consistency in spatial behaviors and the environment selected is seen in

serial offenders as they operate over somewhat limited environments, preferring those that are more familiar to them and therefore, more predictable. For example, it was suggested that offenders may search and select a victim in an environment where they were able to successfully commit the same type of offense. As the offenders return to these locations, they become more familiar with these locations and will tend to use them more consistently due to this perceived familiarity. In the same way, offenders will be more inclined to target locations that bear environmental similarities to their familiar environments. For instance, research on geographic profiling has shown that sex offenders tend to commit crimes close to their home or in familiar environments they go to as part of their non-criminal routine activities (e.g., work, social event) (Brantingham & Brantingham, 1991; Canter & Larkin, 1993; Rossmo, 2000). The rationale being that it is easier to commit crimes in the course of their daily routine activities than planning a special journey to do so. Furthermore, and perhaps more importantly, the offender can perceive a familiar environment as more predictable and easier to escape in the event that something goes wrong in the course of the offence.

As per the criminological literature (e.g., Brantingham & Brantingham, 1993; Felson, 2002; McGloin, Sullivan, Piquero, & Pratt, 2007; McGloin, Sullivan, & Piquero, 2009; Horney, Osgood, & Marshall, 1995), it is also suggested that offenders may favor certain offence types and behaviors due to local life circumstances and, by extension, the routine activities and opportunity structures they bring. For instance, life circumstances and routine activities can impinge on the time and moment the offender is available to search for victims and commit a crime. In short, consistent routine activities can shape repetitive offending behavior, which explain why some specialization can be found.

1.1.3. *Methodological Issues in Crime Linkage Studies*

Even though still sparse, behavioral consistency has been a flourishing field of research over the past decade or so. Prior studies conducted thus far on crime linkage focused exclusively on testing the validity of its assumptions and the reliability of crime linkage for prioritization and investigation purposes. In order to do so, empirical studies have used different methodologies therefore, making it difficult to draw firm conclusions about the validity and veracity of the main assumptions of crime linkage analysis. More

specifically, those studies differ in many ways, relying on different sample sizes and types, different sources and types of data, and focusing on different crime types. Of concern is also the fact that different definitions of serial offending have been used across studies, making it difficult to determine who are serial offenders, what a series is, and how to operationalize it for comparison purposes. For example, prior crime linkage studies usually included “serial” offenders having committed a series of the same crime type. The term serial is usually defined as two or more offences committed by the same offenders (e.g., Bennell & Canter, 2002; Davies, 1992; Lundrigan et al., 2010; Markson et al., 2010; Tonkin et al., 2008; Woodhams et al., 2008). Some also specified a dimension of “event,” stating that crimes have to be committed on different victims on separate occasions (e.g., Beauregard, Proulx et al., 2007; Grubin et al., 2001; Woodhams & Labuschagne, 2012a). Some other studies investigated consistency with a sample of serial offenders having committed at least three (e.g., Bennell & Jones, 2005; Melnyk et al., 2011; Sorochinski & Salfati, 2010), sometimes five or more (e.g., Bateman & Salfati, 2007; Melnyk et al., 2011) offences at different times and locations, in order to maximize the number of crimes in the sample and allow for a more thorough investigation of behavioral consistency.

Such a procedure, or lack thereof, highlights two flaws in prior studies. On one hand, first-time offenders were excluded from most analyses conducted. The exclusion of these offenders may have artificially biased the study findings in such a way as to potentially increase the ability of researchers in linking crimes to a common offender. Indeed, first-time offenders may commit crimes that are very similar to other crimes that are part of a series of other offenders. On the other hand, by restricting their investigation of consistency on offenders having committed a higher number of crimes, it is reasonable to think that different results may have been found, not necessarily representative of serial offenders in general. Such variation between studies highlights the fact that serial offenders greatly vary in terms of their offending frequency and duration. For example, some researchers have referred to the presence of a subgroup of “prolific” offenders (e.g., Bennell & Canter, 2002; Bennell and Jones, 2005; Grubin et al., 2001; Melnyk et al., 2011; Tonkin et al., 2008). In fact, some studies have examined the effect of “expertise” on behavioral consistency in specifically selecting a subgroup of prolific offenders (e.g., Tonkin et al., 2008). However, an arbitrary cut-off number of

offences were selected to define such offenders. Indeed, there is no consensus about what a prolific offender is in terms of offending frequency. More specifically, there are no criteria agreed upon about the number of crimes required to characterize prolific offending. This issue becomes even more complex when we take into consideration the type of the crime committed. Indeed, it is unclear if the required number of crimes committed characterizing prolific offending should change according to the seriousness of crime committed. The term “serial” therefore regroup different types of offending and crime series patterns, from the more occasional and opportunistic to the more persistent and prolific offenders.

Another problem emerged from prior studies in the crime linkage field, related to the data and sampling criteria used. Sampling criteria are a pivotal part of crime linkage studies as it determines the generalization of the findings. The sampling criteria refer to the indicator(s) used to include cases to create a study sample for the analysis. First, researchers most commonly selected all crimes committed during a specific period, in a given location, for a specific crime type (i.e., burglary, homicide, sexual assault, etc.). Rarely were crimes selected based on a pool of individuals. In fact, crime linkage studies are based on different data sources. The majority of researchers have relied on police data or victims statement to the police (e.g., Bateman & Salfati, 2007; Bennell & Jones, 2005; Grubin et al., 2001; Lundrigan et al., 2010; Markson et al., 2010; Melnyk et al., 2011; Salfati & Bateman, 2005; Santtila et al., 2005; Soroichinski et Salfati, 2010; Tonkin et al., 2008; Woodhams & Toye, 2007; Woodhams & Labuschagne, 2012b). While using an offender-based sampling criterion to investigate consistency might not be a true reflection of the reality in which crime analysts must performed crime linkage analysis¹ (see, for example, Tonkin et al., 2011), such procedure allows analysts to include all crimes of the same nature committed by each offender. It is believed that, considering the still lacking knowledge in this specific area, this may help to get a more truthful portrait of serial offenders' behaviors from one crime to the next and their level of consistency.

¹ Indeed, not all offenders are serial offenders and, for the most part, it is more plausible to think that crime analysts will be dealing with crimes committed by “new” offenders rather than a specific pool of offenders having previously committed the same type of crime.

Second, and related to the previous comment, although research on crime linkage examined series of crimes known to be committed by the same offender (solved crimes), not all the crimes included in the offender's series were analyzed. On the other hand, it is standard practice in crime linkage studies to include the same number of offences per offender (see however Woodhams et al., 2008 and Woodhams & Labuschagne 2012b). Most of the time, these studies have limited the number of crimes per offender to two or three offences. The alleged advantage related to restricting the number of crimes analyzed being to limit the influence that prolific offenders may have on the study findings (Bennell & Canter, 2002). In order to do so, different procedures have been used to select crimes as part of the series to be analyzed. Some studies have used the most recent offences committed by the offender (Tonkin et al., 2008; Woodhams & Toye, 2007) while others have selected the first few known offences committed (Bateman & Salfati, 2007; Salfati & Bateman, 2005; Sorochinski & Salfati, 2010). In doing so, the temporal sequence of crimes committed by the offender is taken into account. Other studies have not included such a sequence by simply randomly selecting a predetermined number of crimes among each series (Bennell & Canter, 2002; Bennell & Jones, 2005; Markson et al., 2010). In other words, the vast majority of studies investigating serial offenders' levels of consistency are based on a limited sample of crimes committed by the offenders, rather than being based on their whole crime series, especially more so for the prolific serial offenders. To our knowledge, only one study has acknowledged and tested for the potential influence of the offender's number of crimes committed. In their study, Woodhams and Labuschagne (2012b) found that selecting a fixed number of crimes per series/offender could in fact lead to an underestimation of behavioral consistency.

Finally, when specified, the time period used varies considerably from two (e.g., Markson et al., 2010), four (e.g., Bennell & Jones, 2005), and ten years (e.g., Santilla, Fritzon, et al., 2004), to up to more than thirty years (e.g., Lundrigan et al., 2010; Santilla et al., 2008). Longer time-periods were typically used for more serious violent crimes, such as serial sexual assault and serial homicide, whereas shorter time-periods were mostly used in studies on serial property crime types (i.e., burglary, car theft). Longer time-periods selected for violent crimes, however, did not necessarily mean a longer time-period for each offender included in the sample. Hence, the same starting and end

date was generally used for each offender, meaning that at the starting date of the study period selected some offenders were at the beginning while some others were at the end of their crime series. Therefore, even though the time period for violent crime studies were sometimes long, the time period characterizing the series analyzed varied across offenders between a few days to several decades. Considering that behaviors do not show the same degree of stability over time and that offenders are thought to become more consistent over time, it is reasonable to think that such variation might have influenced the level of consistency found previously and, ultimately, the validity of crime linkage analysis.

Overall, examination of prior studies conducted in the crime linkage field, more specifically on the behavioral consistency assumption, showed that results from this field are mostly based on a limited sample of crimes for each offender — rather than looking at the offender's whole crime series. This observation seems to be reflective of the fact that crime linkage analysis and the investigation of behavioral consistency have mainly been conducted in psychology, more specifically in the field of investigative psychology. As such, this line of research has emerged and evolved almost independently of a long tradition of empirical research in criminology: the criminal career paradigm. Unlike studies from the field of crime linkage and consistency, the wealth of research coming from this field tends to support the importance of using an offender-based approach for sampling purposes when investigating individual tendency for consistency and specialization in crime. In fact, to a broader extent, research coming from the criminal career field helps to better understand behavioral consistency and how to move forward research coming from the field of crime linkage and behavioral consistency.

1.1.4. *Building on the Criminal Career Paradigm*

Criminologists have long been interested in the developmental patterning of criminality and criminal behaviors of offenders over the course of their criminal career (Piquero et al., 2003). For decades now, the criminal career field has developed as a scientific paradigm that focuses on the longitudinal sequence of crimes committed by individuals (Blumstein, Cohen, Roth, & Visser, 1986). Instead of focusing on the crime event, the individuals and their criminal behaviors throughout their career are examined. This longitudinal sequence or “criminal career” has been conceptualized along various

crime parameters such as the age of onset, the offending frequency (or lambda), the length of the criminal career, the seriousness (or aggravation), and the desistance (or termination of offending) (Blumstein et al., 1986).

Results stemming from this field have allowed researchers to better understand and contextualize heterogeneity of offenders and their criminal career. Indeed, distinct groups of offenders who offend at different rates over different career durations, and whose criminal activity is caused by unique factors, have been found over the years (Piquero et al., 2003). For example, in designing a probabilistic model of criminal careers, Barnett, Blumstein, and Farrington (1987) found that offenders had to be divided into two groups: (1) the frequent offenders, showing a high offending frequency; and (2) the occasional offenders, showing a low(er) offending frequency. In terms of career duration, Moffitt (1993) identified two criminal trajectories among offenders: (1) offenders whose antisocial behaviors are limited to the adolescence period — the *adolescent limited* offenders; and (2) offenders who start to commit antisocial behaviors early on and whose criminality persists well into adulthood — the *life-course persistent* offenders. Looking at the offending rate over offenders' career (i.e., lambda), further studies results supported distinct trajectories of offenders in terms of offending frequency *and* duration. For example, various studies identified a group of offenders showing a high rate of offending over a limited period (i.e., high-rate *limited* or short-term, high-rate offenders) and, conversely, a group of offenders showing a low rate of offending over many years (i.e., *low-rate persistent*, *low-rate chronics* or *long-term, low-rate offenders*). In a recent study, Francis, Harris, Wallace, Knight, and Soothill (2013) investigated criminal trajectories of US men referred for civil commitment. Their study allowed to extend “typologies” of general and sexual offending of these men by identifying two more trajectories: (1) the *low-rate limited* offenders, who engage in a relatively short period of offending that is characterized by a low rate of offending; and (2) the *high-rate persistent* offenders, who present a high rate of offending than spans many years. Looking specifically at the sexual offending trajectories of these men, these authors also identified four trajectory groups that somewhat echoed general offending trajectories found previously. Such conclusions challenge the assumption that sexual offenders are a homogeneous group.

Crime Specialization and Crime Switching. The extent to which offenders specialize in their offending has also been, first and foremost, a key question in criminal career research (see Nieuwbeerta et al., 2011). Indeed, criminal career researchers have stressed the importance of examining two aspects of the longitudinal sequence of offending: (a) crime specialization, which is the tendency to repeat the same crime type on subsequent occasions); and (b) criminal versatility or crime switching, which refers to the tendency to commit a wide array of crime types (Blumstein et al., 1986). Based on these parameters, “specialist” offenders are those who predominantly commit a specific type of crime and tend to engage in that behavior repeatedly and frequently as opposed to “versatile” offenders who tend to commit many different types of crime over time without specializing in any of them specifically (Lussier, 2005).

In the traditional view of criminal careers, according to Blumstein, Cohen, and Farrington (1988), offenders are thought to “sample” a wide variety of offenses during the early phase of their career before becoming more specialized, with time, in particular crime types that are more suited to their preferences and skills. In other words, crime switching should be expected in the first few arrests while crime specialization should be found for offenders that are more prolific. In line with such a statement, a study conducted by Beutler and colleagues (1995) demonstrated that a more similar offense pattern throughout the offender’s crime series was associated with a greater number of alleged offenses. Other studies also found that specialization for specific offense types was more likely for more “experienced” and prolific offenders (Brennan, Mednick, & John, 1989; Lussier, Bouchard, & Beauregard, 2011). For example, Brennan, Mednick, and John (1989) found evidence of specialization in violent and property offenses for offenders presenting a persistent and more extensive criminal history.

More recently, researchers have used a more circumscribed approach to analyze specialization (e.g., life-course perspective) and found that, while generality is the norm when offending is viewed over the long-term criminal career, offenders tend to specialize in the short term (i.e., months or years rather than developmental stages or the full career) (DeLisi, Beaver, Wright, Wright, Vaughn, & Trulson, 2011; Francis, Soothill, & Fligelstone, 2004; McGloin et al., 2009; 2007; Soothill, Francis, Sanderson, & Ackerley, 2000; Sullivan, McGloin, Pratt, & Piquero, 2006). For example, Sullivan et al. (2006) found that the level of specialization progressively decreased as the time window

of focus grew broader (i.e., month to year to three years). More directly, Francis et al. (2004) showed that some offenders would transition among or change offender “type” across adjacent five-year brackets.

Studies from the criminal career field have also shown that offenders become more specialized, over time, as they progress in their criminal career (Armstrong, 2008a, b; Armstrong & Britt, 2004; Blumstein et al., 1988; DeLisi et al., 2011). In addition, offenders who started their criminal career earlier are more likely to be versatile (Farrington, Loeber, Elliot, Hawkins, Kandel, Klein, et al., 1990; Loeber & Leblanc, 1990; Piquero, Paternoster, Brame, Mazerolle, & Dean, 1999). However, further investigating the relationship between the age of onset and offense versatility, some researchers found that this association disappeared after controlling for the offender’s age (Mazerolle, Brame, Paternoster, Piquero, & Dean, 2000; Piquero et al., 1999). In other words, this result suggested that there was a tendency for offenders to be more specialized over time regardless of the age at which they initiated offending. When it comes to sexual offenders more specifically, most studies have found that sex offenders do not specialize in sex offenses and that sexual offenses should be seen as being part of a broader propensity to be involved in antisocial activities (Lussier, LeBlanc, & Proulx, 2005; Smallbone, Wheaton, & Hourigan, 2003).

While it has been a common tendency in criminology to dichotomize offenders as specialists or generalists, Soothill and colleagues (2000) suggest that such a distinction is not necessary and that sex offenders can, in fact, be both. Hence, results of their study show evidence that while sex offenders tend to be versatile in terms of their participation in crime over their criminal career, they do specialize in specific types of sex offending (e.g., indecent assault, rape) among their sexual criminal career. Crime specialization, however, has been vastly examined for various crime types, but rarely within specific crime type (see however Lussier, Leclerc, Healey, & Proulx, 2008; Lussier, Deslauriers-Varin, Mathesius, & Proulx, 2014; and Leclerc, Lussier, & Deslauriers-Varin, 2014). As such, criminal career researchers have examined the tendency to specialize in violent crimes whereas crime linkage researchers have looked at the tendency for violent offenders to commit their violent crimes in the same way. While the research question is different, the analytical approach is the same (i.e., examining whether offending behaviors are similar). Therefore, it is argued that criminal

career research has produced various methodological options to analyze these crime parameters (Sullivan, McGloin, Ray, & Caudy, 2009) that are suited for the examination of behavioral consistency. Moreover, the wealth of research stemming from this field is thought to provide essential and useful information on the level of consistency displayed by serial offenders, how to best measure it, and factors that modulate it, which could help researchers and improve research conducted in the field of behavioral consistency.

1.2. Aim of the Dissertation

Crimes are generally committed by a few chronic and persistent offenders (e.g., Braga, 2011; Piquero et al., 2003). Consequently, these offenders and the offenses they are responsible for tend to create issues and challenges for law enforcement. This is especially true for serial sexual offenders where a connection between the offender and the victim rarely exists (Rossmo, 2000), making it much harder to identify these offenders. In the absence of an eyewitness and/or forensic and physical evidence, other methods must then be used to assist police investigators in identifying potential suspects.

In this regard, crime linkage analysis constitutes a potential tool to help investigators prioritize suspects. While crime linkage has been a burgeoning field of research for the last decade or so, a still scarce amount of research limits our knowledge on behavioral consistency in sexual assault cases. More specifically, the notion of consistency in crime linkage literature has typically been applied to crime scene behaviors rather than the geographical aspect of the offence (Grubin et al., 2001) and, when taken into account, studies have usually looked at the journey to crime (e.g., Snook et al., 2006) rather than broader elements of the environment where and in which an offence takes place. A recent study conducted by Lundrigan and colleagues (2010) however, found that environmental consistency was present in serial sexual assaults. Indeed, when combining various temporal and contextual factors together, such as the contact site, the time of the offense, and the area type and land use to commit the offense, serial sex offenders were showing environmental consistency in offense timing and site selection. Considering that little research exists into the extent or nature of serial offenders' consistency in geographic behaviors and offence site selection, such

results provided support to further explore environmental consistency among serial sex offenders.

Furthermore, methodological issues of previous studies on crime linkage and behavioral consistency were identified. Those issues were reinforced by the fact that the crime linkage and behavioral consistency field has developed independently of a wealth of research coming from the criminal career field, which share related research interests. The current dissertation aimed to address the limited knowledge in the field of crime linkage and behavioral consistency while attempting to address some of the methodological limitations of previous studies. In doing so, the current study built upon research from the criminal career literature as a way to improve the study of behavioral consistency of serial sex offenders in the context of crime linkage analysis. Consequently, using secondary data, three exploratory studies (i.e., scientific articles) were conducted based on a sample of 72 stranger serial sex offenders collectively responsible for a total of 361 sexual assaults (at least two crimes per offender), involving a victim of any age and any gender, for which they were charged and convicted. These men were all incarcerated in a Correctional Service of Canada penitentiary between 1995 and 2004 in Quebec. The information about their crimes was gathered through self-report from the offenders as well as correctional file data (see Beauregard, Rossmo, & Proulx, 2007, for more details). The specific aims of the three empirical studies part of this dissertation are elaborated on in detail below.

Recent studies have shown that geographical and environmental aspects of crime are more consistent than those related to the offender's modus operandi. The identification of the salient components of offending behaviors that can be used to reliably link individual crimes as part of a single series, however, remain elusive (Grubin et al., 2001; Sorochinski & Salfati, 2010) and little research exists into the extent or nature of serial offenders' consistency in geographic behaviors and offence site selection. The first empirical study part of the dissertation aimed at investigating offending consistency of geographic and environmental factors among serial sex offenders. More specifically, this study explored the use and influence of different analytical strategies to investigate consistency. For example, criminal career research has identified several analytical strategies that can help estimate the level of behavioral consistency (or crime specialization), and could be used for the analysis of geographic

and environmental aspects of sexual assault cases. As such, the first study investigated serial sex offenders' levels of consistency for specific geographical and environmental factors, using different similarity/specialization coefficients. These selected coefficients all have their own underlying assumptions and come from both the behavioral consistency and the criminal career fields. Such strategy allowed determining pros and cons associated with each analytical approach, their complementarity, as well as highlighting the influence of the analytical approach used when investigating consistency.

The second study aimed at further exploring environmental consistency among serial sex offenders by exploring such an assumption using a crime-event approach. Therefore, the stability of crime sites used to commit a sexual assault over time was examined, rather than the offender's level of consistency. Prior studies on the hunting process, target selection, and offending process, showed that serial offenders were not randomly selecting environments to commit their crimes and tend to patterned themselves geographically (e.g., Beauregard et al., 2007; Canter, 2000; Deslauriers-Varin & Beauregard, 2010; Rossmo, 2000). However, prior studies always investigated the hunting and offending processes and its relationship with the locational settings of the crime; none of these prior studies considered looking only and specifically at the inner characteristics of the site selected and how sites selected evolve across crime series. The second study aimed, more specifically, at determining if specific sites were selected by serial sexual offenders and, if so, to identify their specific nature. In a second step, the stability of these crime sites was investigated across series to determine if sites selected by serial sex offenders were recurrent across series or if new sites emerged as offenders were progressing in their respective series. The exploration of the potential variability of crime sites used by these offenders over time allowed determining if specific crime sites were used earlier or later on in the offenders' crime series, making it relevant for crime linkage and investigative strategies.

Finally, the third study of this dissertation assessed heterogeneity among serial sex offenders. Based on studies coming from the criminal career field, serial offenders should present heterogeneity with regard to their offending frequency and duration. Such heterogeneity could potentially influence offenders' consistency level and its explanation. To date, however, researchers in the crime linkage and behavioral

consistency field assumed that serial offenders are homogeneous. Therefore, they have neglected to examine and control for the influence of crime series patterns in the investigation of serial offenders' consistency. Not taking into account such crime series patterns is thought to minimize the true extent of serial offenders' levels of offending, but also their tendency to be consistent in their offending. As such, it was argued that before investigating serial offenders' consistency, one must first examine if this group of offenders are in fact homogeneous enough to be investigated as a whole when investigating consistency (e.g., without making any distinction or controlling for any other factors). As such, the third and final study of this dissertation aimed at further exploring heterogeneity of serial sex offenders and its influence on their consistency level.

Taken together, these three studies were designed to further investigate environmental consistency of serial sex offenders by: (1) exploring the use and influence of different analytical strategies, coming from both the crime linkage and criminal career field, to measure offenders' levels of environmental consistency; (2) exploring environmental consistency and crime site selection using an alternative approach (i.e., crime-event based); and (3) exploring heterogeneity of offending frequency and duration among serial sex offenders and its relevance for future studies in the crime linkage and behavioral consistency field.

2. Investigating Consistency for Geographic and Environmental Offending Factors among Serial Sex Offenders: A Comparison of Multiple Analytical Strategies

2.1. Abstract

Crime linkage analysis constitutes a tool to help investigators prioritize suspects, but a scarcity of research and methodological issues limits our knowledge on behavioral consistency in sexual offenses. The current study identifies geographic and environmental factors that are useful in examining offending consistency across series of sexual assaults using different specialization coefficients. The current study draws on criminal career research and methodology as a way to improve the study of behavioral consistency. The sample includes 72 serial stranger sex offenders responsible for 361 sexual assaults. Three methods are used (i.e., diversity index, forward specialization coefficient, and Jaccard's coefficient) and reveal a high degree of offending consistency. All three methods also highlight promising factors to rely on for crime linkage of serial sexual offenses. Empirical and methodological implications for behavioral consistency research are discussed as well as practical implications for police investigations and crime linkage.

2.2. Introduction

Suspect prioritization is a central component of criminal investigations as it helps to narrow down the overwhelming number of potential suspects while reducing the direct and collateral costs associated with an investigation (e.g., length of investigation, number of police officers working on the case). The most reliable way to identify a suspect is through forensic evidence (e.g., DNA, fingerprint) found at the crime scene (Grubin et al., 2001), or through a confession by the offender. In the absence of a confession, an eyewitness, or physical evidence, however, other methods must be used to assist police investigators in identifying potential suspects. One such method, crime linkage, involves the identification of similarities between offenses of the same type to help identify the individual responsible for the crime being investigated. More specifically, with the use of police databases, crime linkage helps to determine if a crime, for which the offender is not yet known, presents evidence of similar offender behaviors with another (previous) crime for which the offender is already known (Woodhams, Hollin, et al., 2007). In other words, it is believed that offenders will repeat the same crime, but will also commit these crimes in a consistent way across crime events.

Associated with the emergence of crime linkage, researchers from the field of investigative psychology started to question whether offenders are in fact consistent in the way they commit their crimes. As such, they recently began to examine behavioral consistency in offending using different analytical methods. However, this line of research has emerged and evolved almost independently of a long tradition of empirical research on offending specialization in criminology: the criminal career paradigm. The current study aims to bridge this gap by presenting findings and analytical methods from this field as a way to complement the investigation of offending consistency in sex offending.

2.2.1. *Empirical Findings and Methodological Issues in Behavioral Consistency Studies*

To date, the vast majority of studies on behavioral consistency have used Jaccard's similarity coefficient in order to quantify the degree of similarity and

consistency that exists between crimes committed by the same offender (e.g., Bennell & Canter, 2002; Davies, Tonkin, Bull, & Bond, 2012; Markson et al., 2010; Tonkin et al., 2008; Woodhams et al., 2008; Woodhams & Toye, 2007). This coefficient provides information on the degree of consistency across consecutive offenses for each behavior examined. Jaccard's coefficient is widely used in crime linkage studies because it does not take into account joint non-occurrences (i.e., 0/0), meaning that if a particular behavior is absent across two crimes, the level of similarity between those crimes will not increase (Bennell & Canter, 2002). As such, this coefficient has a great advantage when using official or police data as the information recorded about a crime is not always entered in a consistent manner and the absence of a behavior in an offense report does not mean that the behavior did not occur (Woodhams, Grant et al., 2007). Other coefficients have been proposed and used (e.g., taxonomic similarity index, Woodhams, Grant et al., 2007), but recent studies have not found significant support for the use of one coefficient over another (Melnyk et al., 2011).

Studies analyzing offending consistency have typically examined modus operandi behaviors and have shown evidence that offenders commit crimes in a consistent manner across different types of crime (Grubin et al., 2001; Santtila et al., 2004; Santtila et al., 2005; Woodhams & Toye, 2007; Yokota & Canter, 2004). In recent years, however, studies have examined the geographic and spatial information of the offense (e.g., average distance travelled, range of distance travelled, spatial patterns) and found that these factors could outperform more traditional modus operandi behaviors (Bennell & Canter, 2002; Bennell & Jones, 2005; Bernasco, 2008; Goodwill & Alison, 2006; Markson et al., 2010; Snook et al., 2006; Tonkin et al., 2008). This is especially true for the inter-crime distance, which was recently found as a promising aspect to rely on, to facilitate crime linkage across crime types and categories (Burrell, Bull, & Bond, 2012; Tonkin et al., 2011). In a recent study, Lundrigan, Czarnomski, and Wilson (2010) also examined the consistency displayed by serial sex offenders in the choice of crime location and the characteristics of the crime site selected (referred to as environmental consistency). Their results indicated that these offenders showed high environmental consistency across their crime series, suggesting that serial offenders are not randomly selecting environments to commit their crimes but that whatever might be

influencing the selection of one environment is also influencing the selection of following environments.

While evidence of behavioral consistency was previously found, the level displayed by offenders fluctuates throughout the studies. The unstable levels of behavioral consistency found appear to be partially due to the diversity of variables and behaviors investigated by previous studies. The time-period between offenses forming a series might have played a role as well. Indeed, certain behaviors seem to be temporally less stable and more susceptible to situational influence, especially so for sexual offenses (Alison et al., 2010; Markson et al., 2010). First, on one hand, prior studies have shown that crimes committed in greater temporal proximity showed greater behavioral consistency and that the likelihood of stranger sex offenders displaying behavioral consistency across their series decreased when looking at longer series of crimes (Alison et al., 2010; Grubin et al., 2001. See, however, Harbers et al., 2012). On the other hand, prior studies show that greater levels of consistency are found in offenses committed later in the series investigated as the offenders have achieved a certain offending knowledge and expertise to commit their crime more successfully (Grubin et al., 2001; Woodhams and Labuschagne, 2012b; Sorochinski & Salfati, 2010).

Second, due to the interactional nature of this offense, sexual assault is subject to situational and contextual influence and more prone to crime switching, as offenders might be unable to successfully perform their initial cognitive script and reach their goal. More specifically, previous studies have shown that the target selection process of sex offenders depend heavily on the social, physical, and geographic environment as well as the victim's behaviors and location prior to the crime (e.g., Beaugard, Proulx et al., 2007; Deslauriers-Varin & Beaugard, 2010; Canter & Larkin, 1993; Rossmo, 1997). Variation in the level of behavioral consistency found for this offending aspect should then be expected. However, prior studies have shown that behaviors that are less dependent on situational factors and over which the individual exerts control present a higher level of consistency (Bennell & Canter, 2002; Davies, 1992; Markson et al., 2010; Sorochinski & Salfati, 2010). For example, Bennell and Jones (2005) argued that the location chosen to commit a crime is a decision that the offender has control over. As such, spatial behaviors and the crime site selection should present a higher level of

consistency comparatively to other traditional *modus operandi* behaviors, making them promising aspect to rely on for crime linkage purposes.

Empirical studies on behavioral consistency have used different methodologies, which could explain the unstable levels found and make it difficult to draw firm conclusions about the main assumptions of crime linkage analysis. For instance, previous studies have used different sampling procedures and criteria, which are a pivotal part of the research process because they determine the generalization of the findings. In previous studies examining behavioral consistency, all crimes committed during a specific period for a specific crime type (e.g., burglary, homicide, sexual assault) were selected. Also, when specified, the (follow-up) period used varied considerably from two (e.g., Markson et al., 2010) up to more than thirty years (e.g., Lundrigan et al., 2010; Santilla, Pakkanen, Zappal, Bosco, Valkama, & Mokros, 2008). However, as the samples were not individual-based, but rather crime event-based (see however Sjöstedt et al., 2004), the selection of a longer period does not necessarily imply a long follow-up period for each offender included. Hence, in previous studies, the same start and end date was used for each offender, which means that at the start date of the study period, some offenders might have been at the beginning while others might have been at the end of their crime series. As a result, most studies examined consistency for partial crime series only. Since prior studies found that the likelihood of behavioral consistency could fluctuate as the series gets longer, it is reasonable to think that biased and unstable results might be found when investigating behavioral consistency for partial crime series.

Another sampling procedure used in behavioral consistency studies was to include the same number of offenses per offender. Most of the time, these studies have restricted the number of crimes per offender to two or three offenses (see however Woodhams et al., 2008) to limit the influence that prolific offenders may have on the study findings (Bennell & Canter, 2002). In these cases, different procedures have been used in order to select the crimes to be analyzed. Some studies have used the most recent offenses committed by the offender (Tonkin et al., 2008; Woodhams & Toye, 2007) while others have selected the first known offenses (Bateman & Salfati, 2007; Salfati & Bateman, 2005; Sorochinski & Salfati, 2010). The advantage of these procedures is that the temporal sequence of the series of crimes committed by the

offender is taken into account. Other studies have simply randomly selected a predetermined number of crimes among the series that did not take into account the sequence of offending (Bennell & Canter, 2002; Bennell & Jones, 2005; Markson et al., 2010). Regardless of the selected procedure, only a sample of crimes in the series was examined, which is especially the case for the prolific offenders. In a recent study, however, Woodhams and Labuschagne (2012b) found that selecting a number of crimes per series in order to limit the effect of more prolific offenders does not reflect reality, and could in fact lead to an underestimation of the behavioral consistency. Therefore, researchers should examine all the crimes (of the same nature) committed by the offender rather than selecting a fixed number of crimes per offender.

The analytical strategies used in previous studies might also have influenced the findings. Two analytical strategies were generally used in past studies to test the behavioral consistency assumption of crime linkage. A few studies have investigated behavioral consistency by measuring specific single behaviors (e.g., rare behaviors) among offenses, a procedure that is also known as the signature approach (e.g., Bateman & Salfati, 2007; Harbers et al., 2012; Schlesinger et al., 2010). A more common analytical strategy, however, was to measure similarities between themes or domains of behaviors (e.g., Bennell & Canter, 2002; Burrell et al., 2012; Davies, 1992; Grubin et al., 2001; Santtila et al., 2004; Santtila et al., 2005; Woodhams, Grant et al., 2007). The idea behind this procedure being that consistency in offense behaviors is more likely to be expressed through the common themes underlying different combinations of actions rather than through a single salient action. In combining behaviors under themes, however, methodological issues can arise. For example, the way those themes are operationalized fluctuates from one study to another and can most likely influence the consistency level found (see, for example, Davies et al., 2012). Moreover, by measuring themes or groups of behaviors, rather than individual behaviors, one can expect to find more behavioral consistency.² The consistency level shown by specific behaviors is also left unknown and the identification of reliable salient

² For example, an offender can use a gun to control the victim(s) in one of the crimes selected while binding the victim(s) in another one. Nonetheless, behavioral consistency would still be found among these serial crimes for the “weapon” theme, even if some would argue that using a gun or using ligature to control the victim are two different ways of offending.

components of offending behavior that could be used to link individual crimes as part of a series remains elusive (Sorochinski & Salfati, 2010). The insufficient knowledge about consistency of individual behaviors and the somewhat changing nature and composition of themes/domains of behaviors used in prior studies do not contribute to the development of sound knowledge in crime linkage.

Overall, the review of the scientific literature reveals the scarcity of research and knowledge regarding the behavioral consistency assumption of crime linkage analysis. Moreover, these studies are based on various conceptual, methodological, and analytical procedures, which limit the conclusion that can be drawn. Despite this, findings from previous studies indicate that, when examining suitable behavioral domains or individual behaviors, high stability exists among offenders' behaviors and that these behaviors can be used to successfully link serial crimes (Bennell & Jones, 2005). More specifically, geographic and environmental factors recently appeared as reliable and stable aspects to look at for crime linkage purposes. Considering its importance, research is still needed in order to understand if behavioral crime linkage is an effective and feasible procedure to help in suspect prioritization. More specifically, as pointed out by Tonkin, Grant, and Bond (2008), future research needs not only to assess whether behavioral consistency exists but also *when* and, in this instance, *where* it exists. This is where knowledge from the criminal career field becomes valuable.

2.2.2. *The Value of the Criminal Career Paradigm*

Crime linkage analysis and the investigation of behavioral consistency have been mainly conducted in psychology, more specifically in the field of investigative psychology. This line of research, however, has emerged and evolved almost independently of a long tradition of empirical research in criminology. Hence, the presence of crime specialization and the extent to which offenders specialize in their offending has been a key question in criminal career research (see Nieuwbeerta et al., 2011) and behavioral consistency researchers could significantly benefit from the scientific knowledge, methods, and findings coming from this field. Criminal career research can be described as a scientific paradigm focusing on the longitudinal sequence of crime committed by individuals (Blumstein et al., 1986). Thus, instead of focusing on the crime event, the individuals and their criminal behaviors throughout their career are examined. This

longitudinal sequence or “criminal career” has been conceptualized along various crime parameters such as the age of onset, the offending frequency (or lambda), the seriousness (or aggravation), the length of the criminal career, and the desistance (or termination of offending) (Blumstein et al., 1986).

Crime Specialization and Crime Switching. Criminal career researchers have also stressed the importance of examining two other aspects of the longitudinal sequence of offending: (1) crime specialization (i.e., the tendency to repeat the same crime type); and (2) criminal versatility or crime switching (the tendency to commit a wide array of crime types). Based on these parameters, “specialist” offenders are those who predominantly commit a specific type of crime and tend to engage in that behavior repeatedly and frequently as opposed to “versatile” offenders who tend to commit many different types of crime over time without specializing in any of them specifically (Lussier, 2005).

In the traditional view of criminal careers, according to Blumstein, Cohen, and Farrington (1988), offenders are thought to “sample” a wide variety of offenses during the early phase of their career before becoming more specialized, with time, in particular crime types that are more suited to their tastes and skills. In other words, crime switching should be expected in the first few arrests while crime specialization should be found in offenders who are more prolific. In line with this hypothesis, Brennan, Mednick, and John (1989) found evidence of specialization in violent and property offenses for offenders with more extensive records. More recently, researchers have used a more circumscribed approach to analyze specialization (e.g., life-course perspective) and found that, while generality is the norm when offending is viewed over the long-term criminal career, offenders tend to specialize in the short term (i.e., months or years rather than developmental stages or the full career) (e.g., DeLisi et al., 2011; Francis et al., 2004; McGloin et al., 2009; Soothill et al., 2000). For example, Sullivan et al. (2006) found that the level of specialization progressively decreased as the time window of focus grew broader (i.e., month to year to three years).

While it has been a common tendency in criminology to dichotomize offenders as specialists or generalists, Soothill, Francis, Sanderson, and Ackerley (2000) suggest that such distinction is not necessary and that sex offenders can in fact be both. Hence,

results of their study show evidence that while sex offenders tend to be versatile in terms of their participation in crime over their criminal career, they do specialize in specific types of sex offending (e.g., indecent assault, rape) among their sexual criminal career. Crime specialization, however, has been examined for various crime types, but not within a specific crime type, which has been completed in behavioral consistency and crime linkage studies (see however Lussier et al., 2008; and Leclerc, Lussier, & Deslauriers-Varin, 2014). For example, criminal career researchers have examined the tendency to specialize in violent crimes whereas crime linkage researchers have looked at the tendency for violent offenders to commit their violent crimes in the same way. While the research question is different, the analytical approach is the same (i.e., examining whether offending behaviors are similar). Although criminal career researchers have not examined crime specialization and criminal versatility for the purpose of crime linkage, their research has produced various methodological options to analyze these crime parameters (Sullivan et al., 2009) that are suited for the examination of behavioral consistency. For the purpose of this study, crime specialization is not used in its traditional meaning but is rather defined here as to equal the term consistency used in the behavioral consistency and crime linkage fields, that is, the tendency to commit the same crime type (i.e., sex crime) in the same way.

Crime Specialization and the Forward Specialization Coefficient. A recent review of crime specialization techniques by Sullivan, McGloin, Ray, & Caudy (2009) has shown that the transition matrix has been one of the most widely used methods to examine the level of crime specialization over time. These initial transition matrices, however, were quickly replaced by the forward specialization coefficient (FSC) developed by Farrington (1986), which became the favored measure in specialization research, and is still used by researchers today (Sullivan et al., 2009). The FSC was presented as an improvement over initial transition matrices because the FSC allowed adjusting for sample size as well as the frequency for each offense type analyzed (Farrington, Snyder, & Finnegan, 1988). Indeed, offense types that occur rarely (e.g., homicide) may have initially produced biased findings due to the small cell count. Compared to the previous transition matrix measures, the FSC reduces the effect of the frequency of the offense type by taking into account the total number of offenses for the cell of interest.

The FSC also provide information not only on the degree of specialization or versatility for each offense type, but also on the specialization for one specific category of a variable. In other words, this coefficient indicates crime switching or specialization of the offender for one particular variable (behavior), which can be beneficial for the investigation of behavioral consistency. Moreover, the FSC allows for the investigation of the degree of specialization across consecutive offenses within different types (i.e., sequential specialization) and provides insight into which crimes are most often repeated. This coefficient thus indicates the extent of *sequential* specialization for each offense type by providing an aggregate measure across offenses rather than across individuals. However, due to its aggregate nature, concerns were raised regarding its utility when investigating offending specialization at the individual level (Osgood & Schreck, 2007; Piquero et al., 1999; Sullivan et al., 2006).

Crime Specialization and the Diversity Index. To address the issue of aggregate data and to allow the examination of individualized patterns of crime specialization, researchers have proposed using the *diversity index* (*D* index). Agresti and Agresti (1978) developed the *D* index to measure species variation. In the last decade or so, however, this index has been increasingly used as a measure of offending versatility (e.g., Mazerolle et al., 2000; Miethe, Olson, & Mitchell, 2006; Piquero et al., 1999; Sullivan et al., 2006). The *D* index is a continuum where, on the one end, it represents complete specialization and on the opposite end, it represents complete diversity. The *D* index has attracted a lot of attention from criminal career researchers because it allows investigators to examine the individual factors that may increase or decrease crime specialization (or crime versatility) (e.g., Mazerolle et al., 2000; Miethe et al., 2006; Piquero et al., 1999; Sullivan et al., 2006).

Another aspect of the *D* index is that it provides researchers with an opportunity to determine the level of crime specialization (or crime switching) by simultaneously considering all crimes committed by the individuals, regardless of the chronological order of the offenses. This is an important distinction from the FSC, which only provides an overview of specialization for two consecutive crimes. Therefore, while the *D* index allows the researcher to determine the overall level of specialization across an individual's offending series, the FSC provides an estimate of specialization for specific parts of it. As a result, recent empirical studies have used both the FSC and the *D* index

due to the complementary insight they provide about offending specialization (Lussier et al., 2008; Miethe et al., 2006; Piquero et al., 1999; Sullivan et al., 2009). It is thought that these aforementioned methods could improve knowledge on offending consistency and crime linkage.

2.3. Aim of the Study

Crime linkage analysis constitutes a tool to help investigators prioritize suspects, but a scarcity of research limits our knowledge on behavioral consistency in sexual assault cases. Furthermore, previous studies in this field are characterized by methodological issues that could bias the results found. Despite this, prior studies have shown that geographical behaviors and environmental aspects of crime events are more consistent over time than those related to the offender's modus operandi. The current study thus aims to address the limited knowledge in this field while attempting to address some of the methodological limitations of previous studies. In doing so, the current study draws upon research from the criminal career literature as a way to improve the study of behavioral consistency in the context of crime linkage analysis. More specifically, criminal career research has identified several analytical strategies that can help estimate the level of behavioral consistency, and that can be used for the analysis of geographic and environmental aspects of sexual assault cases. Taken together, the goal of this study is to determine the level of consistency of specific geographical behaviors and environmental factors among serial sex offenders using analytical strategies coming from both the behavioral consistency and criminal career fields.

2.4. Methodology

2.4.1. Sample

The initial sample for the study consisted of all male sex offenders convicted of a sentence of two years or more between 1995 and 2004 in one province of Canada. This list of over 1,000 offenders was examined to identify all serial sex offenders of stranger victims. Ninety-two individuals matched the criteria, and 72 of these agreed to

participate in the study. Together, these men were responsible for 361 sexual assaults for which they were charged and convicted. The participants were all incarcerated in a Correctional Service of Canada penitentiary. The sample included individuals who had committed two or more sexual assaults involving a victim of any age and any gender with whom the offender had no personal relationship prior to the day the offense was committed. Offenders included in this study had sexually assaulted adult women ($n = 33$), children ($n = 17$), or both ($n = 22$), and 80.0% ($n = 291$) of the victims were female. The victim's mean age was 18.7 years ($SD = 9.6$). The majority of the offenders were Caucasian (91.3%; $n = 63$), and the average age at the beginning of the crime series was 30.7 years ($SD = 9.4$). The participants had committed an average of five sexual crimes in their series (ranging from 2 to 37 sexual assaults each) and the average crime series' length was 1,718 days (approximately 5 years).

2.4.2. Procedures

As part of a larger study, a questionnaire was built to collect information from police investigative reports (present in the institution's case file) and to guide in-depth semi-structured interviews with the offenders. This questionnaire includes five sections that allow the collection of information on pre-crime factors, target selection processes, modus operandi, post-crime factors, and geographic behavior. The reliability of responses was monitored by checking for and questioning inconsistencies. Self-reported information was then compared with official data (i.e., police reports). In the case of factual-information discrepancy (e.g., location of the crime, day of the crime), information from the official police data was used to limit memory bias. In order to minimize response distortion, offenders were also promised complete anonymity and confidentiality, and a guarantee that their information provided could not be used in any way against them by the Correctional Service of Canada. Interviews were conducted in a private office, isolated from correctional staff and other inmates. They lasted from two to 12 hours, depending on the number of crimes committed and the participants' verbosity. Due to the sensitive nature of the conversations, permission was not requested to tape-record the interviews, although extensive verbatim notes were taken whenever possible. No participant was paid for participating in the study.

2.4.3. Variables

Two main dimensions of the offender's sexual criminal activity were considered in the present study: (1) geographic behaviors; and (2) environmental indicators. The frequency data for the 12 variables included in the study are presented in Table 2.1

Geographic Behaviors. Three variables associated with geographic-related behaviors committed by the offender during the offense were included in the study. The first two variables are based on the hunting pattern typology developed by Rossmo (1997), relevant to the identification of spatial patterns of serial predators: (1) the offender's hunting style, referring to the victim search methods used by the offenders to commit their offenses (0 = Hunter; 1 = Poacher; 2 = Troller; 3 = Trapper); and (2) the offender's attack method (0 = Raptor; 1 = Stalker; 2 = Ambusher).³ The third variable represents the crime set location, or target's mobility, which designates if the offense occurred all in one location or if the victim was moved to different locations (1 = One location; 2 = Multiple locations) throughout the offense.

Environmental Indicators. The environmental aspects of crime events refer to the "static" characteristics of the offense' environment and includes nine variables associated with the physical, temporal, and contextual features of the offense. The variables included examine the offense's environment for two stages of the offense: (1) the encounter with the victim; and (2) the victim release. The nine variables are as follow: (1) offense timing (0 = Week; 1 = Weekend; 2 = Mixed – week and weekend); (2) offense land area used for the two stages of the offense (i.e., encounter and victim release) (0 = Residential area; 1 = Commercial area; 2 = Industrial area; 3 = Institutional area; 4 = Park; 5 = Wilderness/rural area). For the FSC analyses, this variable has been recoded into four categories for statistical power purposes (0 = Residential area; 1 = Commercial area; 2 = Park/wilderness area; 3 = Other area); (3) offense location (0 = Inside; 1 = Outside) for the two stages of the offense; (4) types of site for the two stages of the offense, referring to whether the offense was committed on a private (e.g., home, backyard) or public/semi-public site (e.g., park, business/shopping site, street) (0 =

³ For more information about the different hunting styles and attack methods, see Rossmo (1997).

Private; 1 = Public/semi-public); and (5) offender and victim familiarity with the offense site (0 = Not familiar to both of them; 1 = Familiar to the offender; 2 = Familiar to the victim; 3 = Familiar to both the offender and the victim) for the two stages of the offense.

Table 2.1. Descriptive Information for the Variables of the Geographic and Environmental Dimensions

Variables	Frequencies % (n)	Variables	Frequencies % (n)
ENVIRONMENTAL FACTORS			
Encounter land area		Victim release land area	
Residential	61.8 (223)	Residential	68.4 (247)
Commercial	25.2 (91)	Commercial	15.5 (56)
Industrial	3.0 (11)	Industrial	2.2 (8)
Institutional	1.4 (5)	Institutional	1.7 (6)
Park	6.9 (25)	Park	4.2 (15)
Wilderness/rural	1.4 (5)	Wilderness/rural	8.0 (29)
Encounter location		Victim release location	
Inside	52.9 (191)	Inside	55.7 (201)
Outside	47.1 (170)	Outside	44.3 (160)
Encounter site		Victim release site	
Private	32.1 (116)	Private	50.1 (181)
Public	67.9 (245)	Public	49.9 (180)
Encounter site familiarity		Victim rel. site familiarity	
Not familiar	0.0 (0)	Not familiar	8.9 (32)
Offender	16.6 (60)	Offender	39.9 (144)
Victim	21.6 (78)	Victim	24.1 (87)
Both	61.8 (223)	Both	27.1 (98)
Offense timing			
Week	68.4 (247)		
Weekend	18.3 (66)		
Mixed	13.3 (48)		
GEOGRAPHIC BEHAVIORS			
Attack method		Hunting style	
Raptor	42.4 (153)	Hunter	54.8 (198)
Stalker	8.0 (29)	Poacher	5.5 (20)
Ambusher	49.6 (179)	Troller	18.8 (68)
		Trapper	20.8 (75)
Target's mobility			
One location	43.5 (157)		
Multiple locations (two +)	56.5 (204)		

Note. n = 361.

2.4.4. Analytical Strategy

The current study compared the utility of three analytical strategies for the purpose of crime linkage: (1) Jaccard's similarity coefficient, coming from the crime linkage and behavioral consistency literature; (2) the standardized diversity index (*D*); and (3) the forward specialization coefficient (FSC), both coming from the criminal career literature. This procedure made it possible to determine how consistency levels found were influenced by the coefficient used to measure it and how the information provided by each strategy was complementary to one another. Indeed, these three coefficients are based on different assumptions: (1) Jaccard's is an individual-level coefficient measuring consistency for consecutive offenses; (2) the *D* index is an individual-level index measuring consistency regardless of the chronological order of the offenses; and (3) the FSC is an aggregated offense-level coefficient measuring consistency for consecutive offenses.

Three steps were taken to examine offending consistency. First, the level of consistency across indicators within the geographic and the environmental domains were compared to determine if one was characterized by higher a level of consistency than the other. Second, the overall consistency of geographic behaviors and environmental aspects of the crime were determined. Third, the consistency of the environmental aspects at two different stages of the offense was investigated (i.e., victim encounter and victim release) to investigate if one of the offense stages was more reliable than the others for crime linkage purpose. These two stages were specifically selected as they represent the two most important locations for police investigations (Rossmo 2000).

Jaccard's Coefficient. Jaccard's coefficient (Jaccard, 1901) was used as a similarity measure for each of the variables included in the study. This coefficient provides information on the degree of consistency across consecutive offenses for each behavior examined. This coefficient ranges from 0, indicating complete inconsistency, to 1, indicating complete behavioral consistency. Jaccard's coefficient can be calculated using the following formula:

Equation 1.

$$a(a + b + c)$$

where a equals the number of behaviors present in both crimes (1/1), b and c equal the number of behaviors present in one crime but not the other (1/0 and 0/1).

Consistency was measured by comparing each offense with the subsequent offense for the full length of each offender's series. Therefore, the coefficient reflects whether two consecutive crimes are similar or not. However, for police investigation the importance is to know if it is possible to rely on behaviors to link crimes together without knowledge of the offender's prior criminal behavior. Indeed, the chronology of the offender's crimes will usually be determined only after his arrest. Therefore, it is important to rely on methods that can help establish if the offenders are consistent in terms of their behaviors throughout their whole career (or series of crimes) rather than chronologically. This is where methods used in the criminal career literature become useful.

Diversity Index. The D index provides a probability that any two offenses randomly selected from an individual's criminal history are in different categories. The D index theoretically ranges from 0 to 1, where 0 represents complete specialization, that is, all of the offender's crimes were of the same type. As the value approaches 1, there is greater evidence of diversity in the types of offenses across an offender's criminal career. For example, an index of 0.6 means that the probability is of 0.6 that two randomly selected offenses are of the same nature. This index is an individual-level measure and draws on offenses proportions rather than sequence (i.e., successive offenses). The larger the number of categories and the more uniformly distributed the observations are over the categories, the higher the index tends to be (Agresti & Agresti, 1978). As such, the maximum value (indicating complete diversity) will vary according to the number of offense categories considered.

Considering the fluctuating nature of the D index, and due to the different scaling of each variable included in the current study, the standardized D index (Agresti & Agresti, 1978) was used. The standardized D index can be computed using the

following equation, in which p is the proportion of crimes committed for each of the $i = 1, 2, \dots k$ categories identified:

Equation 2.

$$I = (1 - \sum_{i=1}^k p_i^2) / (1 - 1/k)$$

Concerns have been previously raised regarding this standardized index and its validity (e.g., Agresti & Agresti, 1978; McGloin et al., 2007). Some have suggested that it does not capture criminal diversity as well as the unstandardized index since it only measures the dispersion of the population among the categories, regardless of the number of categories (Agresti & Agresti, 1978).⁴ However, prior studies using the unstandardized index did not aim at comparing the D index value obtained for various indicators but rather to predict its value. Therefore, in the context of behavioral consistency, and considering the aim of the current study, it becomes essential to standardize this index if one wants to compare the consistency level of specific offending behaviors that include an uneven number of categories. By putting all of the variables on the same scale (0 to 1), it is possible to compare them among each other. In the same way, this allows for the three different coefficients used in the current study (all three on a 0 to 1 scale) to then be comparable to one another.

Forward Specialization Coefficient. This coefficient ranges from 0, indicating complete versatility, to 1, indicating complete specialization. Specialisation is found when every “ $k + 1$ ” offense is of the same type as the “ k ” offense (e.g., hunting style: *trapper* to *trapper*) while versatility is found when every “ $k + 1$ ” offense is not of the same type as the “ k ” offense (e.g., hunting style: *trapper* to *poacher*, Sullivan et al., 2009). An indication of specialization is obtained by computing the FSC_{jk} for each of the diagonal

⁴ For example, by standardizing the D index, the offender who has three “options” to attack the victim and tends to always use the same one is considered as consistent and specialized compared to the offender who has six “options” to choose from.

cells of an offense transition matrix⁵ (where jk refers to a cell on the diagonal) using the following formula:

Equation 3.

$$(O_{jk} - E_{jk}) / (R_j - E_{jk})$$

where O_{jk} represents the observed number of cases in the diagonal cell of interest, E_{jk} is the number of cases in that cell expected by chance, and R_j is the total number of cases for the row of interest (Paternoster, Brame, Piquero, Mazerolle, & Dean, 1998; Sullivan et al., 2009). As the FSC focuses on the transition from one crime to the following one, rather than all of the crimes committed by the offender, a fixed number of crimes per offender was needed. The current study focuses on the crime transitions for the first four sexual crimes committed by the offender (i.e., 3 crime transitions) because as the number of crimes considered increases, fewer offenders could be included in the analyses. For instance, 72 offenders committed two crimes (transition #1: from crime 1 to crime 2), 49 committed three crimes (transition #2: from crime 2 to crime 3), and 27 committed at least four crimes (transition #3: from crime 3 to crime 4).

The Adjusted Standardized Residual (ASR) was also computed to test the statistical significance of the deviation of the observed number from the expected number for any given FSC (Farrington, 1986; Farrington et al., 1988). The ASR was computed using the following formula:

Equation 4.

$$\frac{O - E}{\text{SQRT}(E) \times \text{SQRT}[\{1 - (R/T)\} \{1 - (C/T)\}]}$$

where O = the observed number, E = the expected number by chance, R = the row total, C = the column total, T = the grand total, and $E = RC/T$.

⁵ A transition matrix is a square two-dimensional array that contains the joint distribution of offense type or, in this instance, offense behaviors, on two consecutive occasions (i.e., crimes) (Paternoster et al., 1998).

2.5. Results

2.5.1. Jaccard's Coefficient

Jaccard's coefficient for the geographic behaviors and the environmental aspects of the offense are presented in Table 2.2. Overall, the 72 offenders included in the study show a mean Jaccard's coefficient of .77 (SD = .24), with the coefficients for the variables ranging from .68 to .86. At the dimension level, the geographic behaviors dimension shows a slightly higher Jaccard's coefficient than the environmental dimension, with a mean of .80 (SD = .26) and .76 (SD = .25) respectively. For the geographic behaviors dimension, the *attack method* used by the offenders is the variable showing the highest Jaccard's coefficient with a mean of .86 (SD = .31). In fact, this variable shows the highest Jaccard's coefficient among all 12 variables included in the study. For the environmental indicators dimension, the *encounter site* shows a slightly higher Jaccard's coefficient compared to the other environmental indicators (Jaccard's coefficient = .80; SD = .36). At the other end of the spectrum, *victim release site familiarity* is the indicator with the lowest Jaccard's coefficient (mean = .65, SD = .42).

For Jaccard's coefficient analyses, four groups were created based on the number of sex crimes included in their series: (a) two offenses ($n = 23$); (b) three offenses ($n = 22$); (c) four or more offenses ($n = 27$), and; (d) ten or more offenses ($n = 8$). On one hand, offenders who committed three sexual offenses tend to present lower Jaccard's coefficients than the other groups of offenders. For example, the total mean Jaccard's coefficient for offenders who committed three sex crimes is .68 (SD = .23), compared to .74 (SD = .27) for those who committed two offenses, .86 (SD = .18) for those who committed four sex offenses or more, or .77 (SD = .24) for the total sample ($n = 72$). On the other hand, more prolific offenders, who committed at least four offenses ($n = 27$) generally show higher Jaccard's coefficients compared to the other groups or to the total sample (mean = .86, SD = .18, range for all variables = .80–.90). In fact, almost all the variables used in the study show very high levels of consistency for this group of offenders, none of them showing significantly more or less consistency than the others. This is especially true for offenders having committed at least ten offenses (mean = .96, SD = .05, range for all variables = .92–.99).

Table 2.2. Jaccard's Coefficient for the Geographic Behaviors and Environmental Dimensions by Number of Crimes Committed

	Total (n = 72)		2 offenses (n = 23)		3 offenses (n = 22)		4+ offenses (n = 27)		10+ offenses (n = 8)	
	Mean (SD)	Range ^a	Mean (SD)	Range ^a	Mean (SD)	Range ^a	Mean (SD)	Range ^a	Mean (SD)	Range ^a
Geographic behaviors										
Hunting style	.75 (.39)	.00-1.00	.74 (.45)	.00-1.00	.68 (.42)	.00-1.00	.83 (.30)	.00-1.00	.98 (.07)	.80-1.00
Attack method	.86 (.31)	.00-1.00	.87 (.34)	.00-1.00	.82 (.36)	.00-1.00	.87 (.25)	.00-1.00	.96 (.07)	.83-1.00
Target's mobility	.79 (.34)	.00-1.00	.78 (.42)	.00-1.00	.68 (.36)	.00-1.00	.88 (.19)	.25-1.00	.99 (.02)	.94-1.00
Environmental										
Offense timing	.79 (.35)	.00-1.00	.74 (.45)	.00-1.00	.77 (.34)	.00-1.00	.86 (.25)	.00-1.00	.98 (.07)	.80-1.00
Encounter land area	.78 (.36)	.00-1.00	.87 (.34)	.00-1.00	.57 (.42)	.00-1.00	.88 (.22)	.00-1.00	.92 (.14)	.60-1.00
Encounter location	.75 (.37)	.00-1.00	.70 (.47)	.00-1.00	.66 (.39)	.00-1.00	.88 (.19)	.25-1.00	.92 (.10)	.70-1.00
Encounter site	.80 (.36)	.00-1.00	.78 (.42)	.00-1.00	.68 (.39)	.00-1.00	.90 (.21)	.00-1.00	.98 (.03)	.93-1.00
Encounter site familiarity	.75 (.38)	.00-1.00	.70 (.47)	.00-1.00	.68 (.34)	.00-1.00	.85 (.25)	.00-1.00	.99 (.02)	.94-1.00
Victim release land area	.74 (.38)	.00-1.00	.65 (.49)	.00-1.00	.68 (.36)	.00-1.00	.86 (.25)	.00-1.00	.92 (.14)	.60-1.00
Victim release location	.76 (.34)	.00-1.00	.70 (.47)	.00-1.00	.68 (.29)	.00-1.00	.87 (.19)	.25-1.00	.93 (.11)	.70-1.00
Victim release site	.77 (.35)	.00-1.00	.74 (.45)	.00-1.00	.68 (.33)	.00-1.00	.88 (.23)	.00-1.00	.98 (.03)	.93-1.00
Victim rel. site familiarity	.68 (.42)	.00-1.00	.61 (.50)	.00-1.00	.61 (.41)	.00-1.00	.80 (.33)	.00-1.00	.98 (.04)	.89-1.00
Geographic beh. coefficient	.80 (.26)	.00-1.00	.80 (.30)	.00-1.00	.73 (.27)	.00-1.00	.86 (.20)	.25-1.00	.98 (.03)	.92-1.00
Environmental coefficient	.76 (.25)	.15-1.00	.72 (.28)	.22-1.00	.67 (.25)	.22-1.00	.86 (.19)	.15-1.00	.96 (.06)	.82-1.00
Individual total coefficient	.77 (.24)	.17-1.00	.74 (.27)	.17-1.00	.68 (.23)	.25-1.00	.86 (.18)	.25-1.00	.96 (.05)	.85-1.00

Notes: n = 72.

^a Observed range.

Finally, Jaccard's coefficients for the geographic and environmental indicators by offense stages (i.e., encounter and victim release) were examined. Findings reported in Table 2.3 show that environmental indicators present relatively stable levels of consistency across the offense stages, with the encounter stage presenting a slightly higher coefficient (mean = .77, SD = .27) than the victim release stage (mean = .74, SD = .30). Relatively high levels of consistency are also found when grouping indicators by offense variables (i.e., land area, location, site, site familiarity); the coefficients varying between .78 (SD = .31) for the *offense site* to .72 (SD = .36) for the *site familiarity*.

Table 2.3. Jaccard's Coefficients, Standardized *D* Index, and Forward Specialization Coefficients by Offense Stages and Offense Variables

Variables	Coefficient's mean (SD)		
	Jaccard's coefficient	<i>D</i> index	FSC
Offense stages			
Encounter	.77 (.27)	.25 (.25)	.67
Victim release	.74 (.30)	.30 (.29)	.63
Offense Variables			
Land area	.76 (.32)	.22 (.26)	.68
Residential	-	-	.71
Commercial	-	-	.70
Park/Wilderness	-	-	.68
Others	-	-	.63
Location	.76 (.32)	.29 (.31)	.61
Inside	-	-	.67
Outside	-	-	.54
Type of site	.78 (.31)	.33 (.38)	.63
Private	-	-	.65
Public	-	-	.60
Site familiarity	.72 (.36)	.27 (.28)	.66
Not familiar	-	-	.77
Offender	-	-	.78
Victim	-	-	.55
Both	-	-	.59

Note. *n* = 72.

2.5.2. Diversity Index

Table 2.4 presents the diversity indexes of offending (*D* index) for the geographic behaviors and the environmental indicators of the offense. The unstandardized *D* index was also examined for comparison purposes. While the standardized *D* indexes obtained were all of higher values than their unstandardized counterparts, the results and patterns discussed here were still similar. It is noteworthy, however, that the standard deviations of the standardized indexes were higher, indicating that a lot of variation exists among the offenders.

Examining the individual mean *D* index, the 72 offenders included in the study show a relatively low level of diversity (mean = .26; SD = .22). The maximum diversity value (1.00) is obtained for only three of the 12 variables included in the study (i.e., target's mobility, encounter site, and victim release site). At the dimensional level, the geographic behaviors dimension shows a slightly lower *D* index (mean = .24, SD = .24) than the environmental dimension (mean = .27, SD = .23). For the geographic behaviors dimension, the *attack method* used by the offenders is the variable with the lowest *D* index with a mean of .17 (SD = .30). In fact, this variable shows the lowest *D* index of the 12 variables included in the study. On the other hand, the *target's mobility* is the geographic behavior with the highest *D* index (mean = .33, SD = .43). For the environmental indicators, the *offense timing* (mean = .20, SD = .31), and the *encounter land area* (mean = .21, SD = .28) are two variables with lower *D* indexes compared to the other environmental indicators examined. At the other end of the spectrum, *victim release site* is the indicator with the highest *D* index (mean = .35, SD = .45).

Four groups were also created based on the number of sex crimes included in their series: (a) two offenses ($n = 23$), (b) three offenses ($n = 22$), (c) four or more offenses ($n = 27$), and (d) ten or more offenses ($n = 8$). On one hand, offenders who committed three sexual offenses tend to present higher *D* indexes than the other groups of offenders. More precisely, the total mean *D* index for offenders who committed three sex crimes is .33 (SD = .21), compared to .20 (SD = .21) for those who committed two offenses or .26 (SD = .22) for the total sample ($n = 72$). Despite this, the variables *attack method* (mean = .18, SD = .30) and *victim release site* (mean = .49, SD = .45) still show respectively the lowest and highest *D* index obtained among the 12 variables analyzed.

On the other hand, more prolific offenders who committed at least 10 offenses ($n = 8$), generally show lower D indexes than the total sample with an individual total mean D index of .20 ($SD = .23$). More specifically, these offenders commit their sexual offenses consistently at the same time of the week (*offense timing*; mean = .03, $SD = .09$), using consistently the same hunting style (mean = .05, $SD = .14$), for all their offenses.

Finally, the D indexes for the geographic and environmental indicators by offense stages (i.e., encounter and victim release) were examined. Findings reported in Table 2.3 show that environmental indicators present a relatively stable level of consistency across the offense stages, with the encounter stage presenting a slightly lower mean D index (mean = .25, $SD = .25$) than the victim release stage (mean = .30, $SD = .29$). When examining the mean D indexes by offense variables (combining variables for the two stages analyzed, i.e., land area use, location, site, site familiarity), the *land area* indicator shows the lowest D index (mean = .22, $SD = .26$), while the offense *site* shows the highest D index (mean = .33, $SD = .38$).

Table 2.4. Standardized *D* Indexes for the Geographic Behaviors and Environmental Dimensions by Number of Crime Committed

	Total (<i>n</i> = 72)		2 offenses (<i>n</i> = 23)		3 offenses (<i>n</i> = 22)		4+ offenses (<i>n</i> = 27)		10+ offenses (<i>n</i> = 8)	
	Mean (SD)	Range ^a	Mean (SD)	Range ^a	Mean (SD)	Range ^a	Mean (SD)	Range ^a	Mean (SD)	Range ^a
Geographic behaviors										
Hunting style	.21 (.30)	.00-.85	.17 (.30)	.00-.67	.24 (.30)	.00-.59	.22 (.31)	.00-.85	.05 (.14)	.00-.40
Attack method	.17 (.30)	.00-.86	.10 (.26)	.00-.75	.18 (.30)	.00-.67	.23 (.33)	.00-.86	.20 (.32)	.00-.86
Target's mobility	.33 (.43)	.00-1.00	.22 (.42)	.00-1.00	.44 (.46)	.00-.89	.32 (.41)	.00-1.00	.22 (.42)	.00-1.00
Environmental										
Offense timing	.20 (.31)	.00-.75	.20 (.34)	.00-.75	.24 (.33)	.00-.67	.17 (.26)	.00-.75	.03 (.09)	.00-.25
Encounter land area	.21 (.28)	.00-.80	.08 (.21)	.00-.60	.34 (.30)	.00-.80	.21 (.27)	.00-.75	.24 (.28)	.00-.59
Encounter location	.28 (.34)	.00-.75	.23 (.35)	.00-.75	.33 (.34)	.00-.67	.28 (.33)	.00-.75	.38 (.37)	.00-.75
Encounter site	.30 (.43)	.00-1.00	.22 (.42)	.00-1.00	.40 (.45)	.00-.89	.29 (.41)	.00-1.00	.25 (.41)	.00-1.00
Encounter site familiarity	.23 (.29)	.00-.83	.20 (.31)	.00-.67	.27 (.30)	.00-.59	.22 (.28)	.00-.83	.15 (.28)	.00-.67
Victim release land area	.23 (.29)	.00-.80	.21 (.29)	.00-.60	.29 (.31)	.00-.80	.21 (.29)	.00-.79	.19 (.30)	.00-.79
Victim release location	.29 (.34)	.00-.75	.23 (.35)	.00-.75	.39 (.34)	.00-.67	.27 (.33)	.00-.75	.29 (.36)	.00-.75
Victim release site	.35 (.45)	.00-1.00	.26 (.45)	.00-1.00	.49 (.45)	.00-.89	.32 (.43)	.00-1.00	.25 (.41)	.00-1.00
Victim rel. site familiarity	.31 (.34)	.00-.96	.29 (.34)	.00-.67	.36 (.35)	.00-.89	.29 (.34)	.00-.96	.18 (.27)	.00-.67
Geographic beh. coefficient	.24 (.24)	.00-.81	.16 (.24)	.00-.81	.29 (.22)	.00-.72	.26 (.26)	.00-.77	.16 (.23)	.00-.55
Environmental coefficient	.27 (.23)	.00-.78	.21 (.21)	.00-.60	.35 (.24)	.00-.70	.25 (.23)	.00-.78	.22 (.23)	.00-.59
Individual total coefficient	.26 (.22)	.00-.72	.20 (.21)	.00-.65	.33 (.21)	.00-.65	.25 (.23)	.00-.72	.20 (.23)	.00-.58

Note: *n* = 72.

^a Observed range.

2.5.3. *Forward Specialization Coefficient*

Table 2.5 presents the FS coefficients for the geographic behaviors and the environmental indicators. The coefficients tend to show a somewhat low overall consistency level. It is also noteworthy that a lot of fluctuation exists among each variable across the three crime-transitions analyzed. Thus, there is a common trend for each of the categories of each variable to show consistency at one transition while indicating a trend for inconsistency at another. For example, offenders using the *hunter* hunting style at crime-transition 1 (T_1) show high stability, most often using this style to commit their first and second crime (.86), while demonstrating lower consistency when committing their following crimes ($T_2 = .67$ and $T_3 = .72$). On the other hand, offenders using the *poacher* hunting style appear to use this style in a somewhat inconsistent manner for their first and second crime ($T_1 = .39$) while demonstrating perfect consistency at crime-transition 2 and 3 ($T_2 = 1.00, n = 3; T_3 = 1.00, n = 5$).

At the dimensional level, the geographic behaviors, here again, show a higher mean FSC (mean = .70) than the environmental indicators (mean = .64). For the variables included under the geographic behaviors dimension, the *hunting style* (mean = .73) and the *attack method* (mean = .72) used by the offenders show the highest FSC across transitions, while the *target's mobility* shows the lowest coefficient (mean = .65). More specifically, for the *hunting style*, the offenders using the *poacher* style show the highest FSC (mean = .80) while the *troller* style is characterized by the lowest FSC (mean = .61). As for the *attack method*, the FSC indexes show that offenders using the *raptor* attack method are more consistent (mean = .79) than the offenders using one of the other two attack methods: the *ambusher* (mean = .71) and the *stalker* (mean = .66).

Table 2.5. FSC by Crime-Transition for the Geographic Behaviors and Environmental Dimensions

Variables	Transition	T ₁ (n = 72)	T ₂ (n = 49)	T ₃ (n = 27)	Mean T ₁ to T ₃	Total mean Variable	Dimension Mean
GEOGRAPHIC BEHAVIORS							
Hunting style						.73	
	Hunter to hunter	.86***	.67***	.72***	.75		
	Poacher to poacher	.39***	1.00***	1.00***	.80		
	Troller to troller	.36***	.48**	1.00**	.61		
	Trapper to trapper	.79***	.75***	.72***	.75		.70
Attack method						.72	
	Raptor to raptor	.73***	.63***	1.00***	.79		
	Stalker to stalker	.69***	1.00***	.28+	.66		
	Ambusher to ambusher	.71***	.67***	.74***	.71		
Target's mobility						.65	
	One to one	.51***	.56***	1.00***	.69		
	Multiple to multiple	.57***	.52***	.74***	.61		
ENVIRONMENTAL INDICATORS							
Offense timing						.70	
	Week to week	.57***	.68***	.67**	.64		
	Weekend to weekend	.74***	.86***	.59***	.73		
	Mixed to mixed	.55***	.84***	.79***	.73		
Encounter land area						.73	
	Residential to residential	.73***	.56***	.81**	.75		
	Commercial to commercial	.49***	.84***	.65***	.80		
	Park to park	.64***	.57***	.63**	.61		
	Others to others	.48***	1.00***	.64***	.75		.64
Encounter location						.61	
	Inside to inside	.47***	.51***	1.00***	.66		
	Outside to outside	.62***	.51***	.55***	.56		
Encounter site familiarity						.67	
	Offender to offender	.88***	.76***	.81***	.82		
	Victim to victim	.51***	.48***	.71***	.57		
	Both offender/victim to both	.42***	.78***	.69***	.63		
Victim release location						.60	
	Inside to inside	.58***	.47**	1.00***	.68		
	Outside to outside	.52***	.54**	.46***	.51		

+*p* < .10 **p* < .05 ***p* < .01 ****p* < .001

For the environmental indicators dimension, the *encounter land area* (mean = .73) and the *offense timing* (mean = .70) show the highest FSC across transitions. More specifically, offenders using a commercial area to encounter their victim show higher consistency (mean = .80) than offenders using a residential area (mean = .75), a park (mean = .61), or another land area (mean = .75). In addition, offenders committing their offenses during the week show a lower FSC (mean = .64) than those committing their offenses on the weekend (mean = .73) or during the week and the weekend (mean = .73). All the other environmental indicators analyzed show rather low FSC means ranging from .60 to .67. It is noteworthy, however, that offenders encountering their victim(s) on a site that is familiar to them show the highest FSC obtained across transitions (mean = .82).

2.6. Discussion and Conclusion

The current study aimed to address the limited knowledge in the crime linkage and behavioral consistency fields while attempting to address some of the methodological limitations of previous studies. Using multiple analytical strategies coming from different fields of research, the current study identified geographic behaviors and environmental factors that appeared promising to rely on for the purpose of crime linkage of sexual offenses. The use of different analytical methods to examine behavioral consistency in sexual offenses, two of them coming from the criminal career field, also provided a new and interesting way to analyze offending consistency while allowing a better understanding of the influence of the analytic method used on the results found.

2.6.1. Geographic and Environmental Consistency

First, results found with the three methods show that the geographic behaviors are characterized by a somewhat higher stability and consistency than the environmental variables included in the study. Second, the three methods used also help to highlight specific variables showing higher or lower behavioral consistency in sex offenses of serial offenders. Among the geographic behaviors investigated, results show that serial sex offenders used the attack method in a consistent manner (sequentially or

overall). More specifically, looking at results for the FSC it appears that offenders using the *raptor* attack method are more consistent throughout their series of offenses, followed by those using the *ambusher* method. The *raptor*, on one hand, attacks almost immediately after having encountered the victim (Rossmo, 1997). The *ambusher* attack method, on the other hand, refers to actions taking place in locations where the offender is familiar and feels in control (e.g., residence, workplace; Rossmo, 1997). These two offending types might represent two opposite ends of a spectrum where on the one end, the offender is careful about the location of the offense and where to lure the victim (i.e., the ambusher), while at the other end, such considerations are less relevant than the presence of a suitable target (i.e., raptor). For crime linkage purposes, these two methods (if used by the offender to commit an offense under investigation) could help in suspect prioritization, as chances are that the offender has used the same method previously.

On the other hand, the target's mobility appears to be the geographic behavior showing the lowest consistency level among serial sex offenders. In other words, sex offenders are less likely to follow a consistent pattern or modus operandi when it comes to moving (or not moving) the victim from one place to another throughout the offense (encounter → attack → crime → victim release). Among the environmental factors investigated, the offense timing appears to be a promising factor to rely on for crime linkage. Hence, with both methods used in the criminal career literature (i.e., *D* index and FSC), results show that sex offenders are consistently committing their crimes at the same time of the week. More specifically, offenders who commit their offenses on weekdays are less likely to commit their subsequent offenses at the same time.

Third, the encounter stage shows a tendency for higher (sequential) consistency than the victim release stage. Within the encounter stage, the type of land area, the type of site, the location, and the offender/victim's familiarity with the site are analyzed (combined). Among these, the encounter land area shows the highest consistency. This is not to say that the encounter land area is significantly different from the other aspects of the encounter stage, but that this aspect might be more promising with respect to crime linkage. This is an important finding as the literature on geographic profiling suggests that the encounter location where the offenders first "contact" their victim is often close to where the offender lives (Canter & Larkin, 1993; Davies & Dale,

1996; Rossmo, 1997). Therefore, investigators and crime analysts could use the encounter site characteristics as a starting point to narrow down the pool of potential suspects, knowing that the offender responsible for the offense under investigation most likely lives close by and will also most likely have encountered previous victims in a similar environment. The relative stability of the encounter site and the fact that offenders tend to target victims that are close by, are two potentially important factors that should be analyzed simultaneously in future studies.

Finally, Jaccard's coefficient and *D* index values obtained show interesting results suggesting that the relationship between the number of crimes committed and offending consistency might not be linear. More specifically, findings indicate that offenders who committed three sexual offenses tend to show somewhat more overall versatility in their offending as opposed to those who committed less than three or four or more offenses. Moreover, the most prolific offenders of the study sample are characterized by high consistency. Previous studies, mostly in the criminal career literature, have found that it was usually the other way around, a higher level of versatility found for persistent offenders (Grubin et al., 2001; Heil, Ahlmeyer, & Simons, 2003; Smallbone & Wortley 2004; Sullivan et al., 2009). It is unclear however, how many prolific offenders were included in these studies.

In line with a more traditional view of criminal career (Blumstein et al., 1988) and more recent studies in the behavioral consistency field (Harbers et al., 2012; Sorochinski & Salfati, 2010), this result could suggest that offenders having committed only three offenses are still evaluating the different and most successful ways, locations and moments to commit their crimes while the persistent offenders have achieved a certain offending knowledge and expertise. This result is also consistent with the learning process hypothesis coming from the personality psychology literature suggesting that most offenders will try something different (i.e., committing a crime in a different way) after the first offense but, by their third offense, they will determine what strategy works best for successfully achieving their goal (Sorochinski & Salfati, 2010). However, it is important to keep in mind the small sample size for the current study, specifically for the more prolific offenders ($n = 8$). Nonetheless, this subgroup of offenders seems to be really homogeneous (i.e., low standard deviations on each indicators) and presents really high levels of consistency. The presentation of levels of consistency based on the

number of crimes committed by offenders might in fact have helped to identify a rare but highly consistent subgroup of very prolific serial sex offenders. Future analyses should further examine the influence of the number of crimes committed by the offender by specifically analyzing this variable in a continuous rather than categorical form.

2.6.2. Methodological Considerations and Results

While the methods used in the study are not nested and therefore not fully comparable, all three approaches reveal some degree of geographic behaviors and environmental consistency is present. More specifically, Jaccard's coefficients and the *D* indexes show very similar results indicating strong overall and variable-specific tendency for consistency. For the FSC, however, while still moderately high, values found are somewhat closer to the versatile offending end of the spectrum. Moreover, for this coefficient, it appears easier to highlight variables or categories characterized by higher versatility rather than higher consistency values. It is noteworthy, however, that the FSC has more conceptual and measurement constraints than the *D* index or Jaccard's coefficient. For example, the FSC is based on hierarchical and sequential offending (rather than proportions) and only reflects offending consistency patterns for the first four crimes committed by the offenders (rather than the overall sexual "criminal career"). These constraints are therefore, thought to provide the FSC less freedom to uncover patterns of consistency in the data and can account for the somewhat divergent results found between the FSC and the other methods used (e.g., behaviors and environmental factors used by the offender more consistently with the FSC are not necessarily the same as those highlighted for Jaccard's coefficient and *D* index).

As found by previous studies (Grubin et al., 2001; Woodhams & Labuschagne, 2012b), greater levels of consistency are found in offenses committed later in the series investigated. Researchers need to be aware that by using a method that restricts the number of crimes analyzed per series, a greater or lower consistency will be found. In accordance with the criminal career paradigm, this result shows the importance of selecting all crimes of the same nature in the series instead of a specific number of crimes per offender, which will permit a more realistic understanding of offending consistency. In the same way, the somewhat lower consistency level found using the FSC might also be an indication that, as found by Grubin et al. (2001), the time span

between the crimes of the series investigated needs to be analyzed and controlled for as it might influence the consistency observed. Future analyses should further look at the influence of the number of crimes committed and the length of the crime series.

Interestingly, similar results are found using Jaccard's coefficient and the *D* index. For both of these methods, all of the crimes that were part of the series are analyzed for consistency. However, Jaccard's coefficient takes into consideration the sequence of the offense, while the *D* index does not. Therefore, the similar results found by both of these methods suggests that the chronological order of the crimes might not be that important when investigating the offending consistency of sex offenders, as long as all of the crimes of the offender's series are included.

Overall, results obtained by the three methods highlight the importance of the coefficient used when measuring consistency and the necessity, as researchers, to be aware of their assumptions when interpreting these coefficients. As suggested by Sullivan and colleagues (2009), it is also thought that the best course of action for knowledge building is to use multiple methods; each distinct approach revealing a different aspect of the question under investigation, and providing depth and comprehensive understanding of offending consistency. However, methods used prominently in the criminal career literature (i.e., *D* index and FSC) help to provide a new and interesting way to examine offending consistency for the purpose of crime linkage. More specifically, the FSC provides a more in depth and detailed analysis of consistency by taking into account each category of the variables, something not achieved by the consistency/similarity coefficients used thus far in the crime linkage literature (e.g., Jaccard's coefficient). In the same way, it is noteworthy that the results found using Jaccard's coefficient and the FSC separately are found when using the *D* index. The *D* index might then be a more integrative and complete measure to use when investigating behavioral consistency.

Having considered the main findings of the current study and their implications, the limitations of the current study also need to be reviewed. First, the sample includes only crimes committed by incarcerated stranger sex offenders for which the offenders were charged and convicted. Therefore, the results of the current study might reflect behaviors of offenders who were not able to avoid detection and were apprehended by

the police. Second, the study is based on a relatively small sample of serial sex offenders that precluded the use of more sophisticated statistical analyses. While the sample is relatively small, it is important to stress that it is composed of a very specific group of offenders having committed a relatively rare type of offense (i.e., serial stranger sex offenders). Different results might have been found if the sample had been composed of more offenders as well as different types of sex offenders.

Despite these limitations, the current study provides complimentary methods to measure behavioral consistency and shows the importance of the analytical strategy used on the results found. The notion of consistency in the crime linkage literature has typically been applied to crime scene behavior rather than to the geographical aspect of the offense (Grubin et al., 2001). Moreover, when taken into account, studies have usually looked at the journey to crime (e.g., Snook et al., 2006) rather than broader elements of the environment where an offense takes place. Little research exists on the extent or nature of serial offenders' consistency in geographic behaviors and environmental and offense site selection. This lack of empirical research is especially problematic for the investigation of sexual crimes between strangers where crime linkage becomes a necessity as no connection between the victim and the offender can help to identify potential suspects. The current study is thought to have filled some gaps left by previous studies and to have provided evidence of the importance and reliability of geographic behaviors and environmental factors for successful crime linkage of stranger sexual offenders. Future studies should further investigate the stability and reliability of these factors. More specifically, additional research needs to be conducted to investigate the heterogeneity and stability of sexual offense environments and crime site selection considering that they are less prone to situational influence. It is also believed that future studies should rely more closely on the rich and well-established criminal career literature and methodology in order to improve current practices and knowledge on offending consistency and crime linkage.

3. Consistency in Crime Site Selection: An Investigation of Crime Sites Used by Serial Sex Offenders across Crime Series

3.1. Abstract

Knowing sites used by serial sex offenders to commit their crimes is highly beneficial for criminal investigations. However, environmental choices of serial sex offenders remain unclear to this date. Considering the challenges these offenders pose to law enforcement, the study aims to identify sites serial sex offenders use to encounter and release their victims and investigate their stability across crime series. The study uses latent class analysis (LCA) to identify victim encounter and release sites used by 72 serial sex offenders having committed 361 sex offenses. Additional LCA are performed to investigate the stability of these offense environments across offenders' crimes series. Distinct profiles of crime sites that are recurrent across crime series are found, suggesting that serial sex offenders present a limited diversity of victim encounter and victim release sites. Encounter sites representative of longer crime series are also identified. Specifically, the use of sites known to "attract" potential victims decreases over series and offenders become more risk-taking in regard to sites used to encounter their victims. Following the identification of patterns of site selection for the victim encounter and release in cases of serial crimes, implications for crime linkage and police investigations strategies are discussed.

3.2. Introduction

Crimes tend to cluster at a few and very specific places within communities. Moreover, crimes often happen on very specific times and days of the week and are generally committed by a few chronic and persistent offenders (Braga, 2011). In spite of such patterns, these offenders and the offenses they are responsible for tend to create issues and challenges for law enforcement. This is especially true for serial sexual offenders where a connection between the offender and the victim rarely exists (Rossmo, 2000). In recent years, crime linkage analysis has emerged as an investigative strategy helping to determine whether behavioral evidence can inform police investigators in identifying problematic serial offenders. Crime linkage involves the identification of similarities between offenses of the same type to help identify the individual responsible for the crime being investigated. More specifically, with the use of police databases, crime linkage helps to determine if a crime for which the offender is not yet known presents evidence of similar offender behaviors with another (previous) crime for which the offender is already known (Woodhams, Hollin et al., 2007). In other words, this investigative strategy implies that offenders will repeat the same crime, but will also commit these crimes in a consistent way across crime events.

Associated with the emergence of crime linkage, researchers started to question whether offenders are in fact consistent in the way they commit their crimes across their series (behavioral consistency) and if behavioral evidences could be used to reliably link unsolved crimes. Yet, a review of the scientific literature reveals that the identification of offending behaviors and components to be used to link crimes remains elusive due to the scarcity of research on the behavioral consistency assumption (Soroichinski & Salfati, 2010; Deslauriers-Varin & Beauregard, 2013). Moreover, studies on behavioral consistency are based on various conceptual, methodological, and analytical procedures, which further limit the conclusion that can be drawn (see Deslauriers-Varin & Beauregard, 2013; Woodhams & Labuschagne, 2012b). Nevertheless, findings from recent studies indicate that, when examining suitable behavioral domains or individual behaviors, high consistency exists among offenders' behaviors and that these behaviors can be used to successfully link serial crimes (Bennell & Jones, 2005). For example, previous research has shown that behaviors that are less dependent on situational

factors and over which the individual exerts control present a higher level of consistency (e.g., Bennell & Canter, 2002; Davies, 1992; Markson et al., 2010). More recently, the notion of offense consistency has been applied to geographic and spatial behaviors, which can be seen as less situation-dependent. So far, study findings show that these aspects of a crime could in fact outperform traditional modus operandi behaviors (e.g., Bernasco, 2008; Goodwill & Alison, 2006; Markson et al., 2010; Tonkin et al., 2008). For example, Bennell and Jones (2005) argued that the location chosen to commit a crime is a decision that the offender has control over and is less dependent on the situation. As such, spatial behaviors and crime site selection should present a higher level of consistency comparatively to other traditional modus operandi behaviors, such as the level of violence use during the commission of the offense. Most of the research on geographic consistency, however, has looked at the offender' journey to crime (e.g., distance traveled to crime). Far less research has focused on the environmental characteristics of sites where crimes most likely take place. More specifically, the environmental decision-making and crime site selection of serial offenders across their series remain unclear.

3.2.1. *Crime Pattern*

Crime, as suggested by the crime pattern theory, is not distributed randomly in space and time, but rather occurs within a situation, at a site, on a nonstatic "environmental backcloth." Backcloth, as defined by Brantingham and Brantingham (1993) refers to the variables or "uncountable elements that surround [...] an individual and that may be influenced by or influence his or her criminal behavior" (p. 6). In other words, the backcloth refers to the physical infrastructure of the environment (i.e., buildings, roads, transit systems, land uses, design) at a specific time and place, as well as the people located within that physical infrastructure, as perceived by individuals standing in this environment that surrounds them. Underpinning the notion of environmental backcloth is therefore, the idea that the occurrence of a criminal behavior (i.e., crime opportunity) is dependent on the offender's routine activity patterns and awareness space. That is, the places or areas that the offender visits or regularly spends time in, and has become familiar with (e.g., home location or neighborhood, areas where they work or go to for recreational purposes, and areas they are aware of).

The occurrence of a criminal behavior is also dependent on the distribution of targets (Beauregard, Proulx, & Rossmo, 2005; Clarke & Felson, 1993; Deslauriers-Varin & Beauregard, 2010; Eck & Weisburd, 1995). Indeed, daily activities and lifestyles will nurture a criminal opportunity structure by enhancing the exposure and proximity of crime targets to motivated offenders (i.e., crime concentration) (Felson & Cohen, 1980; Miethe & Meier, 1990; Mustaine & Tewksbury, 2002). As such, certain environments may generate more opportunities than others at certain times of the day and week (Lundrigan et al., 2010). Therefore, specific environments and locations are more prone to be selected over and above others considering the crime opportunities and pool of potential targets they provide (e.g., locations known for attracting potential targets or limiting the presence of guardians). Based on the crime pattern theory, it would therefore be expected that offenders would likely choose offending locations close to their home or familiar to them and part of their awareness space. More specifically, among their awareness space, locations that are known to attract numerous potential victims and to generate criminal opportunities should be privileged (e.g., schools, shopping centers, public transport hubs, parks). Also, because the area where offenders will offend is largely based on their routine activities and awareness space (e.g., Felson & Cohen, 1980; Townsley & Sidebottom, 2010), crime site selection is expected to change over the offender's criminal career (Baudains, Braithwaite, & Johnson, 2013) — new routines changing the awareness space and bringing new opportunities at new locations.

3.2.2. *Environmental Consistency and Serial Offenders*

Studies analyzing the offender decision-making process related to the location of the crime have been mostly carried out for property crimes such as burglary (e.g., Bernasco & Nieuwbeerta, 2005; Clare, Fernandez, & Morgan, 2009; Coupe & Blake, 2006; Nee & Meenaghan, 2006; Wright, Logie, & Decker, 1995) and robbery (e.g., Bernasco & Block, 2009; Bernasco, Block, & Ruiters, 2013; Petrosino & Brensilber, 2003). Recent studies have also investigated target selection and spatial choices of rioters (e.g., Baudains et al., 2013; Martin, McCarthy, & McPhail, 2009). These previous studies have provided evidence that the selection of locations to commit crimes is not random and “irrational” but rather controlled and based on the available information and

internal cost-benefit calculation of the offender. However, not much is known when it comes to person-oriented offenses such as sex crimes. Here again, prior research shows that, while the environmental decision and selection of the site might be influenced by dynamic factors, serial offenders often use the same geographic and ecological space and tend to pattern themselves geographically (e.g., Beauregard, Proulx et al., 2007; Canter, 2000; LeBeau, 1987). In a recent study, Lundrigan, Czarnomski, and Wilson (2010) examined the consistency displayed by serial sex offenders in regard to the crime location and characteristics of the crime site selected — what they refer to as environmental consistency. Their results indicate that these offenders show high environmental consistency across crime series, suggesting that serial offenders are not randomly selecting environments to commit their crimes but that whatever might be influencing the selection of one environment is also influencing the selection of following environments. Canter (2000) suggests that consistency in spatial behaviors and the environment selected is seen in serial offenders as they operate over somewhat limited environments, preferring those that are more familiar to them and therefore, more predictable. The offenders' environmental and site selection decision can then be seen as the reflection of their own knowledge and experience of the environment. This knowledge, as suggested previously, can be gained as the offenders go about their non-criminal and daily routine activities (e.g., Beauregard et al., 2005; Brantingham & Brantingham, 1993; Clarke & Felson, 1993). The offender's familiarity with a specific site can also follow from a previously successful use of a specific site or type of environment to commit crimes. Hence, as suggested by Lundrigan and colleagues (2010), the knowledge and experience of the offenders can lead not only to the consistent use of one specific site but also to the consistent use of similar types of environmental and locational settings. Sexual offenders would then select their targets and crime locations in a somewhat consistent and "rational" way. While consistency for crime sites is found in prior studies, the nature of the sites used by sex offenders, however, has not been described and is still not known.

3.2.3. *Serial Sex Offenders and Crime Sites Used*

Not all serial offenders show the same geographic behaviors and, therefore, classification models have been proposed to describe this heterogeneity. In particular,

these models have been emphasized toward the hunting and target selection patterns of serial sex offenders (e.g., Beauregard et al., 2007; Deslauriers-Varin & Beauregard, 2010; LeBeau, 1987; Rossmo, 2000). For example, Rossmo (2000) developed a hunting pattern typology of serial murderers. Underpinning this typology is the idea that a crime event is composed of multiple stages and that offenders can move location from one offending stage to another. While sites used by offenders throughout their crime series are not all known to the police, two stages have greater likelihood of being known after the commission of a crime: (1) the victim encounter, or the beginning of the crime event; and (2) the release of the victim, or the end of the crime event. Moreover, Rossmo (2000) suggests that the method used by these offenders to commit their crimes (i.e., *modus operandi*) will influence their spatial and geographic behaviors at each stage. More specifically, the offender's victim search methods will influence the victim encounter site selected while his attack methods will influence the victim release site. As such, Rossmo's typology is based on a combination of behaviors at both these stages of the crime-commission process and presents four victim search methods (i.e., *hunter*, *poacher*, *troller*, and *trapper*) and three attack methods (i.e., *raptor*, *ambusher*, and *stalker*). For example, *trappers* use subterfuge or an occupation that persuades potential victims into their home or in an area where they will feel in control. *Trollers*, however, are opportunistic offenders who encounter their victims as they go about their daily routine activities and may be more prone to encounter their victims in public place or outside. The same could be said for *stalkers* (attack method) for whom the victim release site is strongly influenced by the victim-activity space, while the *ambushers* attack their victims on sites where they have a great deal of control. While Rossmo considered environmental and spatial behaviors in his typology, however, the specific nature of sites used by serial sex offenders to commit their crimes was overlooked.

Using Rossmo's hunting typology (2000), other studies further demonstrated that the offender's hunting process and target selection (and, implicitly, the victim routine activity) is closely tied to the site selected for the crime commission (e.g., Beauregard et al., 2007; Deslauriers-Varin & Beauregard, 2010; Hewitt, Beauregard, & Davies, 2012). In their study, Beauregard et al. (2007), used multiple correspondence analysis and hierarchical cluster analysis to identify three hunting process scripts of serial sex offenders: (1) the *Coercive* script, including the *home-intrusion rape* and two *outdoor*

rape tracks; (2) the *Manipulative* script, including the *sophisticated rape track* and *family-infiltrator* tracks; and (3) the *nonpersuasive* script, including the *direct action rape* track. The *home-intrusion rape* and *family-infiltrator* tracks refer to the victim being encountered in an indoor and private location, either at the victim's or the offender's home, whether "invited" or not into the home. The victim is then released at the same location where they encountered the offender. The *outdoor rape* tracks are both characterized by the use of a public place to encounter the victim. In one of the tracks, however, the victim is encountered in an outdoor public place and, most of the time, released in an outdoor public place familiar to the offender. For the other outdoor track, the victim is encountered indoors and released at an outdoor and private site that neither the victim nor the offender are familiar with. For the last two tracks, the *sophistication rape* and the *direct action rape*, the victims are encountered at a site similar to the one where they are released: a public outdoor site known by both the offender and the victim for the *sophistication* track, and a public indoor site also known by both the offender and the victim for the *direct action* track.

In a recent study, using a sample of 77 adult offenders convicted of committing a sexual offence against a child, Leclerc, Wortley, and Smallbone (2010) concluded that almost all offenders used their home at some point during the crime. The use of their own home allows them to have a greater control over the situation and their victim and to reduce the probability of interference by a witness. Offenders also have more time to commit the crime. This location provides them with high odds of successfully committing their crimes. Using the child's home or an isolated area outdoors were also common places used by offenders to abuse their victim.

3.3. Aim of the Study

Sexual offenders and the offenses they are responsible for tend to create issues and challenges for law enforcement. This is especially true for persistent serial sex offenders. Understanding where, when, how, against whom, and by whom, these criminal activities are committed is therefore, highly relevant for the criminal justice system. Prior studies on the hunting process and target selection show that serial offenders are not randomly selecting environments to commit their crimes and that

environmental and spatial patterns of crime exist. For example, the offender's home, the victim's home, and public places were previously identified as crime sites more prone to be used by offenders to find their victims and commit their crime (e.g., Brantingham & Brantingham, 1993; Beauregard et al., 2007; Deslauriers-Varin & Beauregard, 2010; Leclerc & al., 2010; Rossmo, 2000). However, prior studies always investigated the hunting and offending processes and its relationship to the locational settings of the crime; none of these studies considered looking only and specifically at the characteristics of the site selected itself and how sites selected evolve across series. Identifying and describing the nature of sites used by serial sex offenders could be beneficial for police investigations in helping to orient apprehension efforts. Considering the effect of the time at play in the very nature of serial offenders, is it still possible that sites used by serial sex offenders are static across series? In other words, can we assume that offenders are using the same pool of sites to commit their crimes across series? Or rather, are the crime sites used changing across series as offenders are progressing and gaining knowledge and experience, or as their awareness space changes? In such cases, some sites could be indicative of the beginning or later stages in an offender's sex crime series (i.e., reflective of offenders with a shorter or longer sexual crime "career"). Knowing if some sites are more prone to be used by offenders with an already longer sex crime series could be beneficial for offender profiling and crime linkage in helping to narrow down the pool of potential suspects. Therefore, there is a need to investigate how consistent serial offenders are in their site selection across series, specifically for the victim encounter and victim release offending stages. Using the underlying assumptions of the crime pattern theory as a backcloth, the current study addresses this need by, first, identifying if recurrent sites are selected by serial sexual offenders and, second, by investigating if sites used remain stable across series or if new sites emerge as offenders are progressing in their respective series.

3.4. Methodology

3.4.1. Sample

The initial study sample consisted of all male sex offenders convicted of a sentence of two years or more between 1995 and 2004 in Quebec, Canada. Among these, 92 individuals had committed at least two sex crimes against stranger victims, and of these, 72 individuals agreed to participate in the study. Together, these men were responsible for 361 sexual assaults for which they were charged and convicted. The final sample includes individuals who had committed sexual assaults involving a victim of any age and any gender with whom the offender had no personal relationship prior to the day the offense was committed. Offenders included in this study had sexually assaulted adult women ($n = 33$), children ($n = 17$), or both ($n = 22$), and 80.0% ($n = 291$) of the victims were female. The victim's mean age was 18.7 years ($SD = 9.6$). The majority of the offenders were Caucasian (91.3%; $n = 63$), and their average age at the beginning of the crime series was 30.7 years ($SD = 9.4$). The participants had committed an average of five sex crimes in their series (ranging from 2 to 37 sexual assaults each) and the average crime series length was 1,718 days (approximately 5 years).

3.4.2. Procedures

A questionnaire was previously developed, as part of a larger study, to collect information from police investigation reports and to guide in-depth, semi-structured interviews with the offenders. This questionnaire was developed using pre-existing questionnaires (ViCLAS – Violent Crime Linkage System, VICAP – Violent Criminal Apprehension Program, Computerized Questionnaire on Sexual Aggressors; Proulx, St-Yves, & McKibben, 1994) and includes five sections that allow for the collection of information on pre-crime factors, target selection processes, modus operandi, post-crime factors, and geographic behaviors. Information collected on the behavioral and geographic components of the target selection process were gathered from police reports. The lead researcher conducted the interviews in a private office isolated from correctional staff and other inmates. Participants were not paid for participating in the

study. All participants signed a consent form after the purpose of the study was explained to them.⁶

3.4.3. Variables

The investigation of classes of crime sites was performed using eight environmental indicators related to physical and contextual features of the offense at two different stages: (1) the encounter with the victim, and (2) the victim release. As mentioned earlier, these two stages were specifically selected as they represent the two most commonly known locations for police investigations (Rossmo, 2000). The eight variables are as follows: (1) offense land area use for the two stages of the offense (1 = Residential area; 2 = Commercial area; 3 = Park/Wilderness/Rural area; 4 = Others — Industrial and Institutional areas; (2) offense location (1 = Inside; 2 = Outside) for the two stages of the offense; (3) type of site for the two stages of the offense, referring to whether the offense was committed on a private (e.g., home, backyard) or public/semi-public site (e.g., park, business/shopping site, street) (1 = Private; 2 = Public/semi-public); and (4) offender and victim familiarity with the offense site (1 = Not familiar to both of them; 2 = Familiar to the offender; 3 = Familiar to the victim; 4 = Familiar to both the offender and the victim) for the two stages of the offense. The frequency data for the eight variables described above are presented in Table 3.1.

⁶ In order to minimize response distortion, offenders were promised confidentiality and a guarantee that the information provided could not be used in any way against them by the Correctional Service of Canada.

Table 3.1. Descriptive Information on the Study Variables

Variables		Victim encounter % (n)	Victim release % (n)
Land area			
	Residential	61.8 (223)	68.4 (247)
	Commercial	25.2 (91)	15.5 (56)
	Park/wilderness/remote	8.6 (31)	12.2 (44)
	Institutional/Industrial	4.4 (16)	3.9 (14)
Location			
	Inside	52.9 (191)	55.7 (201)
	Outside	47.1 (170)	44.3 (160)
Site			
	Private	32.1 (116)	50.1 (181)
	Public/semi-public	67.9 (245)	49.9 (180)
Site familiarity			
	Not familiar	0.0 (0)	8.9 (32)
	Offender	16.6 (60)	39.9 (144)
	Victim	21.6 (78)	24.1 (87)
	Both	61.8 (223)	27.1 (98)

Note. *n* = 361.

3.4.4. Analytical Strategy

First, Latent Class Analyses (LCA) were performed using variables related to environmental aspects of the crime scenes, for two stages of the offense: (1) Victim encounter and (2) Victim release. LCA are performed separately with the environmental aspects of the crime scene for the encounter stage and the victim release stage. Investigating classes of crime sites for those two stages separately will allow identifying different classes (and prevalence of class) for each stage, if any, while permitting better statistical power.⁷ Classes of sites identified for each offending stage are then cross-tabulated to determine how each latent class of offending site found for the encounter stage associates with the ones identified for the victim release stage. This step is

⁷ Eliminating one or more variables to be estimated can sometimes help to achieve a better model identification. Reducing the number of variables decreases the number of item-response probabilities to be estimated and the number of cells in the contingency table, thereby increasing the number of subject per cell. Identification of the best-fit model in the data is then better achieved (Collins & Lanza, 2010).

conducted in order to determine whether there is some continuity or change between geographical locations across the two offending stages. Second, through additional LCA, classes of crime sites are also investigated over the offenders' series/crime transitions.⁸ In order to do so, crimes are categorized according to their chronological position in each of the offender's crime series. Sites used by offenders to encounter and release their victims are then analyzed separately for each crime transition created. By comparing latent classes of sites selected by offender throughout crimes transition, it is possible to determine if crime sites are stable over crime transitions (transition-independent hypothesis) or if new crime sites emerge as offenders are progressing in their "career" (transition-dependent hypothesis). In other words, this procedure allows investigating whether crime sites used change across sex crime series (i.e., first offense, second offense, and so on) and, therefore, identifying if specific crime sites are representative of, or associated with, shorter or longer crime series. Appropriate

LCA are performed using PROC LCA, an add-on for SAS 9.3 for Windows (Lanza, Collins, Lemmon, & Schafer, 2007). While the application of LCA has been primarily restricted to medical, educational, psychological, and sociological domains, this technique has been increasingly used in behavioral research, particularly in criminology, over the past few years (e.g., Dayton, 2008; Deslauriers-Varin & Beauregard, 2010; Fox & Farrington, 2012; Lanza et al., 2007; McGloin et al., 2009). LCA assumes that discrete latent variables⁹ underlie a specific population and helps to identify underlying

⁸ Advanced LCA models were chosen over Latent Transition Analyses (LTA). LTA is a latent variable modeling technique that is built upon LCA. Basic LCA, however, presumes that the latent classes that are derived are static. When repeated measures are available and when latent classes to be found are believed to be dynamic (i.e., presuming that individuals can "move" through them over time) the longitudinal extension of LCA, LTA, could be used (Chung, Park, & Lanza, 2005; Collins & Wugalter, 1992; Velicer, Martin, & Collins, 1996). For example, LTA can be used to examine crime-switching patterns of serial sex offenders over crime series with regards to latent classes of crime sites used. The aim of the current study however, is to identify latent classes of crime sites used by offenders at different crime transition points. Indeed, the current study does not seek to inspect for the transitioning from one latent class of crime site to another for each offender' crime (i.e., individual-level) but to examine the stability and change of latent classes at each crime transition (i.e., crime event-level). As such, advanced LCA were judged more suitable for the current study. Moreover, such procedures allow for new sites to emerge, something that could not be achieved with the use of LTA considering the small sample size (i.e., 72 sex offenders).

⁹ These variables cannot be observed directly and must be inferred from observed items pre-selected by the researcher (Collins & Lanza, 2010; Lanza et al., 2007).

patterns in data or subgroups of individuals who share important characteristics or behaviors (Collins & Lanza, 2010). More specifically, LCA predicts subjects' subgroup membership based on their responses to a set of observed categorical variables and produces mutually exclusive and exhaustive classes of individuals (Dayton, 2008; Goodman, 1974; Lanza et al., 2007). LCA is particularly valuable when the theoretical construct of interest is made up of qualitatively different groups of individuals, but the group membership of individuals is unknown and must therefore be inferred from the data (Collins & Lanza, 2010).

3.5. Results

3.5.1. Identification of Latent Subgroups of Victim Encounter and Victim Release Sites

First, a series of LCA were conducted using the environmental indicators of the victim encounter and victim release sites. LCA were performed separately for environmental indicators of the victim encounter and those of the victim release sites. For all information criteria used to compare solutions,¹⁰ a smaller value for a particular model suggests that the trade-off between model fit and parsimony was achieved. As shown by the information criteria, the addition of classes beyond four classes provides no improvement in model fit for the victim encounter LCA model. For the victim release LCA model, information criteria are not as clear and suggest that either a four-class model or a five-class model would be a good fit. An inspection of the parameter estimates for the four-class model for both stages suggests that the classes found are distinguishable, non-trivial (i.e., no class with a near-zero probability of membership), and that meaningful labels can be assigned to each class found. Therefore, the four-class model was selected as the model providing the best overall fit to the data for both

¹⁰ The Bayesian Information Criterion (BIC; Schwarz, 1978), Akaike's Information Criterion (AIC; Akaike, 1974) and Adjusted Bayesian Information Criterion (ABIC; Sclove, 1987) are penalized log-likelihood model information criteria that were used to compare competing model fit to the same data (i.e., models with different numbers of latent classes). It was decided to also use the ABIC in order to better identify the best-fit model considering that the BIC tends to underestimate the number of latent classes when limited sample sizes and/or large numbers of parameters are engaged (Yang, 2006).

offending stages (see Table 3.2). For both the encounter site and the victim release site LCA solutions, the estimation was repeated using different sets of starting values (Lanza et al., 2007), and the four-class solution presented here was identified as the dominant solution that was obtained most frequently among the various sets of starting values.

Table 3.2. Comparison of Baseline Models for the Victim Encounter and Victim Release LC

LCA	No. of Classes	Degrees of freedom	AIC	BIC	Adjusted BIC	Entropy
Victim encounter sites						
	2	32	173.80	232.13	184.55	0.92
	3	24	81.88	171.32	98.35	0.97
	4	16	78.41	198.97	100.62	0.98
	5	8	90.51	242.18	118.45	0.82
Victim release sites						
	2	46	328.04	394.15	340.22	0.91
	3	37	236.07	337.18	254.70	0.91
	4	28	114.89	251.00	139.96	0.95
	5	19	109.33	280.44	140.85	0.98

Note. Boldface type indicates the selected model.

AIC = Akaike's Information Criterion (Akaike, 1974); BIC = Bayesian Information Criterion (Schwarz, 1978); ABIC = Adjusted Bayesian Information Criterion (Sclove, 1987).

For both the encounter site model and victim release site model, the likelihood-ratio G^2 statistic was used to compare which four-class solution was the best (lowest G^2 value) among the different four-class solutions obtained using different sets of starting values. The best-fit four-class solution selected for each offending stage presented high classification accuracy based on posterior probabilities,¹¹ confirming their stability and relevance. The assigned label and probability of membership for each encounter site and victim release site class, as well as the item-response probabilities for endorsing each item of the class, are shown in Table 3.3 and

¹¹ Average assignment probabilities based on posterior probabilities for the four-model solution ranged from .973 (.564–.993; neighborhood site profile) to .912 (.413–.999; shopping center site profile) for the victim encounter LCA solution and from .999 (.999–1.00; unfamiliar site profile) to .940 (.536–1.00; shopping center site profile) for the victim release LCA solution.

Table 3.4 respectively. Item-response probabilities vary from 0 to 1.00; an item-response probability closer to 1.00 indicates the presence of the item for the class. All victim encounter and victim release classes identified were labeled based on what seemed to best represent the environment/location where it took place.

Table 3.3. Item-Response for Four-Class Model Based on Probability of Endorsing Item Given Latent Class for the Victim Encounter Stage

Item	Latent classes			
	<i>Neighborhood^a</i> 36.4% (n = 126)	<i>Shopping center^b</i> 28.2% (n = 110)	<i>Victim's home^c</i> 19.1% (n = 67)	<i>Offender's home^d</i> 16.2% (n = 58)
Encounter land area				
Residential	0.72 (0.14)	0.03 (0.05)	0.99 (0.02)	0.98 (0.02)
Commercial	0.05 (0.16)	0.81 (0.06)	0.00 (0.00)	0.02 (0.02)
Park/wilderness/remote	0.23 (0.06)	0.01 (0.02)	0.01 (0.02)	0.00 (0.00)
Institutional/Industrial	0.00 (0.02)	0.15 (0.04)	0.00 (0.00)	0.00 (0.00)
Encounter location				
Inside	0.02 (0.04)	0.68 (0.17)	0.94 (0.05)	0.92 (0.04)
Outside	0.98 (0.04)	0.32 (0.17)	0.06 (0.05)	0.08 (0.04)
Encounter site				
Private	0.03 (0.03)	0.01 (0.01)	0.76 (0.07)	1.00 (0.00)
Public/semi-public	0.97 (0.03)	0.99 (0.01)	0.24 (0.07)	0.00 (0.00)
Encounter site familiarity				
Not familiar*	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Offender	0.03 (0.02)	0.05 (0.02)	0.00 (0.01)	0.87 (0.18)
Victim	0.03 (0.03)	0.06 (0.03)	0.95 (0.11)	0.04 (0.18)
Both	0.94 (0.03)	0.89 (0.03)	0.05 (0.11)	0.09 (0.10)

Note. n = 361; Rho estimates and standard errors (in brackets) are presented; a data-derived prior was applied to the rho parameters to help avoid parameter estimates on boundary values of zero and one.

* None of the encounter site selected among the 361 crime events was unknown to the offender and/or the victim.

This category was then removed from the analyses.

^aSite used by 48.6% (n = 35) of the 72 offenders in the sample.

^bSite used by 50.0% (n = 36) of the 72 offenders in the sample.

^cSite used by 31.9% (n = 23) of the 72 offenders in the sample.

^dSite used by 27.8% (n = 20) of the 72 offenders in the sample.

3.5.2. Victim Encounter Sites

The most prevalent victim encounter site found, labeled *neighborhood*, represents 36% of the 361 sex crime events included in the study and was used at least once by 49% of the 72 offenders in the sample. For this class, the victim is encountered at a residential area (0.72), public or semi-public (0.97), outside (0.98), and both the offender and the victim are familiar with this site (0.94). An example of such environment, as

suggested by its label, is the offender encountering the victims in a neighborhood where they both live. It could also be a residential area, where only the victim lives but where the offender often travels or commutes and then became familiar with over time. The second victim encounter site identified, labeled *shopping center*, represents about 28% of the crime events included in the study and was used by half of the offenders of the sample. The victim is encountered in a public or semi-public (0.99), commercial area (0.81), inside (0.68), and both the offender and the victim are familiar with this site (0.89). The third victim encounter site identified, labeled *victim's home*, represents about 19% of the sex crime events, and was used by 32% of the offenders. The victim is encountered in a private (0.76) residential area (0.99), inside (0.94), and only the victim is familiar with the site (0.95). The last victim encounter site identified, labeled *offender's home*, represents about 16% of the 361 crime events analyzed in the current study and was used by 28% of the offenders. Crime events grouped in this class are characterized by a victim encounter that takes place in a private (1.00) residential area (0.98), inside (0.92), and only the offender is familiar with this site (0.87).

Table 3.4. Item-Response for Four-Class Model Based on Probability of Endorsing Item Given Latent Class for the Victim Release Stage

Item	Latent classes			
	<i>Home</i> ^a 43.7% (<i>n</i> = 157)	<i>Neighborhood</i> ^b 28.5% (<i>n</i> = 104)	<i>Shopping center</i> ^c 17.8% (<i>n</i> = 63)	<i>Unfamiliar site</i> ^d 10.0% (<i>n</i> = 37)
Victim release land area				
Residential	0.97 (0.01)	0.51 (0.05)	0.10 (0.06)	0.98 (0.03)
Commercial	0.03 (0.01)	0.03 (0.03)	0.75 (0.07)	0.00 (0.00)
Park/wilderness/remote	0.00 (0.00)	0.40 (0.05)	0.02 (0.02)	0.02 (0.03)
Institutional/Industrial	0.00 (0.00)	0.06 (0.03)	0.13 (0.05)	0.00 (0.00)
Victim release location				
Inside	0.99 (0.01)	0.00 (0.00)	0.68 (0.07)	0.01 (0.01)
Outside	0.01 (0.01)	1.00 (0.00)	0.32 (0.07)	0.99 (0.01)
Victim release site				
Private	0.91 (0.02)	0.01 (0.01)	0.00 (0.00)	0.99 (0.01)
Public/semi-public	0.09 (0.02)	0.99 (0.01)	1.00 (0.00)	0.01 (0.01)
Victim release site familiarity				
Not familiar	0.00 (0.00)	0.02 (0.01)	0.00 (0.00)	0.83 (0.08)
Offender	0.48 (0.04)	0.60 (0.05)	0.07 (0.04)	0.05 (0.05)
Victim	0.46 (0.04)	0.05 (0.02)	0.10 (0.05)	0.07 (0.05)
Both	0.06 (0.02)	0.33 (0.05)	0.83 (0.06)	0.05 (0.04)

Note. *n* = 361. Rho estimates and standard errors (in brackets) are presented; a data-derived prior was applied to the rho parameters to help avoid parameter estimates on boundary values of zero and one.

^aSite used by 66.7% (*n* = 48) of the 72 offenders in the sample.

^bSite used by 48.6% (*n* = 35) of the 72 offenders in the sample.

^cSite used by 31.9% (*n* = 23) of the 72 offenders in the sample.

^dSite used by 9.7% (*n* = 7) of the 72 offenders in the sample.

3.5.3. Victim Release Sites

The four-class model for the victim release sites includes the following latent classes. The most prevalent victim release site found, labeled *home*, represents about 44% of the crime events in the sample, and was used by 67% of the offenders of the sample. This class regroups crime events where the victim was released at a location that seems to be either inside the offender's or the victim's home. Hence, the victim was released in a private (0.91) residential land area (0.97), inside (0.99), that either the offender (0.48) or the victim (0.46) is familiar with. The second most prevalent victim release site found, labeled *neighborhood*, representing 28% of the crime events and was used by 49% of the 72 offenders in the sample. Victims in the *neighborhood* victim release site profile are released, similarly to the *neighborhood* victim encounter site identified previously, in a public or semi-public (0.99) residential area (0.51), outside

(1.00), that only the offender is familiar with (0.60). Alternatively, the victims may be released in a park, in the wilderness or in a remote area (0.40) that both the victim and the offender are familiar with (0.33). The third victim release site identified, labeled *shopping center*, represents about 18% of the crime events analyzed, and was used by 32% of the offenders of the sample. This profile is also similar to the victim encounter site identified: the victim is released in a public or semi-public (1.00) commercial area (0.75), inside (0.68), and both the offender and the victim are familiar with it (0.83). Finally, the fourth victim release site identified, labeled *unfamiliar site*, is a new site that has not been identified in our previous LCA model analyzing the victim encounter sites. This class, which represents 10% of the crime events analyzed and was only used by 10% of the offenders, is characterized by the victim being released in a private (0.99) and residential (0.98) land area, outside (0.99), that neither the offender nor the victim is familiar with (0.83).

3.5.4. Associations between Victim Encounter Sites and Victim Release Sites

Crosstabulations with the victim encounter site latent classes (LC) and the victim release site LC were performed to analyze how both sets of sites associated with one another (Table 3.5). Overall, the victim encounter site classes found a significant association with their victim release site classes' counterpart ($X^2(9) = 320.9, p < .001$; Contingency coefficient = .69). For example, respectively 94% ($n = 63$) and 93% ($n = 54$) of the crime events included in the *victim's home* and the *offender's home* encounter site profiles associate with the *home* victim release site. In the same way, close to 59% ($n = 74$) of the crime events included in the *neighborhood* victim encounter site profile are also included in the *neighborhood* profile for the victim release site.

Some encounter sites found, however, associate with different victim release sites, creating "new" patterns of environmental site of crime scenes. This is specifically true for the *neighborhood* and the *shopping center* encounter site profiles found. For example, for 20% ($n = 22$) of the crime events where the offender encounters the victim in a *shopping center*, the victim is released in a *neighborhood* profile. In this case, the victim is encountered in a public/semi-public commercial land area, inside, that both the offender and the victim are familiar with, but the victim is released at a public/semi-public

residential or park area, outside, that only the offender is familiar with. In the same way, results show that for crime events where the victim was encountered in a *shopping center*, the victim was sometimes released at an *unfamiliar* site (14%) or a *home* site (12%). Similar patterns are found for crime events where the victims are encountered in a *neighborhood*: after the crime commission, the victims are released in a *home* (21%) or at an *unfamiliar* (18%) site.

Table 3.5. Crosstabulation — % (n) — of the Victim Encounter Site LCA Model and the Victim Release Site LCA Model

Victim encounter Latent classes	Victim release latent classes			
	<i>Home</i> (n = 157)	<i>Neighborhood</i> (n = 104)	<i>Shopping center</i> (n = 63)	<i>Unfamiliar site</i> (n = 37)
<i>Neighborhood</i> (n = 126)	21.4 (27)	58.7 (74)	2.4 (3)	17.5 (22)
<i>Shopping center</i> (n = 110)	11.8 (13)	20.0 (22)	54.5 (60)	13.6 (15)
<i>Victim's home</i> (n = 67)	94.0 (63)	6.0 (4)	0.0 (0)	0.0 (0)
<i>Offender's home</i> (n = 58)	93.1 (54)	6.9 (4)	0.0 (0)	0.0 (0)

Note. $X^2(9) = 320.9$, $p < .001$, Contingency coefficient = .69.

3.5.5. Stability of Victim Encounter and Victim Release Sites over Crime Series

Next, the stability of the latent class solutions across crime transitions was examined to determine if the classes of crime sites found were transition-dependent. The purpose of this series of analyses was to inspect whether the latent classes found for the victim encounter and the victim release sites were consistent independently of their ordering in the offender's crime series. In other words, the analyses seek to determine if the pool of crime sites identified at the beginning of sex offenders' series is the same as the one identified later in their series.¹² Hence, is it possible that certain crime sites are more indicative of the beginning or later stages in an offender's crime

¹² This series of analyses is concerned with crime events rather than offenders. Therefore, the stability of crimes events over time is examined rather than the offender's offending consistency. Hence, the focus of analyses is different from examining whether an offender is using the same site to commit the offense from one crime to the other. An offender's crime series could be characterized by crime switching patterns over time in regards to the crime site selected but the pool of crime sites could remain the same. In other words, offenders could be switching their site selection among a relatively fixed pool of crime sites.

series? The transition-dependent hypothesis suggests that classes of crime sites change across crime transitions, meaning that the pool of crime sites is not static and can vary according to the offenders' progression in their respective series (e.g., awareness space, experience, knowledge, opportunities). The alternative hypothesis, the transition-independence, refers to a situation where the pool of possible crime sites remains the same across offenders' crime series, suggesting that offenders tend to encounter and release their victims in the same type of environments, independent of their series progression.

In order to do so, the four-class solutions found for the victim encounter and the victim release sites were further inspected using a series of LCA. For each LCA analysis, crimes were categorized according to their position in each of the offender's crime series. Four scenarios were inspected to test for the transition-dependent/independent hypotheses: (1) the latent classes of crime sites for the first crime in the offender's series were compared to all other subsequent sex crimes in the offender's series; (2) the first two sex crimes in the offender's series were compared to all other subsequent sex crimes in the offender's series; (3) the first three sex crimes in the offender's series were compared with all other subsequent sex crimes in the offender's series; and (4) the first four sex crimes in the offender's series were compared with all other subsequent sex crimes of the series.¹³ Two models were estimated for each of the four scenarios: (1) a freely estimated (FE) model across crime transition, allowing for, transition-dependent patterns to emerge; and (2) a measurement invariance imposed model (MI) across transition forcing transition-independent patterns. By comparing the model fit for the FE and the MI models, it is possible to test for the transition-dependence/independence hypotheses. Situations where the model fit of the FE model is significantly different than the MI model indicate that classes change across the crime transition tested. Conversely, situations where the model fit of the FE model is not significantly different than the MI model indicate that classes of crime sites do not change across the crime transition analyzed. Results are presented in Table 3.6.

¹³ It was not possible to examine crime at each transition separately due to the small number of offenders having more than three offenses. Therefore, it was decided to keep all the crime events in the analyses and group them according to their ordering in the offender's crime series.

Table 3.6. Fit Statistics for Test of Crime Transition Difference in Latent Class Prevalence for Victim Encounter and Victim Release Site LCA Models

	Victim Encounter four-class model						Victim release four-class model					
	G ²	df	AIC	BIC	ABIC	Entropy	G ²	df	AIC	BIC	ABIC	Entropy
Crime transition 1 (crime 1 vs. 2+)												
Freely estimated	19.67	33	143.67	384.78	188.08	0.88	64.11	57	204.11	476.33	254.26	0.93
Measurement invariance imposed	42.40	61	110.40	242.63	134.76	0.92	87.21	89	163.21	310.99	190.43	0.93
Difference	20.73 (NS)	28					23.10 (NS)	32				
Crime transition 2 (crime 1, 2 vs. 3+)												
Freely estimated	22.10	33	146.10	387.21	190.51	0.90	57.08	57	197.08	469.30	247.22	0.93
Measurement invariance imposed	64.01	61	132.01	264.23	156.37	0.92	93.72	89	169.72	317.50	196.94	0.93
Difference	41.91*	28					36.64 (NS)	32				
Crime transition 3 (crime 1, 2, 3 vs. 4+)												
Freely estimated	20.63	33	144.63	385.74	189.04	0.91	159.60	57	299.60	571.83	349.75	0.90
Measurement invariance imposed	86.44	61	154.44	286.66	178.80	0.94	131.30	89	207.30	355.08	234.52	0.93
Difference	65.81**	28					28.30 (NS)	32				
Crime transition 4 (crime 1, 2, 3, 4 vs. 5+)												
Freely estimated	22.89	33	146.89	388.00	191.30	0.91	160.00	57	300.00	572.22	350.15	0.89
Measurement invariance imposed	83.88	61	151.88	284.10	176.23	0.93	132.41	89	208.41	356.18	235.63	0.93
Difference	60.99**	28					27.59 (NS)	32				

* p < .05 ** p < .001

First, results for the victim encounter sites are examined. The first analysis included the comparison between crime sites for the first crime of the offender's crime series to all other crimes (i.e., 2nd, 3rd, 4th, etc.). The crime transition hypotheses were tested by comparing the G^2 statistic of both the FE ($G^2 = 19.67$) and the MI ($G^2 = 42.40$) models. The G^2 difference between the two models found was not statistically significant at $p < 0.05$ (G^2 difference = 20.73, $df = 28$). Therefore, classes of crime sites found for the first crime of the offenders' series are not different from classes of crime sites found for subsequent crimes.

The second analysis conducted included the comparison between classes of crime sites for the first and second crimes of the offenders' series with all other crimes (i.e., 3rd, 4th, 5th, etc.). The difference between the G^2 statistic of both the FE ($G^2 = 22.10$) and the MI ($G^2 = 64.01$) models was statistically different (G^2 difference = 41.91, $df = 28$) at $p < 0.05$. Therefore, classes of crime sites found for the third and subsequent crimes of the offenders' series are different from the sites selected for the first two crimes committed. If the third crime marks shifts in the victim encounter sites found, this difference becomes even more pronounced for subsequent crimes. Hence, the difference in model fit between the FE and the MI models for the third and fourth transitions become statistically significant at $p < 0.001$.

Subsequent analyses (not shown) were performed in order to further examine the significant difference found between the FE and MI models analyzed. Three main results emerged from the additional LCA performed. First, the number of site classes changes across offenders' crime series. More specifically, the findings of this study suggest that the number of crime site classes found changes at the third transition (i.e., fourth crime). Indeed, the additional LCA analyses show that three classes of victim encounter sites are found at the beginning of a crime series (i.e., first three crimes of the offenders' crime series): (1) *shopping center*, (2) *victim's home*; and (3) *neighborhood*. At the third transition, the same three classes are found but the *offender's home* site emerges. In other words, the *offender's home* is an encounter site that is selected by offenders later on in their series as no latent class of this nature is found for the previous crime transitions. Second, the prevalence of the victim encounter site classes found changes. For example, until the third transition (i.e., fourth crime), the *shopping center* class represents about 35% of the first three crimes committed. That is to say, that in

35% of the first three crimes committed by offenders, the *shopping center* site will be used to encounter their victims. However, when analyzing sites for the subsequent crimes in the offenders' series (fourth and up) the prevalence of this site drops to 22%. It appears that sex offenders are less likely to use this site to encounter their victim after their third crime. Third, and in line with the previous result, the most prevalent victim encounter sites at the beginning of the offenders' series are not the most prevalent later in the series. For instance, the *shopping center* and the *victim's home* profiles are the two most prevalent sites among the first three crimes of the offenders' series, each representing about 35%. For the following crimes, however, the *neighborhood* becomes the most prevalent site, increasing from 30% to 43%. While the offenders will more likely use the *shopping center* and the *victim's home* site to encounter their victims at the beginning of their series, they will more likely use the *neighborhood* to encounter them later on in their series.

Next, results for the victim release sites are examined. Here again, the first analysis included the comparison between crime sites for the first crime of the offender's crime series to all other crimes. Using the G^2 statistic, the crime transition hypotheses were tested by comparing it for both the FE ($G^2 = 64.11$) and the MI ($G^2 = 87.21$) models. The G^2 difference between the two models found was not statistically significant at $p < 0.05$ (G^2 difference = 23.10, $df = 32$). Therefore, classes of victim release sites found for the first crime of the offenders' series are not different from those found for subsequent crimes. In fact, none of the crime transitions for the victim release sites shows a statistically significant difference in model fit between the FE and the MI models. Therefore, in line with the transition-independent hypothesis, types of victim encounter sites stay the same across offenders' crime series. This does not mean, however, that offenders are not switching victim release locations across sex crime transitions, but rather, that the nature and prevalence of victim release sites are relatively constant, independent of whether the offense is committed at the beginning or later in the crime series. Inspection of LCA solutions tested (not shown) confirms this stability.

3.6. Discussion

The current study aimed at investigating consistency in crime site selection by a sample of convicted adult male serial sex offenders. Using LCA, results show distinct classes of crime sites that are recurrent across sex crime series. These sites are similar to those found in prior studies and show that, in line with what Canter (2000) suggested, serial offenders operate over limited environments. The prevalence and nature of distinct and recurrent crime sites highlights that serial sex offenders show a limited diversity of victim encounter and victim release sites. The victim encounter and victim release sites are relatively bound together and part of environmental crime scripts characterizing this sample. In fact, in line with the crime pattern theory and prior research (e.g., Baudains et al., 2013; Brantingham & Brantingham, 1993; Bernasco, 2010; Felson & Cohen, 1980; Townsley & Sidebottom, 2010), it seems that they tend to specifically select sites that are more familiar to them but also known to attract more potential victims and generate more criminal opportunities. The current study also provides preliminary data suggesting that there are connections between the encounter site and the offender's series progression. Indeed, results help to identify encounter sites more likely to be selected by offenders having a longer crime series. Taken together, the current study provides new insight into the geographical behaviors of serial sex offenders across their crimes series. More specifically, the current research highlights five key empirical observations regarding sex offender's geographical behaviors.

First, consistency in crime site selection was generally found across offenders' series. Indeed, and in line with the crime pattern theory, it was possible to identify a relatively fixed pool of recurrent sites selected by serial stranger sex offenders that would hold across crime series. Four latent classes of victim encounter sites (i.e., *neighborhood*, *shopping center*, *victim's home*, and *offender's home*) and four classes of victim release sites (i.e., *home*, *neighborhood*, *shopping center*, *unfamiliar site*), and their respective prevalence of use, were found. Therefore, specific locations are more prone to be selected over and above others across offenders' crime series.

Second, results found when analyzing the victim release stage suggest more stability of crime sites selected by offenders over crime series. The current study is

concerned with crime events rather than offenders. Therefore, the stability of crime events over time is examined rather than the offender's offending consistency. Hence, this result does not mean that one offender is consistently using the same site to commit the offense from one crime to the other. In fact, it was previously found that the victim release site characteristics showed a lower level of individual consistency compare to the encounter site characteristics (see Deslauriers-Varin & Beauregard, 2013). Instead, it means that victim release sites selected by offenders for the first few crimes of their series are not different from those selected for any other subsequent crimes committed by the offenders. In other word, even if offenders might be individually inconsistent (or consistent) in their victim release site selection, they are still selecting the site/location to release their victims in a relatively fixed pool of crime sites.

Third, as expected and as suggested by prior studies on offenders' site selection (e.g., Baudains et al., 2013; Townsley & Sidebottom, 2010), series of analyses conducted to investigate the stability of the encounter sites provide evidence of the diversification of the sites selected with longer series. More specifically, the study findings suggest that the number of crime sites found changes at the third transition (fourth crime). For example, when taking into consideration recurrent sites selected at each crime transition individually, there are only three prevalent sites used by serial sex offenders for the first three crimes of their series. After the third crime, however, a fourth crime site emerges. In that regard, the initial LCA solution found when including all crimes committed is more representative of the pool of sites selected for crimes committed later in the series. This result could be interpreted in two ways. On one hand, it could be that offenders with a fewer number of offenses are somewhat different than those with more offenses in regard to where they typically encounter their victims across crime series. Futures studies should try to further investigate sites used by serial sex offenders while taking into account the importance of the number of sex crimes they have committed. If offenders with shorter series (in regard to the number of sex crimes committed) do have a distinctive pattern, perhaps it would be worthwhile to distinguish serial sex offenders based on the number of crimes committed (i.e., offenders with shorter versus longer crime series). On the other hand, it could also be that, as the series become longer, offenders are modifying their offending which results in the patterns observed. In line with a more traditional view of criminal career (Blumstein et

al., 1988) and more recent studies in the behavioral consistency field (e.g., Deslauriers-Varin & Beauregard, 2013; Harbers et al., 2012; Sorochinski & Salfati, 2010), this result could indeed suggest that offenders having committed three offenses or less are still discovering and evaluating the different and most successful ways and locations to encounter their victim and commit their crime. This result is also consistent with the learning process hypothesis suggesting that most offenders learn from their past experiences and will try something different (i.e., committing a crime in a different way, at a different place) after the few first offenses in order to determine what strategy works best for successfully achieving their goal (e.g., Cusson, 1993; Rossmo, 2000; Sorochinski & Salfati, 2010). Once a successful strategy has been determined, the offender can then start to reproduce it when committing his following crimes, which leads to the consistent use of specific sites or sites with similar locational settings (Lundrigan et al., 2010). Considering crime linkage purposes, it might be beneficial for police investigators and crime analysts to be aware that a switch in terms of the site selected to encounter potential victims might happen, especially after the first few sex crimes.

Fourth, the prevalence of sites used by offenders to encounter their victims changes across series. Indeed, results show that even if the same classes of sites can be found, the prevalence of use of these sites can vary across series. Consequently, the most prevalent victim encounter sites at the beginning of the offenders' series are not the most prevalent sites used later in the series. Accordingly, it can be expected that crimes committed later in the offenders' series will tend towards more prevalent crime sites. For example, the *shopping center* and the *victim's home* are the two most prevalent sites among the first three crimes of the offenders' series. For the following crimes, however, the *neighborhood* becomes the most prevalent site used by offenders to encounter their victim. Therefore, it can be expected that more offenders will select such an environment to find their victims once they are more "established" in their sexual career. Also, if some sites seem to be more prevalently used by offenders as their series progresses, this suggests that some offenders are switching and changing their way of operating to encounter their victims. While specific characteristics of the crime site have shown individual consistency (see Deslauriers-Varin & Beauregard, 2013), the pool of sites used by offenders has shown some diversity as the offender progresses in his crime series. For example, it is noteworthy that the use of the *neighborhood* to

encounter victims becomes more prevalent as the crime series gets longer. This information could potentially inform police investigator of the offender's "standing" in terms of his sexual crime series. Indeed, knowing that this type of site is associated with a crime committed later in the crime series, police investigators could then focus their attention on suspects having a more extensive sexual criminal background.

Last, some crime sites are more indicative of crimes committed later during the series. In that regard, the use of the *offender's home* to encounter the victim is associated with crimes committed later in the crime series. Offenders are therefore, using their own home as a site to encounter and commit their crime once they are more "established" in their sexual career. Consequently, when faced with a crime where the victim was encountered (and possibly released) at the offender's home, it may be assumed that this offender has committed sex offenses before. This information could be of interest for crime linkage purposes. Indeed, considering that this type of site is associated with a crime committed later in the crime series, investigators arresting an offender who has committed a sexual offense in his home could well be in presence of a serial sex offender. A retrospective search for unresolved sex crimes that fit the offender's characteristics and whereabouts could then contribute to solve crimes for which a suspect has not been identified yet. Moreover, this result suggests that, as offenders progress in their series of sex crimes, they might become more confident and risk-taking and will start to select sites they are more familiar with to encounter their victim, which explains the emergence of the *offender's home* site. This hypothesis is also supported by the fact that the *neighborhood* site also becomes more prevalently used by offenders having committed more than three sex offences. Indeed, linking it back to the crime pattern theory, after using sites known for providing high crime opportunities and potential targets for their first few crimes (e.g., *victim's home*, *shopping center*) these offenders gain experience and confidence and start using sites that are more risky and uncertain to encounter their victims (e.g., *neighborhood*, *offender's home*), which might have led to their current arrest. It might also be that their first few crimes are more opportunistic but, become more planned and organized as their series becomes longer. This would explain the "switch" from sites known to attract victims and where the likelihood of a criminal opportunity is higher to sites that are more risky, uncertain and where they could be more easily recognized and identified.

Although this study is one of the few investigating the homogeneity and stability of offense environments of serial sex offenders, this study suffers from limitations that need to be acknowledged. First, the sample included only crimes committed by incarcerated offenders and for which the offenders were charged and convicted. Therefore, the results of the current study might reflect only the offense site selection of offenders who were not able to avoid detection and were apprehended by the police. Second, this study is based on self-reported information gathered during semi-structured interviews with the offenders, which might reflect only the offender's perception of the crime. Safeguarding against this concern, it is important to emphasize the fact that self-reported information was compared to official data (i.e., police reports) when possible. Third, the crime events under consideration are nested within individuals and therefore not independent of one another. Offenders included in the sample differed in the number of sex crimes they committed, ranging from 2 to 37. This might have had an influence on the results, as the weight that each offender carries on the final LCA solution is not equal. More specifically, assuming stability in an offender's crime site selection, the prevalence of each site found might be the result of our decision to count an uneven number of crimes per offender. However, additional analyses showed that the victim encounter and release sites identified in the current study were used by a good proportion of offenders of the sample and, therefore, were not only found due to a small number of more prolific offenders who used a specific type of site several time across series. Finally, the current study only included offenders who had committed at least two sex crimes. Considering that, in practice, crime analysts will search databases of offenses whose author will sometimes be a serial offender but more likely a one-time offender, it would have been ideal to include single-offense offenders in the current analyses. This would have allowed determining whether these offenders are distinct from serial offenders and showing a different pattern and pool of crime-site locations.¹⁴ Future studies should further investigate if differences exist between crime sites used by single- and multiple-offenses offenders. If some sites used were found to be specific to single-offense or serial sex offenders, here again, police investigative strategies could be

¹⁴ Indeed, prior studies tend to suggest that significant difference might exist between one-time and serial offenders (e.g., criminal history: Trojan & Salfati, 2011; modus operandi behaviors: Corovic, Christianson, & Bergman, 2012).

enhanced and crime linkage analysts could better identify whether they are likely in the presence of a serial sex offender.

3.7. Conclusion

The location where the victim is encountered and then released is one of the least ambiguous elements of an offence. Fortunately, in line with the crime pattern theory, prior studies have shown that serial offenders are not randomly selecting environments to commit their crimes and that environmental patterns of crime exist. In other words, because offenders operate over somewhat limited environments and that the offence environment selection by offenders is influenced by their awareness space, knowledge, experience, and target needs, offenders tend to pattern themselves geographically. Results from this study tend to support this affirmation. Indeed, it has been possible to demonstrate that offenders are relatively consistent in the sites they use to encounter and release their victims. While the use of some crime sites are associated with crimes committed later in the series, offenders are still selecting the location to encounter and release their victim in a relatively fixed and small pool of crime sites. Combined with geographic profiling information, this suggests that police departments could not only focus their search and patrols in specific geographic areas when looking for a presumed sex offender, but could also further concentrate their attention on specific sites most likely to be used by the offender *among* these identified areas (e.g., shopping centers). In doing so, the potential for suspect prioritization and apprehension efforts in the investigation of repetitive offences could be greatly enhanced. Moreover, results from this study show that serial sex offenders, prior to their arrest for their index crime, tend to move to more uncertain (i.e., attracting less potential victims) and risk-taking encounter crime sites over time. This lends further support to the notion that spatial patterns and environmental decision-making of serial offenders can be used to reveal something about them and their understanding of the environment in which they operate. The environmental and locational patterns identified here can also provide useful information for crime linkage purpose that might help police investigator to prioritize potential suspects, better understand the offender they are dealing with and his “standing” in terms of his sexual crime series, and to help solve crimes for which a suspect has not been identified yet.

4. Unravelling Crime Series Patterns among Serial Sex Offenders: Duration, Frequency, and Environmental Consistency

4.1. Abstract

Crime linkage and the investigation of behavioral consistency among serial offenders has been a flourishing field of research over the past decade or so, especially with respect to serial sex offenders. The emerging research in this field has often portrayed serial sex offenders as a single, distinct, and homogeneous group. Such an assumption, however, has never been empirically examined. Using a criminal career approach and sample of 72 serial sex offenders who have collectively committed 361 sexual assaults on stranger victims, the current study aims to examine and describe subgroups of crime series patterns among serial sex offenders in terms of offending frequency and series duration. The level of environmental consistency display (i.e. offender's choice of crime location and characteristics of the crime site selected) across subgroups of crimes series patterns is also examined. Study findings suggest heterogeneity of crime series patterns among serial sex offenders. Moreover, the offenders' level of environmental consistency varies across the different crime series patterns identified, allowing for the identification of subgroups of offenders showing higher or lower level of environmental consistency based on their crime series patterns.

4.2. Introduction

Crime linkage analysis is an investigative technique that can help police investigators to determine, based on behavioral similarities displayed across different crime scenes, whether they are faced with a possible series of related offenses committed by the same offender. Special units among certain police departments therefore rely on the assumption that serial offenders, whether burglars or sex offenders, tend to repeat their offending over time and be consistent in how they go about it. This approach relies on the associated ideas that, at some point in time, these individuals are caught, arrested and become known to the police, in terms of their type of offense, modus operandi, location of offenses, and so on. Different explanations have been put forward to explain why serial offenders would become consistent from one crime to the next. For the most part, researchers have suggested that offenders are decision-makers who will act in a consistent fashion based on their knowledge and experience (e.g., Beauregard & Leclerc, 2007; Beauregard, Rossmo, & Proulx, 2007; Bernasco, Block, & Ruiters, 2013; Deslauriers-Varin & Beauregard, 2010; 2014; Lundrigan et al., 2010). As offenders learn from their previous experiences, they try out various strategies at different times and places during the first few offenses in order to determine what strategy works best for successfully achieving their goal (e.g., Cusson, 1993; Rossmo, 2000; Sorochinski & Salfati, 2010). Once a successful strategy has been determined, the offender may decide to limit their repertoire to this offending strategy, which leads to the consistent use of specific behaviors or offense sites (Lundrigan et al., 2010). More specifically into environmental consistency, offenders have been found to operate over limited environments, preferring those familiar and close to their home or areas of routine activities (e.g., Brantingham & Brantingham, 1991; Bernasco, 2010; Canter, 2000; Clarke & Felson, 1993; Rossmo, 2000). In other words, environments selected to offend can be seen as limited and consistent from one crime to the next in that familiarity somewhat defines offenders' knowledge about opportunities and the range of their search (Lundrigan et al., 2010).

Associated with the emergence of crime linkage, researchers started to analyze whether serial offenders are in fact consistent in the way they commit their crimes across

series (behavioral consistency) and if behavioral evidences could be used to reliably link crimes. For such an approach to be effective, it becomes essential to understand the possible patterns of offending among serial offenders. Yet, criteria used to define a serial offender changes across studies. For example, studies in this field of research tend to agree that an offender must have committed at least two crimes of the same nature in order to be defined as a serial offender (e.g., Bennell & Canter, 2002; Grubin et al., 2001; Markson et al., 2010; Lundrigan et al., 2010). Some will also add a dimension of “event,” stating that crimes have to be committed on different victims on separate occasions (e.g., Woodhams & Labuschagne, 2012a; Beauregard et al., 2007; Grubin et al., 2001). This strategy allows excluding offenders such as mass-murderers or individuals having offended against multiple victims during one crime event. Furthermore, a gap sometimes exists in prior studies between the conceptual and the operational definition of serial offenders, adding to the confusion. For example, although they might still agree on the conceptual definition of serial offenders previously suggested (i.e. two crimes committed on separate occasions), researchers investigate consistency with a sample of serial offenders having committed at least three (e.g., Bennell & Jones, 2005; Melnyk et al., 2011; Sorochinski & Salfati, 2010), sometimes five or more (e.g., Bateman & Salfati, 2007; Melnyk et al., 2011) offences at different times and locations. Such a cut-off number of victims in the operational definition of serial offenders is often used in order to maximize the number of crimes in the sample and allow for a more thorough investigation of behavioral consistency. In doing so, potential patterns of serial offending are left out. Such variation among the conceptual and operational definition of “serial offenders” suggests:

- a lack of agreement of who “serial offenders” are or what exactly constitute “a series”;
- the fact that researchers have almost exclusively relied on a count of victims and events to identify serial offenders without considering other important dimensions; and
- the fact that there is a continuum of offenders and crime series, which requires researchers to draw an arbitrary line to select a sub-group of serial offenders.

As such, it is believed that the potential heterogeneity of serial offenders and the patterning of their crime series need to be examined before going further into the investigation of serial offenders and their level of behavioral consistency.

4.2.1. Criminal Career and Crime Specialization

Studies on serial offenders and the investigation of behavioral consistency have mainly been conducted in the field of investigative psychology. This line of research, however, has emerged and evolved almost independently of a long tradition of empirical research in criminology. Indeed, criminologists have long been interested in the developmental patterning of criminality and criminal behaviors of offenders over the course of their criminal career (e.g., Piquero et al., 2003). For decades now, the criminal career field has developed as a scientific paradigm that focuses on the longitudinal sequence of crimes committed by individuals (Blumstein et al., 1986). Results stemming from this field have allowed us to better understand and contextualize heterogeneity of offenders and their criminal career. Indeed, distinct groups of offenders who offend at different rates over different career durations, and whose criminal activity is caused by unique factors, have been found over the years (e.g., Piquero et al., 2003; Wortley & Smallbone, 2013). For example, in designing a probabilistic model of criminal careers, Barnett, Blumstein, and Farrington (1987) found that offenders had to be divided into two groups: (1) the frequent offenders, showing a high offending frequency; and (2) the occasional offenders, showing a low(er) offending frequency. In terms of career duration, Moffitt (1993) identified two criminal trajectories among offenders: (1) offenders whose antisocial behaviors are limited to the adolescence period — the *adolescent limited* offenders; and (2) offenders who start to commit antisocial behaviors early on and whose criminality persists well into adulthood — the *life-course persistent* offenders. The modeling of offending patterns by criminologists, therefore, has often been based on the simultaneous examination of the duration of offending and the frequency of offending while the offender was active. The element of time, therefore, is important given that it contextualizes repetitive offending and its intensity (e.g., five offenses over six months versus over ten years) and such aspect has been overlooked in the crime linkage field and, to a broader extent, the investigative psychology field.

The extent to which offenders specialize in their offending has also been, first and foremost, a key question in criminal career research (see Nieuwbeerta et al., 2011). Indeed, criminal career researchers have stressed the importance of examining two aspects of the longitudinal sequence of offending: (1) crime specialization, which is the tendency to repeat the same crime type on subsequent occasions; and (2) criminal

versatility or crime switching, which refers to the tendency to commit a wide array of crime types (Blumstein et al., 1986). Based on these parameters, “specialist” offenders are thus those who predominantly commit a specific type of crime and tend to engage in that behavior repeatedly and frequently while, on the opposite, versatile offenders tend to commit many different types of crime over time without specializing in any of them specifically (Lussier, 2005).¹⁵

In the traditional view of criminal careers, offenders are thought to “sample” a wide variety of offenses during the early phase of their career before becoming more specialized, with time, in particular crime types that are more suited to their preferences and skills (Blumstein et al., 1988). In other words, crime switching should be expected in the first few arrests while crime specialization should be found for more prolific offenders. In line with such a statement, a study conducted by Beutler and colleagues (1995) demonstrated that a more similar offense pattern throughout the offender’s crime series was associated with a greater number of alleged offenses. Other studies also found that specialization for specific types of offenses was more likely for more “experienced” and prolific offenders (Blumstein et al., 1988; Lussier et al., 2011). For example, Brennan, Mednick, and John (1989) found evidence of specialization in violent and property offenses for offenders presenting a persistent and more extensive criminal history (compared to those whose criminal career might be shorter in time and less prolific). More recently, researchers have used a more circumscribed approach to analyze specialization (e.g., life-course perspective) and provided support to the idea that, while generality is the norm when offending is viewed over the long-term, offenders tend to specialize in the short term (i.e., months or years rather than developmental stages or the full career) (e.g., DeLisi et al., 2011; Francis et al., 2004; McGloin, Sullivan, & Piquero, 2009; Sothill et al., 2000). For example, Sullivan et al. (2006) found that the level of specialization progressively decreased as the time window of focus grew broader (i.e., month to year to three years).

¹⁵ In other words, criminal career researchers have examined the tendency to specialize in, for example, violent crimes, whereas crime linkage researchers have looked at the tendency for violent offenders to commit their violent crimes in the same way.

Taken together, results coming from the criminal career field suggest that the specialization level found among offenders, and its explanation, is not expected to be the same whether we are looking at more or less prolific offenders (i.e., number of crimes committed) having offended over a shorter or longer period (i.e., career duration). However, unlike researchers from the behavioral consistency field, most researchers in the criminal career field have not investigated offenders' level of specialization for one specific type of crime. Therefore, applied to the current field of research, these results suggest that different crime series patterns should be found among serial sex offenders, and that such patterns should modulate the consistency level found among offenders.

4.2.2. Consistency, Offending Frequency, and Series Duration

Studies investigating offending consistency have shown that offenders commit crimes in a consistent manner across crime types and categories (e.g., Burrell et al., 2012; Tonkin et al., 2011), especially more so when geographic and spatial behaviors (over more traditional modus operandi behaviors, such as the level of violence) are used (e.g., Bernasco, 2008; Goodwill & Alison, 2006; Markson et al., 2010; Tonkin et al., 2008). In recent studies (Deslauriers-Varin & Beauregard, 2013, 2014; Lundrigan et al., 2010) the consistency displayed by serial sex offenders with regard to the crime location and characteristics of the crime site selected (i.e., environmental consistency) was also examined. Results indicate that offenders: (1) are not randomly selecting environments to commit their sex crimes, (2) show high environmental consistency across their crime series; and (3) tend to commit their crimes in a relatively fixed pool of crime sites. While recent studies in the crime linkage and behavioral consistency field suggest much variation among serial offenders and their crime series, no study in this field has so far investigated such heterogeneity of crime series patterns among serial offenders and their potential influence on offenders' consistency level. In fact, behavioral consistency studies have so far included the same number of offences per offender (i.e., usually the first two or three crimes committed) in order to *limit* the influence of prolific offenders (e.g., Bennell & Canter, 2002; Bennell, Jones, & Melnyk, 2009; Santtila et al., 2005). Such handling of the offending data does not take the offender's whole series into account, which may lead to unnecessary biases.

To our knowledge, few researchers have acknowledged and tested for the potential influence of the offender's number of crimes committed on serial offenders' consistency level. In their study, Woodhams and Labuschagne (2012b) found that selecting a fixed number of crimes per series/offender could in fact lead to an underestimation of behavioral consistency. Deslauriers-Varin and Beauregard (2013) came to a similar conclusion when comparing offenders' consistency level using different coefficients. While no statistical analyses were used to empirically test for the influence of the number of crimes committed, their study suggests that serial sex offenders having committed more crimes (i.e., four or more) present a higher level of environmental consistency compared to less "prolific" offenders (Jaccard's of .67 for offenders having committed three crimes, compared to a Jaccard's of .86 for offenders having committed at least four crimes, and .96 for offenders with at least 10 crimes). While these results are interesting, they do not account or take into consideration the duration of the series or the time during which the offender was criminally active. In fact, when it comes to empirically testing for the influence of time, studies in the crime linkage field have mostly been focused on the time span between offenses, known as temporal proximity (e.g., Tonkin et al., 2011). Others have also compared the difference, in terms of the consistency level found, between the first and the last known offense pairs (Grubin et al., 2001; Markson et al., 2010; Tonkin et al., 2008; Woodhams & Labuschagne, 2012b). No study, to our knowledge, has investigated the influence of the series duration on consistency. Nevertheless, prior research from the fields of criminal career and crime linkage still suggest that:

- (1) crimes committed in greater temporal proximity should show greater behavioral consistency;
- (2) the likelihood of serial offenders displaying behavioral consistency across their series decreases when looking at longer series of crimes; and
- (3) serial offenders should display a higher level of consistency later in their series (or career) due to their increasing knowledge and experience (e.g., Alison et al., 2010; Blumstein et al., 1986; Grubin et al., 2001; Sullivan et al., 2006; Woodhams & Labuschagne, 2012b).

4.3. Aim of the Study

Results coming from the criminal career field support the heterogeneity of offending patterns (i.e., offending frequency and career duration) among offenders. Such heterogeneity in offending patterns is also found to influence the level of specialization display by offenders. Criminal career researchers, however, have not examined the consistency within a particular type of persistent offending. In the field of investigative psychology, researchers have not examined in a systematic way the duration of a crime series and how behavioral consistency varies across series type. Not taking into account such crime series patterns is thought to minimize the true extent of serial offenders' level of offending, but also their tendency to be consistent in their offending. The current study tries to bridge this gap by exploring the influence and variation of offending frequency and series duration among serial sex offenders. It is argued that distinct patterns of crime series exist among serial sex offenders, which will modulate the level of consistency found. Moreover, it is believed that accounting for crime series patterns among serial sex offenders could help to better contextualize how series unfolds over time, the heterogeneity of serial sex offenders and their crime series patterns, as well as provide insight on the offender's motivation and decision-making process in the commission of their sex crimes.

4.4. Methodology

4.4.1. *Sample*

The initial sample for the study consisted of all male sex offenders convicted of a sentence of two years or more between 1995 and 2004 in one province of Canada. This list of over 1,000 offenders was examined to identify all serial sex offenders of stranger victims. Ninety-two individuals matched the criteria, and 72 of these agreed to participate in the study. These men were all incarcerated in a Correctional Service of Canada penitentiary at the time of the interview and are responsible for 361 sexual assaults for which they were charged and convicted. These individuals have committed two or more sexual assaults involving a victim of any age and any gender with whom they had no personal relationship prior to the day of the offense. Offenders included in

this study have sexually assaulted adult women ($n = 33$), children ($n = 17$), or both ($n = 22$). The victim's mean age is 18.7 years ($SD = 9.6$) and 80.0% ($n = 291$) of the victims are female. The majority of the offenders are Caucasian (91.3%; $n = 63$), and their average age at the beginning of the sex crime series is 30.8 years ($SD = 10.5$). The participants have committed an average of five sexual crimes in their series (ranging from 2 to 37 sexual assaults each) and the average crime series' duration is 1,728 days (approximately 5 years).

4.4.2. Procedures

As part of a larger study, a questionnaire was developed to collect information from police investigation reports and to guide in-depth, semi-structured interviews with offenders. The questionnaire includes five sections that allow for the collection of information on pre-crime factors, target selection processes, modus operandi, post-crime factors, and geographic behaviors. Data, especially on the behavioral and geographic components of the target selection process, were collected from police reports and coded in the questionnaire. The interviews, conducted by the lead researcher of this larger study, took place in a private office isolated from correctional staff and other inmates. Participants were not paid for their involvement in the study. All participants signed a consent form after being explained the purpose of the study.¹⁶

4.4.3. Variables

The frequency distributions for all variables included in the study are presented in Table 4.1.

Consistency Coefficient-Environmental Indicators. Jaccard's coefficient (Jaccard, 1901) is used as a similarity measure for each of the environmental indicators included in the study. This coefficient provides information on the degree of consistency across consecutive offenses for each behavior examined. It ranges from 0, indicating

¹⁶ In order to minimize response distortion, offenders were promised confidentiality and a guarantee that the information provided could not be used in any way against them by the Correctional Service of Canada.

complete inconsistency, to 1, indicating complete behavioral consistency. Consistency is measured by comparing each offense (i.e., environmental aspects of the offense) with the subsequent offense for the full duration of each offender's series. The coefficient thus reflects whether two consecutive crimes are similar or not in terms of the environmental aspects of the crime.

Nine environmental indicators of the offense are used to calculate Jaccard's coefficient. The first indicator, offense timing, refers to the time of the crime (1 = Week; 2 = Week-end; 3 = Mixed). The eight remaining environmental indicators are related to physical and contextual features of the offense at two different stages of the crime event: (1) the encounter with the victim (beginning of the crime event); and (2) the victim release (end of the crime event, that is, the closure stage). These two stages are specifically selected as they represent the two most important and commonly known locations for police investigations (Rossmo, 2000). The eight indicators are as follow: (1) offense land area use for the two stages of the offense (1 = Residential area; 2 = Commercial area; 3 = Park/Wilderness/Rural area; 4 = Others — Industrial and Institutional areas; (2) offense location (1 = Inside; 2 = Outside) for the two stages of the offense; (3) types of site for the two stages of the offense, referring to whether the encounter or the release of the victim took place on a private (e.g., home, backyard) or public/semi-public site (e.g., park, business/shopping site, street) (1 = Private; 2 = Public/semi-public); and (4) offender and victim familiarity with the site (1 = Not familiar to both of them; 2 = Familiar to the offender; 3 = Familiar to the victim; 4 = Familiar to both the offender and the victim) for the two stages of the offense.

Two steps were used to measure Jaccard's environmental consistency. First, the level of consistency for each indicator was calculated. Second, a mean individual environmental consistency score was calculated for each offender included in the study based on the consistency score for each variable.¹⁷

¹⁷ For more information, see chapter 2 of the current dissertation.

Table 4.1. Descriptive Information on the Sample of Serial Sex Offenders

Individual characteristics	% (n)	Mean (SD), median, range
Marital status		
Single	53.6 (37)	
In a relationship	46.4 (32)	
Employment status		
Unemployed	40.6 (28)	
Employed	59.4 (41)	
Effective academic degree		
Elementary	13.0 (9)	
High school	59.4 (41)	
Post-secondary	27.5 (19)	
Prior criminal record		
No	10.1 (7)	
Yes	89.9 (62)	
Prior charges for a sexual non-violent crime (yes)	19.4 (14)	
Number of prior charges		1.0 (3.1), 0.0, 0-17
Prior charges for a sexual violent crime (yes)	55.6 (40)	
Number of prior charges		2.9 (6.3), 1.0, 0-43
Prior charges for a non-sexual violent crime (yes)	56.9 (41)	
Number of prior charges		2.5 (4.4), 1.0, 0-21
Prior charges for a non-sexual non-violent crime (yes)	80.6 (58)	
Number of prior charges		12.0 (19.6), 4.0, 0-104
Age at start of series		30.8 (10.5), 27.0, 16-60
Age at end of series		35.6 (11.0), 35.0, 18-66
Sex offender type based on victims' age		
Pedophile	31.9 (23)	
Rapist	45.8 (33)	
Mixed	22.2 (16)	
Crime series parameters		
Series duration (months)		56.3 (61.0), 37.0, 0-234.2
Number of crimes on distinct victims		5.0 (5.9), 3.0, 2-37
Environmental consistency		
Total individual Jaccard's coefficient		.76 (.25), .83, .15-1.00

Note. $n = 72$.

Crime Series Parameters. Two crime series parameters are used in the current study to measure crime series patterns among serial sex offenders: (1) crime series duration at the time of interview, referring to the time elapsed, in months, between

the offender's first and last sex crime committed (i.e., sexual "career" duration); and (2) number of sex crimes committed on distinct victims.¹⁸

Offender's Characteristics. Eleven variables related to the offender's sociodemographic status and criminal background, at the time of the index crime, are used as control variables and to better describe the subgroups identified: (1) marital status (0 = Single/has previously been in a relationship; 1 = In a relationship); (2) employment status (0 = Unemployed; 1 = Employed); (3) effective academic degree of offender (1 = Elementary; 2 = High school; 3 = Post-secondary); (4) prior criminal record (0 = No; 1 = Yes); (5) number of prior charges for a sexual non-violent crime; (6) number of prior charges for a sexual and violent crime; (7) number of prior charges for a non-sexual violent crime; (8) number of prior charges for a non-sexual non-violent crime; (9) age of the offender at start of sex crime series; (10) age of the offender at end of sex crime series; and (11) sex offender's type based on the victims' age (1 = Pedophile; 2 = Rapist; 3 = Mixed).¹⁹

4.4.4. Analytical Strategy

First, using offender's characteristics described previously, negative binomial generalized linear models (GLM) are performed in order to determine if the number of crimes committed and the series duration are two separate and independent aspects to look at or if looking at these two aspects *simultaneously* can provide further and distinctive information about serial offenders. In order to do so, negative binomial GLM are first performed separately with the number of crimes and series duration to investigate their specific covariates.²⁰ Negative binomial GLM are then performed with

¹⁸ Note that this variable does not refer to the total number of sex crimes the offender might have committed. Offenders having sexually assaulted the same victim multiple times are only counted as one crime/event.

¹⁹ The age cut-off was fixed at 16 years old. Offenders who offended only against victims that were less than 16 years old were classified as pedophiles, those who offended against victims that were all 16 years old and older were classified as rapists, and those who offended against both types of victim were classified as mixed offenders.

²⁰ Generalized linear models are used considering that both the offending frequency and series duration were not normally distributed and that relationship other than linear might be present. Generalized linear models were run with both negative binomial and Gamma

the number of crimes committed, now controlling for the series duration (used here as an offset variable). Such analysis allows investigating if the number of crimes committed (events) is modulated by the offender's time at exposure (i.e., series duration (log)), therefore adjusting for the amount of opportunity an event has. In doing so, it is then possible to examine if combining these two crime series parameters provides distinctive information, which would support the need to investigate them simultaneously (i.e., patterns of crime series). Second, following these preliminary analyses, subgroups of crime series are created based on the offenders' series duration and number of crimes committed. In order to further investigate crime series patterns identified and control for the influence of offender's characteristics (in the identification of subgroups of crime series patterns), bivariate statistical analyses are also performed. Finally, environmental consistency for these subgroups is investigated (using Jaccard's coefficient) to determine if some offenders are more or less likely to display consistency.

4.5. Results

4.5.1. *Covariates of Offenders' Series Duration and Number of Victims*

Table 4.2 presents associations between offender's characteristics and the offender's series duration and number of sex crimes committed. Results show that three out of the 11 offender's characteristics used are significant covariates of the series duration and four of these 11 variables are significant covariates of the number of crimes committed. It is noteworthy, however, that series duration and number of crimes do not share any of the offender's characteristics examined. In other words, significant covariates of the series duration are not significant covariates of the number of sex crimes committed.

Focusing on covariates of the series duration first, results show that offenders having prior criminal records are about three times more likely to have longer series

distributions. Similar results were found. It was thus decided to present analyses using the negative binomial distribution only.

duration [Exp(B) = 2.92, $p < 0.01$] than those with no prior record. Furthermore, offenders having prior charge(s) for a sexual violent crime are four times more likely to have a longer series duration [Exp(B) = 3.99, $p < 0.001$] than those without such a prior record. Also, those offenders whose crime series ends at a later age are more likely to have a longer crime series [Exp(B) = 1.04, $p < 0.001$] than younger offenders. Although not significant, two trends are also noticeable. On one hand, it seems as though offenders having prior charges for a sexual non-violent crime are more likely to have longer crime series. On the other hand, offenders who have offended against adult victims only (16 years old and over) appear to have a shorter series duration. Finally, environmental consistency (as measured by Jaccard's coefficient) is not a significant covariate of offenders' series duration.

Examining covariates for the total number of sex crimes committed, results show that offenders being in an intimate relationship [Exp(B) = 1.96, $p < 0.01$], employed [Exp(B) = 1.60, $p < 0.05$], and having a post-secondary degree [Exp(B) = 1.65, $p < 0.05$] at the time of index crime, are more likely to have sexually offended on a higher number of victims than those respectively not in a relationship, unemployed, and having an elementary degree. Moreover, offenders having prior charges for a non-sexual non-violent crime are more likely to have committed more crimes against different victims [Exp(B) = 1.57, $p < 0.05$]. Finally, environmental consistency displayed by offenders is also strongly associated with offending frequency. Offenders showing more environmental consistency are close to five times more likely to have sexually assaulted a higher number of victims [Exp(B) = 4.76, $p < 0.001$].

Table 4.2. Covariates of Crime Series Parameters

Individual characteristics	Series duration	Number of crimes	Number of crimes adjusting for series duration ^c
	ExpB (95% CI)	ExpB (95% CI)	ExpB (95% CI)
Marital status (In a relationship)	1.32 (.80-2.19)	1.96 (1.22-3.14)**	1.00 (.36-2.75)
Employment Status (Employed)	1.58 (.89-2.79)	1.60 (1.01-2.52)*	.63 (.23-1.67)
Effective academic degree ^a			
<i>High school</i>	1.19 (.60-2.37)	1.32 (.81-2.17)	1.70 (.41-7.03)
<i>Post-secondary</i>	1.37 (.67-2.77)	1.65 (1.03-2.65)*	.80 (.21-3.13)
Prior criminal record (Yes)	2.92 (1.45-5.90)**	1.39 (.90-2.16)	.76 (.22-2.62)
Prior charge(s) for a sexual non-violent crime (Yes)	1.63 (.96-2.71)+	1.42 (.84-2.40)	.35 (.15-.83)*
Prior charge(s) charges for a sexual violent crime (Yes)	3.99 (2.46-6.47)***	1.03 (.57-1.85)	.17 (.08-.35)***
Prior charge(s) charges for a non-sexual violent (Yes)	.91 (.56-1.49)	1.14 (.67-1.94)	1.27 (.47-3.42)
Prior charge(s) charges for a non-sexual non-violent crime (Yes)	1.64 (.88-3.07)	1.57 (1.10-2.26)*	1.11 (.39-3.21)
Age at start of sex series	.98 (.95-1.02)	.99 (.97-1.00)+	1.03 (1.00-1.07)+
Age at end of sex series	1.04 (1.02-1.07)***	.99 (.97-1.01)	.97 (.92-1.02)
Sex offender type based on victims' age ^b			
<i>Rapist</i>	.61 (.35-1.09)+	.90 (.54-1.50)	2.33 (.88-6.23)+
Mixed	.74 (.42-1.30)	1.39 (.68-2.84)	1.49 (.38-5.93)
Environmental consistency			
Total individual Jaccard's coefficient	.65 (.26-1.62)	4.76 (2.25-10.06)***	35.88 (9.56-134.71)***

Note. $n = 72$. + $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$.

^a Elementary degree used as reference category.

^b Pedophile offenders used as reference category.

^c Represents the rate of events (number of crimes) per unit time (series duration); Series duration in months (logged) used as the exposure variable.

Table 4.2 also presents covariates of the number of crimes committed when adjusting for the series duration. In other words, in combining these two dimensions, it is not the covariates of the volume of offending that is analyze but rather the rate of offending. Results show that covariates of the rate of offending are somewhat different than those for the number of crimes and series duration separately. First, the marital and employment status as well as the degree of education are not significantly

associated with the offending rate. Second, having prior charge(s) for a sexual non-violent crime is a significant covariate of the offending rate [Exp(B) = .35, $p < 0.05$]. Third, showing high level of environmental consistency [Exp(B) = 35.88, $p < 0.001$] and having prior charge(s) for a sexual violent crime [Exp(B) = .17, $p < 0.001$] are also significant covariates of the offending rate. Therefore, the environmental consistency level is not significantly associated with the series duration specifically but is significantly related to the number of crimes committed on different victims over the series duration (offending rate).

4.5.2. Identification of Subgroups of Serial Sex Offenders Based on Crime Series Patterns

Based on preliminary analyses, it appears that the series duration and the number of sex crimes committed are two distinct parameters that need to be taken into account simultaneously — rather than separately — when investigating serial sex offenders. This result reinforces the idea that, in combining these two parameters, crime series patterns among serial sex offenders can be identified. As such, subgroups of crime series patterns were created from these two parameters simultaneously. Based on prior studies from the criminal career field, distinct groups of offenders exist with regard to their offending frequency (i.e., lower vs. higher) as well as their series duration (i.e., shorter vs. longer). However, no further information or theoretical background exists informing on what exactly is a shorter versus longer series duration or a lower versus higher offending frequency, and where to specifically draw the line in order to further examine subgroups of crime series patterns among serial offenders. As such, the median value of these two parameters was considered to be the most suitable value to rely on to start exploring potential patterns until further theoretical rationale is provided.²¹

Based on the median value (i.e., series duration = 37 months; number of sex crimes = 3), both crime series parameters are dichotomized, thereby creating two

²¹ Considering that these two indicators are both highly skewed, the median value rather than the mean is privileged, as the presentation of averaged findings masked important differences among offenders.

subgroups for each of them: (1) series duration: 1 = 0-37 months, 2 = more than 37 months; and (2) number of sex crimes: 1 = 2-3, 2 = 4 or more. These parameters' subgroups are then combined, creating four subgroups of crime series patterns (see Table 4.3):

- (1) offenders with shorter crime series (i.e., less than 3 years) who have offended against a fewer number of victims (i.e., 2-3);
- (2) offenders with shorter crime series (i.e., less than 3 years) having offended against a higher number of victims (i.e., 4 or more);
- (3) offenders with longer crime series (i.e., more than 3 years) having offended against a fewer number of victims (i.e., 2-3); and
- (4) offenders with longer crime series (i.e. more than 3 years) having offended against a higher number of victims (i.e., 4 or more).

Table 4.3. Identification of Subgroups of Offenders Based on Crime Series Patterns

Series duration	Frequency of offending	
	Fewer crimes (2 or 3)	More crimes (at least 4)
Shorter series (3 years or less)	<i>Typical</i> offenders (<i>n</i> = 28; 38.9%)	<i>Explosive</i> offenders (<i>n</i> = 10; 13.9%)
Longer series (More than 3 years)	<i>Opportunistic</i> offenders (<i>n</i> = 17; 23.6%)	<i>Chronic</i> offenders (<i>n</i> = 17; 23.6%)

Table 4.4 provides further information on the four subgroups of crime series identified. The comparison of the series duration, number of crimes, and monthly offending rate provides interesting information about the nature of the subgroups identified and tends to support distinctive patterns of crime series. The first subgroup identified is composed of offenders whose sexual criminality is more “limited” in time (i.e., shorter series duration) and who committed a fewer number of crimes. These offenders are the ones presenting the shortest series duration of all subgroups (mean = 8.93 months; SD = 12.86). It is also the most prevalent crime series pattern (*n* = 28). As such, this group of offenders could be seen as more “*typical*” offenders. The second subgroup, the *explosive*, is composed of offenders still displaying a limited series duration over time but who sexually offend frequently. This subgroup is the one

characterized by the highest number of crimes committed among the four subgroups identified (an average of 12 sexual crimes on distinct victims). Their high monthly offending rate is also the reflection of such explosive sexual offending (mean = 1.16; SD = 1.38). This subgroup of offenders is the least prevalent of the four subgroups identified ($n = 10$). The third subgroup, *opportunistic* offenders ($n = 17$), have a crime series characterized by longer series duration but few crimes and could be seen as occasional offenders. Their sexual offending is persistent, as shown by rather long series duration (8 years on average), but is not associated with a high offending frequency. Indeed, these individuals seem to act when a good opportunity arises, which may explain their low monthly offending rate (mean = .03; SD = .06). Finally, the fourth subgroup of offenders ($n = 17$), includes individuals with longer series duration (mean = 112.71 months; SD = 59.11) and a higher number of crimes. In fact, this is the subgroup with the longest series duration. Even though their offending frequency is high, their monthly offending rate is rather low (mean = .09; SD = .06) owing to the long period they have offended on (about 10 years). This subgroup can be seen as *chronic* offenders who will persist, at a high frequency, in their sexual offending over time.²²

²² It is noteworthy that standard deviations for all subgroups identified are high, suggesting the presence of “outliers” among subgroups.

Table 4.4. Descriptive Information on Subgroups of Offenders Based on Crime Series Patterns

Crime series parameters	Subgroups of crime series patterns			
	<i>Typical</i> (n = 28)	<i>Explosive</i> (n = 10)	<i>Opportunistic</i> (n = 17)	<i>Chronic</i> (n = 17)
Series duration (months)				
Mean (SD)	8.93 (12.86)	18.30 (12.75)	96.29 (42.75)	112.71 (59.11)
Median	2.50	17.00	92.00	100.00
Range	0-37	1-37	38-190	38-234
Number of crimes				
Mean (SD)	2.36 (.49)	11.80 (12.21)	2.70 (.47)	7.70 (4.21)
Median	2.00	5.00	3.00	6.00
Range	2-3	4-37	2-3	4-18
Monthly offending rate				
Mean (SD)	1.23 (1.03)	1.16 (1.38)	.03 (.06)	.09 (.06)
Median	1.00	.59	.03	.06
Range	.05-3.00	.11-4.00	.02-.07	.03-.26

Note. n = 72.

4.5.3. Individual Characteristics and Subgroups of Crime Series Patterns

Table 4.5 presents statistical associations between the individual characteristics considered and the four subgroups of offenders identified based on their crime series patterns. Subgroups identified are (marginally) significantly different on three of the individual characteristics investigated. First, while it has to be acknowledged that all four subgroups are composed of offenders who generally have at least one prior record, there seems to be a trend for offenders with a longer series duration to have a prior record compared to offenders with a shorter series duration (Cramer's $V = .31, p < 0.10$). For example, *opportunistic* (i.e., longer crime series/fewer number of crimes) and *chronic* (i.e., longer crime series/more crimes) offenders almost all have a prior record (100% and 93% respectively) while this is true for 70% of *explosive* offenders (i.e., shorter series/more crimes). In that regard, it is noteworthy that all four subgroups have a relatively high number of prior charges for a non-sexual non-violent crime, ranging from seven charges for *opportunistic* offenders to a high of 15 charges for *chronic* offenders, with an average of 12 prior charges across subgroups. Offenders, thus appear to be active offenders, independent of their sex crime series. Second, statistical differences exist for the number of previous charges for both sexual non-violent and sexual violent

crimes. More specifically, *chronic* offenders have, on average, a higher number of previous sexual non-violent charges (i.e., 2.5) compared to the other three subgroups (.46 charge on average). This is even more noticeable for prior charges for a sexual violent crime: these offenders have about eight prior charges compare to about one or two for the other three subgroups.

Table 4.5. Associations between Individual Characteristics and Subgroups of Offenders Based on Crime Series Patterns

Individual characteristics	Subgroups of crime series patterns				Cramer's V
	<i>Typical</i> % (n)	<i>Explosive</i> % (n)	<i>Opportunistic</i> % (n)	<i>Chronic</i> % (n)	
Marital status (In a relationship)	40.7 (11)	70.0 (7)	37.5 (6)	50.0 (8)	.22
Employment Status (Employed)	48.1 (13)	70.0 (7)	75.0 (12)	56.3 (9)	.23
Effective academic degree:					.21
<i>Elementary</i>	7.4 (2)	30.0 (3)	12.5 (2)	12.5 (2)	
<i>High school</i>	70.4 (19)	30.0 (3)	56.3 (9)	62.5 (10)	
<i>Post-secondary</i>	22.2 (6)	40.0 (4)	31.3 (5)	25.0 (4)	
Sex offender type based on victims' age					.24
<i>Pedophile</i>	17.9 (5)	50.0 (5)	29.4 (5)	47.1 (8)	
<i>Rapist</i>	64.3 (18)	30.0 (3)	41.2 (7)	29.4 (5)	
<i>Mixed</i>	17.9 (5)	20.0 (2)	29.4 (5)	23.5 (4)	
Prior criminal record (Yes)	88.9 (24)	70.0 (7)	100.0 (16)	93.8 (15)	.31 ^a
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Kruskal-Wallis Nonparametric test (p value) ^a
Age at start of sex series	33.04 (12.31)	32.86 (10.32)	26.81 (7.10)	30.56 (10.15)	.31
Age at end of sex series	33.72 (12.04)	33.33 (9.94)	35.19 (8.08)	40.31 (11.98)	.18
Number of charges for a sexual non-violent crime	.77 (3.15)	.30 (.95)	.31 (.70)	2.5 (4.63)	.05
Number of charges for a sexual violent crime	.96 (2.22)	1.8 (3.55)	1.56 (.96)	8.12 (11.14)	.00
Number of charges for a non- sexual violent	3.08 (5.21)	2.60 (5.62)	1.87 (3.14)	1.94 (3.33)	.50
Number of charges for a non- sexual non-violent crime	13.19 (26.31)	11.70 (13.86)	7.06 (8.77)	15.12 (18.18)	.84

Note. n = 69. +p < .10.

^a p values in bold are those found significant.

4.5.4. Environmental Consistency across Subgroups

Finally, the consistency displayed by subgroups of offenders is investigated (Table 4.6). First, it seems important to emphasize that a really high level of consistency is found for each subgroups of offenders (average Jaccard's coefficient of .78, ranging from .59 to .91).²³ Even though, results show that statistically significant differences exist among the four subgroups and help identifying the most inconsistent (i.e., versatile) subgroup of offenders (rather than the most consistent) in terms of their site selection. Indeed, it is found that offenders presenting an *opportunistic* crime series pattern appear to be the most versatile one, which is consistent with the proposed label. Differences between this subgroup of offenders and the other subgroups are significantly noticeable when it comes to the consistency displayed for the offense timing (i.e., whether the offender commits their crime on the week, week-end, or both) and the nature of the victim encounter area land used (i.e., whether the offender encounters their victims in a residential area, commercial area, park/wilderness/rural area, or industrial and institutional areas). More specifically, compared to the other subgroups identified, offenders presenting an *opportunistic* crime series pattern are more likely to switch with regard to the offense timing and the area land used to encounter their victims.

²³ Studies that have used Jaccard's coefficient reported lower coefficients for linked crime pairs, ranging from .41 to .47, with an average Jaccard's of .42 (Woodhams & Labuschagne, 2012b). It is important to remember, however, that these coefficients represent the level of consistency for specific pairs of linked crimes rather than for the offender's complete crime series, which is the case in the current study. The only other study providing consistency coefficient for all crimes in the series still reports an average Jaccard's coefficient of .52 (Woodhams & Labuschagne, 2012b). Also, prior studies have investigated consistency for modus operandi behaviors. Keep in mind that the current study focuses on environmental consistency, which may explain why a higher level of consistency is found.

Table 4.6. Associations between Jaccard's Coefficients and Subgroups of Offenders' Crime Series Patterns

Jaccard's Consistency coefficient – environmental indicators	Subgroups of crime series patterns Means (SD)				Kruskal-Wallis Nonparametric test (<i>p</i> value) ^a
	<i>Typical</i> (<i>n</i> = 28)	<i>Explosive</i> (<i>n</i> = 10)	<i>Opportunistic</i> (<i>n</i> = 17)	<i>Chronic</i> (<i>n</i> = 17)	
Offense timing	.87 (.32)	.90 (.22)	.56 (.43)	.83 (.27)	.01
Victim encounter stage:					
Nature of the area land used	.86 (.33)	.94 (.11)	.50 (.43)	.84 (.26)	.01
Location	.73 (.42)	.91 (.16)	.59 (.44)	.86 (.21)	.42
Site	.82 (.34)	.93 (.12)	.59 (.48)	.88 (.25)	.31
Site familiarity	.77 (.40)	.87 (.22)	.56 (.46)	.84 (.27)	.28
Victim release stage:					
Area land used	.70 (.44)	.94 (.11)	.62 (.42)	.82 (.30)	.34
Location	.68 (.43)	.93 (.12)	.71 (.31)	.84 (.21)	.48
Site	.75 (.40)	.93 (.12)	.65 (.39)	.85 (.27)	.42
Site familiarity	.66 (.45)	.85 (.23)	.53 (.45)	.77 (.38)	.49
Total individual Jaccard's coefficient	.80 (.25)	.91 (.12)	.59 (.24)	.84 (.23)	.01

Note. *n* = 72.

^a *p* values in bold are those found significant.

4.6. Discussion and Conclusion

The current study first aimed at exploring and describing crime series patterns (i.e., offending frequency-series duration) among serial sex offenders and offenders presenting such patterns. In a second step, the current study aimed at exploring environmental consistency level across these subgroups of crime series patterns. Study findings show much heterogeneity across serial sex offenders with regard to their series duration and offending frequency across crime series. To illustrate such heterogeneity, the study identified four subgroups of serial offenders whose crime series varied in terms of frequency-duration patterns. Environmental consistency was found to be relatively high for all subgroups, irrespective of their crime series pattern, although one of the subgroups identified showed a more inconsistent pattern of environmental behaviors across sex offenses over time. Based on the overall results of the current study, some

general conclusions can be drawn about serial sex offenders, their offending pattern, and how their environmental behaviors and site selection process may change across their series.

First, findings showed that covariates of how long a crime series lasts are different than those of the number of crimes committed during that series. These two parameters of crime series thus appear to be relatively independent of one another and explained distinctively by individual factors. Indeed, the study findings show that offenders more actively involved in criminal behaviors, specifically for sexually violent crimes, are more likely to be involved in longer sex offending series, while offenders with a more “conventional” lifestyle are more likely to have committed a higher number of sex crimes during their series. It can be hypothesized, on one hand, that offenders more actively involved in a criminal lifestyle (e.g., prior criminal records, a higher number of charges for sexual and violent crimes) are more likely to recidivate and continue on for a longer period, hence the longer crime series (see, for example, Cusson, 1989 and Hanson & Harris, 1998). On the other hand, presenting a profile of conformity (i.e., in a relationship, employed, more educated) seems to allow offenders to sexually assault more victims. Considering their more conventional background and their “social involvement,” these offenders may meet more people in the course of their daily routine and present an image of conformity which may facilitate the gaining of trust of potential victim, which, in turn, may generate a higher number of criminal opportunities. Looking at criminal achievement, McCarthy and Hagan (2001), among others, previously suggested that factors contributing to legitimate achievement (i.e., earnings) were contributing to criminal achievement as well (e.g., higher criminal earnings). Extending criminal achievement principles to sex offending, Lussier, Bouchard, and Beauregard (2011) found that, under certain circumstances, offenders displaying a profile of conformity were more “productive” (i.e., higher offending rate) and more successful at avoiding detection for a longer period.

Second, four subgroups of serial sex offenders were identified based on their pattern of offending frequency and series duration: the *typical* serial offenders (i.e., presenting a short crime series and having sexually assaulted a few victims), the *explosive* serial offenders (i.e., presenting a short series but having assaulted a high(er) number of victims), the *opportunistic* serial offenders (i.e., presenting a long series

duration and having a few number of victims), and the *chronic* serial offenders (i.e., presenting a long series duration and having assaulted a high(er) number of victims).

It is interesting to note that similar subgroups of offenders were observed in prior studies investigating involvement in criminal activities in general (i.e., criminal trajectories; e.g., Francis, Harris, Wallace, Knight, & Soothill, 2013; Moffitt, 1993) as well as for specific type of crimes (e.g., Francis et al., 2013; Lussier et al., 2014; Vaughn, DeLisi, Beaver, & Howard, 2009; Wortley & Smallbone, 2013). For example, much like the current study, Francis and colleagues (2013) identified four criminal trajectories based on a sample of men referred for civil commitment in the US (i.e., considered to be a more serious set of offenders): the low-rate limited offenders, the high-rate limited offenders, the low-rate persistent offenders, and the high-rate persistent offenders. Vaughn, DeLisi, Beaver, and Howard (2009) also identified three latent classes of multiple homicide offenders. Much like *explosive* serial sex offenders identified in the current study, Vaughn and colleagues found a group of offenders with no or a low criminal history who suddenly “snap” and escalate to commit multiple murders over a short period. This subgroup of offenders also bears much resemblance to a specific type of sexual aggressors against women, namely the *angry* rapist, which has been described by clinical researchers for quite some time (e.g., Groth & Birnbaum, 1977; Lussier et al., 2014; Proulx, St-Yves, Guay & Ouimet, 1999). While much research needs to be conducted to explain such precipitation into violent crimes, prior studies have hypothesized that the criminal outburst of these offenders could be related to some “life-changing” factors and events or mental illness (e.g., Holmes & Holmes, 1992; Vaughn et al., 2009). Their use of coercive strategies and criminal violence (including sexual violence) could also be seen as an attempt to restore their self-esteem and image in response to some perceived injustice, threat, or provocation (Felson, 2002; Lussier et al., 2014).

Moreover, similar to *chronic* offenders identified in this study, Vaughn and colleagues (2009) also found a subgroup of multiple murderers presenting a high offending level, with an extensive criminal background, and a sustained involvement in various forms of violence. Interestingly, these multiple murderers were found to be significantly more likely to commit rape. Unlike *explosive* offenders, their sustained involvement in criminal behaviors is rather thought to be associated with psychopathic

personality traits (Vaughn et al., 2009). Said differently, these results suggest that the criminality of subgroups of offenders identified in the current study could be explained differently based on their crime series pattern (i.e., offending rate). Once arrested, identifying the crime series pattern of serial sex offenders could then provide information on the explanation of their sexual criminality, which could help police investigators during interrogation.

Third, it seems important to highlight that serial sex offenders included in the current study are all criminally “active” offenders, independently of their sex crimes. Indeed, these four subgroups of offenders have an extensive criminal background, specifically for crimes that are neither violent nor sexual. This finding is in line with prior studies in the criminal career field showing that sex offenders do not specialize in sex offenses and that sexual offenses should rather be seen as being part of a broader propensity to be involved in antisocial activities (Lussier et al., 2005; Smallbone, Wheaton, & Hourigan, 2003). In fact, and in line with Soothills’ approach (2000), results suggest that serial offenders included in the current study are versatile offenders, across crime types, who specialize in the way they commit their sex crimes — in terms of environmental aspects of their crimes, at least.

Fourth, an association was found between subgroups of offenders identified based on their crime series patterns and the level of environmental consistency displayed. Prior studies suggested that crimes committed closer in time should be more similar (i.e., consistent) than crimes committed farther apart (e.g., Alison et al., 2010; Grubin et al., 2001; Woodhams, Hollin et al., 2007). Consistency should then be found for shorter crime series. Prior studies have also suggested that offenders with longer crime series should be more consistent. Faced with more criminal opportunities, these offenders can gain experience and knowledge, which allows them to become more specialized, with time, in particular crime types more suited to their preferences and skills (e.g., Blumstein et al., 1988; Deslauriers-Varin & Beauregard, 2013; Woodhams & Labuschagne, 2012b). From this, consistency should then be found for more prolific offenders with long crime series. The study findings tend to support both these conclusions. On one hand, it was found that *explosive* offenders show a very high level of environmental consistency. These offenders have assaulted a high number of victims over a short period of time, suggesting that the time span between crimes was short. On

the other hand, *chronic* offenders also show a high level of consistency. These offenders, contrary to *explosive* offenders, have sexually assaulted a high number of victims over the course of a long crime series. In other words, offenders with short crime series as well as those with long crimes series both show high level of environmental consistency. These findings suggest that, in fact, it is not necessarily the duration of the crime series, nor the number of crimes he has committed, that will influence the offender's consistency level, but rather the number of crimes committed *over* his crime series (i.e., offending rate). This finding also suggests that distinctive processes are at play and that consistency over a short period of time (e.g., days, weeks) is not carrying the same meaning than consistency over a long period (e.g., months, years). Indeed, consistency over a short series may be the result of repeated encounters with similar opportunities while consistency over a long series may be more a reflection of criminal preferences, fantasies and skills, and of an "established" way of offending.

4.6.1. Crime Series Patterns and Crime Linkage

On the basis of the subgroups of crime series identified, implications for crime linkage are addressed. First, while all offenders were found to have an extensive criminal background for non-sexual non-violent crimes, only one of the four subgroups of offenders, the *chronic* offenders, appears to be known by the police for their sexual crimes, more specifically sexual *and* violent crimes. Moreover, this group of *chronic* offenders is highly consistent when it comes to the environment selected to encounter and release their victims. In other words, not only are they already known by the police for prior sexual crimes (violent or not) but they also are highly consistent, environmentally, in their sexual offenses. These offenders would then be good "candidates" for crime linkage analyses and probably the easiest offenders to identify with the help of police databases. Indeed, there is a great likelihood that these offenders will already be "on file" for a sexual crime they have committed in a similar way. This is of particular interest as it is this specific kind of serial offenders that police agencies want to identify with the use of crime linkage analyses: chronic offenders that are well established in their serial sexual career and who are posing a great and long-term threat to others.

Second, on the opposite, *opportunistic* offenders are the least likely to be identified through crime linkage analyses. Indeed, these offenders are not necessarily known for prior sex crimes and are the least consistent subgroup of offenders in term of the environment selected to commit their crimes. In other words, they are the least likely to be in police databases and, if they are, crime linkage would be difficult as they seem to switch their environmental offending patterns from one crime to the other, adapting to the opportunities arising. The fact that a long period elapses between each offense does not facilitate identification and linkage either. Future studies should aim to further explore consistency displayed by these *opportunistic* and occasional offenders for behaviors not investigated in the current study in order to see if crime linkage could rely on other behavioral aspects of the crime scene to better and faster identify these persistent though inconsistent serial sex offenders.

Finally, *explosive* offenders have a crime series characterized by a high number of sexual assaults committed over a limited period of time. These offenders can be described as prolific offenders in terms of their monthly offending rate (one of the highest of the four subgroups); they offend over a short period of time but make the most out of it. Their numerous sex offenses occurring closely from one another, these offenders display a very high level of environmental consistency. While they are not necessarily known by the police for prior sexual crimes, the fact that they are highly consistent and will most likely reoffend quickly in the same type of environment could help investigators to faster identify and arrest them by concentrating police patrols (e.g., patrol saturation; see Rossmo, 2000) in environments where recent sex assaults were reported. The same could be said for *typical* offenders identified in the current study.

Having considered the main findings of the current study and their implications, its limitations are also reviewed. First, the sample only includes crimes committed by incarcerated stranger sex offenders for which the offenders were charged and convicted. Therefore, the results of the current study might only reflect behaviors of offenders who were not able to avoid detection and were apprehended by the police (see Beauregard & Martineau, 2013). Moreover, because all offenders were arrested and convicted for the sex crimes investigated in the current study, it is possible that these crimes were already showing high internal consistency level, which may explain why offenders were identified, arrested, and convicted for these crimes in the first place. Second, the current

study did not take into account the offenders' time at risk. In other words, it did not consider whether offenders were hospitalized, incarcerated, on parole, and so on, during their crime series duration, which might have limited their ability to offend and, consequently, might have affected their offending rate. On the basis of criminal career literature, the time at risk can provide valuable additional information on the offender's crime series patterns. Third, this study is based on a relatively small sample of serial sex offenders that precluded the use of more sophisticated statistical analyses. Although the sample is relatively small, it is important to stress that it is composed of a very specific group of offenders having committed a relatively rare type of offense (i.e., serial stranger sex offenders). Fourth, it is also essential to keep in mind that offenders' crimes series used here are potentially truncated series. In other words, it is possible — and probably correct to say — that sexual crime series of some offenders included in the study were not completed at the time of the current study and that some offenders might still have sexually offended following their release. Therefore, some offenders included in the *typical* subgroups (i.e., shorter series duration/fewer victims) may be or may become, in fact, *explosive* (i.e., shorter series duration/higher number of victims) or even *chronic* (i.e., longer series duration/higher number of victims) offenders. Finally, it seems important to state that, while analyses conducted tend to support the presence of subgroups among serial sex offenders in terms of their crime series patterns, these subgroups were somewhat artificially created by the authors rather than based on statistical analyses. Rather than suggesting that these *are* subgroups of serial sex offenders, the current study highlights the fact that different crime series patterns exist among serial offenders, such patterns associating with distinctive levels of environmental consistency. Future studies should further investigate subgroups of crime series of serial sex offenders and how they modulate the level of consistency found. Future studies should also try to expand to other factors that might play a role in the offenders' level of consistency in order to help crime linkage analyses to be more accurate.

In conclusion, researchers in the crime linkage and behavioral consistency field investigate serial offenders and their behaviors although the operational definition of a "serial offender" is still undetermined and fluctuates from one study to another. This suggests much variation among serial offenders, with regard to their offending frequency and crimes series duration, and questions the true extent of serial offenders' consistency

level found so far. The necessity to address such variation when investigating serial offenders then becomes pivotal. The current study it thought to have provided better knowledge about the unfolding of crime series of serial sex offenders, their heterogeneity, and their crime series patterns. Study findings also open up on the need to control for the number of crimes committed over the offenders' crime series duration in order to get a full and more truthful portrait of serial sex offenders and their consistency level. In doing so, it is also believed that a better understanding of the offender's motivation and decision-making process in the commission of their sex crimes is achieved.

5. Conclusions, Implications, and Considerations for Future Studies

There is more than half a century of research on the offending behaviors of adult sex offenders. In spite of the scientific literature on adult sex offenders, the current state of knowledge on serial offenders has remained relatively scarce, especially with regard to their sex offending over time and across offenses. During the past decade or so, there has been an increasing number of studies on serial offenders and, more specifically, on serial sex offenders to determine the extent to which these offenders are consistent in their offending behaviors over time and across crime series. This emerging field of research, known as the crime linkage and behavioral consistency field, has made significant theoretical, methodological and empirical contributions upon which the foundation of this dissertation was built. Even so, much remains to be known about the level of consistency displayed by serial offenders, how to best measure offending consistency across time and offenses, what the nature of consistencies and inconsistencies are, and what factors influence the course of a crime series. Moreover, even though sharing a similar goal — that is investigating offenders' level of consistency from one crime to the next — this relatively new field of research has developed independently of the rich and established research coming from the criminal career field. The criminal career approach has made several key contributions to the study of the longitudinal sequence of offenses committed by individuals. This approach, using the term of crime specialization, has proposed several measures and indicators to study offending consistency across various offenses and different offenders. The methodological and empirical contribution of criminal career researchers has rarely been used in the context of serial offending. Criminal career research has typically been conducted with general samples of offenders precluding the analysis of crime series by small subgroups of offenders such as serial sex offenders. Using a criminal career approach, the current dissertation aimed to bridge the gap between these two areas of research (i.e., criminal career and crime linkage and behavioral consistency) by

addressing the limited knowledge in the crime linkage and behavioral consistency field while attempting to tackle some of the methodological limitations of previous empirical studies.

Empirical knowledge on behavioral consistency of serial offenders is pivotal for the theoretical development about serial offending, but also crucial to support and guide police investigations. More specifically, this dissertation tackled the issue of behavioral consistency among serial sex offenders. On the one hand, criminal career research has neglected the examination of the behavioral pattern of chronic and specialized offenders, typically focusing on either chronic versatile or more occasional offenders. On the other hand, the field of crime linkage and behavioral consistency has neglected to investigate consistency of single salient behaviors or aspect of the crime scene, preferring to analyze consistency for themes or domains of behaviors. To a broader extent, researchers from the crime linkage and behavioral consistency field also almost exclusively investigated consistency for modus operandi behaviors. The dissertation aimed to extend the investigation of consistency to more precise and objective indicators. Drawing on environmental criminology, the dissertation examined a series of indicators measuring crime scene locations of sex offenses and patterns of sex offenses over time.

More specifically, three distinct empirical studies (i.e., scientific articles) were conducted for the purpose of this dissertation. These three empirical studies were designed to further investigate environmental consistency of serial sex offenders by: (1) exploring the use and influence of different analytical strategies (coming from both the crime linkage and criminal career field) to measure offenders' levels of environmental consistency over time; (2) exploring environmental consistency and crime site selection using an alternative approach (i.e., crime-event based); and (3) exploring heterogeneity of offending frequency and duration among serial sex offenders and its relevance and potential impact for future studies in the crime linkage and behavioral consistency field. In order to do so, using secondary data previously collected for a larger study, these studies were based on a sample of 72 stranger serial sex offenders collectively responsible for a total of 361 sex assaults. These offenders had each committed at least two sex assaults involving a victim of any age and any gender for which they were charged and convicted. These men were then all incarcerated in a Correctional Service

of Canada penitentiary at the time the data was collected. The information about their crimes and environmental aspect of their offenses was gathered through self-report from the offenders as well as correctional file data.

The three empirical studies raised several key methodological and conceptual issues and highlighted important findings. First, serial sex offenders showed a rather high level of environmental consistency, independently of the analytical method and indicators used to measure such consistency. Second, the use of multiple analytical methods to measure behavioral consistency in sexual offenses allowed a better understanding of the influence and biases associated with the analytic method used when investigating consistency. Third, specific geographic behaviors and environmental factors that are promising for the purpose of crime linkage of sexual offenses were identified. Fourth, using a crime event-based approach, serial sex offenders also showed stability of victim encounter and victim release site selection across crime series, reinforcing the idea that serial offenders pattern themselves geographically over time. Fifth, there is much heterogeneity across serial sex offenders in terms of their crime series. In fact, subgroups of offenders were identified based on their offending frequency (i.e., the number of victims) and series duration (i.e., length of time elapsed between the first and last offense). Sixth, these identified crimes series, or offending patterns, were found to be associated with offenders' level of consistency. In other words, serial sex offenders differ in terms of behavioral, time, and environmental aspects of their offending. Taken together, the findings of the dissertation highlighted the heterogeneity of serial sex offenders while demonstrating high geographical and environmental stability between their past and future behaviors. Moreover, results from this dissertation helped to contextualize how crime series unfold over time and how the knowledge of such unfolding provide insight on the offender's decision-making process in the commission of his sex crimes, as well as reasons explaining such stability and consistency between past and future crimes.

5.1. Serial Sex Offenders and Environmental Consistency

The notion of consistency in the crime linkage literature has typically been applied to crime scene behaviors rather than geographical aspects of the offense

(Grubin et al., 2001). Geographical aspects of offenses, when taken into account, have been usually looked at in the context of the “journey to crime” (e.g., Snook et al., 2006) rather than broader elements of the environment where an offense takes place. Journey to crime refers to the offender’s mobility and the distance travelled to commit an offense rather than the specific geographical location where the offense is taking place at various stages (e.g., victim encounter, attack of the victim, victim release). Hence, little research exists on the extent or nature of serial offenders’ consistency in environmental behaviors and offense site selection. This lack of empirical research is especially problematic for the investigation of sex crimes between strangers (as opposed to intrafamilial sex crimes), for which crime linkage appears particularly useful, if not essential, as no connection between the victim and the offender can help identifying potential suspects. The current dissertation helped to fill this gap and provided a better understanding on serial sex offenders and their consistency over time. More specifically, five key results need to be further highlighted.

First, in line with prior studies in the field (e.g., Bateman & Salfati, 2007; Grubin et al., 2001; Lundrigan et al., 2010; Santtila et al., 2005; Tonkin et al., 2011), the findings of the current dissertation show much stability between offender’s past and future behaviors during the commission of sex crimes. In other words, the findings suggest that serial sex offenders are relatively stable and consistent with regards to their geographic behaviors and environmental aspects of sites used during two key stages of a sex offense: (a) where the victim is encountered; and (b) where the victim is released. It is important to emphasize that, using Jaccard’s coefficient, a higher level of consistency was found in the current dissertation compared to prior studies. The vast majority of prior studies (e.g., Grubin et al., 2001; Markson et al., 2010; Tonkin et al., 2008), however, investigated the level of consistency for specific pairs of linked crimes rather than for the offender’s complete crime series, which is the case in the current dissertation (see however Woodhams & Labuschagne, 2012b). One would expect that taking the offender’s entire offending sequence would yield lower consistency levels, but it is not the case. Also, prior empirical studies have mostly been focused on the consistency of the offender’s modus operandi behaviors rather than environmental aspects of the crime (e.g., Grubin et al., 2001; Salfati & Bateman, 2005; Santtila et al., 2004; Woodhams & Toye, 2007; Yokota & Canter, 2004). It was previously suggested

that behaviors that are less dependent on situational factors and over which the offender exerts control present higher levels of consistency (e.g., Bennell & Canter, 2002; Davies, 1992; Grubin et al., 2001; Markson et al., 2010). Therefore, by investigating geographic behaviors and environmental aspects of the crime, thought to be less situation-dependent (Bennell & Jones, 2005), it can be argued that higher levels of consistency were to be found in the current study compared to studies looking at traditional modus operandi behaviors. Examining simultaneously both environmental and modus operandi-related behaviors across offender's crime series would help to clarify this matter.

Second, the dissertation highlighted the importance and complementarity of two levels (or unit) of analysis to study crime series. The crime-event perspective focuses on the event and the situational aspects and determinants that may have played a role on a specific offense. The offender-level (or individual-level) approach focuses on the entire sequence of crimes committed by a person over time. Both perspectives are complementary and help to answer different questions. On the one hand, the crime-event approach may serve to answer, among other things, how prevalent is a particular crime type or behavior among serial sex offenders? On the other hand, the offender-level approach can help to answer questions such as whether an offender is always committing his crimes in the same way (e.g., outside, inside). When using an offender-level perspective, generally high levels of consistency were found for each of the geographical and environmental aspects of the offense investigated and the study helped to identify specific behavioral and environmental aspects that were particularly stable across offenses. For example, the offender's strategy to attack his victim was very stable and consistent across victims. More specifically, offenders known to attack their victims almost immediately after encounter and those, presumably more controlled and strategic, who will only attack their victims in locations that are familiar to them (respectively named the *raptor* and the *ambusher*; Rossmo, 1997) were found to be highly consistent across crime series. The attack method used in sex crimes, therefore, may be a key aspect to rely on for police investigation and crime linkage purposes. Results also showed that serial sex offenders tend to follow some sort of routine that will influence the time at which the crime is committed. This result somewhat provided

support to the routine activity approach suggesting that crime-commission is a function of the convergence of lifestyles and criminal opportunity (Felson & Cohen, 1980).

Third, when using a crime-event perspective, results showed the presence of distinct classes of crime sites that were recurrent across sex crime series. These identified site patterns were found to be similar to those found in prior studies and, in line with what Canter (2000) suggested, showed that serial offenders operate over limited environments with regard to their victim encounter and victim release sites. Moreover, in line with the crime pattern theory and prior research (e.g., Baudains et al., 2013; Brantingham & Brantingham, 1993; Bernasco, 2010; Felson & Cohen, 1980; Townsley & Sidebottom, 2010), it appeared that offenders were more prone to select sites that were familiar to them but also known to attract more potential victims and generate more criminal opportunities. In other words, not only are offenders individually consistent with regard to geographic behaviors and environmental aspects of their sex crimes, they are also selecting locations to encounter and release their victims in a relatively fixed pool of geographical locations or type of sites.

Fourth, in both investigations at the offender-level and crime-level, the stability of crime sites used and the consistency level of environmental aspects of the crime appeared to be modulated by the offender's offending frequency and series duration. On one hand, findings indicated that, when comparing offenders' consistency level based on the number of sex crimes committed, offenders who committed three sexual offenses showed somewhat more overall versatility in their offending as opposed to those who committed less than three or four or more offenses. Moreover, it is worth noting that the most prolific offenders of the study sample (having committed more than 10 sex crimes) were characterized by a near perfect consistency level for each of the behaviors and environmental aspects investigated. These results somewhat suggested the presence and identification of a small group of chronic serial sex offenders who are highly consistent. On the other hand, results also provided preliminary data suggesting a link between the victim encounter site and the offender's series progression. Indeed, series of analyses conducted to investigate the stability of the encounter sites provided evidence of the diversification of the sites selected as offenders' crime series were getting longer. Indeed, even if the same classes of sites were found, the prevalence of use of these sites presented variation across series. Consequently, the most prevalent

victim encounter sites at the beginning of the offenders' series were not necessarily the most prevalent sites used later in the series. More specifically, noticeable changes with regard to the number and prevalence of crime sites identified were found at the third transition (fourth crime).

Fifth, these preliminary results about the influence of the offender's frequency and duration of offending were further investigated in this dissertation. Prior empirical studies in the field have generally referred to serial sex offenders as those individuals with at least two sex crimes committed on separate occasions. The current dissertation highlighted the conceptual limitation of this definition by showing the presence of much heterogeneity between serial sex offenders in terms of: (a) the number of victims they offended against during their series; and (b) the duration of the sex crime series. Crime series refer to two key aspects of offending, repetition and time. It appears therefore, that offenders go through their offending series differently. Some will offend against a greater number of victims, while others will tend to somehow limit themselves to certain victims or sex crime opportunities. Time-wise, some serial sex offenders will maintain their series over a decade or so while others may offend over a limited period of time (e.g., few hours or few days). Combining a frequency and a temporal dimension, the dissertation allowed to better contextualize the sex crime series investigated. In fact, combining these two dimensions helped to distinguish four crime series patterns among the sample of serial sex offenders: (a) the *typical* serial offender; (b) the *explosive* serial offender; (c) the *opportunistic* serial offender; and (d) the *chronic* serial offender. Furthermore, these offenders presented statistically different levels of consistency, suggesting that the offender's crime series pattern influences the stability of the environmental aspects of the offense.

In sum, these results provided support for the idea that the relationship between the number of crimes committed and offending consistency was not linear and revealed the importance of the offending frequency and series duration when investigating serial sex offenders' consistency levels. Such an assumption was further supported following the identification of various serial sex offenders' crime series patterns in terms of frequency and duration of offending; these patterns distinctively associating with levels of environmental consistency. More than just highlighting differences among serial sex

offenders, such heterogeneity leads to substantial theoretical, methodological, and practical implications that are discussed below.

5.2. Considerations and Implications

5.2.1. *Theoretical Considerations and Implications*

There has been limited theorizing regarding the explanation and prediction of consistency among serial offenders in general and serial sex offenders more specifically. There are three main ways to approach and explain behaviors of serial sex offenders: (a) the mental disorder hypothesis; (b) the sexually deviant hypothesis; and (c) the rational-choice hypothesis. Serial sex offenders or sexual recidivists are often depicted and perceived as dangerous, mentally disordered, impulsive and irrational individuals incapable of controlling their sexual impulses and sexual urges. The irrational and impulsive nature of these individuals would suggest that they are prone to random acts and rather unpredictable behaviors. If this is the case, such behavioral randomness and unpredictability should characterize their sex offending. Consequently, it would be expected that sex crime series would show rather little internal consistency. From a police investigation perspective, these individuals would represent a significant challenge considering their always fluctuating offending process and, therefore, the absence of information allowing the identification of the offender. This situation would also represent a significant challenge for the underlying assumptions of crime linkage and behavioral consistency. Another perspective suggests that sex crimes are the acting out of deviant sexual fantasies or sexual preferences. The sex crime event is then a reflection, at least in part, of the internal world of the offender. Serial sex offenders being prone to deviant sexual fantasies, their series would then represent attempts to act out on these sexual fantasies. It could be expected from this perspective that such fantasies are relatively stable over specific time periods and, as a result, the offending process of these offenders should be relatively consistent (although some changes may be seen due to situational contingencies; e.g., victim resistance, unexpected presence of a witness). Finally, the rational choice hypothesis depicts serial sex offenders as individuals who are trying to maximise the benefits and positive aspects of their sexual interests while minimizing the negative consequences of their behavior.

These offenders are then rather seen as decision-makers who will act in a consistent fashion based on their knowledge and experience. After successive and successful crime commissions, an offender becomes more familiar with cues associated with good or successful targets, locations or environments to find a target and commit a crime. These cues then become part of a fixed knowledge structure or schemas (also known as scripts) that will influence the commission of future offending behaviors. Under such perspective, the situational and contextual contingencies will weigh heavily on the offender's decision to offend, but also on how, when, and how long to offend. The rational choice approach suggests that the offending behaviors of serial offenders will be more versatile over time not because of their impulsiveness and unpredictability, but rather, because of offenders' ability to adapt and modify their behaviors to avoid apprehension. Once a successful strategy has been determined, however, the offender is expected to reproduce it when committing successive crimes, which leads to the consistent use of specific behaviors or offense sites. The testing of these three hypotheses is not straightforward but it does raise questions about the nature and extent of offending consistency over time.

The vast majority of empirical studies in the crime linkage and behavioral consistency field have been dedicated to empirically testing the validity of the following crime linkage assumption: do serial offenders demonstrate stability and consistency between their past and future behaviors and, if so, to what extent? Only a few of them elaborated on the "why?" and "when?" consistency should be found (e.g., Lundrigan et al., 2010; Tonkin et al., 2011; Woodhams & Labuschagne, 2012b). While not suggesting that the current dissertation specifically focused on empirically testing theories that may explain consistency among serial offenders, it is argued that a better description of sex crime series is a necessary condition toward the explanation of serial sex offending. In that regard, the use of literature and findings coming from the criminal career field to guide this dissertation helped to provide some insight into these two key questions (i.e., why? and when? consistency should be found). For example, in investigating offending rate of serial offenders, the current dissertation allowed an understanding of why offenders who committed a different number of sex crimes over different crime series duration could still present a high level of consistency. Indeed, findings of the current dissertation support the conclusion that it is not necessarily, in itself, the duration of the

offender's crime series that is associated with their consistency level, but rather the number of crimes committed over their crime series (i.e., offending rate). This finding also suggested that distinctive processes were at play to explain consistency levels found. For example, consistency over a short series may be the result of repeated encounters with similar opportunities while consistency over a long series may be the reflection of criminal preferences, fantasies and skills, and of an "established" way of offending. Moving forward into the identification and description of different patterns of crime series among serial offenders also helped to understand what might have triggered their specific offending pattern (e.g., mental illness, personality traits, life-changing factors). Such explanations suggest the need to adopt different investigative and prevention strategies adapted to the specific characteristics of each group of offenders (see Wortley & Smallbone, 2013).

The current dissertation also has implication for the environmental criminology field. Crime, as suggested by the crime pattern and criminal opportunity theories, is not distributed randomly in space and time but is rather a function of the convergence of lifestyles and criminal opportunity (Felson & Cohen, 1980). From this theoretical perspective, the occurrence of a criminal behavior is in fact dependent on the distribution of targets and the presence of more or less guardianship (e.g., Clarke & Felson, 1993). Indeed, daily activities and lifestyles will nurture a criminal opportunity structure by enhancing the exposure and proximity of crime targets to motivated offenders (i.e., crime concentration) while influencing the presence of guardianship (Felson & Cohen, 1980; Miethe & Meier, 1990; Mustaine & Tewksbury, 2002). As such, certain environments may generate more opportunities than others at certain times of the day and week. Specific environments and locations are therefore more prone to be selected, by offenders, over and above others considering the crime opportunities and pool of potential targets they provide (e.g., locations known for attracting potential targets or limiting the presence of guardians such as schools, shopping centers, public transport hubs, and isolated parks). Findings of this dissertation support such theoretical perspective. Indeed, this dissertation allowed identifying distinct and recurrent offense sites used by serial sex offenders to encounter and release their victims. More specifically, the nature and characteristics of these identified offense sites are somewhat expected and explained based on such theoretical perspective. On the one hand, the

shopping center type of site identified, although characterized by a higher level of guardianship, is known for attracting a high number of potential victims, which enhance the offender's likelihood of encountering a suitable target. In that regard, Smallbone and Wortley (2000) found that 13% of extrafamilial offenders had selected their targets in public bathrooms, this site providing a high pool of potential targets while lowering the risk of being caught as the offender can easily hide and the number of potential witnesses is reduced (compared to offending in other "open spaces" in a shopping center). The *neighborhood* type of site identified, on the other hand, is characterized by a somewhat lesser pool of potential victims. However, the fact that guardianship might be less prevalent too may explain why some offenders would prioritize such a site to encounter their victims. Indeed, the presence of a potential victim might be less certain on such a site but, when a victim is present, the offender can more easily act on knowing that low are the chances of a third party witnessing or intervening to prevent the sex crime from occurring. Finally, the use of their own home also allows them to have a greater control over the situation and their victim and to reduce the probability of interference by a witness. This location therefore provides them with high odds of successfully committing their crimes. Offenders also have more time to commit the crime which is another benefits associated with the use of their home. Using the victim's home or an isolated area outdoors can also provide the same benefits. Indeed, findings from a recent study showed that serial sex offenders perpetrating a sex assault in the course of a break and entry were more likely to get completely undressed and to penetrate the victim during the sexual assault (Deslauriers-Varin & Beauregard, 2010). Having more time with the victim allows them to take more risks and to complete the sex assault. The use of their home or the victim's home can then be seen as more "rational" as the benefits will normally outweigh the risks associated with the commission of the crime (Clarke & Cornish, 1985).

Underpinning the crime pattern theory is also the idea that the occurrence of a criminal behavior (i.e., crime opportunity) is dependent on the offender's routine activity patterns and awareness space. That is, the places or areas that the offender visits or regularly spends time in, and has become familiar with (e.g., home location or neighborhood, areas where they work or go to for recreational purposes, and areas they are aware of). Such familiarity with the site used can make them feel more secure and

in control in case the offense does not go as planned or as anticipated. It is also easier, if the site is well known, to escape or quickly leave the site without being caught. It is not surprising then, in the current dissertation, that for almost all sites used by the offender to encounter or release their victims, the offender was familiar with the site. This fact, therefore, also supports the crime pattern theory and the idea that offenders pattern themselves geographically owing to their routine activities and awareness space; the offenders' environmental and site selection decision somewhat reflecting their own knowledge of their environment.

Overall, the dissertation contributed to the identification of several key points that may stimulate theoretical development and explanations of serial sex offending: (1) serial sex offenders are not a homogenous group and there are several indications that this heterogeneity is reflected in the sex crimes series they were involved in; (2) sex crime series develops along at least two dimensions: time and frequency of offending; (3) several factors may influence the offending frequency and temporal progression of a sex crime series; (4) there is a limited set of geographical locations where serial offenders choose to commit their sex offenses; (5) the dissertation focused on environmental factors and the findings highlighted that there is much stability as to where offenders choose to commit their sex offenses; (6) certain locations are preferred at the start of a series, but as the series progressed, other locations are prioritized; (7) such change and patterning is more specific to where the victim is encountered rather than where the victim is released. In other words, the factors influencing where offenders target their victims might be more dynamic over time than where the offender choose to release the victim after the offense; (8) keeping in mind that the study findings is based on a sample of convicted serial sex offenders, progression toward certain sites may explain, at least in part, why these individuals were eventually apprehended, arrested and convicted for their sex offenses; and (9) the heterogeneity of sex crime series, the different crime series patterns found, and the association between the environmental consistency level found and these crime series patterns all suggest the importance of moving forward into the identification and description of different patterns of crime series among serial offenders when investigating consistency.

From a theoretical perspective then, the dissertation stresses the importance of approaching crime series along three broad lines of research. The first line of research

should be dealing with the behavioral aspect of the crime series. For example, what are the factors influencing the nature of the series offenders are involved in? What factors influence or mediate the nature of the sex crimes serial offenders are committing? What factors influence or mediate the number of crime events a serial offender is involved in? The second line of research should relate to the geographical aspect of crime series and how they relate to the behavioral aspect. Where are the geographical locations offenders are involved in at each stage of the crime commission? Are these locations influenced by the type of crime the offender is perpetrating? Are the modus operandi and the victim selected modulating crime site selection or is it the other way around? In other words, are offenders choosing a location to fit the characteristics of their offense or are they flexible with respect to who they offend against and how they do so as long as they are in a "secure" location or a site where they feel comfortable and in control? The third line of research should be dealing with the duration or longitudinal aspect of the crime series. Although some stability in the environmental aspects of the offending was found, the study also identified different crime series patterns of sex offending. Such patterns varying both in terms of how many victims an individual offend against and over what time period these crime events are taking place. This longitudinal aspect of crime series raises important aspects about the behavioral and geographical aspects of persistent sex offending. For example, what are the factors influencing the behavioral and geographical progression and consistency of the crime series over time? Who are the serial offenders more likely to adjust or to modify the behavioral and environmental aspects of their offending from one victim to another? These three lines of research could help to: (a) improve the understanding of what triggered the onset of the crime series and its progression; (b) identify factors responsible for the specific offending pattern observed over time (e.g., mental illness, personality traits, life-changing factors); and (c) increase our understanding of the behavioral-environmental interactions over time and how such interactions influence the decision-making process of serial offenders.

5.2.2. *Methodological Considerations and Implications*

The dissertation highlighted several key areas that may help to improve, methodologically speaking, how research is conducted in the area of offending profiling, crime linkage and behavioral consistency.

First, building on the criminal career research field allowed identifying other methodological tool and methods to investigate offenders' consistency not previously used in the crime linkage and behavioral consistency field. To a broader extent, results of the current dissertation also further advocated criminal career research as a guideline and resourceful field for the investigation of behavioral consistency among serial offenders, both methodologically and theoretically.

Second, and related to this, this dissertation demonstrated the benefits of using multiple analytical methods rather than one to examine offenders' consistency levels; each distinct approach revealing a different aspect of the question under investigation, and providing depth and comprehensive understanding of offending consistency. While a few prior studies tried to determine if other coefficients recently used in the crime linkage field could outperformed Jaccard's (e.g., Bennell et al., 2010; Ellingwood et al., 2013; Melnyk et al., 2011), the current dissertation rather highlighted the complementarity of the various coefficients used by allowing to control the limitations of each of the other method used.

Third, in accordance with the criminal career paradigm, the findings highlighted the importance of the inspection of the entire sequence of offenses committed by the offender (i.e. crime series) rather than a particular subset of offenses committed at some point in time. Support for this conclusion comes from various observations: (a) with the use of multiple analytical methods, it was possible to determine that offenders' levels of consistency were somewhat biased and lowered when using a method that restricted the number of crimes analyzed per series (e.g., FSC); (b) when using methods including all sex crimes that are part of the offenders' series, whether measuring sequential or non-sequential consistency, similar levels of consistency were found for specific indicators, which suggested that the chronological order of the crimes was not as important, as long as all the crimes were included; and (c) heterogeneity among serial offenders with regard to their crime series patterns was found to be associated with distinct levels of

consistency. More specifically, the rate at which offenders commit crimes was found valuable in the investigation of behavioral consistency. Such a rate of offending, however, is only achieved and measurable once the total number of crimes part of the offenders' series is taken into consideration *over* the duration of their series. In other words, without including all crimes of the same nature committed by the offender, the investigation of the level of consistency of serial offenders will much likely be biased.

Fourth, to a broader extent, these observations also support the need to carefully examine sampling criteria, as these will highly influence the level of consistency found. Findings of the current dissertation, along with research from the criminal career field, highlighted the contribution and advantages related to using an offender-based approach for sampling purposes when investigating individual tendency for consistency and specialization in crime. While it has to be acknowledged that such a procedure might be further away than the reality in which crime analysts must perform crime linkage analysis, it however helps to better contextualize how offenders' series unfold over time, and the heterogeneity of serial sex offenders and their crime series patterns. It also provides a better insight on the offender's motivation and decision-making process in the commission of their sex crimes, which can lead to better recommendations and support for crime analysts. For example, as per the criminal career literature, offenders are thought to "sample" a wide variety of offenses during the early phase of their career before becoming more specialized, with time, in particular crime types that are more suited to their preferences and skills. Such observation was also supported by the current dissertation; that of offenders gaining experience and displaying a higher level of consistency as the number of crimes committed increased. However, offenders having committed a few number of crimes but close in time from one another also displayed a high level of consistency. This consistency however, might be reflective of repeated encounters with similar opportunities rather than an increased experience and knowledge in the commission of this particular crime type in this particular environment. Such distinction and subtleties would not have been found without the use of an offender-based approach for sampling purposes. In other words, findings from this dissertation highlighted the relevance of longitudinal data about each offender (and each of their offenses) to help investigate the progression of their crime series and their unfolding over time.

Fifth, this dissertation also stressed the importance of distinguishing the various offense stages (e.g., victim encounter and victim release) when investigating consistency, which refer, as the findings suggest, to significantly distinct offending phase and may require relatively distinct explanatory factors.

Finally, this dissertation also reiterates the importance of broadening the scope of crime scene indicators and aspects studied when investigating consistency by also taking into account geographical and environmental aspects of sex crimes at different stages of the offense.

5.2.3. *Practical Implications for Criminal Investigations and Crime Linkage*

Taken together, findings also enable tentative recommendations to be made that can guide criminal investigations and, more specifically, the linking of crimes in practice by crime analysts.

First, and most importantly, the current dissertation provided support to crime linkage analysis by demonstrating rather high stability between serial sex offenders' past and future behaviors during the commission of sexual crimes. Using a single-behavior approach applied to various geographic and environmental behaviors and aspects of the crime – rather than a theme or domain approach – it was however found that not all behaviors and factors investigated showed a high level of consistency. The current dissertation, in this regard, allowed highlighting those that appeared more reliable for crime linkage purposes. Going a step further, this dissertation also indicated that environmental factors specific to the victim encounter stage of the offense were more reliable and showed better a level of consistency. In line with prior studies (e.g., Bennell & Canter, 2002; Markson et al., 2010; Salfati, 2003; Sorochinski & Salfati, 2010), it could be argued that this specific stage of the offense is less prone to situational influence than other stages (i.e., attack, crime commission, release of the victim), as the victim's reaction and behaviors are not yet brought into play. This is an important finding from a practical perspective because it indicates that crime analysts who are engaged in conducting behavioral case linkage should focus only on specific environmental factors while leaving out those that do not demonstrate consistency. This finding also illustrates

the contribution that research on crime linkage and behavioral consistency can make to police investigations. The current dissertation showed indeed that research can help to highlight aspects of the crime that should facilitate a most accurate and reliable way of linking crimes, while minimizing the time and effort associated with crime linkage (see Tonkin et al., 2011).

Second, specific crime sites were also highlighted as being consistently and recurrently used by serial sex offenders in the commission of their crimes, while others informed on the offender's progression in their series. More specifically, it appeared that, after using sites known for providing high crime opportunities and potential targets for their first few crimes, offenders became more confident and risk-taking and started to select sites they were more familiar with to encounter their victims. Here again, this is an important finding for investigations because it suggests that police investigators could not only focus their search and patrols in specific geographic areas when looking for a presumed sex offender, but could also concentrate their attention on specific sites (over others) likely to be used by offenders *among* these identified areas.

Finally, the current dissertation provided a preliminary support to the notion of heterogeneity among serial sex offenders and its influence on levels of consistency found. In doing so, the current dissertation helped to identify offenders more or less likely to be consistent from crime to crime, based on their crime series patterns. Such identification is thought to provide valuable information for investigations and crime analysts, in helping to understand who among potential suspects is more likely to act consistently across series. To a broader but related extent, this finding also helped to contextualize which offenders crime linkage analyses are most likely to help identify: consistent offenders with a prior (and extensive) criminal background. In other words, crime linkage will unlikely help to identify offenders at the beginning of their series; who are not yet known to police; who are switching their environmental offending patterns from crime to crime, more likely to adapt to situational contingencies; and/or who are committing crimes farther apart, time-wise, from one another. Findings such as these reinstate and reinforce the recent suggestion and portrait made of "successful" sexual offenders who are able to stay active while undetected by the criminal justice system (see Lussier et al., 2011, and Lussier & Mathesius, 2012).

5.3. Limitations

The current dissertation was based on a sample of convicted male sex offenders serving a sentence of two years or more, between 1995 and 2004, in the province of Quebec, Canada, who had committed two or more sexual assaults involving a stranger victim. Therefore, the findings should be interpreted with these parameters in mind. That is, they might only apply to federal inmates, or in other words, relatively serious adult offenders who were not able to avoid detection and were apprehended by the police. The current dissertation also did not allow investigating “intrafamilial” sex crimes. Moreover, because all offenders were arrested and convicted for the sex crimes investigated in the current dissertation, it is possible that these crimes were characterized by high internal consistency level, which may explain why offenders were identified, arrested, and convicted for these crimes in the first place (i.e., solved cases). It is also noteworthy that the dissertation only included serial offenders who had committed at least two sex crimes, at different times and places. In other words, single-offense offenders were not considered here. Keeping in mind that, in practice, crime analysts will search databases of offenses whose author will sometimes be a serial offender, but more likely a one-time offender, the addition of single-offense offenders could have led to different results, beneficial to crime linkage analysts.

Moreover, this dissertation is based on self-reported information gathered during semi-structured interviews with the offenders, which might only reflect the offender’s perception of the crime. The use of retrospective self-report data is also accompanied by threats to validity such as poor recall and memory bias. Given the context of the interviews used for the current dissertation (i.e., in a correctional facility), respondents may have minimized or exaggerated certain aspects of their behaviors. Safeguarding against this concern, it is important to emphasize the fact that self-reported information was compared to official data (i.e., police reports) when possible. Furthermore, the fact that the current dissertation is retrospective and based on solved crimes poses inherent problems to the capacity to generalize the study findings. Also, while this was not the goal of the current dissertation, the predictive value of behavioral consistency is left unknown. Indeed, investigating behavioral consistency based on retrospective data can

lead to biased findings and preclude assessing whether crime linkage can be effectively conducted in a predictive way.

On a more macro level, it is important to note that findings of the current dissertation are specific to the particular geographical location studied. This aspect is even more important as this dissertation focused on environmental and site-selection consistency. The actual characteristics of the geographical location are therefore important and may influence the level of stability in offending found and the nature of environments selected to commit crimes. For example, the presence of stability of offending across a series could simply reflect that within a specific location, sex offenders tend to repeat their modus operandi or chose similar crime settings (see, for example, Beauregard, Rebocho, & Rossmo, 2010). In the same line, it is reasonable to think that specific locations might be more favorable to crime switching than others (see, for example, Brantingham & Brantingham, 1993).

The offenders' time at risk was also not taken into account in the current dissertation. In other words, it was not considered whether offenders were hospitalized, incarcerated, on parole, and so on, during and over their crime series duration, which might have limited their ability to offend and, consequently, might have affected their offending rate. Based on the criminal career literature, the time at risk can provide valuable additional information on the offender's crime series patterns. Finally, the current dissertation solely focused on assessing one of the crime linkage assumptions, that is, behavioral consistency. Therefore, the validity of the behavioral distinctiveness assumption was not assessed. As most studies in crime linkage have tested for this later assumption and mostly suggested its validity, the current findings can be combined with those of prior studies in order to provide a better knowledge on crime linkage analysis and the validity of its assumptions.

5.4. Directions for Future Research

The three empirical studies part of this dissertation are thought to have filled some gaps left by previous studies and to have provided evidence of the reliability of geographic behaviors and environmental aspects of the offense for successful crime

linkage of stranger serial sex offenders. Future studies should further investigate the stability and reliability of these factors. More specifically, additional research needs to be conducted to investigate the heterogeneity and stability of sexual offense environments and crime site selection, considering that they are less prone to situational influence and that a high level of consistency was found in the current dissertation. Futures studies should also try to expand on other factors that might modulate offenders' levels of consistency, such as the age of onset or the time at risk. Relying on various analytical strategies coming from different but related fields of research would also be beneficial in order to move forward the crime linkage field and help crime linkage analyses to be more accurate. For example, related to the identification of crime sites used by serial sex offenders, the use of latent class analyses — relatively new to the criminology field — helped to provide information on the nature and variability of sites selected across series. As a step forward, future studies should further examine site selection across crime series using latent transition analyses to examine the switching patterns of crime sites most likely to be found among serial offenders.

This dissertation is also thought to have provided a better knowledge of the unfolding of crime series of serial sex offenders, their heterogeneity, and their crime series patterns. The dissertation also opened up on the need to control for the number of crimes committed *over* the offenders' crime series duration, in order to get a full and more truthful portrait of serial sex offenders and their consistency level. In doing so, it is also believed that a better understanding of the offender's motivation and decision-making process in the commission of their sex crimes can be achieved. This dissertation also highlighted the fact that different crime series patterns existed among serial offenders, influencing the level of consistency found. The current dissertation, however, only glanced at subgroups of crime series pattern that may exist among serial sex offenders. One important suggestion for future research would be to further investigate crime series patterns of serial sex offenders and how they modulate the level of consistency found using appropriate statistical methods. Furthermore, even though this dissertation, as well as prior studies from the criminal career literature, has identified subgroups of offending patterns, the cut-off point for such categorization is still unknown. Indeed, no study clearly states when an offender becomes a *chronic* or a *persistent* offender and where the line should be drawn for the classification of offenders. Most

researchers in the criminal career field have avoided this problem by using group-based trajectories modeling, in which the method determines the cut-off point. As such, no clear indication is provided to date. Even though, such an approach could still be beneficial for future research in crime linkage. An important line of future research should however, focus on establishing guidelines for such classification of crime series patterns among serial offenders. At a more practical level, the crime linkage field would also benefit from replication of the current dissertation' focus and analyses to other crime types — such as serial burglaries — in order to determine if such heterogeneity also exists among other types of serial offenders.

Finally, and to a broader extent, the use of criminal career research in the current dissertation represents a departure from previous studies in the crime linkage and behavioral consistency field. Considering that these fields have related research interests and considering its richness, it is argued that future studies in the crime linkage field should rely more closely on literature from this field in order to move forward current practices and knowledge of offending consistency and crime linkage.

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