CRIMINOLOGY

DETERRENCE, CRIMINAL OPPORTUNITIES, AND POLICE*

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In this article, we join three distinct literatures on crime control—the deterrence literature, the policing literature as it relates to crime control, and the environmental and opportunity perspectives literature. Based on empirical findings and theory from these literatures, we pose a mathematical model of the distribution of criminal opportunities and offender decision making on which of those opportunities to victimize. Criminal opportunities are characterized in terms of the risk of apprehension that attends their victimization. In developing this model, our primary focus is on how police might affect the distribution of criminal opportunities that are attractive to would-be offenders. The theoretical model we pose, however, is generalizable to explain how changes in other relevant target characteristics, such as potential gain, could affect target attractiveness. We demonstrate that the model has important implications for the efficiency and effectiveness of police deployment strategies such as hot spots policing, random patrol, and problem-oriented policing. The theoretical structure also makes clear why the clearance rate is a fundamentally flawed metric of police performance. Future research directions suggested by the theoretical model are discussed.

We develop a theoretical model that joins elements of three distinct literatures on crime control—the deterrence literature, the policing literature as it relates to crime control, and the environmental and opportunity perspectives literature. Each of these literatures frames crime control differently. The deterrence literature mainly frames crime prevention in terms of two theoretical concepts—the certainty and severity of punishment. The focus of the environmental and opportunity perspectives literature is the identification of situational characteristics of the physical and social environment that influence the vulnerability of potential criminal targets, whether human or physical, to victimization. The policing literature as it relates to crime control is largely evaluative—by how much, if at all, do police numbers and deployment strategies affect crime rates? The mechanism by which any effect is achieved is left in the background. Our objective is to offer a theoretical framework that links these literatures for the purpose of characterizing and systematically analyzing how police numbers and deployment strategies could deter crime.

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We do this by posing a deterrence-based model in which the effect on crime of changes in police numbers or deployment strategies is mediated by its effectiveness in altering the availability of attractive criminal opportunities. Potential criminal opportunities are characterized in terms of the risk of apprehension were that opportunity victimized. This process in turn allows us to formalize the concept of the distribution of criminal opportunities in terms of a mathematical function $f(p_a)$, where p_a denotes the probability of apprehension. We specify a model of criminal behavior in which ceteris paribus an offender's decision to victimize a target depends on the target's attendant p_a. This model provides a theoretical structure for analyzing the crime prevention effectiveness of different strategies for using police resources in terms of their impact on $f(p_a)$. The model, for example, helps to explain why hot spots policing is more effective in preventing crime than random patrol. It also provides insight into why actual apprehension is not synonymous with crime prevention by deterrence.

Although it is not the central focus of this article, the framework we propose provides the basis for analyzing the potential crime prevention effects of formal legal sanctions, informal sanctions, and many of the subjects of environmental criminology and opportunity perspectives such as target hardening, problem solving using crime prevention through environmental design, and various forms of guardianship.

DETERRENCE, CRIMINAL OPPORTUNITIES, AND POLICING

The origins of most modern theories of deterrence can be traced to the work of the Enlightenment-era legal philosophers (Beccaria, 1986 [1764]; Bentham, 1988 [1789]). Beccaria and Bentham argued that three key ingredients to the deterrence process are the severity, certainty, and celerity of punishment. These concepts, particularly the certainty and severity of punishment, form the foundation of nearly all contemporary theories of deterrence. The enduring impact of their thinking is remarkable testimony to their innovation.

Recent reviews of the deterrence literature by Nagin and colleagues (Apel and Nagin, 2010; Durlauf and Nagin, 2011; Nagin, 2013a, 2013b) have concluded that evidence of the deterrent effectiveness of these three ingredients is strongest for the certainty of punishment but with one important qualification. The certainty of punishment is the product of a series of conditional probabilities—the probability of apprehension given commission of a crime, the probability of being charged given apprehension, the probability of conviction given charge, and the probability of various formal sanctions given conviction. Support for the deterrent effect of certainty of punishment, however, pertains almost exclusively to the certainty of apprehension. Thus, as Nagin (2013a: 199) stated: "[T]he more precise statement [about deterrence] is that the certainty of apprehension, not the severity of the ensuing consequences, is the more effective deterrent."

Discussions of the measurement of the probability of apprehension in the deterrence literature, whether by an official statistic such as the percentage of crimes cleared by arrest or offender perceptions of the risk of apprehension, commonly neglect a fundamental feature of p_a that is widely recognized in the environmental criminology literature—it is closely connected to the characteristics of the criminal opportunity, even in microplaces. Consider the example of a street block in an urban city lined with row homes on both sides and flanked at the beginning and end by intersections that lead to other streets. Behind the rows of homes are alleys that face the backs of other rows of homes to paralleling streets. Environmental criminology (Bottoms and Wiles, 1994; Brantingham and Brantingham, 1981, 1982, 1984, 1993; Jeffery, 1971; Newman, 1972), opportunity perspectives (Clarke, 1983, 1995, 1997; Felson and Clarke, 1998), routine activities theories (Clarke and Felson, 2004; Felson, 1987; Groff, 2008; Sherman, Gartin, and Buerger, 1989), and empirical studies of crime concentrations at places (Sherman, Gartin, and Buerger, 1989; Weisburd et al., 2004) all emphasize that the risk of victimization could vary for specific targets and locations even within this street block.

Many environmental, situational, and routine activities factors contribute to this variation in the risk of victimization across targets in this block, but among the most prominent is the risk of apprehension if a target is victimized (Clarke, 1997). For example, Clarke and Cornish (1985) argued that burglars do not victimize just any home on our hypothetical block but are attuned to particular characteristics of specific homes that influence the risk of apprehension. These attributes could be, for example, homes with open doors, lack of alarms, hidden areas for ease of concealment, or absence of residents. Other attributes might include the presence of an alley behind the home that allows offenders inconspicuous entry and exit or the home's adjacency to a vacant home, which reduces the chance someone will see or hear the perpetrator and call the police. Other locational characteristics that contribute to apprehension risk include lighting quality, accessibility of patrol cars to the location, and proximity to a transportation hub or intersection that allows offenders to flee more easily. More recently, Johnson and Bowers (2004) and Bowers and Johnson (2005) found that homes next to those recently burglarized are at a greater risk of burglary. Successfully burglarized homes could signal to offenders that nearby homes also have low apprehension risk.

The risk of apprehension for any given criminal opportunity also depends on the willingness of citizens to either stop a crime or call the police. This willingness might be contingent on their perceptions of the willingness and capacity of police to intervene effectively, which in turn might be affected by their trust in the police. Skogan (1986) observed that crime-ridden areas may result from (and result in) members of a community being too afraid to call the police. Likewise, Sampson (2011) argued that neighborhoods that lack social ties and collective efficacy also will lack the informal social control mechanisms necessary to control crime at these places, which could influence the willingness and capacity of community members and leaders to cooperate with the police.

Beyond characteristics of the opportunity itself and its immediate physical and social environment, the police are the most important set of actors affecting certainty of apprehension. Two distinct literatures analyze the crime prevention effectiveness of policing. One examines the impact of changes in police numbers, whereas the other examines the crime prevention effects of alternative strategies for deploying police resources, often at specific places.

The literature on the effects of abrupt and large changes in police presence has supported the conclusion that police presence affects crime, at least in some circumstances. A dramatic example is the account by Andenaes (1974) of the effect of the arrest of the entire Danish police force by the Germans during their occupation of Denmark in the Second World War. Crime rates rose immediately but not uniformly. The frequency of street crimes like robbery, whose control depends heavily on visible police presence, rose sharply. By contrast, crimes like fraud were less affected. Contemporary tests of the police–crime relationship based on abrupt increases and decreases in police presence also find large impacts, albeit less dramatic because the proportional changes in police numbers are far smaller. For reviews of this evidence, see Apel and Nagin (2010), Durlauf and Nagin (2011), and Nagin (2013a, 2013b).

The literature on the effectiveness of alternative police deployment strategies has found that police presence affects crimes rates but that the effect is dependent on how the police are used. We elaborate more on this literature because of its relevance to the interpretation of the theoretical model we develop.

Sherman's (2013) informative review of the policing literature distinguished two distinct eras in thinking about effective strategies for managing police resources to prevent crime. In the 1960s through the 1980s, such thinking was governed by the three-R philosophy of random patrol, rapid response, and reactive investigation (Berkow, 2011). As Wilson and McLaren (1972: 320) put it, "An impression of omnipresence is created by frequent and conspicuous patrol at every hour and in all sections of the community." The three-R philosophy has since been supplanted by what Sherman called the "triple-T" philosophy of targeting, testing, and tracking.

The best-known test of the three-R strategy was the Kansas City Patrol Experiment (Kelling et al., 1974), which tested the efficacy of the first R—random patrol. The experiment found no evidence that increasing the intensity of random patrol activity decreased crime. At the time of the study's release, this finding was widely interpreted as implying that police presence had no impact on crime. Sherman (2013) pointed out, however, that because of weaknesses in the design of the experiment and lapses in treatment fidelity during the course of the experiment, this negative conclusion on the ineffectiveness of police cannot be sustained. Still, as will be elaborated, there are good reasons for skepticism about the efficiency and effectiveness of random patrol.

Concerning the other two components of the three R's, studies of the effect of rapid response to calls for service (Kessler, 1977; Spelman and Brown, 1981) did not directly test for deterrence but found no evidence that rapid response improved apprehension effectiveness. This may be because most calls for service are made well after the crime event and after the perpetrator has fled the scene. Thus, as Spelman and Brown (1981) suggested, it is doubtful that rapid response by police materially affects apprehension risk and, in turn, crime rates. Similarly, apprehension risk is probably not materially affected by improved investigations. Eck (1992: 33) concluded that "it is unlikely that improvements in the way investigations are conducted or managed have a dramatic effect on crime or criminal justice." Most crimes are solved either by the offender being apprehended at the scene or by eyewitness identification of the perpetrator (Chaiken, Greenwood, and Petersilia, 1977). Modern forensic methods could improve the effectiveness of postcrime investigations, but as Braga et al. (2011) noted, clearance rates for several crime types have remained stable over the period 1970 to 2007.[1]

Rapid response and reactive investigation could have longer term deterrent effects by altering perceptions of the likelihood of apprehension. Anwar and Loughran (2011) and

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1. Cronin et al. (2007:12) reported that homicide clearance rates have *declined* steadily since the 1960s from 92 percent in 1961 to 61 percent in 2005. Subsequent investigation of Uniform Crime Reports data by Lum and Vovak (2014) between 1981 and 2011 indicate that clearance rates for assaults and burglary have only slightly declined, from 61 percent to almost 60 percent for assaults and about 16 percent to 14 percent for burglary. Clearance rates for robbery incidents have fluctuated steadily within the range of 30 percent to 35 percent.

Lochner (2007) found that the experience of apprehension triggers upward revisions in perceived probability of apprehension. Scholars of procedural justice also have suggested that how the arrest is made, in particular the treatment of parties involved, might have long-term deterrent impacts (Tyler, 1990; Tyler and Huo, 2002). The most persuasive evidence of the deterrent effect of policing pertains to the first T—targeting.

One example of a targeting strategy for which there is good evidence of effectiveness is "hot spots" policing. The idea of hot spots policing stems from a striking empirical regularity that crime concentrates at specific and discrete locations (cf. Brantingham and Brantingham, 1999; Eck, Gersh, and Taylor, 2000; Roncek, 2000; Sherman, Gartin, and Buerger, 1989; Weisburd and Green, 1995; Weisburd et al., 2004). Sherman and Weisburd (1995) were the first to test the efficacy of concentrating police resources on crime hot spots. In this randomized experiment, hot spots in the experimental group were subjected to, on average, a doubling of police patrol intensity compared with hot spots in the control group. Declines in total crime calls ranged from 6 percent to 13 percent, with even more impressive impacts on disorder-related calls. Weisburd and Green (1995) also found that hot spots policing reduces disorder calls for service, although it had less impact on violent or property crime calls. Braga, Papachristos, and Hureau's (2012) informative review of hot spots policing summarized the findings from ten experimental and nine quasi-experimental studies, which involved 25 distinct tests of hot spots policing. Of the 25 tests of hot spots policing, all but 5 found evidence of significant reductions in crime without evidence of displacement to adjacent locations (Weisburd et al., 2006).

Then what can explain the success of targeted policing strategies compared with reactive strategies, especially those that focus on arrest? Nagin (2013a) provided a useful perspective on the answer to this question. He distinguished two distinct crime prevention functions of the police—their role as apprehension agents after the commission of a crime and their role as sentinels. In their sentinel role, the police are acting in the parlance of Cohen and Felson (1979) as "capable guardians." Capable guardians are persons whose presence discourages a motivated offender from victimizing a criminal opportunity (Eck and Weisburd, 1995; Felson, 1994, 1995). Especially in places where attractive crime opportunities are abundant, partly because of the lack of non–police-capable guardians, the police are the sole potential guardians (i.e., sentinels).

Nagin (2013a) argued that in their sentinel role, police deter crime by reducing offender perceptions of the probability that the crime can be completed successfully. More than four decades ago, Wilson and McLaren (1972: 320) made the same point: "The elimination of the actual opportunity, or the belief in the opportunity, for successful misconduct is the basic purpose of patrol. The thief's desire to steal is not diminished by the presence of the patrolman, but the opportunity for successful theft is." Failure to complete the crime has two undesirable consequences from the offender's perspective. One is that he or she does not enjoy the gain from having committed the crime; in which case, there is no point in committing it in the first place. The second is that failure to complete the crime leaves the perpetrator vulnerable to apprehension and the imposition of legal sanctions. By contrast, in their role as apprehension agents, police are responding to a criminal event that has already occurred and by definition has not been deterred. Apprehension cannot undo a criminal event that has already occurred; it can only potentially deter future criminal events by the person apprehended and possibly others who see or hear of the apprehension. Wilson and McLaren (1972: 320) made this point with their observation:

"Insofar as patrol fails to eliminate desire and belief in opportunity, misconduct results, [patrol is left to] investigate offenses, apprehend offenders, and recover stolen property."

Although apprehensions may protect public safety by capturing and incapacitating sometimes dangerous and repetitive offenders, evidence that apprehensions themselves result in a material deterrent effect is limited to a few suggestive studies noted previously. By contrast, the evidence on the crime prevention effects of police presence suggests that in their sentinel role, police can have a material deterrent effect, especially when targeting locations in which opportunities for crime are abundant (i.e., hot spots). We turn now to formalizing these observations about deterrence and criminal opportunities and the role of police in influencing both.

MODEL

The model is intended to provide a theoretical framework for understanding how target and situational characteristics and police deployment strategy affects crime and arrest rates. Although its parameters are unlikely to be amenable to empirical estimation, the model structure does serve to highlight important research topics that are amendable to empirical analysis. These topics are discussed in the Conclusion.

The model assumes that would-be offenders are rational, not necessarily in the formal sense of the term as applied in much of economics, but in the sense used in the rational offender tradition of criminology (Clarke and Cornish, 1985; Nagin and Paternoster, 1993). As used in criminology, rationality implies a conscious weighing of the benefits and costs of offending contingent on and constrained by factors of the environment, situation, and individual. Offending occurs if the perceived benefits exceed the perceived costs. The attractiveness of a criminal opportunity from the perspective of a would-be criminal depends on a multitude of factors. One is the potential gain from its victimization. For acquisitive crimes like robbery and burglary, this will include the monetary value of the property that is taken. The thrill of offending could be part of the accounting of gain. Included on the cost side are the risk and severity of both formal and informal sanctions. As noted, the probability of incurring formal and informal sanction costs is the product of a series of conditional probabilities—probability of apprehension given the crime is committed, probability of conviction given apprehension, and so on. Because of its centrality in the deterrence process, our focus is on the probability of apprehension.

The model we lay out in this article builds on valuable and underappreciated work by Cook (1979). His purpose was to critique the validity of econometric models of that era that regressed the crime rate on various measures of the clearances rate. Cook demonstrated that the clearance rate is not a valid measure of the risk of apprehension posed by the police; therefore, its association with the crime rate cannot possibly identify the deterrent effect of policing. We make this same point with a model that shares some characteristics with Cook's model. We move beyond Cook's econometric focus by positing a specific distribution of criminal opportunities as they relate to p_a and exploring its implications for various policing strategies and criminal justice policies more generally for preventing crime. Our work also is informed by recent reviews of the deterrence literature on the central role of apprehension risk in the deterrence process.

We begin by laying out a model of the decision to victimize a criminal opportunity and develop its implications for target selection as a function of risk of apprehension. A key parameter of this model is p_a^*, which measures the maximum risk conditional on target characteristics that offenders are willing to incur. We explore the implications of this model for the efficient use of police resources to prevent crime and for the measurement of police performance. We then explore the implications of a more general model that allows for heterogeneity in p_a^*.

The model assumes that would-be offenders are on the lookout for "profitable" targets—namely targets in which expected gain (denoted by G) exceeds expected costs by some threshold amount K. Two broad classes of cost are distinguished—formal and informal sanction costs as well as all other costs such as shame or victim resistance cost that are unrelated to sanction risk. Profitable targets are those in which:

$$G - p_a p_{s|a} S - C > K \tag{1}$$

where $p_{s|a}$ is the probability of sanction given apprehension, S is perceived total informal and formal sanction cost, and C measures all other perceived costs that are unrelated to sanction risk. Equation 1 is described as measuring the expected "profit" from victimizing a target because the first term measures the total gain in terms of both loot and other psychological factors and the second two terms measure potential cost of victimizing the target. Thus, targets will only be victimized if perceived profit exceeds the threshold K. Many factors could influence K, including the possibility of victim retaliation and the offender's risk preferences. Also relevant is the availability and attractiveness of legal alternatives to crime. Potential offenders with better legal alternatives to crime, whether because of the general availability of legal employment in their community or their personal skill and aptitude, would be expected to have a larger K. This decision rule could be elaborated in various ways; for example, by explicitly accounting for risk preference or the impact of prior contacts with the criminal justice system on perceptions of sanction costs. However, our purpose is to focus on the role of p_a.

Equation 1 can be rearranged to define the maximum value of p_a that is acceptable, which we denote by p_a^*, for the target to be victimized:

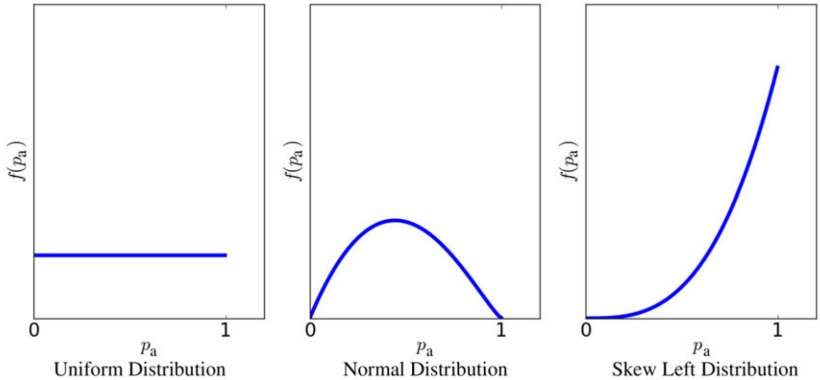
$$p_a^* < \frac{G - C - K}{p_{s|a} S} \tag{2}$$

Equation 2 implies that measures that reduce the gains (G) from crime like electronics that make radios stolen from cars inoperable or increase non–sanction-related costs such as shame will reduce p_a^*. P_a^* also can be reduced by increasing the denominator of equation 2, which would involve increasing sanction cost. By reducing the attractiveness of targets by either reducing gain or increasing sanction cost, rational offenders will respond by reducing the maximum risk they are willing to bear. We will return to this observation shortly.

We note that equation 2 shares some connections with Cornish and Clarke's (2003) taxonomy of crime prevention techniques. One component of the taxonomy—reducing rewards—is explicitly represented. Others are incorporated implicitly. Both increasing effort and increasing risks can be seen as increasing C. Others such as reducing provocations and removing risk, however, have no natural mapping.

As noted, p_a widely varies across criminal opportunities. Another noteworthy feature of variation in p_a is that it spans the full range of allowable values of a probability—0 to 1. The probability of successfully robbing a well-guarded public official such as the President of the United States is 0 because the probability of apprehension is 1, whereas the

Figure 1. Some Possible Forms of the Distribution of Criminal Opportunities

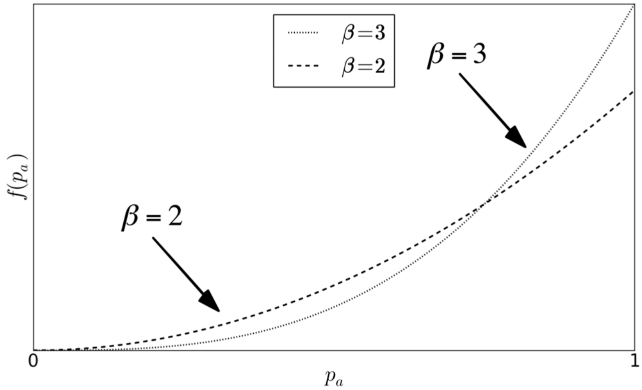


probability of apprehension is close to 0 if the target is an elderly individual on a secluded street. Banks and convenience stores also are exemplars of this point: The probability of apprehension attending the robbery of a bank in a congested downtown location is far higher than the probability of apprehension if the target is a rural convenience store late at night. As these examples make clear, a discussion of the probability of apprehension without reference to the characteristics of the criminal opportunity is ill posed.

Let $f(p_a|T)$ denote the probability distribution of criminal opportunities over the range of p_a, namely 0 to 1, *conditional* on a vector T, composed of other relevant target characteristics that contribute to the attractiveness of a criminal opportunity from the perspective of the would-be offender, namely G, S, C, and $p_{s|a}$ in our model. To reduce notational clutter in the ensuing discussion, we drop T from our reference to $f(p_a)$, but it is important to keep in mind that $f(p_a)$ is conditional on a fixed set of other relevant target attractiveness characteristics.

The exact functional form of $f(p_a)$ is unknown. Figure 1 depicts three very different possibilities—a uniform distribution over the 0–1 interval, a normal-like distribution over the 0–1 interval, and a skew left distribution over the 0–1 interval. In our judgment, the skew left distribution probably most closely reflects reality. This implies that "sure-thing" opportunities where p_a is small are less available than more risky opportunities. We speculate that this is the case for several reasons. The concentration of large amounts of crime at a very small proportion of microplaces indicates that the best opportunities for crime (those with low apprehension risk) concentrate at these locations. Hot spots are places where guardianship is low, where environmental factors are conducive to offending (i.e., poor lighting, alleys and hiding places, empty houses, transportation hubs, and busy malls), and where converging routines of offenders and victims provide opportunities for crime. Second, as emphasized, $f(p_a)$ is conditional on other target characteristics affecting the attractiveness of a criminal opportunity including the value of the property at the target. Targets of any material value are almost always secured in ways that increase the risk of apprehension if the target is victimized. Those that are not so secured are quickly victimized and thereby removed from the distribution of opportunities. Thus, by a Darwinian-like selection process, low-risk apprehension targets are winnowed from

Figure 2. The Distribution of Criminal Opportunities ($f\ (p_a)$) for $\beta = 2$ and $\beta = 3$



the population of criminal opportunities either by their being better secured or by their removal from the population by their victimization.

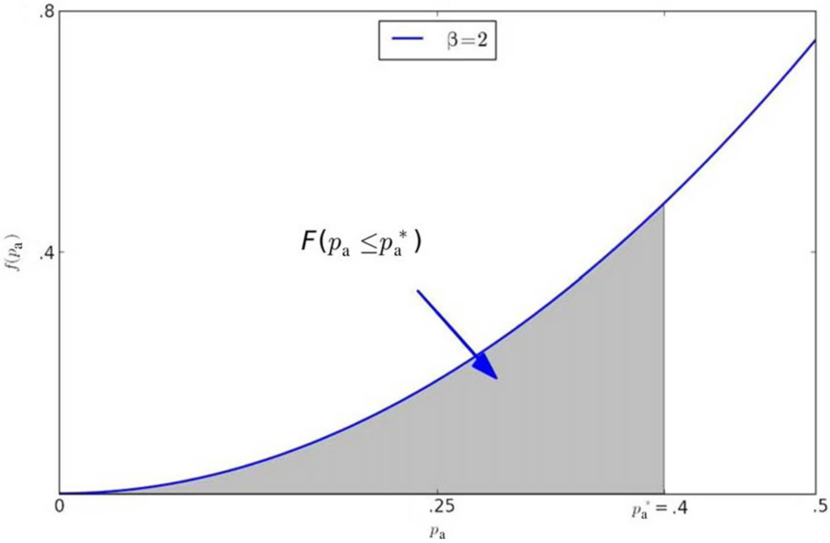
The key points we wish to make, however, do not depend on the assumption of a leftward skewed distribution of $f\,(p_a)$ or more generally on its specific functional form. Notwithstanding, it is helpful to pose a specific functional form of $f\,(p_a)$ to illustrate concretely our key conclusions. In the analysis that follows, we assume:

$$f\,(p_a) = (\beta + 1)\,p_a^{\beta}, \text{ where } \beta \geq 1 \text{ and } 0 \leq p_a \leq 1 \tag{3}$$

For this functional form, the degree of leftward skew is determined by the parameter β. Figure 2 graphs $f\,(p_a)$ for $\beta = 2$ and $\beta = 3$. Observe that $f\,(p_a)$ is left skewed and always rising in p_a for both values of β.[2] However, the degree of leftward skew is greater for $\beta = 3$ than for $\beta = 2$, which implies that the availability of low-risk opportunities where p_a is small becomes increasingly sparse as β increases. This observation in turn implies that actions that improve the protection of the entire population of opportunities by increasing the risk of apprehension attending their victimization can be characterized as policies that increase β.[3] For example, more valuable property will typically, but not always, be better protected than less valuable property. Actions by property owners to improve the security of their property in ways that increase the risk of apprehension if the target were victimized, for example, by installing an alarm system, will have the effect of increasing β in the context of our model. Thus, we would expect a higher prevalence of high-value targets for the $\beta = 3$ curve than in the $\beta = 2$ curve. We develop implications of how policing strategies could affect β in the next sections. See Cook (1986) for an extended discussion of how target characteristics and overall crime rates influence self-protection efforts by private citizens.

2. Equation 3 also is defined for $0 \leq \beta < 1$. However, over this range, $f(p_a)$ is right skewed.
3. As we will elaborate, we characterize policies that increase risk of apprehension for the *entire* population of opportunities as "β increasing" to distinguish such policies that are targeted on increasing apprehension risk for selected opportunities.

Figure 3. The Crime Rate ($F(p_a \le p_a^*)$) for $\beta = 2$ and $p_a^* = 0.4$



The model assumes that all targets for which $p_a \le p_a^*$ will be victimized. Let $F(p_a \le p_a^*)$ denote the cumulative distribution function of $f(p_a)$. $F(p_a \le p_a^*)$ measures the proportion of opportunities for which p_a is less than a threshold value p_a^*. It equals:

$$F(p_a \le p_a^*) = p_a^{*(\beta+1)} \tag{4}$$

Under this setup, $F(p_a \le p_a^*)$ measures the crime rate, namely the proportion of potential criminal opportunities that are actually victimized, despite whether those victimizations are reported to the police. Figure 3 graphically depicts $F(p_a \le p_a^*)$ for $\beta = 2$ and $p_a^* = .4$. $F(p_a \le p_a^*)$ equals the shaded area to the left of p_a^*.

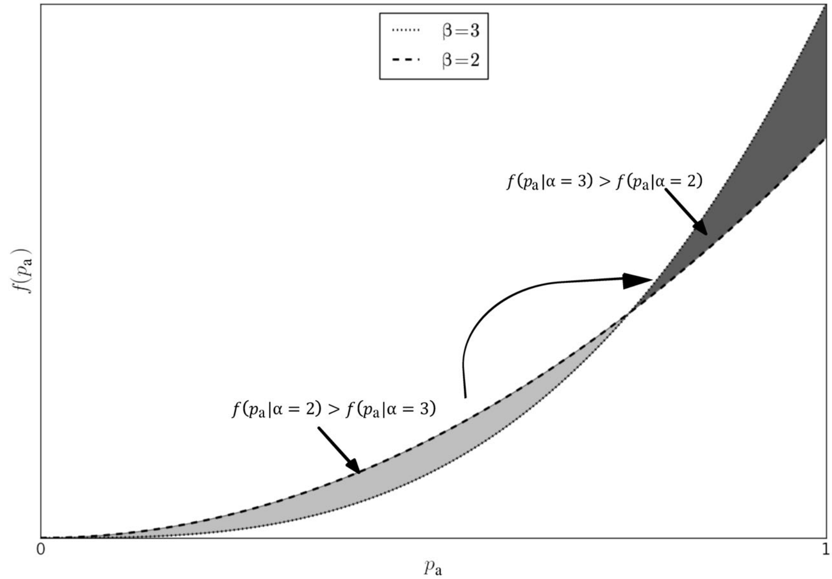
One final quantity is useful for our purposes. It measures the proportion of criminal opportunities that are actually victimized, namely those for which $p_a \le p_a^*$, that result in apprehension. This quantity is the equivalent of the clearance rate—the proportion of crimes that result in arrest. We denote the clearance rate by A. It equals[4]:

$$A = \frac{\beta+1}{\beta+2} p_a^* \tag{5}$$

Thus, for example, for $\beta = 2$ and $p_a^* = .4$, the clearance rate A equals .3. Its location is shown in figure 4. Note that A is always less than p_a^* because it is averaging only over all $p_a \le p_a^*$. As such it is not a valid measure of the average of p_a over all potential targets. It is only the average of p_a over the nonrandom set of opportunities that are actually victimized. Thus, it only measures police effectiveness in their role as apprehension agents, not their effectiveness in deterring crime in their role as sentinels. Their effectiveness in

4. $A = \frac{\int_0^{x^*} (\beta+1) x^{n+1} dx}{x^{*n+1}} = \frac{\frac{\beta+1}{\beta+2} x^{*\beta+1}}{x^{*n+2}}$

Figure 4. Moving Criminal Opportunities by Increasing β from 2 to 3



deterring crime depends on their ability to alter $f(p_a)$ in a way that reduces the availability of attractive targets.

The model reaffirms a point made by Cook (1979) three decades ago—the clearance rate is a fundamentally flawed metric for assessing police performance with regard to crime prevention and deterrence. Put differently, police effectiveness in their role as apprehension agents is an outgrowth of a failure in their role as sentinels to have successfully prevented the crime from happening in the first place.

The model highlights a fundamental distinction between police preventing crime by increasing p_a and the actual event of an arrest. Suppose $p_a = .3$ for a particular target. This value implies that over the long run, if this target were repeatedly victimized, then an arrest would occur in 30 percent of those occasions of victimization. In our model, each of those arrests marks an occasion in which the police are successfully operating in their role as apprehension agents. Their 30 percent success rate is what in fact defines p_a to be .3. If police slip in their effectiveness as apprehension agents, then this will have the effect of reducing p_a below .3, which in turn will make it an even more attractive target for victimization. Consequently, if police are ineffective in their role as apprehension agents, then their deterrent credibility is undermined.

Formally, our model requires that the long-run rate of apprehension of persons who *actually victimize* potential targets of crime with the same p_a equals p_a for those targets. The words "actually victimize" are emphasized because the objective of the sentinel role is to project a sufficiently high p_a to avert the victimization of criminal opportunities entirely. In the prior example, the fact of the target's repeated victimization even at $p_a = .3$ implies that $p_a \leq p_a^*$, which in turn implies that police in their role as sentinels were not successful in preventing its victimization in the first place. Suppose, however, in their sentinel role the police were successful in increasing p_a to a level, say .4, where

$p_a > p_a^*$. It would now be the case that the target would never be victimized and as a consequence would never generate actual arrest events.

An analogy from the Cold War era between the United States and the Soviet Union is nuclear deterrence. In this context, the objective of both sides was to pose a sufficiently high threat of nuclear retaliation to deter either side from actually initiating a nuclear attack. Thankfully, deterrence was effective in this context. Of course, in the current context, deterrence is not always possible. However, it is important to recognize that arrest events are triggered by a failure of deterrence to avert the commission of the crime in the first place.

Manski (2005, 2006) offered a social accounting framework that is useful in clarifying the ideal role of police in crime prevention. The accounting framework includes three components—the cost of crime, the cost that attends the apprehension and punishment of offenders, and the costs associated with implementation of the enforcement tactic itself. In an ideal world, the objective is to minimize the sum of these costs. As emphasized, our model requires the apprehension and punishment of offenders at a rate consistent with p_a for deterrence to be effective, which in turn averts the social cost of crime. However, as the Manski cost accounting framework is intended to make clear, the apprehension and punishment of offenders is not costless to either society as a whole or to the individual offender and his or her family. This point is inherent in Cesare Becarria's (1986 [1764]) admonition that it is "better to prevent crimes than punish them." When prevention is successful, the social cost of both crime and punishment is averted.

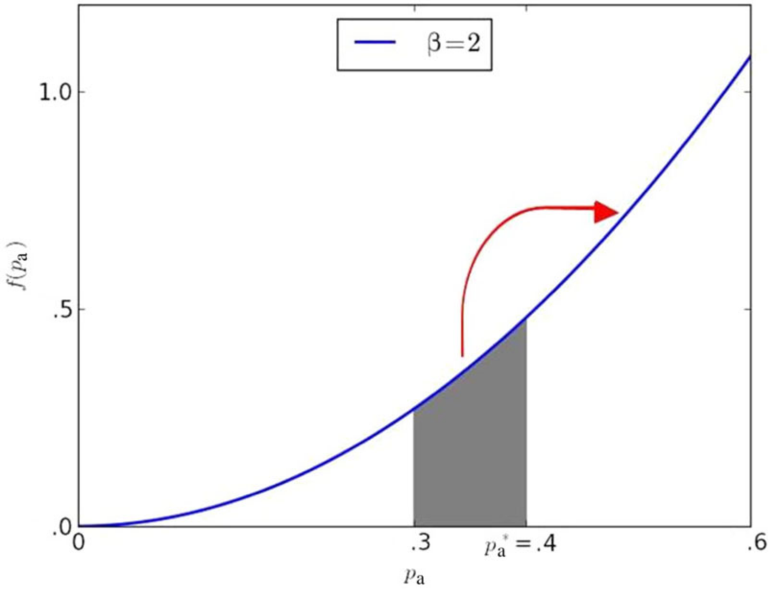
We return now to the question of how police might prevent crime in their role as sentinels. In the context of our model, this can be done in three ways: 1) increase the left skew in $f(p_a)$ by increasing β; 2) for a selected set of opportunities increase their p_a so that $p_a > p_a^*$, which thereby averts their being victimized; and/or 3) increase p_a^*. We discuss these alternatives in turn.

Policies that increase β will reduce crime for any fixed p_a^*. Such policies thin out the low-risk tail of $f(p_a)$ and thicken its density for higher risk opportunities where p_a is closer to 1. Figure 5 illustrates such a shift for a change in deterrence regime from $\beta = 2$ to $\beta = 3$. The shaded area in the lower tails of the density functions below the intersection where $f(p_a|\beta = 2) > f(p_a|\beta = 3)$ is "transferred" to the other shaded area where $f(p_a|\beta = 3) > f(p_a|\beta = 2)$ in the upper regions of the density functions.

We describe policies of this type as nontargeted because they are designed to increase p_a for the entire universe of opportunities. Examples of such policies in the policing domain are increasing random patrols without regard to the spatial distribution of crime or hiring more police and distributing them across police stations in proportion to status quo staffing levels. These types of deployment strategies have the effect of increasing p_a for the entire population of criminal opportunities. Examples of noncriminal justice policies that might increase β are requiring all residences be alarmed or uniformly improving street lighting across a city.

Although nontargeted policies that increase β will necessarily reduce the availability of attractive opportunities where $p_a \leq p_a^*$, they also will increase p_a for opportunities where p_a is already greater than p_a^*. Likewise, this increase occurs for other opportunities where $p_a < p_a^*$, p_a will not be increased sufficiently to make them unattractive. For these reasons, we are skeptical of the effectiveness and efficiency of nontargeted policies because they will have the effect of marginally increasing p_a for many opportunities that are already

Figure 5. Targeting Opportunities Where .3 ≤ p_a ≤ .4 ($\beta = 2$)



unattractive and do not increase p_a sufficiently for many currently attractive targets to make them unattractive.

Consider next targeted policies that focus on increasing p_a for selected targets. In the context of our model, the most effective and efficient policies for targeted crime prevention are those that focus on opportunities in which $p_a \leq p_a^*$. To illustrate this point, consider again the case of $\beta = 2$ and $p_a^* = .4$. As shown in figure 4, suppose a tactic could be identified that moved the entire set of opportunities with $.3 \leq p_a \leq .4$ to the region of $f(p_a)$ above p_a^*. Such a move would be the equivalent of a policy that reduced p_a^* to .3 because in this stylized example, there are no longer any opportunities in the interval from .3 to .4. If this were possible, then the crime rate would decline by 57.0 percent. The clearance rate A also would fall from 30.0 percent to 22.5 percent. The clearance rate declines because the only remaining attractive targets have $p_a \leq .3$. These opportunities are hardest for the police to solve in their roles as apprehension agents. To be clear, this result does not reflect declining competence. To the contrary, it is a reflection of the effectiveness of the sentinel-based policy that moved all targets in the interval $.3 \leq p_a \leq .4$ into the unattractive range of $p_a > .4$. This policy has another attractive feature: The decline of the clearance rate implies that the police will be making fewer arrests. Thus, this policy can reduce crime and punishment, both of which are socially costly.

For a concrete example of such a targeting strategy, consider a street that has a check-cashing business on the corner, next to a narrow alley between two buildings or rows of homes. Customers cash their checks in the evening, and would-be robbers wait in the alley for these individuals to walk by so they can victimize them. The specific location and time of such opportunities allow for a low apprehension risk: The alley reduces the visibility of the offender and provides a viable escape route, and the evening hour also helps to reduce visibility. Increased (but not predictable) police presence at that location would increase p_{a} for these crime opportunities. Officers who understand the environment and crime opportunities will look for and see individuals lurking in the alley around the time people are cashing their paychecks. They might choose to question such individuals, or would-be offenders could simply move on when seeing a police officer walking around the area on foot or patrolling nearby. Other environmental changes, such as lighting, closed-circuit television cameras, or a fence that blocks the narrow alley, also might be ways of making this opportunity less attractive to offenders. In all of these situations, the crime is averted by shifting the opportunity from under to over the offender's acceptable maximum apprehension risk threshold. Indeed, when the opportunity is not victimized (and no arrest is made), both the rate of crime and number of apprehensions decline in this locale. At hot spots, the possibility of this effect is concentrated because low-apprehension-risk opportunities concentrate at those places.

The effectiveness of targeting policies in reducing both crime and arrest, however, is predicated on the targeting policy being effective in moving formally attractive criminal opportunities where $p_{\mathrm{a}} < p_{\mathrm{a}}^*$ to the region where $p_{\mathrm{a}} > p_{\mathrm{a}}^*$. Targeting policies that do not increase p_{a} above p_{a}^* could backfire. Not only will they be ineffective in reducing crime, but also they will increase the clearance rate by increasing p_{a} for these opportunities but not by enough to prevent crime. Targeting might fail in this fashion for many reasons. Police officers could sporadically hit crime hot spots, not stay long enough to maximize a deterrent or residual deterrent effect, or do so with great predictability, all of which could reduce their ability to prevent crime (see Koper, 1995; Sherman, 1990). They might drive through hot spots without getting out of their vehicles or engaging with suspicious individuals. If they choose to arrest an individual for a low-level disorder crime (also known as "zero tolerance" or disorder policing), then the officer might be removed from the location for a predictable period of time, leaving opportunities vulnerable to victimization. Officers might lose authority in some places if they treat people poorly, reducing their respect or the believability of their authority in a neighborhood and, in turn, reducing the motivation for residents to call them. All of these factors could blunt the ability of police to increase apprehension risk of attractive criminal opportunities into the unattractive range. The result will be that crimes will not be averted because of the marginal but insufficient increases in p_a, but clearance rates might increase even though the policy was a failure in reducing crime. This example is another illustration of why the clearance rate is a poor performance measure of police performance.

The third way to reduce crime in the context of this model is to create incentives that would cause would-be criminals to reduce the maximum risk of apprehension that they are willing to accept, namely to cause them to reduce p_{a}^*. In the context of our model, these policies reduce the rewards of crime (G), increase perceived sanction cost (S), increase perceived nonsanction cost (C), or increase the sanction risk given apprehension ($p_{\mathrm{s|a}}$). These policy levers often involve the police working with other agents of the criminal justice or social service systems to alter these parameters of the model effectively. Operation Ceasefire (Kennedy, Braga, and Piehl, 2001) is an example of such coordinated effort in which the Boston Police coordinated with prosecutors to increase the certainty and severity of sanctions for gang members who committed violent crimes. Similarly, "pulling levers" and other problem-oriented policing strategies focused on high-risk offenders (Kennedy, 1997, 2008; Tita et al., 2003; see also the systematic review by Braga and Weisburd, 2012) and places (Taylor, Koper, and Woods, 2011) have been promising in combining deterrence efforts targeting high-risk offenders at places while applying other innovative approaches to reduce an offender's p_a^*. These strategies can be seen as increasing sanction cost (S) for targeted offenders. Police could partner with social service agencies to create incentives for offenders to take advantage of training opportunities that provide legal alternatives to crime as was done in the Chicago Safe Neighborhoods program (Papachristos, Meares, and Fagan, 2007). If it is successful, then this program will increase K, the minimum acceptable "profit" from crime.

Not all programs focus on threatening offenders with apprehension or sanctions. P_a^* could be reduced effectively through the application of procedural justice or restorative shaming (Mazerolle et al., 2014; Tyler, 1990), or increasing knowledge and accessibility of treatment or programs (see Howell and Hawkins, 1998), in which the police may be involved directly or indirectly. Such an effort can be seen as affecting nonsanction costs, C.

Our analysis assumes that all offenders have the same p_a^*. We next explore the implications of heterogeneity in p_a^*. The potential sources of such heterogeneity include differences across offenders in risk preferences, perceptions of the costs of criminal and noncriminal sanctions, and motivation (e.g., for drug-addicted offenders, "motivation" could be the time since their last "fix"). Also, variation in the social and physical environment that offenders populate could influence perceptions of costs, benefits, and risk. We explore the implications of such heterogeneity, not the reasons for it. We do, however, return to the important topic of its sources in the discussion of future research.

In the context of our model, the introduction of heterogeneity in p_a^* requires the specification of the density function $g(p_a^*)$, which describes the distribution of p_a^* across the population of potential offenders. Equations 6 and 7 specify the calculation of the crime rate (F) and clearance rate (A) for the case where p_a^* is heterogeneous:

$$F = \int_0^1 p^{*^{\beta+1}} g\left(p_a^*\right) dp_a^* \tag{6}$$

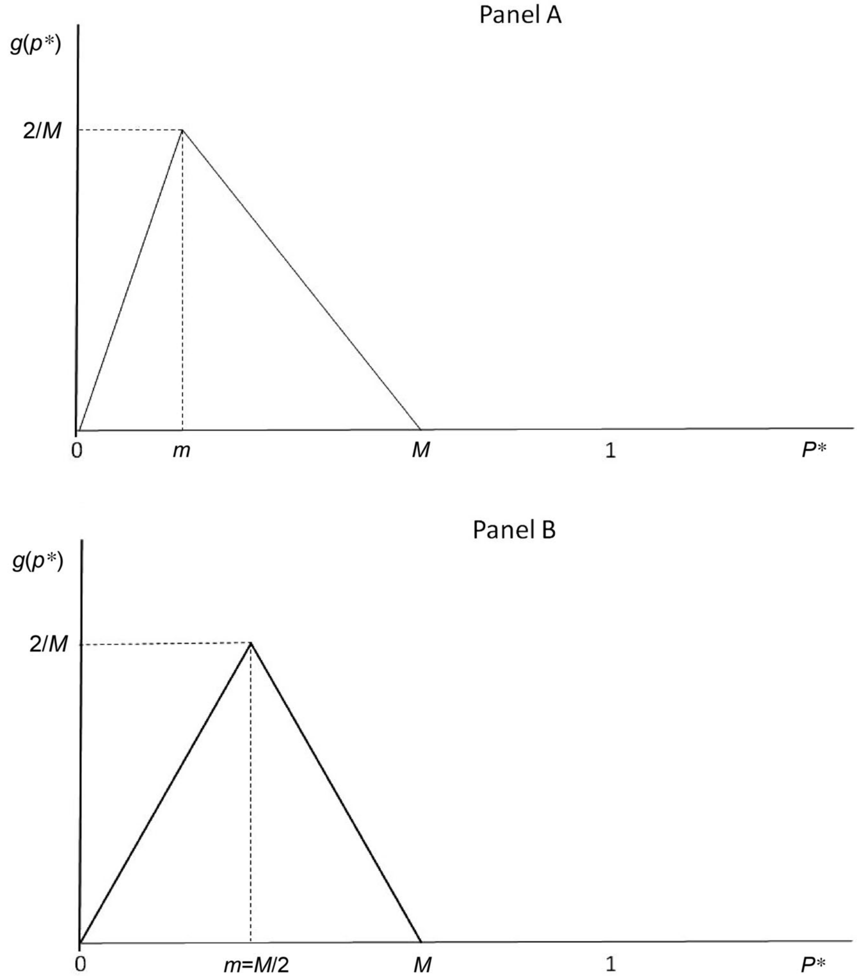
$$A = \frac{\beta+1}{\beta+2} \int_0^1 p^* g\left(p_a^*\right) dp_a^* \tag{7}$$

Observe that equations 6 and 7 generalize their counterpart relationship with homogeneous p_a^*, equations 2 and 5, respectively, by integrating over the now heterogeneous distribution of p_a^*.

The quantities F and A can be calculated numerically for any density $g\left(p_a^*\right)$. We explore the specific case where $g\left(p_a^*\right)$ follows the triangular distribution shown in panel A of figure 6. This distribution is defined by two parameters—M, which defines the maximum value of p_a^* in the offender population, and m, which defines the value at the peak of the triangle (i.e., modal value of p_a^*). As shown in figure 6, $g\left(p_a^*\right)$ must equal $2/M$ at m to ensure that the total area of the density equals 1.

We chose to explore the implications of heterogeneity in p_a^* based on this triangular distribution for several reasons. First, it generates a closed-form solution of F and A. Second, its parameters, as described previously, are easily interpretable. Third, although there is no empirical evidence on the distribution of p_a^*, if only because of the novelty

Figure 6. Triangular Distribution of $g\,(p_{\mathrm{a}}^{*})$



of the model, the triangular distribution in our judgment is plausible. It implies most offenders have roughly similar p_{a}^{*} (i.e., close to m) but that there is a minority of outliers with comparatively large or small p_{a}^{*}. The latter can be thought of as the small group of very high-risk-taking offenders who as a consequence commit crime at a high rate.

Equations 8a and 8b define $g\,(p_{\mathrm{a}}^{*})$ for this triangular distribution:

$$g\,(p_{\mathrm{a}}^{*}) = \frac{2}{mM}p^{*} \quad \text{for} \quad p^{*} < m \tag{8a}$$

$$g\,(p_{\mathrm{a}}^{*}) \;= \frac{2}{M}\left(\frac{M - p^{*}}{M - m}\right) \quad \text{for} \quad p_{\mathrm{a}}^{*} > m \tag{8b}$$

For the triangular distribution of p_a^* defined by equations 8a and 8b, it can be shown that:

$$F = \left[\frac{2}{(\beta+2)(\beta+3)}\right]\left[\frac{M^{\beta+2} - m^{\beta+2}}{M-m}\right] \tag{9}$$

$$A = \left(\frac{\beta+1}{\beta+2}\right)\left(\frac{M+m}{3}\right) \tag{10}$$

To explore implications of allowing for heterogeneity in p_a^*, we consider two specific cases. One in which the triangular distribution is symmetrical is shown in panel B of figure 6. Symmetry occurs when $m = M/2$. For this case, p_a^* in the homogenous model equals the mean or expected value of p_a^* in the model with heterogeneity, $M/2$. This equality provides a useful basis for comparing the predictions and implications of the models with and without heterogeneity. We also consider the case where $m = 0$.

For the case of symmetry, F and A are as follows:

Homogeneous p_a^*

$$F = \left(\frac{M}{2}\right)^{\beta+1} \tag{11a}$$

$$A = \frac{\beta+1}{\beta+2} M/2 \tag{11b}$$

Heterogeneous p_a^*

$$F = \left[\frac{4M^{\beta+1}}{(\beta+2)(\beta+3)}\right][1 - .5^{\beta+1}] \tag{12a}$$

$$A = \frac{\beta+1}{\beta+2} M/2 \tag{12b}$$

In these circumstances, the clearance rate in both models is the same. Their equality is reflective of the more important point that the clearance rate is a faulty measure of police effectiveness in preventing crime regardless of whether p_a^* is homogenous or heterogeneous.

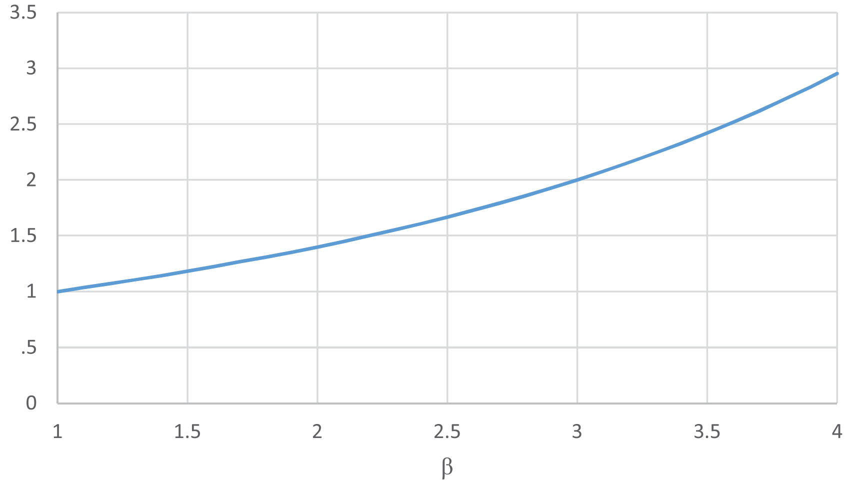
Table 1 calculates the crime rate in the models with and without heterogeneity for various values of β and M. In both models, the crime rate declines as β increases. Thus, our conclusion from the homogeneous model that the nontargeted type policies that increase β and thereby thin out the tail of low-apprehension-risk opportunities holds in the more general model that allows for heterogeneity in p_a^*.

However, interesting differences are shown in the crime rate between the two models. For $\beta = 1$, the crime rate is equal for the models with and without heterogeneity for all values of M. However, for $\beta > 1$, the crime rate with heterogeneity is higher than that with homogeneous p_a^* for all values of M. Furthermore, the relative difference between

Table 1. Crime Rates With and Without Heterogeneity in p_{a}^*

β	*M*	Crime Rate Without Heterogeneity (3)	Crime Rate With Heterogeneity (4)	Ratio of (4) to (3)
1	.50	.0625	.0625	1.00
2	.50	.0156	.0219	1.40
3	.50	.0039	.0078	2.00
4	.50	.0010	.0003	2.95
1	.25	.0156	.0156	1.00
2	.25	.0020	.0027	1.40
3	.25	.0002	.0005	2.00
4	.25	.0000	.0000	2.95
1	.10	.0025	.0025	1.00
2	.10	.0001	.0002	1.40
3	.10	.0000	.0000	2.00
4	.10	.0000	.0000	2.95

Figure 7. Ratio of the Crime Rate With and Without Heterogeneity in p_{a}^*



the heterogeneous and homogeneous cases grows with β even as the absolute level of the crime rate declines.

These patterns are reflective of the effect of β on the shape of $f(p_{\mathrm{a}})$. For $\beta = 1$, $f(p_{\mathrm{a}})$ rises linearly from 0 to 1. The linearity of $f(p_{\mathrm{a}})$ combined with the assumption that $g(p_{\mathrm{a}}^*)$ is triangular and symmetrical results in no difference in the crime rate between the heterogeneous and homogenous model regardless of M. However, for $\beta > 1$, $f(p_{\mathrm{a}})$ has a nonlinear leftward skew, which implies that the crime-committing frequency of offenders with $p_a^* > M/2$ grows faster than the decline in offending frequency of those with $p_{\mathrm{a}}^* < M/2$. Thus, even though the proportion of offenders is the same (50 percent) with p_{a}^* above and below $M/2$, the crime rate is higher for the heterogeneous p_{a}^* model. Furthermore, because of the leftward skew as β increases, the relative differences grows with β. Finally, note that the relative difference in crime rate is independent of M and thus depends only on β. Figure 7 graphs the ratio of crime rate with heterogeneity to the rate without heterogeneity as a function of β.[5]

We also consider the case where $m = 0$. In this case, the modal value of p_a^* is 0, which corresponds to individuals who will never commit a crime regardless of the attractiveness of the target. In this case, $g(p_a^*)$ declines linearly from $p_a^* = 0$ to $p_a^* = M$. Because p_a^* is small for most offenders and most offenders commit few crimes, only the minority with a p_a^* in the region of M will commit larger numbers of crimes. This model will generate the right skew in offending rates that has been repeatedly documented. For this model, it can be shown that the mean value of p_a^* equals $M/3$. In the homogeneous p_a^* model for $p_a^* = M/3$, $F = (M/3)^{\beta+1}$ and $A = \frac{\beta+1}{\beta+2}M/3$. By comparison, for the heterogeneous model $F = \frac{2}{(\beta+2)(\beta+3)}M^{\beta+1}$ and $A = \frac{\beta+1}{\beta+2}M/3$. Observe that, as in the symmetrical case, the clearance rate in the models with and without heterogeneity is the same. It also can be shown that the crime rate is always higher in the heterogeneous model for all values of M and β. Also, as in the symmetrical case, the relative difference between the heterogeneous case and the homogeneous case is independent of M and increasing in β. Thus, our key conclusions are not dependent on the specific form of the triangular distribution.

We turn now to the issue of the policy implications of the model with heterogeneity compared with the model without heterogeneity. First, we reiterate that our criticism of the clearance rate as a performance measure stands in the model with heterogeneity. Second, the conclusion that policies that increase β will reduce the crime rate by thinning out the tail of attractive low-risk opportunities also stands in the model with heterogeneity. Third, figure 7 implies that the crime-reduction gains from policies that increase β are larger in the presence of heterogeneity because no clear boundary in the form of a single p_a^* demarks attractive from unattractive criminal opportunities, as is the case when all offenders have the same p_a^*. For example, increases in the risk of apprehension at opportunities with apprehension risk above the average p_a^* for a specified $g(p_a^*)$ might still serve to insulate them from victimization by individual offenders whose p_a^* also is above average. Thus, recognition of heterogeneity in p_a^* confirms that nontargeted policies such as random patrol still have a role in the portfolio of crime prevention policies.

The introduction of heterogeneity in the model, however, does not change the logic of the value of targeting police and other resources at crime hot spots for the purpose of deterring criminal activity at those locations. The high level of criminal activity at a crime hot spot confirms its attractiveness as a location for committing crime. However, the recognition that the perpetrators of crime have heterogeneous p_a^* implies that there will be a "dose-response" type of relationship between the degree of crime reduction at the location and the degree to which police presence is heightened. Our model is not designed to trace out the form that dose-response relationship might take, but it implies that the greater the heterogeneity in p_a^*, the more dosage will be required to suppress criminal activity completely at the location.

IMPLICATIONS FOR POLICING

The model we lay out is intended to focus attention on the influential role of risk of apprehension in the deterrence process. Although the model has broad implications for

5. This ratio equals $\frac{4}{(\beta+2)(\beta+3)}(2^{\beta+1} - 1)$.

crime prevention, our central focus has been on its implications for policing. The model makes a strong distinction between apprehension risk p_a and the actual event of an arrest. Apprehension risk, like all probabilities, is an ex ante quantity. It measures the relative frequency that an arrest will occur if a target is victimized. In our model, the goal of the police is to deploy in a fashion that increases p_a to a level that makes the target unattractive to a would-be offender. When police are functioning in this capacity, we describe them as sentinels. By contrast, the event of an arrest occurs in the aftermath of the failure of deterrence—a crime occurs and the police in their apprehension agent role successfully arrest the perpetrator. In the context of our model, p_a measures the relative frequency that police are successful as apprehension agent. Thus, arrest can be seen as a "two-edged sword." It is a consequence of a failure of the police in their sentinel role to deter the crime from happening in the first place but a success in their apprehension role in arresting the perpetrator.[6]

As discussed, success in the sentinel and apprehension agent roles is intertwined. If police are ineffective in their apprehension agent role, then their credibility as sentinels is undermined. Still the largest body of evidence on police effectiveness in preventing crime suggests that it stems from sentinel-like functions that increase p_a to a level that makes the criminal opportunity unattractive. When police are successful in their sentinel role, the social costs of both crime and punishment are averted—this outcome is ideal. When no crime occurs, there is no one to arrest and punish. This observation has important implications for the organization and deployment of the police beyond those described.

Reorienting police to focus on their sentinel-like crime prevention function rather than on their apprehension agent function poses a major organizational challenge from which our model abstracts. As noted, part of the challenge stems from the reality that the two roles are intertwined. Furthermore, bringing the perpetrators of crime to justice supports other important social objectives beyond crime prevention. Another major challenge is organizational. Police are highly trained and socialized in the apprehension agent role, and the standard operating procedures of most police agencies center around this core function. Police officers and detectives feel a sense of satisfaction, certainly not failure, when they make arrests—the reward is immediate and obvious. These rewards are institutionalized in organizational performance metrics that emphasize arrest and clearance-based statistics.[7] By contrast, generally no tangible reward is given for preventing crime in the first place, precisely because it is a nonevent and therefore is difficult to measure. Medals of bravery and valor are not generally given to officers who demonstrate reduced crime rates in their beats. Rather, they are bestowed for heroic actions at the scene of a crime.

Although police executives are becoming more aware and interested in crime reduction as a performance measure, how to translate this into tangible incentives that reward officers and detectives on the street for preventing crimes through strategies such as proactive place-based patrol or problem-solving is not clear. Thus, whereas the research and our model indicate that being a sentinel is the key to an officer's and agency's ability to

6. We, of course, recognize that police arrest, either intentionally or not, of individuals who are not guilty of the crime they are arrested for does occur, but such error or malfeasance of the police is outside the scope of our model.
7. One only needs to attend a few CompStat managerial meetings to see how much arrest is valued.

reduce crime, existing incentive structures and organizational culture reward officers for acting as apprehension agents not as sentinels.

Further complicating incentivizing beat-level officers to act as sentinels is that the line between the sentinel and the apprehension agent role is sometimes blurred. The hot spots literature, for example, clearly has pointed to the effectiveness of targeting crime concentrations with increased presence. But what officers do at those hot spots also matters. Systematic reviews of police crime control evaluations conducted by Braga, Papachristos, and Hureau (2012); Lum, Koper, and Telep (2011); and Weisburd et al. (2010) indicated that problem-solving, proactive, place-based, and tailored strategies seem to work best (as opposed to merely increasing police presence or even conducting arrest-based crackdowns). However, the effectiveness of these approaches often depends on the arrest authority of the police. In certain circumstances, exercising that authority is necessary to establish the credibility of a problem-solving or place-based strategy.

The interconnection of and tension between the sentinel and apprehension roles also is reflected in zero-tolerance strategies, where officers are encouraged to arrest for any crime, including and especially low-level misdemeanors and disorders. This policing tactic stems from Wilson and Kelling's (1982) "broken windows" thesis suggesting that low-level disorder, when left unchecked, creates an environment for more serious crime opportunities to flourish. The 1990s-era police crackdown-and-arrest approach on crime and disorder was one translation of the broken windows thesis. Whether this strategy was intended by Wilson and Kelling and whether zero tolerance is effective is not the point of discussion here, although Harcourt and Ludwig (2006) concluded that it was not effective. What is interesting is the choice of the police to tackle crime in the way they knew best—as apprehension agents, not as sentinels.

Thus, to achieve the gains suggested by our model—to shift emphasis away from the apprehension agent to the sentinel role—a fundamental shift must occur in the way police operate. As Lum et al. (2012) and Lum and Koper (2012) argued, this includes police thinking carefully about modifying their tactical and deployment choices; their training, incentives, and rewards infrastructures; and their systems of technology, management, and leadership to emphasize crime prevention, not arrest. The shift to the sentinel role, therefore, requires more than just directives from management or the establishment of a specialized problem-solving or community policing unit. The translation of this knowledge and its application in policing requires adjusting the systems that control and mediate officers' beliefs about their everyday roles and functions.

CONCLUSION

The purpose of this article was to join insights from three distinct literatures on crime control—the deterrence literature, the policing literature as it relates to crime control, and the environmental and opportunity perspectives literature—to pose a mathematical model of the distribution of criminal opportunities and offender decision making concerning which of those opportunities to victimize. Criminal opportunities are characterized in terms of the risk of apprehension that attends their victimization. Our primary focus was on how police could affect the distribution of criminal opportunities that are attractive to would-be offenders.

As noted, the model we lay out is unlikely to be amenable to empirical estimation. It is intended instead to provide a theoretical framework for thinking through how target and situational characteristics and police deployment strategy affect crime and arrest rates. However, in so doing, it highlights important research topics that are amendable to empirical analysis. We close by describing several topics that we deem particularly important.

The model underscores the strong connection of target and situational characteristics with the probability of apprehension. Although this topic has been studied qualitatively in the environmental criminology and criminal opportunity literatures, we know of no empirical analyses that have developed statistical models of the relationship between apprehension risk and target and situational characteristics. We note that future analyses of this type must address the selection problem that is central to our analysis, and the earlier work by Cook (1979)—the set of targets that are victimized and whether the perpetrator is arrested—is not a representative sample of the population of potential targets, which also includes those that are not victimized.

Furthermore, the model highlights the importance of gaining a better understanding of offenders' perceptions of the linkage between apprehension risk and target and situational characteristics. Although a large ethnographic literature exists on this topic, adding a quantitative dimension based on survey data to existing qualitative research would be highly valuable. The methodological challenge is devising survey instruments that can be administered successfully to active offenders. In addition, there are human subject concerns related to the confidentiality of the responses and the safety of the interviewer.

For both of these research recommendations, calibrating the influence of police presence and tactics on apprehension risk and offender perceptions of that risk should be a priority. As we have noted, our model abstracts from how police presence actually influences both actual and perceived apprehension risk. There are, however, good reasons to believe various forms of sentinel-like police activities ranging from the more passive, such as only patrolling, to more proactive, such as stopping and questioning persons deemed suspicious, will have differing effects on apprehension risk and perceptions thereof.

We are optimistic that creative interviewing techniques can be devised to identify how police tactics influence offender perceptions of apprehension risk. More challenging is identifying how police tactics affect actual risk. One approach is to expand experimental evaluations of the effectiveness of alternative police deployment tactics to prevent crime to measure not only reported crimes as an outcome measure but also whether those crimes result in the apprehension of the perpetrator. Here again, the selection problem described previously must be addressed.

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