An evaluation of bylaw and policy changes on pharmacy robberies in British Columbia

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Executive Summary

On 15 September 2015, the College of Pharmacists of British Columbia implemented a set of by-law and security policy changes in an effort to reduce robberies and burglaries in BC pharmacies. These changes were put forth in the Pharmacy Operations and Drug Scheduling Act – BYLAWS and the Professional Practice Policy – 74. Prior to these by-law and security policy changes, pharmacy robberies had been increasing for approximately five years. Subsequent to the implementation of these by-law and security policy changes, these robberies decreased significantly. In this Report, we evaluate the potential impact of the by-law and security policy changes on pharmacy robberies in four regions within British Columbia. The by-law and security policy changes are reviewed, along with reviews of the relevant crime prevention literature, theoretical and empirical. We find strong evidence supporting that the reduction in pharmacy robberies is a result of the by-law and security policy changes. Specifically, there was an immediate and substantial drop in pharmacy robberies within Vancouver, with a change in trend (now decreasing instead of increasing) for the Lower Mainland less Vancouver and the Interior. These results should be considered strong evidence for the maintained implementation of these by-laws and security policy changes here in British Columbia as well as their adaptation in other areas of Canada.
Introduction
As a response to a recent increase in robberies and burglaries in pharmacies across British Columbia, the College of Pharmacists of BC implemented by-law and security policy changes to reduce these robberies and burglaries in BC pharmacies. These changes came into effect 15 September 2015. In this report, we evaluate the impact of these by-law and policy changes on pharmacy robberies across British Columbia; due to police data availability, we focus on pharmacy robberies, and not pharmacy burglaries—identifying pharmacy-related burglaries across the Province was not practical given the nature of the records management system used by the police in British Columbia.

We consider pharmacy robberies in four regions across British Columbia: Vancouver, Lower Mainland less Vancouver (to avoid double counting), Vancouver Island, and Interior. The relatively large regions of Vancouver Island and Interior were necessary for analysis because of the low frequency of pharmacy robberies in these regions and the corresponding appropriate statistical methods. Overall, we find that the by-law and policy changes may be considered as responsible for the significant drop of pharmacy robberies in Vancouver and a change in the trend of pharmacy robberies in the Lower Mainland less Vancouver and the Interior. No significant impact was found for Vancouver Island.

The remainder of this report briefly reviews the changes that occurred to the pharmacy bylaws and policies, the theoretical background for why such changes are expected to lead to a decrease in pharmacy robberies, and an empirical review of the literature that supports the theory. This is followed by a discussion of the data and statistical methods used for this evaluation, the results, and a conclusion with future policy suggestions.
Changing Pharmacy Bylaws and Policies
The security aspects of the Pharmacy Operations and Drug Scheduling Act – BYLAWS (hereafter referred to as Bylaws) and the Professional Practice Policy – 74 (hereafter referred to as PPP-74) are discussed below with statements on how they correspond to the principles of Crime Prevention through Environmental Design (CPTED) and situational crime prevention.

The Bylaws, Community Pharmacy Security Section 11.1, states that a community pharmacy must have the following security measures:

• a locked metal safe with a time delay set at a minimum of 5 minutes for the storage of narcotics and controlled drugs,
• a security camera system that is checked daily for proper operation and has date/time stamped images that are archived and available for at least 30 days,
• motion sensors in the dispensary,
• a monitored alarm in the dispensary area if the space in which the community pharmacy is operating, if a full pharmacist is not present at all times and the location is accessible to non-registrants,
• physical barriers to protect schedule I and II drugs, controlled drug substances, and personal health information, if a full pharmacist is not present at all times and the location is accessible to non-registrants,
• signage that states the presence of a video surveillance system, limited targeted drugs are on site, and that narcotics are stored in a time-delay lock safe, and
• A community pharmacy that exists at the time of these Bylaws coming into force and does not have these security measures has 3 years from the time these Bylaws come into force to comply.

PPP-74 states that the “physical barriers can be tailored to the needs and structure of the particular community pharmacy”, referring to examples such as locked gates, cabinets, doors, and shelving units. The purpose of these physical barriers is to prevent access to the stored items in the community pharmacy.

It is also important to note that physical barriers, as well as a monitored alarm within the dispensary area, are only required when a full pharmacist is NOT present at all times and the location is accessible to non-registrants—in most cases this is when a pharmacy is closed. This would include commercial retailers that close the community pharmacy component of their retail outlet and remain open to the public for other retail items. The purpose of these security measures is to reduce the number of commercial robberies and commercial break-ins. These security measures are supported through the principles of CPTED and situational crime prevention.

CPTED has three principles: surveillance, access control, territorial reinforcement, and image and maintenance—the first three are most relevant to the current context. In the current context, surveillance would include building design that allows clear sightlines within the community pharmacy allowing for the natural surveillance of the pharmacy, as well as security cameras and security patrols that act as “mechanical” forms of surveillance. Access control includes clear definitions of controlled spaces that limits access as well as locks and alarms. And territorial reinforcement refers to clearly marking off areas that are
off limits to particular individuals through symbolic barriers, signage, and visual cues (Cozens et al., 2005).

Situational crime prevention considers 25 techniques that are organized into 5 categories: increase the effort, increase the risk, reduce the rewards, reduce provocations, and remove excuses. The Bylaws discussed here are primarily concerned with increasing effort and increasing risks. Increasing the effort includes such security measures as target hardening and access control, whereas increasing the risks includes such security measures as surveillance and place management (security cameras).

It should be clear that safes, security cameras, motion sensors, alarms, physical barriers, and signage all conform to the principles of CPTED and the techniques of situational crime prevention. There are numerous studies that support security measures, like those listed under situational crime prevention, are an evidence based form of crime prevention. Specifically in the context of pharmacies, and further reviewed below, La Vigne and Wartell (2015) have found that robbery prevention for pharmacies is best undertaken considering the following: security camera systems, time-locked safes, physical barriers, and reinforced locks on doors and windows.

An important component of CPTED and, specifically, situational crime prevention, is the need for crime prevention activities to be situational, or localized. In other words, context is important and specific security measures should address specific crime problems. It is important to note that the security measures prescribed in the Bylaws are sufficiently general to allow for adaptation to any specific needs of particular pharmacies.

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1 See also CPTED Ontario for further discussion of these principles: http://cptedontario.ca/mission/what-is-cpted/.
2 See the Center for Problem-Oriented Policing for further discussion of these techniques: http://www.popcenter.org/25techniques/.
Theoretical expectations and empirical evidence for crime prevention
Crime Prevention through Environmental Design (CPTED)

When C. Ray Jeffery developed Crime Prevention through Environmental Design (CPTED), he assumed that there was a complex human-environment interaction and that this interaction produced probabilistic effects (Jeffery, 1971). Though this harks back to the attempts of crime prevention that assumed a deterministic process, C. Ray Jeffery did not believe that there was a deterministic process, only a relationship. However, that relationship was strong enough to justify the implementation of changes in the environment to prevent criminal events. C. Ray Jeffery’s CPTED environment is a complex idea: people interact with and adapt to their environment. Some environments make criminal events easier to commit than other environments, as evidenced by the nature of spatial crime patterns—criminal events are most often quite clustered in particular areas. As such, we should be able to modify existing environments to make non-criminal behavior the fittest adaptation. This simply means that potential offenders will undertake non-criminal activities if particular environments are developed and, hence, prevent criminal events; in other words, the environment can be made such that potential criminals never realize their criminal potential. In the current context, the environment is the pharmacy and the behaviour is that of potential individuals who will consider robbing or burgling those pharmacies. A salient component of crime prevention that falls under the umbrella of CPTED is situational crime prevention.
Situational Crime Prevention

The study of crime prevention is an area of study within criminology that is grounded on several “dispositional” and “situational” theories (Clarke, 1983). Theories that are classified as “dispositional” involve examining the biological, psychological, or sociological characteristics of individuals (Clarke, 1980). “Situational” theories, however, provide an examination of the environmental factors that are external to the individual. Such theories place a larger emphasis on the setting of the crime, rather than the motivations of the offender committing the crime (Clarke, 1997). In 1980, Ronald Clarke posited a situational approach to crime prevention that has since evolved into a multifaceted approach that is a common approach in the crime prevention literature and research today. While situational crime prevention originated in the UK, it has been influenced by other policy research within the study of environmental criminology in the United States, namely “defensible space” (Newman, 1972), and “crime prevention through environmental design” (Jeffrey, 1971). Clarke defines the situational crime prevention in the following manner:

[Situational crime prevention contains] opportunity-reducing measures that are (1) directed at highly specific forms of crime (2) that involve the management, design, or manipulation of the immediate environment in as systematic and permanent a way as possible (3) so as to increase the effort and risks of crime and reduce the rewards as perceived by a wide range of offenders (Clarke, 1983; 1997).

Situational crime prevention emerged in a period where most criminological theories focused on motivation of offenders or the socio-structural causes of crime (Clarke, 1983). It differed in that it drew focus to the context of a criminal event, i.e. the situational factors that either allow for, or detract from, the commission of a crime.
Situational crime prevention advocates an approach that focuses on specific crime types and includes a greater emphasis on situational factors that are held to be more susceptible to manipulation in a way that may reduce the occurrence of crime (Hayward, 2007, p. 235). Clarke (1980, 136) argues that crime prevention must be based on a thorough understanding of the causes of crime, addressing the mistrust directed at the use of physical measures to reduce crime, and the favourtism among academics and researchers toward a “dispositional” approach, in response to the alleged lack of concern of criminological theories for the situational determinants or “root causes” of crime. Clarke merely argues for an alternative emphasis on the choices and decisions made by offenders, which leads to a more realistic approach in the study of criminality.

In his subsequent research, Clarke further discusses situational crime prevention as an approach that: (a) is best directed at specific forms of crime; (b) involves the design, management, or manipulation of the environment; and (c) reduces the opportunity for crime and increases its risks to a large range of potential offenders (Clarke, 1983, p. 225; Clarke, 1997, p. 4). As such, Clarke proposes that any theory of criminal events should be comprised of two components: a description of the nature and distribution of criminal opportunities, and an account of how offenders’ decisions are affected by personal history, upbringing, and the circumstances and situation in which they are found (1983, p. 231).

In short, the perspective of situational crime prevention has paved the way for a practical application in the study of environmental criminology and crime prevention through safe urban design (Hayward, 2007, p. 236). Situational crime prevention is by definition an approach that is tailored to specific crimes, the environment, and the reduction of opportunity for the commission of crime (Lersch & Hart, 2011, p. 176). As will
be discussed in greater detail later, the manipulation of situational factors of crime is reflected by the attention given to the built environment in urban planning and design such that crime can be reduced and prevented.

**Situational crime prevention techniques**

Clarke (1997) introduces sixteen opportunity-reducing techniques for situational crime prevention in *Situational Crime Prevention: Successful Case Studies 2nd Ed.* Drawing in part from prior influential literature on crime prevention through environmental design (CPTED), rational choice theory, and routine activity theory, Clarke (1997) provides a list of strategies used to manipulate the built environment in order to reduce the opportunity for crime to occur (Figure 1.0). While not all of the techniques are organized in mutually exclusive categories, this list of techniques was the first attempt to strike a balance between maintaining the definitional clarity of situational crime prevention, while avoiding overextending the reach of the theory and thus complicating the definition (Clarke, 1997). These techniques are organized into four broad categories that include increasing perceived effort, increasing perceived risks, reducing anticipated rewards, and removing excuses (Clarke, 1997, p. 18).

Richard Wortley (2001) proposed sixteen complementary techniques for reducing the precipitators of crime in response to Clarke’s (1997) initial list of sixteen situational techniques. Wortley stressed the importance of drawing a distinction between precipitators and opportunities, as focusing heavily on opportunity reduction strategies may only lead to the displacement of criminals to more conducive targets (Wortley, 2001). While opportunity implies that only certain situational factors will allow individuals to
carry out a certain course of action, precipitators include the conditions that precipitate the behaviour. Precipitators may be defined as the circumstances and conditions upon which the decision to commit a crime is contingent. In the paper, *A classification of techniques for controlling situational precipitators of crime*, Wortley (2001) enumerates four categories of techniques aimed at reducing precipitators of crime, with four specific strategies in each category. These four techniques for controlling precipitators of crime include controlling prompts, controlling pressures, reducing permissibility, and reducing provocations (Wortley, 2001, p. 6). One of the stark differences between Wortley’s proposed sixteen techniques for reducing situational precipitators of crime is the addition of the social policy considerations. While Clarke’s sixteen opportunity-reducing techniques focused largely on modifying the built environment to reduce opportunity, Wortley’s techniques for controlling precipitators addresses real-world precipitators that may precede the commission of crime (Figure 3.0).

In response to Wortley’s (2001) introduction of sixteen complementary ways in which precipitators of crime may be controlled, Cornish and Clarke (2003) released a critique of his approach, and acknowledge common ground between the two approaches of situationally reducing crime. *Opportunities, Precipitators and Criminal Decisions: A Reply to Wortley's Critique of Situational Crime Prevention* (2003) addresses both the similarities between Clarke’s aforementioned sixteen techniques, and Wortley’s proposed techniques for controlling precipitators. Cornish and Clarke (2003) proposed a pragmatic merging of the two perspectives, as there existed much overlap between the two lists of techniques. In amending the current list of techniques, Cornish and Clarke merge “reducing permissibility” under a new category labelled “remove excuses”, and include many of
Wortley’s (2001) strategies for controlling prompts, pressures, and reducing provocations in a new category titled “reduce provocations” (Figure 3.0) (Cornish & Clarke, 2003, pp. 88-89).

In their publication *Crime Analysis for Problem Solvers in 60 Small Steps*, Clarke and Eck (2005) enumerate twenty-five techniques for situational crime prevention (Figure 2.0). These methods have been often cited in more recent research on situational crime prevention, as these techniques have drawn on aggregate results from decades of criminological research (Clarke, 2005, p. 46; Clarke, 2008, p. 184). Combining Wortley’s (2001) techniques for controlling precipitators, this list of twenty-five techniques encompass the entirety of situational crime prevention. These twenty-five steps are the current standard for situational crime prevention, as it has undergone much evolution and revision in the decades since its formulation (Figure 2.0). Using these twenty-five steps, situational crime prevention has been implemented and used as a tool for crime prevention by addressing space-based strategies to reduce precipitators and opportunities for the commission of crime (Eck, Madensen, Payne, Wilcox, Fisher & Scherer, 2009). While situational crime prevention may be applied for many types of crime, Clarke & Eck (2005) postulate that rapid and sustained crime reduction can only come as a result of addressing situational causes of crime that brings an immediate solution to the problem at hand (p. 89).

As mentioned, situational crime prevention is a practical tool for implementing strategies with real-world implications. Eck et al. (2009) conducted a study on the implementation of SCP on place-based crime prevention and found that place-based crime policies were most effective in locations with high-crime, rather than those with average
levels of crime and disorder (p. 117). Eck et al. also concluded from their findings that place-based crime prevention strategies should be adjustable based on the context of the place, and the strategies that account for economic and political contexts are most effective (Eck et al., 2009, p. 119). Given the dynamic nature of many environments where SCP may be applied, Eck et al. (2009) emphasizes the importance of a situational crime prevention strategy that accounts for varying circumstances and environments.

As this theory is still in its infancy, more research is needed on the effectiveness of SCP as a long-term crime reduction strategy. However, much literature tangentially related to SCP, exists within the realm of (CPTED), which has been adopted worldwide by law enforcement agencies, policy makers, city planners, and stakeholders on both a micro and macro level scale (Cozens & Love, 2015; Amandus, Hunter, James, & Hendricks, 1995; Casteel & Peek-Asa, 2000; Jongejan & Woldendorp, 2013). CPTED influenced much of the early development of SCP, and the two perspectives share many similarities as both criminological theories and practical tools for crime prevention (Clarke, 1997). The inclusion of rational choice theory within the framework of SCP lends itself to create a framework whereby its crime reduction strategies are grounded within a much larger and popularized theory with a larger body of empirical support.

*Rational choice theory*

Many criminological theories rely on the basis that crime is not random, and that crimes are committed primarily through conscious and rational decision. This train of thought forms the basis of the rational choice theory, which is a widely popularized theory within criminology (Clarke & Cornish, 1985; Felson, 1986). This theory, which is used to examine
the decision-making process of offenders, also underpins the situational crime prevention approach, which is based on the assumption of rational offenders (Pease, 2001).

Economist and sociologist Herbert A. Simon quantified a concept of rational choice in *A Behavioral Model of Rational Choice*, through several mathematical models that illustrate an “economic man”, which is the idealistic “rational human being” (Simon, 1955, p. 114). This “economic man” is one who is assumed to have relative knowledge of the relevant aspects of his environment, a well-organized system of preferences, an ability to calculate alternative courses of action that are available to him, and which of these courses will allow him to reach the highest goal of his preferred outcomes (Simon, 1955, p. 99). Simon states that the purpose of the construction of these mathematical models was to, “provide some materials for the construction of a theory of the behaviour of a human individual or of groups of individuals who are making decisions in an organizational context” (Simon, 1955, p. 114).

Becker (1968) built on the works of Simon and other economic theorists on the rational choice perspective by drawing from the principle of expected utility, whereby individuals analyze the cost of crime compared to the potential rewards (p. 176). Becker states that some individuals become criminals not because their basic motivations differ from that of other persons, but rather because their perceived benefits and costs differ (Becker, 1968, p. 176). With this rational choice model of analyzing criminal behaviour, Becker contends that the classical theories are no much less suited than a rational choice perspective. In his own words Becker states, “a useful theory of criminal behaviour can dispense with special theories of anomie, psychological inadequacies, or inheritance of
special traits and simply extend the economist’s usual analysis of choice” (Becker, 1968, p. 170).

This cost-benefit analysis is also the foundation for the rational choice models popularized by Clarke and Cornish (1985) in their paper titled *Modeling Offenders’ Decisions: A Framework for Research and Policy* (p. 149). In this piece, Cornish and Clarke criticize current theoretical models of criminal behaviour and postulate that these models tend to ignore the offender’s decision-making process and the conscious thought processes (Clarke & Cornish, 1985, p. 147). In their summary of contemporary economic theories, they state current economic models of criminal decision are useful in the analysis of financially motivated crimes, yet lacking in theoretical application for individual criminal analysis. They summarize contemporary economic models as follows (Clarke & Cornish, 1985):

1. Contemporary economic models of criminal decision making “demystify and routinize criminal activity”.
2. These economic models extend their analysis beyond financially motivated crimes. Attempts have been made to find room for non-financial gains as a part of the expected utility principle.
3. Economic models imply that criminals are deterrable and suggest a range of factors beyond traditional deterrence theory’s “severity of punishment” that may be manipulated for the interests of crime control (p. 156).

Cornish and Clarke note the efficacy of economic theory contributions to criminological theorizing and the evaluation of policy, however they argue that a variety of economic
models generate little empirically based micro-level analysis of individual criminal behaviour (Clarke & Cornish, 1985, p. 147).

Their contribution to the rational choice theory is based on the assumption of a rational offender who carefully weighs the risks and potential rewards of criminal behaviour (Clarke & Cornish, 1985; Cornish & Clarke, 1986). These decisions are a result of the offender’s expected effort and reward compared with the likelihood of punishment and other costs of the crime (Johnson & Payne, 1986). The rational choice approach makes the assumptions of human action that considers, a) the bounded rationality of human action; b) its interactional, transactional, and adaptive nature; c) the need to study offenders’ perceptions, decision-making activities, and choices; d) the need for a crime-specific approach noting the nature of different person-situation criminal events; e) the need for separate accounts of the reflected differences in variables, decision sequences, and time scales (Cornish, 1993, p. 364).

**Limited rationality**

Cornish and Clarke (1985) also note the important fact that individuals do not always make the most “rational” decision based on the circumstances and the information available (p. 160). This limited decision-making based on information processing constraints is a concept known as “bounded rationality”, which has many practical implications in a real-world analysis of criminal behaviour (Simon, 1972, p. 162).

Herbert A. Simon’s (1955) theory of predictable rationality faces the issue of reliability in a real-world setting, as the model of a theoretical “economic man” does not necessarily possess attributes that are an accurate representation of characteristics of
individual humans. The problem of this untestable “economic man” vanishes when he is
substituted for an organism with “limited knowledge and ability” (Simon, 1955, p. 114). As
Simon (1955) writes, “the organism’s simplifications of the real world for purposes of
choice introduce discrepancies between the simplified model and the reality; and these
discrepancies, in turn, serve to explain many of the phenomena of organizational
behaviour” (p. 114). Bounded rationality addresses the ways in which human rationality
are limited by cognitive ability, access to information, and a predisposition to process
information in a certain manner (Clarke & Cornish, 1985, p. 161). Proponents of this
concept argue that even when an individual has complete information, the complexity of a
situation may be such that maximizing is not feasible, and an individual may choose an
option that may be considered “good enough” (Goldthorpe, 1998, p. 171). As individuals
may greatly differ in their ability to process information, and cognitively process
information, the concept of bounded rationality assists in the analysis of individuals in a
real-world setting.

Theory integration
Early iterations of situational crime prevention have been accused of being atheoretical in
nature, until elements of rational choice theory were adopted (Marongiu & Newman, 1997,
p. 117). Today, situational crime prevention contains elements of rational choice theory,
which provide its guiding framework (Pease, 2001). There exists much overlap between
the two theories, and both may be used to explain crime as an event involving the
intersection of multiple variables within time and space.
Both theories involve the presumption of a rational decision-maker, and as such, both theories are strengthened by the notion that situations may be changed or controlled in order to reduce opportunity or remove precipitators, and prevent crime from occurring. This may be accomplished through the manipulation of situational factors, which will in turn manipulate the decision-making process of potential offenders. Notwithstanding the notion of bounded rationality, rational decision-makers are by virtue predictable, and the removal or addition of particular stimuli within the environment may preclude the commission of a crime.

Most criminological theories are best suited to study particular types of crime. Certain dispositional theories are best suited to study the motivations of offenders, as these theories focus on the psychological, biological, and sociological antecedents of criminal behaviour (Clarke, 1980). Situational theories are particularly appropriate for the study of crime prevention measures for commercial businesses, as situational crime prevention measures may be applied with a broad scope on the macro level, while utilizing crime-specific measures on a micro scale (Exum, Kuhns, Koch, & Johnson, 2010).

**Pharmacy crime prevention**

Within the criminological literature there exists a large gap in crime prevention research pertaining to pharmacies, and more specifically – the robbery and burglary of pharmacies. Past studies have examined crime prevention strategies for convenience stores (Amandus, Hunter, James, & Hendricks, 1995; Exum, Kuhns, Koch, & Johnson, 2010) and liquor stores (Casteel, Peek-Asa, Howard, & Kraus, 2004), though a gap exists within the academic
literature specific to empirical studies on the efficacy pharmacy crime prevention strategies.

Rational choice theory suggests that rationally motivated individuals will implement a subjective cost-benefit analysis when deciding to commit a crime such as a robbery or burglary (Feeney, 1986; Clarke, 1997). Though pharmacies experience crime much like any other commercial establishment, little research has been conducted on the proximal and distal characteristics specifically related to pharmacy crimes. While pharmacies may be similar to other commercial businesses, they also have differing and arguably unique business practices given the sale of prescription drugs. Over the past decades, many pharmacies throughout North America have introduced modern security features that reduce the suitability of pharmacies as ideal targets for robbery or burglary (La Vigne & Wartell, 2015). Some features include CCTV, time-locked safes, physical barriers, and reinforced locks on doors and windows (La Vigne & Wartell, 2015).

**Robbery and burglary statistics**

While robberies and break and enters have been declining steadily in Canada since the 1990s until 2015, breaking and entering has increased within the province of British Columbia by 7 percent between 2014 and 2015 (Allen, 2015). Within the United States, the DEA reported an increase in the total number of robberies of pharmacies of 82 percent from 2006 to 2011 (La Vigne & Wartell, 2015). In Australia, the Australia Institute of Criminology published a report in 2003 that provided statistics on the rising rate of pharmacy crime between 1993 and 2000 (Taylor, 2003). This report states that pharmacies experienced an increase of 65% in recorded robberies between 1993 and
2000, with the majority of robberies being armed robbery (Taylor, 2003, pp. 2-3). While the accessibility of pharmacy crime statistics is limited, the online web tool “RxPATROL” contains a database of reported crime within pharmacies in the United States, including incidents of burglary and robbery (Smith, Graham, Haddock, & Steffey, 2007). In a descriptive, nonexperimental study published in the *Journal of the American Pharmacists Association*, it was found that between 2005 and 2006, robbery represented 16.6 percent of all reported incidents and burglary represented 11.2 percent (Smith, Graham, Haddock, & Steffey, 2007, p. 601). The statistics for robbery and burglary within pharmacies are indicative of a need for further empirical research in order to find effective solutions for preventing incidents of crime.

**Crime prevention measures**

Situational crime prevention, crime prevention through environmental design, and rational choice theory help to explain the phenomena of robbery and break and enter, particularly as it pertains to commercial businesses such as pharmacies. As there exists a lack of empirical research on crime prevention measures specific to pharmacies, literature on crime prevention methods used in comparable commercial businesses may be used to determine “what works” within the context of these environments. Previous studies have examined risk factors of convenience stores, and the degree by which they are at risk for robberies, based on principles of situational crime prevention (Amandus, Hunter, James, & Hendricks, 1995; Hendricks, Landsittel, Amandus, Malcan, & Bell, 1999). While not a direct comparison, situational crime prevention strategies have been utilized within liquor stores,
fast-food restaurants, and convenience stores resulting in lower crime rates (Exum, Kuhns, Koch, & Johnson, 2010; Casteel, Peek-Asa, Howard, & Kraus, 2004).

Casteel, Peek-Asa, Howard, and Kraus (2004) conducted a study on the effectiveness of CPTED in reducing criminal activity within liquor stores. An intervention program was developed based on CPTED concepts from a previous study by the Western Behavioral Sciences Institute, which had previously been successful in reducing robberies by nearly 20% during an 8-month period for 60 convenience stores in Southern California (Casteel et al., 2004, p. 451). Some of the implementations within the intervention program included target hardening features, improved cash handling policies, alarms, improved locks on doors, and improved lighting (Casteel et al., 2004). Furthermore, the intervention program was individualized for each liquor store in order to meet specific needs of each store. Using Poisson regression models, this study concluded that the largest statistically significant reductions in crime over the intervention period were for robbery and shoplifting with these crime rates reduced by 82.2% and 87.1% respectively (Casteel et al., 2004, p. 454).

In addition to SCP being successfully implemented within convenience stores in the United States, SCP has also been used as a crime prevention method for convenience stores and fast-food restaurants. Exum, Kuhns, Koch, and Johnson (2010) conducted a study on the efficacy of situational crime prevention within North Carolina in order to determine whether typical crime control strategies were as effective at reducing robbery within fast-food restaurants as they were within convenience stores (Exum et al., 2010). It was noted that fast-food restaurants and convenience stores are quite different in their design, operation, and business practices, and as such, the techniques that may prevent crime in one type of business may not be as effective in another. Using logistic regression, this study
found that the most statistically significant predictor of future robbery in the multivariate model was whether or not the establishments were robbed in the previous year (Exum et al., 2004, p. 286). Despite the lack of statistically significant results among the variables in this study, this was the first study conducted comparing robbery of fast-food restaurants to convenience stores. Based on three other statistically significant variables in this study, SCP recommendations were also given: the level of guardianship could be increased by adding an ATM to retain more patrons within convenience stores, a drop-safe sign should be displayed in convenience stores that contain drop-safes, and public transportation stops should be no closer than “200 yards” from each establishment (Exum et al., 2004, p. 288). Given the results of this study, Exum et al. conclude that fast-food restaurants and convenience stores should both plan for future safety measures based on past victimization or experiences with criminal activity.

The Center for Problem-Oriented Policing Services (COPS) published a report in 2015 providing an overview of pharmacy robberies in the United States, with specific crime prevention measures based on situational crime prevention techniques (La Vigne & Wartell, 2015). Congruent with situational crime prevention, COPS suggests four categories of measures that may be taken to reduce pharmacy robbery: increasing the risk of detection, increasing the effort to commit a robbery, and decreasing the susceptibility to robberies. The recommended steps taken to increase the risk of detection include (1) informing pharmacy employees about robbery trends, (2) providing prevention guidelines to pharmacy employees, (3) managing risk factors, (4) installing a panic alarm, (5) using video surveillance, (6) tracking the stolen drugs or offender, and (7) using deterring signage (La Vigne & Martell, 2015, p. 20-21). These techniques both modify the built
environment as to reduce criminal opportunity, and allow for more informed employees who are aware of the risks relating to pharmacy robberies. Furthermore, the article lists measures to increase the effort required, which include employing security measures such as increased lighting, locking up narcotics, installing physical barriers, and insuring that front windows are clear (La Vigne & Wartell, 2015). While not all of these recommendations proposed by COPS have been evaluated for their implementation within pharmacies, several techniques have shown to be successful in reducing robberies within convenience stores (La Vigne & Wartell, 2015, p. 23). Finally, the report recommends two measures to be taken that will decrease the susceptibility to robberies, which include limiting the drugs available and limiting drug information available over the telephone (La Vigne & Wartell, 2015). All of the techniques recommended by COPS fall within the scope of the twenty-five techniques proposed by Cornish and Clarke (2003), and are supported within the situational crime prevention literature.
Data and methods

Police data
The data used in the analyses below were provided by the Vancouver Police Department. These data include all robberies that occurred in British Columbia organized into Vancouver, Lower Mainland less Vancouver, Vancouver Island, and Interior. For the City of Vancouver, we were provided with the exact location of the pharmacy robbery, potentially allowing for a spatial analysis within the City of Vancouver, but there were so few incidents after 15 September 2015 that these few locations cannot be analyzed to obtain useful information.

The variables provided by the Vancouver Police Department were the monthly counts of pharmacy robbery, organized in to the various regions in the Province. For the City of Vancouver, data began in January 2001, whereas the remaining regions (Lower Mainland less Vancouver, Vancouver Island, and Interior) data began January 2006. All regions have their robbery counts until April 2017.

Statistical methods
The analysis of the impact of the by-law and policy changes regarding security to reduce pharmacy robberies is done using regression analysis considering a structural break test. In an evaluation, structural break tests may be used to test whether the independent variables have had different impacts on subgroups of the population. For example, Piehl et al. (2003) demonstrate the value of a structural break test in their evaluation of a youth homicide reduction program in Boston, MA (USA). In the Piehl et al. (2003) evaluation, the researchers were faced with some difficult challenges. Specifically, similar to our current evaluation, there were no control (or comparison) groups and the precise date that the
intervention was implemented was unknown—we know the precise date of the intervention, however. By using a structural break test, the Piehl et al. (2003) were able to identify a statistically significant reduction of youth homicide shortly after the estimated intervention date. By controlling for a variety of variables, Piehl et al. (2003) were able to claim, with reasonable confidence, that the reduction was due to a program effect rather than an unrelated change in the outcome measure. We employ a similar statistical method here.

The nature of the regression analysis is to identify, statistically, any changes in the trend/trajectory of crime in pharmacy robberies resulting from by-law and policy changes regarding security in British Columbia. Therefore, a number of variables are included to control for changes over time. First, an overall trend variable is included. It is well-known that reported crime has been declining for the past two decades and a variable representing this decline (or incline) is included (LaFree, 1999; Levitt, 2004; Farrell et al., 2011); we also include a trend-squared variable that allows for the longer-term trend in pharmacy robberies to be non-linear/curved. Also, both property and violent crime have been found to increase in the summer months (Harries et al., 1984). There are a number of explanations for this that are often based on there being more people outside during the summer months, routine activity theory (Cohen and Felson, 1979). We include month and month-squared to capture this seasonal effect in the data. The last control variable we include is the number of days in each month because more days increases the probability of a pharmacy robbery. Two variables of interest are included to represent the time period of the intervention, by-law and policy changes. As stated above, the timing of the by-law and policy changes is 15 September 2015 to the present. The first variable is a
dichotomous (dummy) variable that takes on a value of one when the date is 15 September 2015, and zero otherwise; the second variable is a trend variable for the same time period that takes on consecutive values (1, 2, 3, ...) from 15 September 2015 forward, and zero otherwise. This will allow for the identification of an immediate and sustained change in the number of pharmacy robberies (the dichotomous variable) as well as continued changes over time (bylaw trend variable) because the by-law and policy changes may only change the trend of pharmacy robberies, not having an immediate effect.

The purpose of all these variables is to attempt to identify the independent effect of the by-law and policy changes regarding security. For example, it may be the case that crime is trending down British Columbia, in general, and a particular crime classification decreases in the summer months. Therefore, if the only variables in the analysis are related to the intervention one may attribute the decrease in crime from the intervention when it is simply a seasonal effect. Including these other variables allows for the identification of the effect from the by-law and policy changes regarding security with all the other time trends in criminal activity accounted for.

Because of the “rare events” nature of criminal behaviour, including pharmacy robberies, count data models have been becoming increasingly popular in the criminological literature—both Poisson and negative binomial regression (Gardner et al., 1995; Groff & Lockwood, 2014; MacDonald & Lattimore, 2010; Osgood 2000). Poisson models assume that the variance and the mean of the dependent variable’s distribution are

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3 Because the by-law and policy changes began in the middle of September 2015, the bylaw trend variable takes the value of 0.5 that first month, then sequentially starts from 1.
equal; negative binomial models have no such assumption such that the variance may be greater than the mean (over-dispersion in the data). In the analyses below, we considered Poisson formulations for all models and applied a dispersion test with the null hypothesis of equidispersion against the alternative of over-dispersion (Cameron & Trivedi, 1990). In all cases, the null hypothesis was rejected and we estimated negative binomial regression models. In either case, negative binomial regression models will generate the same results of a Poisson regression model if the assumption of equidispersion is not rejected. As such, negative binomial regression models are, most often, the best option.

The output from a negative binomial regression model does include a parameter than may be interpreted through its sign: positive or negative, representing positive and negative relationships between the predictor variables (bylaw, for example) and the number of expected events. However, the strict interpretation of the estimated parameters in a negative binomial regression is as follows: with a one-unit change in the predictor variable, the difference in the log of expected counts for the outcome variable is expected to change by the value of the estimated parameter. Aside from identifying positive and negative relationships, interpretations of these estimated parameters is not intuitive. Rather, we use the relative risk ratio (RRR). The RRR is the exponentiated value of the estimated parameter: \( \exp(\text{estimate}) \). This transformation of the estimated parameter makes it much simpler to interpret. This new number can be used to interpret the percentage change in the counts from a one-unit change in the predictor variable. For example, consider the bylaw variable. If the RRR for bylaw was 0.80, then that would represent a 20 percent decrease in the count of pharmacy robberies: \( 0.80 - 1 = -0.20, 20 \) percent decrease. If the RRR for bylaw was 1.20, then that would represent a 20 percent
increase in the count of pharmacy robberies: $1.20 - 1 = 0.20$, 20 percent increase. As such, a
RRR of 1 (unity) represents no change: think of multiplying the count of pharmacy
robberies by 1. If the RRR value is greater than one, there is a positive relationship, and if
the value is less than 1, there is a negative relationship.

We include two sets of output for each area. First, the full model that retains all of
the variables discussed above, whether they are statistically significant or not. And second,
a final model that only includes the variables that remain after removing statistically
insignificant variables. These variables are removed one-by-one using a general-to-specific
testing methodology: the variable with the largest p-value that is greater than 0.10 is
removed and the negative binomial regression model is estimated again without this
variable. Joint significance tests (Likelihood Ratio Tests) are also undertaken to ensure that
variables are not incorrectly removed because of multicollinearity.
Results and discussion
The annual counts of pharmacy robberies are shown in Figure 1: from 2001 for Vancouver and from 2006 for the other three regions. The results for Vancouver show a very low and flat trend in Vancouver from 2001 to 2006, followed by a steady increase, with a spike in 2013, until 2014. Though it does appear as though the decline in pharmacy robberies began in 2014, a year too soon for the by-law and policy changes regarding security to have had an impact on the change in pharmacy robbery counts, this is not necessarily the case. In 2013, Vancouver had an aberrant two months of pharmacy robberies (April and July), such that if these two months had the expected value of pharmacy robberies the spike effectively disappears. This is one of the difficulties in analyzing rare events. Also clear for Vancouver is that the count of pharmacy robberies decreased steadily until 2016.

Figure 1. Pharmacy robbery counts, 2001 – 2016
Lower Mainland, less Vancouver, has a much more volatile trajectory over time. There appears to be a general decreasing trend (with a lot of volatility) beginning in 2009 with pharmacy robberies most definitely at their lowest point in 2016. Vancouver Island, aside from an increase in 2008 and 2009 has a relatively flat trend over the entire study period. And Interior has a steady increase in pharmacy robberies from 2006 until 2014, with a small decrease in 2015 and a subsequent decrease in 2016. Overall, these patterns most certainly appear to be consistent with the by-law and policy changes regarding security for Vancouver and the Interior, but possibly not for Lower Mainland less Vancouver and Vancouver Island. Such inferences much be taken with caution, however, because the monthly counts are not plotted here (they are too volatile to discern any patterns) these plots do not control for the other seasonal and temporal factors, discussed above.

The results of the negative binomial regression analyses are shown in Table 1 to 4. Table 1, the results for Vancouver corroborate the trend shown in Figure 1. In the full model that includes all statistically significant variables, whether they are statistically significant or not, shows that the dichotomous variable (bylaw) is statistically significant and negative. Moreover, this estimated parameter is of a large magnitude with the RRR being 0.167, stating that the by-law and policy changes regarding security led to an 83 percent decrease in pharmacy robberies. As such, this not only represents a statistically significant decrease in pharmacy robberies, but a large magnitude decrease as well. In the final model that only included the remaining statistically significant variables, the bylaw variable remained negative and statistically significant, but its absolute value magnitude
has increase: the new by-law and policy changes regarding security led to a 94 percent decrease in pharmacy robberies.

Table 1. Negative binomial results, full and final models, Vancouver

|               | Full model |             | RRR | Pr(>|z|) |
|---------------|------------|-------------|-----|---------|
|               | Estimate   | Std. Error  | RRR | Pr(>|z|) |
| Bylaw         | -1.781     | 0.729       | **0.168** | 0.015  |
| Bylaw trend   | -0.112     | 0.081       | 0.894 | 0.170   |
| Month         | -0.082     | 0.153       | 0.921 | 0.591   |
| Month-squared | 0.002      | 0.012       | 1.002 | 0.867   |
| Number of days | 0.262     | 0.151       | **1.300** | 0.083  |
| Trend         | 0.037      | 0.024       | 1.038 | 0.117   |
| Trend-squared | 0.000      | 0.000       | 1.000 | 0.597   |

Turning to the results for the Lower Mainland less Vancouver, Table 2, none of the variables in the full model were statistically significant at the 10 percent level (p-value <= 0.10), a common threshold for statistical significance. However, when the general-to-specific testing methodology is employed, the bylaw trend variable becomes statistically
significant, representing a monthly decrease in pharmacy robberies of approximately 20 percent. Over time, this will clearly lead to a notable drop in pharmacy robberies in the Lower Mainland.

Table 2. Negative binomial results, full and final models, Lower Mainland, less Vancouver

|                          | Full model |               |               |               |
|--------------------------|------------|---------------|---------------|---------------|
|                          | Estimate   | Std. Error    | RRR           | Pr(>|z|)      |
| Bylaw                   | -0.633     | 0.658         | 0.531         | 0.336         |
| Bylaw trend             | -0.125     | 0.108         | 0.882         | 0.247         |
| Month                   | -0.048     | 0.145         | 0.953         | 0.74          |
| Month-squared           | 0.004      | 0.01          | 1.004         | 0.708         |
| Number of days          | -0.091     | 0.121         | 0.913         | 0.451         |
| Trend                   | 0.029      | 0.018         | 1.030         | 0.106         |
| Trend-squared           | -0.001     | 0.001         | 0.999         | 0.246         |

|                          | Final model |               |               |               |
|--------------------------|------------|---------------|---------------|---------------|
|                          | Estimate   | Std. Error    | RRR           | Pr(>|z|)      |
| Bylaw trend             | -0.228     | 0.087         | **0.796**     | < 0.01  

The results for Vancouver Island, Table 3, are essentially the same for the full model as Lower Mainland less Vancouver: all estimated parameters are statistically insignificant. Once the removal of statistically insignificant variables was undertaken, neither of the by-
law and policy changes regarding security variables remained statistically significant; only trend and trend-squared remained statistically significant in the final model.

**Table 3. Negative binomial results, full and final models, Vancouver Island**

|                         | Full model |                     |               |               |
|-------------------------|------------|---------------------|---------------|---------------|
|                         | Estimate   | Std. Error          | RRR           | Pr(>|z|)       |
| Bylaw                  | 0.089      | 1.688               | 1.094         | 0.958         |
| Bylaw trend            | -0.088     | 0.071               | 0.916         | 0.218         |
| Month                  | -0.525     | 0.433               | 0.591         | 0.225         |
| Month-squared          | 0.041      | 0.033               | 1.042         | 0.208         |
| Number of days         | -0.101     | 0.364               | 0.904         | 0.782         |
| Trend                  | 0.028      | 0.027               | 1.029         | 0.296         |
| Trend-squared          | -0.001     | 0.001               | 0.999         | 0.428         |

|                         | Final model |                     |               |               |
|-------------------------|-------------|---------------------|---------------|---------------|
|                         | Estimate    | Std. Error          | RRR           | Pr(>|z|)       |
| Trend                  | 0.036       | 0.022               | **1.036**     | 0.099         |
| Trend-squared          | -0.001      | 0.001               | **0.999**     | 0.063         |

The results for the Interior, Table 4, show the result expected from Figure 1. In the full model, bylaw trend, as well as trend and trend-squared, are statistically significant. With regard to bylaw trend, every month there is a 20 percent decrease in pharmacy robberies. After the removal of statistically insignificant variables, bylaw trend remained
statistically significant representing a 19 percent decrease in pharmacy robberies each month attributable to the by-law and policy changes regarding security.

Table 4. Negative binomial results, full and final models, Interior

|                      | Full model | Final model |
|----------------------|------------|-------------|
|                      | Estimate   | Std. Error  | RRR | Pr(>|z|) | Estimate   | Std. Error  | RRR | Pr(>|z|) |
| Bylaw                | 0.039      | 1.279       | 1.041 | 0.975   | -0.211 | 0.128 | **0.810** | 0.099 |
| Bylaw trend          | -0.226     | 0.121       | **0.798** | 0.062 |          |          |       |          |
| Month                | -0.331     | 0.227       | 0.718 | 0.145   | -0.079 | 0.046 | **0.924** | 0.086 |
| Month-squared        | 0.021      | 0.018       | 1.021 | 0.258   |          |          |       |          |
| Number of days       | -0.092     | 0.264       | 0.912 | 0.726   |          |          |       |          |
| Trend                | 0.109      | 0.039       | **1.115** | 0.006   | 0.109 | 0.036 | **1.116** | 0.002 |
| Trend-squared        | -0.001     | 0.001       | **0.999** | 0.025 |          |          |       |          |
Conclusion
In response to rapid increases in the volume of pharmacy robberies and burglaries, the College of Pharmacists of British Columbia implemented new by-law and policy changes regarding security. These by-law and policy changes included a safe, security systems, motion sensors, a monitored alarm, physical barriers, and signage to deter would-be offenders. The report evaluated the impact of the by-law and policy changes regarding security using police data on pharmacy robbery—pharmacy burglary data were not made available.

In this evaluation, monthly counts of pharmacy robbery in four police regions in British Columbia were analyzed. The results indicate that there was an immediate drop in pharmacy robberies in Vancouver that corresponded to the by-law and policy changes, and a change in trend in the Lower Mainland less Vancouver and the Interior that decreased the trajectory of pharmacy robberies that corresponded to the by-law and policy changes. Although more certainty cannot be claim because this was not an experimental design with control and treatment groups (some pharmacies implemented changes to their premises based on the by-law and policy changes and other (similar) pharmacies did not), the timing of the changes in the trends of pharmacy robberies coincides with the changes in the by-law and policy changes. Speaking with police on this issue, there have not been any confounding police activity changes that could account for the drop in pharmacy robberies and the lack of an impact on Vancouver Island is likely just because of the low counts of events—this makes it more difficult to find statistical evidence for such a change.

In conclusion, it appears that the by-law and policy changes had their intended effect in reducing pharmacy robberies either through an immediate drop (Vancouver) or a
decreasing trend (Lower Mainland less Vancouver and the Interior). With these results, drastic in the context of Vancouver, the evidence presented here in support of the by-law and policy changes implemented by the College of Pharmacists of BC has implications for the rest of Canada. These by-law and policy changes were implemented in response to an increase in pharmacy robberies and burglaries, but should be considered in other contexts as well. The implementation of similar by-law and policy changes in other areas of Canada could be used to reduce levels of pharmacy robberies and burglaries, generally speaking.
References
Amandus, H., Hunter, R., James, E., & Hendricks, S. (1995). Reevaluation of the Effectiveness of Environmental Designs to Reduce Robbery Risk in Florida Convenience Stores.

*Journal of Occupational and Environmental Medicine, 37*(6), 711-717.

Becker, G. (1968). Crime and Punishment: An Economic Approach. *Journal of Political Economy, 76*(2), 169-217.

Cameron, A.C., & Trivedi, P. K. (1990). Regression-based tests for overdispersion in the Poisson model. *Journal of Econometrics, 46*(3), 347–364.

Casteel, C., & Peek-Asa, C. (2000). Effectiveness of Crime Prevention Through Environmental Design (CPTED) in Reducing Robberies. *American Journal of Preventative Medicine, 18*(4), 99-115. [http://dx.doi.org/1016/S0749-3797(00)00146-X](http://dx.doi.org/1016/S0749-3797(00)00146-X)

Casteel, C., Peek-Asa, C., Howard, J., & Kraus, J. (2004). Effectiveness of Crime Prevention Through Environmental Design in Reducing Criminal Activity in Liquor Stores: A Pilot Study. *Journal of Occupational and Environmental Medicine, 46*(5), 450-458.

Clarke, R. (1980). “Situational” Crime Prevention: Theory and Practice. *The British Journal of Criminology, 20*(2), 136-147.

Clarke, R. (1983). Situational Crime Prevention: Its Theoretical Basis and Practical Scope. *Crime and Justice, 4*, 225-256. [http://dx.doi.org/10.1086/449090](http://dx.doi.org/10.1086/449090)

Clarke, R. (1997). Introduction. In R. Clarke (Ed.), *Situational Crime Prevention: Successful Case Studies* (pp. 2-43). Guilderland, NY: Harrow and Heston.

Clarke, R. (2005). Seven misconceptions of situational crime prevention. In N. Tilley (Ed.), *Handbook of Crime Prevention and Community Safety* (pp. 39-70). Portland, OR: Willan.

Clarke, R. (2008). Situational Crime Prevention. In R. Wortley &L. Mazerolle (Eds.), *Environmental Criminology and Crime Analysis* (pp. 178-194). Portland, OR: Willan.
Clarke, R. & Cornish, D. (1985). Modeling Offenders’ Decisions: A Framework for Research and Policy. *Crime and Justice, 6*, 147-185. [http://dx.doi.org/10.1086/449106](http://dx.doi.org/10.1086/449106)

Clarke, R. & Eck, J. (2005). *Crime Analysis for Problem Solvers in 60 Small Steps*. Retrieved from Community Oriented Policing Services: [http://www.cops.usdoj.gov/pdf/crimeanalysis60steps.pdf](http://www.cops.usdoj.gov/pdf/crimeanalysis60steps.pdf)

Cohen, L.E., & Felson, M. (1979). Social change and crime rate trends: a routine activity approach. *American Sociological Review, 44*(4), 588 – 608.

Cornish, D. (1993) Theories of Action in Criminology: Learning Theory and Rational Choice Approaches. In R. V. Clarke & M. Felson (Eds.), *Routine Activity and Rational Choice: Advances in Criminological Theory* (pp. 351-382). New Brunswick, NJ: Transaction Publishers.

Cornish, D. & Clarke, R. (1986). Introduction. In D. B. Cornish & R. V. Clarke (Eds.), *The reasoning criminal* (pp. 1-16). New York: Springer-Verlag.

Cornish, D. & Clarke, R. (2003). Opportunities, precipitators, and criminal decisions: A reply to Wortley’s critique of situational crime prevention. In M. Smith & D. Cornish (Eds.), *Theory for practice in situational crime prevention* (pp. 41-96). Monsey, NY: Criminal Justice Press.

Cozens, P., and Love, T. (2015). A Review and Current Status of Crime Prevention through Environmental Design (CPTED). *Journal of Planning Literature 30*(4): 393-412. Retrieved from [http://dx.doi.org/10.1177/0885412215595440](http://dx.doi.org/10.1177/0885412215595440)

Cozens, P., Saville, G., & Hillier, D. (2005). Crime Prevention through Environmental Design (SPTED): A review and modern bibliography. *Property Management, 23*(5), 328 – 356.
De Haan, W. & Vos, J. (2003). A crying shame: The over-rationalization conception of man in the rational choice perspective. *Theoretical Criminology, 7*(1), 29-54.  
http://dx.doi.org/10.1177/1362480603007001199

Exum, M., Kuhns, J., Koch, B., & Johnson, C. (2010). An Examination of Situational Crime Prevention Strategies Across Convenience Stores and Fast-Food Restaurants. *Criminal Justice Policy Review, 21*(3), 269-295

Farrell, G., Tseloni, A., Mailley, J., & Tilley, N. (2011). The crime drop and the security hypothesis. *Journal of Research in Crime and Delinquency, 48*(2), 147 – 175.

Feeney, F. (1986). Robbers and Decision-Makers. In D. B. Cornish & R. V. Clarke (Eds.), *The reasoning criminal* (pp. 53-71). New York: Springer-Verlag.

Felson, M. (1986). Linking Criminal Choices, Routine Activities, Informal Control, and Criminal Outcomes. In D. B. Cornish & R. V. Clarke (Eds.), *The reasoning criminal* (pp. 119-128). New York: Springer-Verlag.

Gardner, W., Mulvey, E. P., & Shaw, E. S. (1995). Regression analyses of counts and rates: Poisson, overdispersed poisson, and negative binomial models. *Psychological Bulletin, 118*(3), 392–404.

Goldthorpe, J. (1998). Rational Action Theory for Sociology. *The British Journal of Sociology, 49*(2), 167-192.

Groff, E. R., & Lockwood, B. (2014). Criminogenic facilities and crime across street segments in Philadelphia uncovering evidence about the spatial extent of facility influence. *Journal of Research in Crime and Delinquency, 51*(3), 277-314.

Harries, K.D., Stadler, S.J., & Zdorkowski, R.T. (1984). Seasonality and assault: explorations in inter-neighborhood variation, Dallas 1980. *Annals of the Association of American
Geographers, 74(4), 590 – 604.

Hayward, K. (2007). Situational Crime Prevention and its Discontents: Rational Choice Theory versus the ‘Culture of Now’. Social Policy & Administration 41(3), 232-250.

http://dx.doi.org/10.1111/j.1467-9515.2007.00550.x

Hendricks, S., Landsittel, D., Amandus, H., Malcan, J., & Bell, J. (1999). A Matched Case-Control Study of Convenience Store Robbery Risk Factors. Journal of Occupational and Environmental Medicine, 41(11), 995-1004.

Jeffery, C. R. (1971). Crime prevention through environmental design. Beverly Hills, CA: Sage Publications.

Johnson, E. & Payne, J. (1986). The Decision to Commit a Crime: An Information-Processing Analysis. In D. B. Cornish & R. V. Clarke (Eds.), The reasoning criminal (pp. 170-185). New York: Springer-Verlag.

LaFree, G. (1999). Declining violent crime rates in the 1990s: predicting crime booms and busts. Annual Review of Sociology, 25, 145 – 168.

La Vigne, N. & Wartell, J. (2015). Robbery of Pharmacies. Problem-Oriented Guides for Police, Problem-Specific Guide No. 73. Washington, DC: Office of Community Oriented Policing Services.

Levitt, S.D. (2004). Understanding why crime fell in the 1990s: four factors that explain the decline and six that do not. Journal of Economic Perspectives, 18(1), 163 – 190.

MacDonald, J., & Lattimore, P. (2010). Count models in criminology. In A. Piquero, and D. Weisburd (Eds.), Handbook of Quantitative Criminology (pp. 683 – 698). New York: Springer.
Marongiu, P., & Newman, G. (1997). Situational Crime Prevention and the Utilitarian Tradition. In G. Newman, R. V. Clarke, & S. G. Shoham (Eds.), Rational Choice and Situational Crime Prevention (115-135). Brookfield, VT: Ashgate.

Osgood, D. W. (2000). Poisson-based regression analysis of aggregate crime rates. Journal of Quantitative Criminology, 16(1), 21-44.

Pease, K. (2001). Rational Choice Theory. In E. McLaughlin & J. Muncie (Eds.), SAGE Dictionary of Criminology (pp. 235-236). London: SAGE Publications Ltd.

Piehl, A.M., Cooper, S.J., Braga, A.A., & Kennedy, D.M. (2003). Testing for structural breaks in the evaluation of programs. Review of Economics and Statistics, 85(3), 550 – 558.

Simon, H. (1955). A Behavioral Model of Rational Choice. The Quarterly Journal of Economics 69(1), 99-118. http://dx.doi.org/10.2307/1884852

Simon, H. (1972). Theories of Bounded Rationality. In C. B. McGuire & R. Radner (Eds.), Decision and Organization: A Volume in Honor of Jacob Marschak (pp. 161-176). Amsterdam, Netherlands: North-Holland Pub. Co.

Smith, M., Graham, A., Haddox, J., & Steffey, A. (2009). RxPatrol: A Web-based tool for combating pharmacy theft. Journal of the American Pharmacy Association, 49, 599-603.

Allen, M. (2015). Police-reported crime statistics in Canada, 2015. Juristat, 36(1), 1-55. Ottawa, Canada: Statistics Canada.

Taylor, N. (2002). Robbery Against Service Stations and Pharmacies: Recent Trends. Australian Institute of Criminology: Trends & Issues. Retrieved from http://www.aic.gov.au

Wortley, R. (2001). A classification of techniques for controlling situational precipitators of crime. Security Journal, 14(4), 63-82.