



The effects of devaluation and solvability on crime clearance

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ABSTRACT

Purpose: Scholars suggest that clearance rates reflect (a) the solvability of cases (Gottfredson & Hindelang, 1979; Roberts, 2007), and/or (b) the populations that the police choose to prioritize (Black, 1976). But few studies consider the totality of contextual and situational characteristics that may explain clearance rates and contribute to important disparities among them. The current study presents a framework that considers the effect of various types of devaluation and solvability on clearance.

Methods: Linear probability modeling is used to test the framework's utility and whether complaint, neighborhood, and police district characteristics affect the clearance of violent crimes in St. Louis, MO.

Results: The findings suggest that while minority victims and neighborhoods may be devalued, specific crime features physically hinder crime-solving. Important interactions emerge between devaluation and solvability indicators, and crime types are found to have distinctive clearance predictors. The results suggest that witness and victim-offender relationship information might be particularly important in clearing crimes involving Black victims.

Conclusions: Overall, the results highlight the importance of comprehensively studying crime-solving. Future research should continue to work toward developing a comprehensive conceptualization to explain police case clearance.

1. Introduction

Racial disparities appear to be persistent in clearance rates, with crimes involving Black victims and occurring in disadvantaged, minority communities having particularly low clearance rates (Petersen, 2017; Roberts & Lyons, 2009). But important conceptualization and measurement issues surround the study of crime-solving, and research has yet to determine whether clearance rates reflect the solvability of cases (Gottfredson & Hindelang, 1979; Klinger, 1997; Roberts, 2007), and/or the populations that the police choose to prioritize (Black, 1976; Jarvis & Regoeczi, 2009).

Two theoretical perspectives have been developed to explain crime clearance rates: (1) the devaluation thesis, which claims that disadvantaged, minority individuals and neighborhoods will not be prioritized by the police and therefore cases involving these characteristics will have lower clearance rates (Black, 1976; Jarvis & Regoeczi, 2009; Petersen, 2017); and (2) the solvability perspective, which argues that police and situational characteristics, such as police workload and physical evidence, determine the likelihood of clearance (Gottfredson & Hindelang, 1979; Roberts, 2007). But research examining the influence of such factors on crime clearance has been limited in a number of respects. First, devaluation and solvability

perspectives have overlapping constructs, and research has yet to disentangle their competing operationalizations. Secondly, few studies have considered the interaction of devaluation indicators, such as victim race, and solvability factors, such as weapon type (Petersen, 2017; Regoeczi & Jarvis, 2013). Exploring these interactions is an important first step in disentangling alternative perspectives and their relative influences on clearance. Finally, few studies have considered the clearance of crimes other than homicide (Taylor, Holleran, & Topalli, 2009). Since police departments are pressured to solve homicides, they may be less impacted by extralegal factors, such as victim and neighborhood race (Klinger, 1997). Therefore, one remaining question concerns whether factors related to clearance are crime type-dependent.

This paper addresses these three issues by examining which contextual and situational characteristics may explain clearance rates and contribute to important disparities among them. First, a working conceptualization of police clearance is presented that accounts for alternative perspectives and considers the ways in which characteristics of victims, crimes, and places affect clearance. The paper then uses linear probability modeling to empirically examine the influence of various theoretical predictors and their interactions on clearance using a dataset consisting of 19,602 offenses spread across 360 block groups and

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nine police districts in St. Louis, Missouri over a four-year period. Testing whether a wide range of operationalized characteristics affect the solving of violent crimes bridges the gap between traditional perspectives and brings us closer to building a refined theoretical framework.

2. Traditional explanations of police clearance

2.1. Victim and group devaluation

The victim and group devaluation perspectives follow conflict theories and argue that individuals and communities deemed less valuable in a society will not be prioritized by criminal justice actors (Black, 1976; Jarvis & Regoeczi, 2009; Litwin, 2004). For instance, crimes involving young and Black victims will be less likely to be cleared than those involving older and White victims (Black, 1976). While the traditional perspective views males as being valued over females (Black, 1976), scholars suggest that females are in fact more readily provided with a legitimate, or “ideal victim,” status that makes them a priority for law enforcement (Christie, 1986). Communities can also be devalued. At the aggregate level, crimes that occur in disadvantaged, minority communities are expected to have lower clearance rates than those that occur in affluent, White communities regardless of the characteristics of the victim (Black, 1983). The devaluation perspective therefore expects that the low clearance rate of crimes committed against minority, particularly Black, victims and in minority areas can be explained by the willingness, motivation, or bias of police officers toward certain people or places. Recent work also suggests devaluation on the part of individuals or groups who do not believe in the ability of the police to bring offender(s) to justice. Minority individuals and communities may be unwilling to activate the criminal justice system or cooperate with investigations when a crime has occurred (Hipple, Thompson, Huebner, & Magee, 2019; Natapoff, 2009; Rios, 2011).

Empirical research examining the relationship between extralegal factors and arrest clearance suggests that victim and community characteristics are associated with crime clearance. A number of studies have demonstrated that crimes involving non-White victims are less likely to be cleared than those involving White victims (Addington, 2007; Alderden & Lavery, 2007; Lee, 2005; Marché, 1994; Regoeczi, Jarvis, & Riedel, 2008; Roberts & Lyons, 2009). For instance, Lee's (2005) examination of 9442 homicides in Los Angeles County over a five-year period (1990–1994) finds that cases involving non-White victims are 30% less likely to be solved than ones involving White victims. Other studies, however, have demonstrated that crimes involving non-White victims are less likely to be cleared than those involving White victims (Regoeczi et al., 2008; Roberts & Lyons, 2009), and still others find nonsignificant race effects (Addington, 2006; Jiao, 2007; Puckett & Lundman, 2003).¹ Clearance rates appear to be similar for male and female victims or in fact higher for crimes involving female victims, suggesting partial support for the “ideal victim” hypothesis (Addington, 2006; Geberth, 1996; Lee, 2005; Litwin, 2004; Litwin & Xu, 2007; Regoeczi et al., 2008; Roberts, 2007; Wellford & Cronin, 1999; Wolfgang, 1958). Studies have also found that young children are more likely than victims aged 13 and older to have their crimes cleared (Addington, 2006; Cardarelli & Cavanagh, 1992; Riedel & Rinehart, 1996).

Some research findings appear to support the group devaluation thesis at the macro level. For instance, crimes occurring in economically disadvantaged communities (Litwin & Xu, 2007; Mancik, Parker, & Williams, 2018; Paré, Felson, & Ouimet, 2007), large, urban areas (Paré

¹ Nonsignificant race effects have been particularly prevalent in explanations of homicide clearance (e.g., Addington, 2006; Jiao, 2007; Puckett & Lundman, 2003; Litwin & Xu, 2007; McEwen & Regoeczi, 2015; Mouzos & Muller, 2001; Petersen, 2017).

et al., 2007), and areas with large minority populations (Litwin & Xu, 2007; Petersen, 2017) tend to have low clearance rates.

It is important to note that when victim and neighborhood variables are considered simultaneously, victim characteristics tend to be more consequential than neighborhood racial composition, concentrated disadvantage, and residential instability (Addington, 2006; Lee, 2005; Litwin, 2004; Puckett & Lundman, 2003; Riedel & Rinehart, 1996; Wellford & Cronin, 1999). This suggests that individual-level victim characteristics are more powerful predictors of crime clearance than community characteristics.

2.2. The solvability perspective

Critics of the devaluation hypothesis suggest that lower clearance rates among persons and places are not an automatic indicator of devaluation. Instead, crimes involving minority victims and those that occur in disadvantaged, minority neighborhoods are less likely to be cleared simply because they are more difficult to solve (Litwin, 2004; Litwin & Xu, 2007). Solvability theories claim that crime clearance is dependent upon a large range of police district characteristics and the situational characteristics of a crime (Puckett & Lundman, 2003; Quinney, 1977; Roberts, 2007). Police workloads and resources directly affect clearance. As detective workloads increase, resources are strained and the pressure to work efficiently increases among officers, causing them to dedicate less time to individual incidents (Klinger, 1997). Police districts also experience unique pressures by their departments and the public to focus their attention on solving serious violent crimes such as homicides (Bynum, Cordner, & Green, 1982; Gottfredson & Hindelang, 1979). Situational factors, such as the presence or absence of firearms, strangers, physical evidence, and information from witnesses, are also particularly important to consider in studies of crime clearance because they affect officers' ability to solve crimes (Geberth, 1996; Litwin, 2004; Riedel & Rinehart, 1996).

Studies of solvability and clearance demonstrate the importance of controlling for police-level ecological characteristics. Though results from a RAND Corporation study found that investigators did not spend much time on crime-solving (Chaiken, 1975; Chaiken, Greenwood, & Petersilia, 1977; Greenwood et al., 1975; Greenwood & Petersilia, 1975), subsequent studies have found that investigations are important for clearing crimes (Abrahams, Jewkes, Martin, & Mathews, 2011; Eck, 1983; Braga & Dusseault, 2018). Particular elements of investigation, such as information from the public and the role of the patrol officer, have been found to be critical for investigations (Horvath, Meesig, & Lee, 2001), and studies have demonstrated negative relationships between detective workloads and clearance (Borg & Parker, 2001; Chaiken et al., 1977; Liska, Chamlin, & Reed, 1985) as well as positive associations between investigative effort and clearance (Abrahams et al., 2011; Braga & Dusseault, 2018; Fallik, 2017; Hawk, 2015; McEwen & Regoeczi, 2015; Schroeder & White, 2009; Wellford & Cronin, 1999).² A recent study by Cook, Braga, Turchan, and Barao (2019) predicted what would have happened to investigations if they were provided different levels of effort and resources. The study found investigative effort at the scene of a crime and during the first 48 hours following a crime to be especially important for clearance. Data limitations have made it difficult to explain the influence of police-related variables on crime (Wellford, Lum, Scott, Vovak, & Scherer, 2019). In their recent review of studies assessing investigations of homicides, Wellford et al. (2019) argue that better case, investigative effort, and organizational variables are needed in studies to determine whether investigations are important in solving crimes.

Situational variables, such as physical evidence and witness participation, have been found to increase the odds of clearance above and

² But see Rinehart (1994), who found no relationship between detective caseload and clearance.

beyond victim and neighborhood status characteristics (Keel, Jarvis, & Muirhead, 2009; Litwin, 2004; Roberts, 2007). Violent incidents involving physical evidence and victim injuries have higher likelihoods of arrest clearance than incidents that lack physical evidence or injured victims (Addington, 2006; Lee, 2005; Litwin, 2004; Puckett & Lundman, 2003; Taylor et al., 2009). Because they do not require close contact between victims and offenders, and because they often lack sufficient physical evidence, crimes involving firearms and incidents involving strangers have a low likelihood of clearance (Litwin, 2004; Litwin & Xu, 2007; Regoeczi, Kennedy, & Silverman, 2000). In contrast, crimes involving knives and personal weapons such as fists, and ones involving offenders that are known to the victim are more likely to be solved (Addington, 2006; Mouzos & Muller, 2001; Puckett & Lundman, 2003; Regoeczi, 2018; Roberts, 2007). Homicides tend to have higher clearance levels than assaults, and robberies have particularly low clearance rates (Federal Bureau of Investigation, 2017; Taylor et al., 2009). Crimes that occur on weekdays and during the day time have been found to have higher clearance likelihoods than those that occur on weekends and during the early morning, evening, and night (Regoeczi et al., 2008). Research by Cook et al. (2019) also suggests interesting interactions between situational features. The researchers find that homicides involving firearms are much more likely to be cleared than assaults with guns, and that differences in clearance can largely be explained by differences in effort to obtain witness cooperation, forensic evidence, and quick arrests. Taken together, this empirical evidence suggests that a large range of solvability features – apart from victim or neighborhood characteristics – can be linked to crime clearance.

2.3. Devaluation and solvability

Studies that simultaneously examine devaluation and solvability characteristics have produced equivocal results. Importantly, while solvability and victim characteristics may be important on their own, they may also interact with one another to impact clearance.

Recent journalistic investigations portend three important interactions between devaluation and solvability characteristics that have yet to be explored empirically (Leovy, 2015; Lowery, Kelly, Mellnik, & Rich, 2018; Ryley, Singer-Vine, & Campbell, 2019). They suggest that Black victims and community residents are afraid to speak out against perpetrators as witnesses, and that this lack of witness cooperation and known victim-offender relationships can make clearance particularly difficult (Leovy, 2015; Lowery, Kelly, & Mellnik, 2018). These relationships make theoretical sense, as scientists have argued that Black victims and witnesses may be more reluctant to assist the police in investigations because they do not trust the police or fear retaliation (Natapoff, 2009; Rios, 2011). The development of a “stop snitching” campaign, decreased witness cooperation, and increasing retaliatory violence have likely worsened police-community relations, increased officers’ recording of crimes as involving stranger victim-offender relationships, and negatively affected police clearance (Leovy, 2015; Natapoff, 2009; Rios, 2011).

Two hypotheses can be deduced from these journalistic accounts. First, while crimes involving Black victims are expected to have low clearance probabilities, crimes involving Black victims and witnesses should have significantly increased probabilities of clearance. Second, crimes involving Black victims and strangers are expected to have markedly low clearance likelihoods.

Recent news articles have also paid particular attention to the low clearance rates among nonfatal robbery and assault cases (Dean, 2019; Ryley et al., 2019). Between 1981 and 2013, homicide cases (65%) have been more likely than assault (60%), and robbery (28–32%) cases to be cleared among police departments with 100 or more officers (Lum, Wellford, Scott, & Vovak, 2016). Although few studies have examined crimes other than homicide (Briggs & Opsal, 2012; Roberts, 2008; Roberts & Lyons, 2009), research suggests that influence of

devaluation – and victim race in particular – on clearance may be especially dependent on crime type. Scholars have found that while robberies and aggravated assaults involving Black victims are less likely to be cleared than those involving non-Black victims, racial differences do not influence the solving of sexual assaults (Briggs & Opsal, 2012) or homicides (Riedel & Rinehart, 1996; Wellford & Cronin, 1999). Such findings are in line with the argument that police officers must devote a greater amount of effort to heinous, violent crimes such as homicides (Bynum et al., 1982; Gottfredson & Hindelang, 1979; Puckett & Lundman, 2003). According to this perspective, then, crimes involving Black and non-Black victims should be solved at similar rates in cases involving homicides because police officers are pressured by their departments and the public to solve such cases (Marche, 1994; Regoeczi et al., 2000).

3. Toward a revised framework

Conceptualization and modeling issues surrounding clearance perspectives have prevented researchers from clearly explaining the factors associated with crime clearance. Most importantly, solvability characteristics have been pitted against victim and group devaluation factors, although these components are theoretically and conceptually intertwined (Rydberg & Pizarro, 2014). Studies have yet to disentangle variables definitionally and in analyses, with certain indicators being used as proxies for both devaluation and solvability. In their study of homicide clearance, for instance, Puckett and Lundman (2003) use neighborhood racial composition as a proxy for trust in the police and willingness to assist detectives, and suggest that racial composition leads to lower clearance because of poor police relations and lack of witness involvement. Thus, when operationalizing variables, researchers use group devaluation concepts as measures of solvability and vice versa, producing confusion. Furthermore, variables associated with incidents (e.g., weapon type), neighborhoods (e.g., crime levels), police districts (e.g., case workloads), and police information gathering (e.g., witnesses and evidence) have been used interchangeably as proxies for solvability, with little acknowledgment of their different meanings and relations to clearance. Measuring the respective contributions of devaluation and solvability on clearance rates requires an approach that distinguishes between devaluation and solvability constructs. Indeed, unless all relevant case, neighborhood, and police district indicators are included in a framework, it is difficult to assess the origins of any disparities.³

In this section, I present a working framework that captures the theoretical factors that have been proposed to impact clearance (see Table 1). The new framework breaks traditional solvability and devaluation characteristics into clear, logical categories, and corrects operationalizations that have been misleading. In addition, it operationalizes concepts that have yet to be examined empirically, but have been labeled important in journalistic accounts and organizational theory. In the revised framework, each clearance predictor fits with one and only one theory, and all relevant features of clearance are examined. By incorporating and controlling for all relevant theoretical predictors, we are better able to discern the theoretical mechanisms that are affecting clearance.

3.1. Devaluation

The framework utilizes traditional victim and group devaluation perspectives, which claim that disadvantaged, minority individuals (i.e., victim devaluation) and neighborhoods (i.e., group devaluation) will not be prioritized by the police (Black, 1976; Jarvis & Regoeczi,

³ As Hawley (1950) noted, “[s]implification is indeed an objective as well as a procedure in scientific work, but it should not be achieved at the expense of completeness” (p. 209).

Table 1
Toward a revised conceptualization of clearance.

Traditional perspective	Hypothesis	Revised concept	Level of analysis	Relevant construct
Devaluation	Crimes involving non-Black victims are more likely to be solved than ones involving Black victims. Crimes involving female victims are more likely to be solved than ones involving male victims. Crimes involving young victims are more likely to be solved than ones involving old victims. Crimes that occur in block groups characterized by high levels of concentrated disadvantage will have lower clearance levels than those that occur in block groups characterized by low levels of concentrated disadvantage. Crimes that occur in block groups with high percentages of Black residents will have lower clearance levels than those that occur in block groups characterized by small Black populations. Crimes that occur in communities with high levels of crime will have lower clearance probabilities than ones that occur in low-crime communities. Complaints with major and minor injuries to victims are more likely to be cleared than crimes involving no injury or unknown injuries. Firearm crimes will be less likely to be cleared compared to those committed with personal weapons or knives. Homicides will have higher clearance levels than assaults, and robberies will have low clearance levels compared to assaults. Crimes that occur on weekdays will have higher clearance likelihoods than those that occur on weekends. Crimes that occur during the day time will have higher clearance likelihoods than those that occur during the early morning, evening, and night. Cases involving offenders that are known to the victim will be cleared more often than those involving strangers or persons unknown to the victim. Crimes involving witnesses are expected to have higher clearance likelihoods than those that do not involve witnesses. Police districts that experience high detective workloads are expected to have lower clearance.	Victim devaluation thesis Group devaluation thesis Association devaluation thesis Situational thesis	Case level Community level Community level Case level	Victim race Victim sex Victim age Concentrated disadvantage Racial composition Crime rate Victim injury Weapon type Crime type Day of week Time of day Victim-offender relationship
Solvability		Case solvability thesis Workload/resources thesis	Case level Police district level	Witness information Detective workload, crime rate

2009; Petersen, 2017). Victim characteristics include factors such as race, sex, age, and marital status. Examples of group devaluation are racial composition, concentrated disadvantage, and residential instability.

An additional aspect of devaluation that has yet to be incorporated into empirical studies is association devaluation. Association devaluation is introduced in the framework to examine whether police officers' judgements about communities – and the people who make them up – affect clearance (Klinger, 1997). The association devaluation thesis is based on the idea that, in higher crime areas, the police “encounter more situations in which the line between victim and offender is blurred” and “believe that larger segments of the population are undeserving” (Klinger, 1997, p. 291). Thus, crimes that occur in communities with high levels of crime are predicted to have lower odds of clearance (Chaiken, 1975; Klinger, 1997).

3.2. Solvability

The traditional solvability perspective is broken up to include (a) the situational thesis, which claims that crimes involving particular characteristics of incidents, such as victim-offender relationship and weapon type, determine the likelihood of crime clearance (Gottfredson & Hindelang, 1979; Roberts, 2007); (b) the case solvability thesis, which suggests that information collected and used by the police (e.g., witness information and fingerprints) affects clearance; and (c) the workload/resources thesis, which claims that detectives' work and resource levels impact clearance (Borg & Parker, 2001; Klinger, 1997; LaFree, Baumer, & O'Brien, 2010; Liska et al., 1985; Mouzos & Muller, 2001; Ousey & Lee, 2010).

Situational characteristics are viewed as distinct from case solvability indicators and include characteristics of crime incidents that cannot be influenced by the police. An incident's location, day of occurrence, victim-offender relationship, weapon type, and crime type fit into this category.

The case solvability concept that is described and used in this framework differs greatly from traditional definitions of solvability. Rather than testing traditional solvability factors together, case solvability is viewed as being distinct from characteristics of neighborhoods and police organizations. In line with Wellford and Cronin's (1999) notion that police practices and procedures should be distinguished from case characteristics over which the police lack control, case solvability refers to information collected, controlled, and used by the police to investigate crime incidents. Case solvability characteristics can include, for instance, witness information, information about suspect (s), and forensic evidence collected at the scene of a crime.

Detective workload and resource amounts have been hypothesized to affect clearance above and beyond devaluation and other solvability aspects (Wellford & Cronin, 1999). Crimes involving Black victims may occur in places where detectives struggle with high caseloads (Borg & Parker, 2001; LaFree et al., 2010), and this may explain why Black victims' cases have lower odds of clearance. Factors associated with police districts are refined in the framework and in analyses to accurately measure factors that are theoretically expected to impact clearance.

Traditional studies of clearance have used crime or homicide rates (Borg & Parker, 2001; Litwin, 2004; Litwin & Xu, 2007) or patrol officer workloads (Paré et al., 2007; Petersen, 2017) as measures of police workload, or they have looked at the impact of individual officers' training and skill on clearance (Keel et al., 2009). Because detectives are typically assigned to solve serious violent incidents, detective workload is viewed as a more meaningful and theoretically appropriate variable in the relationship between case workload and crime-solving (Klinger, 1997; Puckett & Lundman, 2003). Higher detective workloads and police district crime rates are expected to lower the ability of detectives to spend the time, effort, and resources needed to solve violent crimes.

4. Current study

This paper uses data from the St. Louis Metropolitan Police Department (SLMPD; 2010–2013) and U.S. Census (2013) to examine the characteristics of people, crime complaints, block groups, and police districts associated with violent crime clearance.⁴ It focuses on 19,602 crimes nested within 13,729 complaints that occurred in St. Louis, Missouri between January 1, 2010 and December 31, 2013. St. Louis's history, social organization, and crime levels make it an ideal study location. During the mid- and late 1900s, deindustrialization in the Midwestern city and other similarly situated cities resulted in depopulation, heightened segregation, and rising crime (Gordon, 2009; Wilson, 1987). Today, the city's violent crime rate remains higher than most large U.S. cities (Federal Bureau of Investigation, 2017), with regular questions about the role of its police in perpetuating it (see Brunson & Weitzer, 2009; Kubrin & Weitzer, 2003).

5. Data

5.1. Data source and file structure

Data for this study come from the St. Louis Metropolitan Police Department (SLMPD) and the U.S. Census. The SLMPD data were merged with block group-level data from the 2009–2013 American Community Survey (U.S. Census). The final file includes 13,729 complaints containing Uniform Crime Report (UCR) violent Part I offenses (homicide, robbery, and assault) and their corresponding offenses spread across 360 block groups and nine police districts between January 1, 2010 and December 31, 2013.⁵⁻⁶

The unit of analysis for this study is the crime complaint because complaints, and not incidents, are cleared by the SLMPD. A given complaint contains all offenses that occurred together in a given time and place, and each offense's corresponding person, weapon, and solvability information.

5.2. Variables

The outcome of interest in this study is clearance. A complaint is coded as 1 (cleared) if it was coded as "cleared" by the SLMPD by the current year (2018); complaints are otherwise coded as 0 (not cleared).⁷⁻⁸

⁴ Block groups are used as proxies for neighborhoods in this study (Sampson & Raudenbush, 2004).

⁵ These particular years are chosen for analyses because SLMPD underwent redistricting in 2014.

⁶ To prevent the loss of meaningful data, cases were retained if they involve a Part I violent offense and other offense types (i.e., corresponding offenses). Other crime types include crimes such as rape, kidnapping/abduction, arson, shoplifting, motor vehicle theft, destruction of property, drug violations, disorderly conduct, and drunkenness.

⁷ The SLMPD does not consistently update its case status field, which includes information pertaining to types of clearance (e.g., arrest clearance and exceptional clearance). Thus, a limitation of this study is its inability to distinguish between clearance types. Though studies typically combine clearance types (Addington, 2006; Alderden & Lavery, 2007; Lee, 2005; Mouzos & Muller, 2001; Puckett & Lundman, 2003; Regoeczi et al., 2000) and multiple studies have demonstrated similar results across clearance types (Litwin, 2004; Litwin & Xu, 2007), exceptions to such studies exist and caution must be taken in interpreting these results. Jarvis and Regoeczi (2009) found different predictors across types of clearances, and Riedel and Boulahanis (2007) caution against including exceptional clearances in total clearances, as clearance percentages might be inflated.

⁸ A number of variables, such as victim age and sex, have been shown to impact the "survival time" of a case, or the number of days until a case is cleared (Regoeczi, 2008). Since complaints may clear after the study period's end, censoring poses an issue. A four-year period was deemed sufficient (Regoeczi, 2008; Roberts & Lyons, 2009).

5.2.1. Victim devaluation

Since complaints, and not victims or offenses, are the unit of analysis in this study, victim and offense characteristics are collapsed and studied at the complaint level. Victim race (all Black victim(s), victims of multiple races, and all non-Black victim(s) as the reference category) and victim sex (only male victim(s), male and female victims, and only female victim(s) as the reference category) are measured as categorical variables. Victim age is a continuous measure and represents the average age of victims within a complaint. A squared victim age term is also included in the model to account for non-linearity. Finally, the model includes a variable to control for complaints containing victims of multiple age categories.

5.2.2. Situational features

The SLMPD ranks complaints according to the most serious offense. Categories include homicides, robberies, and assaults. Because assaults are highly correlated with robberies, they, and not homicides, are the omitted reference category. Since the purpose of the study was to examine complaints containing UCR Part I offenses, cases that included an assault or robbery, but ranked a different crime type as most serious, were dropped ($n = 1302$). A control variable flags cases with multiple crime types. These cases can include a combination of homicide, assault, and robbery offense types or a combination of UCR Part I offense types and "other" crimes.

Crimes are broken up into three time periods to reflect common police "shifts" in St. Louis: between 8 a.m. and 3:59 p.m. (first shift), between 4 p.m. and 11:59 p.m. (second shift), and between midnight and 7:59 a.m. (third shift). The first shift is the reference category due to the advantages of policing during daylight (Regoeczi et al., 2008). All models include a day of week variable (1 = weekday/0 = weekend). Weapon type includes firearm, knife, personal weapon, other weapon, unknown weapon, multiple weapon types, and no weapon categories. Since they are most likely to involve victim-offender contact and to leave physical evidence, personal weapons are the omitted reference category (Puckett & Lundman, 2003).

Victim-offender relationships are based on NIBRS categories and are categorized as all stranger, all within family, all outside of family but known to victim, all other relationships, relationship unknown, relationship category not applicable, and multiple victim-offender relationship categories.⁹ Crimes involving strangers are least likely to be cleared, and this category is used as the reference category to allow for comparisons with other relationships (Jarvis, Mancik, & Regoeczi, 2017). It is important to note that the victim-offender relationship measure is at least partly endogenous, or a function of clearance.

Victim injuries are separated into no/unknown injury, minor injury, major injury, and multiple injury types. These variables are coded positively if at least one victim within a complaint was injured, with the exception of no/unknown injury. Following Roberts and Lyons (2009), the no/unknown injury category (reference category) includes none/unknown injury and probable/not apparent injury types. Minor and major injuries include cases coded by the police as involving minor injury, apparent broken bones, other major injuries, possible internal injury, loss of teeth, severe laceration, and unconsciousness.

Since nearly one-third of complaints include multiple charges ($n = 3773$) and involve more than one victim ($n = 3915$), the models control for number of charges and number of victims nested within a complaint. In addition, all models control for whether offenses are

⁹ "All within family" includes spouse, common-law spouse, parent, sibling, child, grandparent, grandchild, in-law, stepparent, stepchild, stepsibling, other family member, and legal guardian. "All outside of family but known to victim" includes acquaintance, friend, neighbor, babysitter, boyfriend/girlfriend, child of boyfriend/girlfriend, homosexual relationship, ex-spouse, employee, employer, otherwise known, former employee, ex-boy/girlfriend, and roommate. "All other relationships" includes the NIBRS category of victim was offender.

attempted (0) or completed (1).¹⁰

5.2.3. Case solvability

A witness variable is used as a measure of case solvability. It is coded as 1 if a witness (an individual other than a suspect or victim) was present at the time of a crime and 0 otherwise.

5.2.4. Group and association devaluation

Key block-group constructs include concentrated disadvantage, racial composition, and block group crime rates.¹¹ Principal components factor analysis was used to combine the percentage of residents living in poverty and the percentage of female-headed households into a measure of concentrated disadvantage. Racial composition records the percentage of Black residents in each block group. Association devaluation is measured using block group crime rates (number of violent crimes per 1000 residents).

Consistent with prior research, the empirical models control for block group area population (Borg & Parker, 2001; Litwin, 2004; Wolfgang, 1958). A variable also controls for whether a block group is cross-classified into multiple districts.¹²

5.2.5. Detective workload and resources

Police district characteristics include detective workload and crime rates. Detective workload is measured using a ratio of crime counts over detective averages. Specifically, it divides the total number of UCR violent Part I crimes that occurred between 2010 and 2013 by the average number of detectives assigned to each district over the four year period.¹³ Crime rates record the number of violent crimes that occurred in each district over the study period, divided by 1000 residents.

5.2.6. Methodological considerations

As in other studies of clearance, data were missing on important predictors. Victim injury ($n = 6355$) and victim-offender relationship data ($n = 2706$) were missing on a particularly large number of cases. Prior studies suggest that missing data, including victim-offender relationship data, are missing at random (MAR) and Regoeczi and Riedel (2003) suggest that information about these variables can be predicted from observed variables in the dataset. To prevent the loss of meaningful data and address problems with missing data, multiple imputation techniques are used in analyses. This strategy is particularly useful because it creates multiple imputed datasets (Allison, 2001), and it has been used in a number of recent studies of clearance (e.g., Jarvis et al., 2017; Roberts, 2015). In line with research suggesting the use of five to 10 imputations (e.g., Rubin, 1987; Schafer, 1999), STATA15 was used to create 10 imputed datasets for each offense (Royston, 2004), and

¹⁰ Only robbery cases were coded as attempted. Since attempted crimes are cleared less often than completed ones, completion status was viewed as an important control (Taylor et al., 2009; Walfield, 2016). Models were run without attempted cases, and the results were unchanged.

¹¹ Variance inflation factor (VIF) statistics were calculated to assess multicollinearity among block group variables. All VIFs were less than 1.5, indicating that multicollinearity was not an issue.

¹² Over a quarter ($n = 3654$) of complaints are nested within block groups that transcend district boundaries. A dummy variable was computed to flag block groups that were cross-classified into multiple districts, and cross-classified block groups were recoded to reflect the districts within which the majority of their land areas fall. The effect sizes from cross-classified multilevel models are largely consistent with the results presented in this paper.

¹³ Variance inflation factor (VIF) statistics were calculated to assess multicollinearity among police district variables. Multicollinearity was an issue when patrol officer workload was included as a control variable alongside detective workload and was thus removed. From an organizational standpoint, this makes sense as one overarching police agency likely distributes patrol officers and detectives proportionally.

STATA's MI ESTIMATE command combined imputed datasets for each offense to allow for thorough analysis.

6. Analytic strategy

Complaints are nested within block groups and police districts, creating a hierarchical data structure. Therefore, the use of ordinary least squares (OLS) regression is problematic, leaving heterogeneity across levels unaccounted for and increasing the likelihood of underestimated standard errors and Type I statistical errors (Johnson, 2010; Raudenbush & Bryk, 2002). Multilevel models allow for the reliable analysis of effects of complaint, neighborhood, and police district variables on clearance, and the examination of main effects and interactions within and between levels (Bryk & Raudenbush, 1992; Guo & Zhao, 2000; Raudenbush & Bryk, 2002). The linear probability model is particularly useful when modeling dichotomous outcomes and probabilities that are a linear function of predictor variables, and it allows for clear interpretation of coefficients and interactions among them, particularly when examining interactions among variables with small cell sizes (Scott Long, 1997).

All models are mixed effects multilevel linear probability regressions that estimate the effect of predictor variables on clearance with random intercepts for block groups and clustered standard errors for police districts.¹⁴ Coefficients are averaged across imputed datasets, and standard errors represent the each coefficient's variability across imputed datasets and average standard errors. To gain a broad understanding of clearance and to allow for comparison, the first model uses the full sample of cases to investigate the relationships between complaint- block group-, and police district-level characteristics and clearance. Interactions are added to the multilevel model in Models 2–4. Crime types are analyzed separately in Models 5–10 and compared and contrasted to full models. Additional analyses are conducted to test robustness and the sensitivity of results to differing model specifications (Models 11–12).

7. Results

7.1. Descriptive statistics of the sample

As shown in Table 2, approximately 3% of complaints involve homicides, and assaults and robberies are ranked as the most serious offenses in 49.7% and 46.9% of complaints, respectively. The majority of complaints in the sample (62.5%) remain unsolved. More than half of complaints involving homicides (58%) are cleared, nearly 45% of assaults are cleared, and robbery clearance remains low at 28.3%.¹⁵

Most victims are Black (64.9%) and male (59.1%), with the combined average age of victims in a complaint being 32.5 years of age ($SD = 14.0$). Approximately 36% of cases involving Black victims are cleared, compared to 59.7% of complaints involving Black and non-Black victims and 36.1% of cases involving only non-Black victims.¹⁶ Complaints involving only male victims have a 34% clearance rate, compared to the 42% of cases involving female victims and victims of both sexes. Whereas most complaints involving young victims (55.7%) are cleared, over 60% of complaints involving victims aged 13 and

¹⁴ It is important to note that the proportion of variation in clearance occurring at neighborhood (1.4%) and police district levels (0.8%) was incredibly low, and the effects of complaint-level predictors on clearance did not significantly vary across block group or police district units. When three-level mixed linear probability and logistic regressions were modeled, significance levels and parameter estimates did not significantly differ from those shown here.

¹⁵ These numbers are lower than homicide (65%), assault (60%), and robbery (28–32%) clearance averages found among police departments with 100 or more officers between 1981 and 2013 (Lum et al., 2016).

¹⁶ Black victims account for especially high proportion of homicide (82.7%) and assault (74.1%) victims, and males are more likely than females and males and females to be victims of all types of crime.

Table 2
Summary statistics: St. Louis violent offenses (SLMPD, 2010–2013)

Variable category	Variable name	N	Percent	Mean	SD	Missing
Dependent variable	Cleared (1,0)	5146	37.5%			
Victim and offense characteristics						
Victim sex	All male victim(s)	8111	59.1%			
	All female victim(s)	3439	25.1%			
	Victims of multiple sexes	2001	14.6%			178 (1.3%)
Victim race	All Black victim(s)	8903	64.9%			
	All non-Black victim(s)	3988	29.1%			
	Victims of multiple races	625	4.6%			213 (1.6%)
Victim age	Average age	13,481		32.5	14.0	248 (1.8%)
	Victims of multiple ages	2064	15.0%			
Crime type	Homicide	457	3.3%			
	Robbery	6445	46.9%			
	Assault	6827	49.7%			
Weapon type	Number of charges	13,729		1.4	0.9	
	Number of victims	13,551		1.5	1.2	178 (1.3%)
	Only gun	6235	45.4%			
	Only knife	709	5.2%			
	Only personal weapon	2402	17.5%			
Victim injury	Only unknown/other weapon	2058	15.0%			
	Multiple weapon types	2019	14.7%			
	No weapon	306	2.2%			
	No/unknown injury	804	5.9%			
	Minor injury	3557	25.9%			
Victim-offender relationship	Major injury	2827	20.6%			6355 (46.3%)
	Multiple injury types	186	1.4%			
	Within family	311	2.3%			
	Outside of family	2815	20.5%			
	Stranger	5830	42.5%			
Time of day	Relationship unknown	842	6.1%			
	Not applicable	407	3.0%			
	Other	30	0.3%			
	Multiple	788	5.7%			2706 (19.7%)
	First shift	3436	25.0%			
Neighborhood characteristics	Second shift	6674	48.6%			
	Third shift	3619	26.4%			
	Weekday	9291	67.7%			
	Attempted	695	5.1%			
	Witness(es)	1071	7.8%			
Police district characteristics	Concentrated disadvantage			-0.1	1.0	
	Racial composition			67.6	32.5	
	Area population (logged)			6.8	0.4	
	Cross-classified	3654	26.6			
Police district characteristics	Neighborhood crime rate			0.08	0.05	
	District crime rate			2.24	0.6	
	Detective workload			495.7	169.6	

older go unsolved. Complaints involving victims aged 60 and older have particularly low clearance levels (28.8%). About 46% of complaints involving multiple victims are solved.

Most crimes contain one victim and one offense, occur during the second shift (48.6%), are completed (> 94%; as opposed to attempted), involve known injuries (> 55%), and involve known weapons of some kind (83%), with firearms being the most common weapon (present in 45.4% of all complaints). Nearly 50% of assaults involve firearms, and most homicides (86.2%) and robberies (60.7%) involve them. Knives are present in 7% of assault complaints, and personal weapons are involved in 24.3% of robberies and 12% of assaults. Nearly 15% of complaints involve multiple weapon type combinations. Almost half of complaints that occur during the first shift are cleared, compared to those that occur during the second (36.7%) and third (29.4%) shifts. Cases involving minor or major injuries have higher clearance (39.9%) than crimes involving no or unknown injuries (35.2%). Complaints involving multiple victims have higher clearance levels (43.9%) than those involving only one victim (34.9%).¹⁷ While only 30.1% of cases

involving one charge are cleared, 57% of complaints involving multiple charges are cleared.

Less than 10% of complaints in the sample involve witnesses. Witnesses are present in 30.9% of homicide cases, but are only present in approximately 7% of assault and robbery complaints. About 37% of complaints that do not involve witnesses are solved, compared to the 42.4% of crimes involving witnesses that are solved.

St. Louis neighborhoods experienced an average of about 83.73 crimes (*SD* = 49.1) over the four-year period. About 50% of block groups experienced 70 crimes or less during the entire four-year period. Block groups are on average about 67.6% Black, and most violent crimes (56.1%) occur in block groups with Black populations of 70% or more. Most crimes occur in block groups in which 25% or more residents are in poverty (59.8%) and block groups in which 25% or more residents live in female-headed households (50.1%). Over 77% of homicides are committed in predominately Black (> 70%) neighborhoods, compared to 61.6% of assaults, and 48.8% of robberies. About 35.4% of

(footnote continued)

involving multiple charges involve two (18.9%) or three (5.3%) charges. Assaults are more likely (63.6%) than homicide (4.4%) and robbery (31.9%) complaints to involve multiple victims, and assaults are more likely than robberies to involve injuries.

¹⁷ The majority of cases involving multiple victims involve two victims (16.9% of the total sample), 6.3% of the sample complaints involve three victims, and 2.9% of complaints involve four victims. The majority of cases

crimes that occur in predominately black neighborhoods (>70%) are cleared. About 42.9% of crimes that occur in non-Black neighborhoods (<30%) are cleared.

Crime varies by police district, with District 2 experiencing the least amount of crime ($n = 566$), and District 6 experiencing the most ($n = 2240$). Districts experienced an average of about 2241 ($SD = 599.6$) crimes over the four-year period. The average number of detectives across all neighborhoods is 6.5 ($SD = 2.1$). The number of crimes per detective ranges from about 213 to about 875, with an average of about 495.7 crimes. Districts vary only slightly in their clearance levels, with District 7 having the lowest percentage of crimes cleared (32.7%), and District 2 solving the highest percentage of its total complaints (49.7%).

Interesting relationships exist across theoretical concepts and levels of analysis. In predominately Black block groups (>70%), for instance, complaints involving only Black victims account for 85% of crime victims. Small differences seem to exist in terms of case solvability, with witnesses being present in 8% of complaints involving Black victims, and in only 7% of complaints that involve non-Black victims. Situational characteristics differ based on victim characteristics and neighborhood composition. The majority of crimes committed in predominately Black block groups (60.8%) and against Black victims (59.8%), for instance, involve firearms, while only about 43% of crimes that occur in non-Black block groups and 41.9% of crimes that are committed against non-Black victims involve firearms.

7.2. Violent crime models

In Model 1, complaint, block group, and police district factors are modeled to predict clearance. Victim race emerges as a significant predictor of clearance. Crimes involving Black victims are less likely to be cleared than those involving non-Black victims ($\beta = -0.03$). In line with the ideal victim hypothesis, victim sex is also a significant indicator of clearance, with complaints involving all male victims and male and female victims having lower clearance likelihoods compared to those only involving females. Victim age is not a significant predictor of clearance.

Crime type, weapon type, victim-offender relationship, and officer shift (i.e., time of day) emerge as significant predictors of clearance in ways that are in line with the situational thesis. Homicides have probabilities of clearance that are 0.16 higher than for assaults. Complaints involving firearms have probabilities of clearance that are significantly lower than ones involving personal weapons ($\beta = -0.11$), and complaints involving unknown or other weapon types are about 11% less likely to be cleared than personal weapon complaints. Complaints involving knives and multiple weapon types are about five and 17% more likely than ones involving one type of weapon to be cleared, respectively. Victim-offender relationships have large effects on clearance. Compared to crimes involving strangers, those involving persons known to the victim have probabilities of clearance that are significantly high, with complaints involving within-family relationships having the largest effect ($\beta = 0.35$). Complaints with unknown victim-offender relationships are significantly less likely than stranger complaints to be cleared, and those cases falling within the relationship not applicable category are more likely to be cleared. Crimes that occur during the late afternoon, evening, night, and early morning are significantly less likely to be cleared than offenses that occur in the morning and early afternoon. Relative to first shift offenses, those that occur during the second and third shifts have probabilities of clearance that are 5.3 and 10.7% lower, respectively.

In contrast to the situational thesis and past research (e.g., Taylor et al., 2009), crimes involving no/unknown injuries have clearance probabilities that are significantly higher ($\beta = 0.05$) than those for crimes involving minor or major injuries, and crimes involving multiple injury types are less likely than ones involving one injury type to be cleared. Though research has demonstrated victim injury has been

found to positively and significantly increase clearance odds for rape (D'Alessio & Stolzenberg, 2003), assault (D'Alessio & Stolzenberg, 2003), and robbery (Snyder, 1999), recent evidence from St. Louis, MO suggests that victims might not cooperate with criminal justice systems, even when seriously injured (Hipple et al., 2019). Qualitative research should be conducted to further examine this finding.

Number of charges and number of victims emerge as significant predictors of clearance in expected ways, with the probability of clearance increasing by 0.88 each time a charge is added to a complaint, and lowering by about 1% each time a victim is added to a complaint. Crimes that occur on weekdays are more likely to be cleared than ones that occur on weekends ($\beta = 0.02$), and attempted crime status is negatively and significantly associated with clearance ($\beta = -0.06$). In contrast to the case solvability thesis, the witness predictor is non-significant.

Concentrated disadvantage is a non-significant predictor of clearance, and racial composition is significant. In line with the group devaluation perspective, crimes committed in areas with larger Black populations are significantly less likely to be cleared than those committed in predominately non-Black block groups, but the effect size is small ($\beta = -0.001$). Contrary to the association devaluation hypothesis, neighborhood crime emerges as a positive, significant predictor of clearance in this model ($\beta = 0.24$), suggesting that high-crime communities may be more heavily attended to than low-crime communities. While detective workload has a non-significant effect on crime clearance, district crime rates negatively and significantly affect crime clearance ($\beta = -0.02$). Thus, even when controlling for police district characteristics, characteristics of incidents, neighborhood crime levels, – and to a smaller degree, victim factors and neighborhood race – significantly impact the probability of a crime being cleared.¹⁸

7.3. Interaction effects

One of the more valuable aspects of including indicators from multiple theories is the ability to test their impact on one another. In an attempt to better understand the recent predictions made by journalists and social scientists in relation to victim race and clearance, interaction terms between Black victim race and case solvability, victim-offender relationship, and crime type are added to the multilevel model (Table 3; Models 2–4).¹⁹ First, an interaction between case solvability (i.e., witness present) and victim race is added to the model (Model 2). The results demonstrate a significant positive interaction and indicate that cases involving Black victims and witnesses are significantly more likely to be cleared than cases that involve witnesses and are perpetrated against non-Black victims or victims of multiple races ($\beta = 0.14$; see Fig. 1). This suggests that the clearance of crimes committed against Blacks might depend on the presence or absence of witnesses during investigations.

As illustrated in Fig. 1, the difference in the predicted probability of

¹⁸ Rape (when categorized as the most serious offense) and domestic complaints were excluded from original analyses because they greatly differ from other part I offenses (Walfield, 2016). When domestic offenses (coded 1 if it occurred in the home, and zero otherwise; $n = 2612$) and complaints that rank rape as the most serious offense ($n = 600$) are included in the full model (Model 1), effect sizes and significance levels change. Positive, significant effects found for complaints involving mixed race victims ($\beta = 0.05$), knives ($\beta = 0.03$), and domestic flags ($\beta = 0.15$). Neighborhood crime rates are positively and significantly associated with clearance ($\beta = 0.20$), attempted complaints are not significantly less likely to be cleared than completed complaints, and district crime is not a significant predictor of clearance.

¹⁹ To test whether victim devaluation and neighborhood factors work together to affect clearance, cross-level interactions were modeled between Black victim race and three block group-level factors: racial composition, concentrated disadvantage, and crime rate. The results indicated that neighborhood effects do not depend on victim race.

Table 3
Multilevel linear probability models for clearance in St. Louis, MO (2010–2013).

Predictor	Model 1			Model 2			Model 3			Model 4		
	Victim, case, neighborhood & police district factors			Interacting case solvability & victim race			Interacting victim-offender relationship & victim race			Interacting crime type & victim race		
	β		Robust SE	β		Robust SE	β		Robust SE	β		Robust SE
All male victim(s)	-0.034	*	0.016	-0.035	*	0.016	-0.017		0.016	-0.034	*	0.017
Victims of multiple sexes	-0.058	**	0.019	-0.060	**	0.019	-0.027		0.023	-0.059	**	0.019
All Black victim(s)	-0.033	*	0.014	-0.041	**	0.012	0.012		0.019	-0.033	*	0.014
Victims of multiple races	0.044		0.025	0.045		0.025	0.035		0.020	0.044		0.025
Victim age	0.001		0.001	0.001		0.001	0.001		0.002	0.001		0.001
Victim age squared	-0.00		0.000	-0.000		0.000	-0.000		0.000	-0.000		0.000
Victims of multiple ages	0.027		0.014	0.026		0.014	0.032	*	0.013	0.026		0.014
Homicide	0.16	***	0.020	0.157	***	0.020	0.250	***	0.026	0.143	**	0.044
Robbery	-0.02		0.014	-0.031	**	0.013	-0.094	***	0.016	-0.031	*	0.013
Number of charges	0.088	***	0.008	0.089	***	0.008	0.076	***	0.008	0.089	***	0.008
Number of victims	-0.012	***	0.003	-0.012	***	0.003	-0.009	**	0.003	-0.012	***	0.003
Only gun	-0.111	***	0.013	-0.108	***	0.014	-0.071	***	0.012	-0.108	***	0.014
Only knife	0.045	***	0.012	0.047	***	0.013	0.018		0.018	0.045	***	0.012
Only unknown/other weapon	-0.109	***	0.015	-0.119	***	0.014	-0.054	**	0.019	-0.118	***	0.014
Multiple weapon types	0.171	***	0.016	0.171	***	0.017	0.140	***	0.016	0.171	***	0.017
No weapon	-0.046		0.025	-0.048	*	0.024	-0.020		0.026	-0.049	*	0.024
Minor victim injury	-0.075	***	0.012	-0.075	***	0.011	-0.050	**	0.015	-0.075	***	0.011
Major victim injury	-0.085	***	0.012	-0.087	***	0.013	-0.042	***	0.012	-0.086	***	0.013
Multiple victim injury types	-0.086	*	0.035	-0.088	*	0.034	-0.073	*	0.036	-0.087	*	0.034
Within-family relationship	0.353	***	0.029	0.347	***	0.028	0.328	***	0.030	0.353	***	0.028
Outside of family relationship	0.328	***	0.016	0.329	***	0.016	0.300	***	0.026	0.329	***	0.016
Relationship unknown	-0.161	***	0.017	-0.162	***	0.018	-0.214	***	0.024	-0.162	***	0.018
Relationship not applicable	0.103	***	0.021	0.076	***	0.020	0.057	**	0.019	0.077	***	0.020
Other relationship	0.042		0.055	0.043		0.053	0.029		0.024	0.042		0.053
Multiple relationships	0.258	***	0.019	0.261	***	0.019	0.235	***	0.025	0.260	***	0.019
Second shift	-0.053	***	0.009	-0.049	***	0.008	-0.031	***	0.008	-0.049	***	0.008
Third shift	-0.107	***	0.019	-0.102	***	0.019	-0.088	***	0.019	-0.101	***	0.019
Weekday	0.021	*	0.010	0.018		0.010	0.012		0.011	0.018		0.010
Attempted	-0.016		0.025	-0.029		0.024	-0.047		0.026	-0.028		0.024
Witness(es)	0.038		0.032	-0.054		0.048	0.034		0.035	0.038		0.033
Concentrated disadvantage	-0.004		0.003	-0.004		0.003	-0.005		0.005	-0.004		0.003
Racial composition	-0.001	***	0.000	-0.001	***	0.000	-0.001	***	0.000	-0.001	***	0.000
Area population	-0.008		0.008	-0.009		0.007	-0.007		0.011	-0.010		0.008
Cross-classified	0.006		0.012	0.006		0.011	0.007		0.012	0.007		0.011
Neighborhood crime rate	0.238	**	0.083	0.217	**	0.084	0.244	*	0.098	0.237	**	0.084
District crime rate	-0.021	**	0.008	-0.022	**	0.008	-0.020	*	0.008	-0.019	*	0.008
Detective workload	-0.000		0.000	-0.000		0.000	-0.000		0.000	-0.000		0.000
Witness(es) x Black victim				0.135	**	0.042	-		-	-		-
Stranger x Black victim				-		-	-0.074	***	0.021	-		-
Homicide x Black victim				-		-	-		-	0.019		0.066
Constant	0.489	***	0.061	0.499	***	0.054	0.533	***	0.077	0.488	***	0.055
Level 2 (μ_{1j})	0.032(0.004)			0.031(0.004)			0.032(0.005)			0.031(0.004)		
Level 1 residual variance (τ_{1j})	0.413(0.006)			0.410(0.005)			0.419(0.005)			0.411(0.005)		

L1 N = 13,717 offenses; L2 N = 352 block groups; clustered in 9 police districts.

* Indicates p < .05.

** Indicates p < .01.

*** Indicates p < .001.

clearance for crimes involving Black victims compared to those not involving Black victims is greater in cases involving witnesses compared to cases that lack witnesses. Interestingly, complaints involving non-Black victims and witnesses are predicted to have lower clearance than those that lack witnesses and involve non-Black victims. Complaints involving robberies and lacking weapons emerge as significant in this model, with robbery crimes being less likely to be solved compared to assaults, and crimes involving no weapons being less likely to be solved than ones involving personal weapons.

A second interaction term is examined in Model 3 to determine whether violent crimes committed against Black victims with stranger victim-offender relationships are particularly unlikely to be solved compared to cases involving non-Black victims and within-family,

outside of family, relationship unknown, not applicable, and other relationships (Mouzos & Muller, 2001). The results indicate a significant negative interaction between Black victim and stranger victim-offender relationship ($\beta = -0.07$). Predicted probabilities (Fig. 2) demonstrate this finding clearly and suggest that crimes involving Black victims are even less likely to be solved when they involve stranger relationships compared to other relationship types. Victim factors become non-significant in this model, with the exception of complaints involving victims of multiple ages emerging as a positive and significant indicator of clearance. In this model, the effects for homicide and robbery predictors are larger, and certain weapon predictors are no longer significantly related to clearance.

Recent attention has been devoted to the low clearance rates of

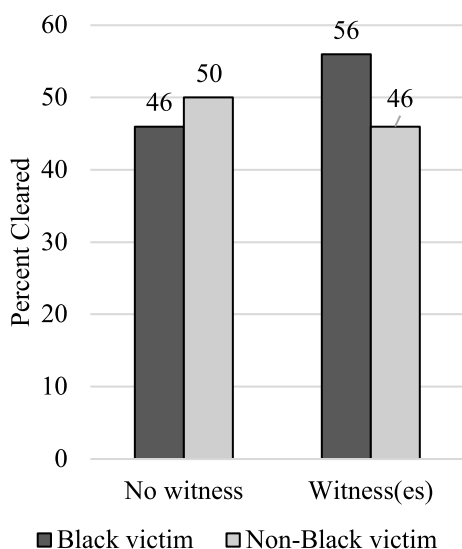


Fig. 1. Predicted clearance for violent crime: Moderation effects for complaint victim race and case solvability.

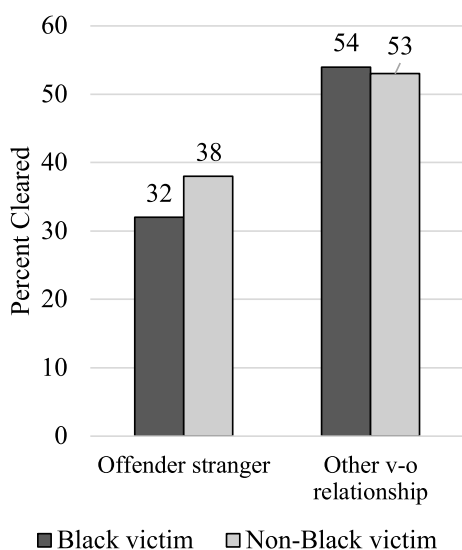


Fig. 2. Predicted clearance for violent crime: Moderation effects for complaint victim race and victim-offender relationship.

nonfatal robberies and assaults (Dean, 2019; Ryley et al., 2019), and the solvability hypothesis assumes that victims will not be devalued when serious crimes, such as homicides, are committed because the police are pressured to solve such crimes (Bynum et al., 1982; Gottfredson & Hindelang, 1979). But the significant relationships between victim predictors (particularly victim race) and clearance, and the positive and significant relationship between homicide and clearance, brings this hypothesis into question. An interaction term between victim race and homicide is added to determine whether crimes involving Black victims are more likely to be solved when they involve homicide complaints compared to other types of crimes (Model 4). In contrast to the victim devaluation thesis, and in line with the situational thesis, crimes committed against Black victims and non-Black victims have similar probabilities of clearance for homicides and non-homicides. In line with victim devaluation, victim race and sex again emerge as significant predictors of clearance, and in line with the situational thesis, complaints involving knives and lacking weapons emerge as significantly more and less likely to be cleared than ones involving personal weapon types, respectively.

7.4. Crime type models

Crime types are examined separately and demonstrate important differences, particularly between homicide and other crime types (see Table 4). Few predictors of clearance emerge as significant in the homicide model (Model 5). Though the lack of significant effects for most predictors of homicide is in contrast to research examining the influence of various devaluation and solvability indicators on clearance, it is in line with a number of recent studies suggesting that non-fatal violent crimes are provided less effort than homicides and are thus more influenced by various case factors (e.g., Braga, Turchan, & Barao, 2019). The strongest associations are found between victim-offender relationships and clearance, with complaints involving outside of family victim-offender relationships and multiple relationship types being nearly 30 and 46% more likely to be cleared than ones involving stranger victim-offender relationships, respectively. Crimes involving firearms are significantly less likely and ones involving multiple types of weapons are significantly more likely to be cleared than ones involving personal weapons. In line with group devaluation, neighborhoods characterized by concentrated disadvantage have lower clearance likelihoods than non-disadvantaged neighborhoods.

Black victim race is only a significant, negative predictor of clearance, and multiple crime types are only significantly and positively related to clearance, in assault and robbery models. Victim sex and age variables are only significant in assault models. A small, but significant positive effect is found between victim age and clearance for assault crimes, and across assault models, crimes involving victims of multiple ages are found to be more likely to be cleared than those occurring against victims of one age category. In assault models, complaints involving knives become significantly more likely to be solved than ones involving personal weapons, and ones involving no weapons and unknown/other weapons become significantly less likely to be solved. Victim injuries again appear to be negatively associated with clearance, and victim-offender relationships again emerge as significant and powerful predictors of clearance in expected directions. In each assault model, concentrated disadvantage or racial composition is negatively and significantly associated with clearance. In contrast to association devaluation, neighborhood crime rates are positively and significantly associated with clearance, and in line with detective workload/resources, police district crime is negatively and significantly associated with clearance across all assault models. Police shifts emerge as significant in assault models, and witnesses appear to be important in solving cases, with assaults involving witnesses being nearly 7% more likely to be cleared than ones without witnesses.

Victim race is a significant predictor of clearance in one robbery model, and compared to crimes involving stranger victim-offender relationships, those with within-family, outside of family, relationship unknown, and multiple victim-offender relationships are significant predictors of clearance and have large effect sizes. Relationship not applicable is also significant, but the effect size is small. Other important predictors of robbery clearance include multiple crime types and the presence of firearms or multiple weapons. Victim injury appears to be less important in solving robbery cases than assaults. Police shift and day of week emerge again as significant in expected directions, as does racial composition.

When interactions are modeled, positive and significant interactions are found between Black victim race and case solvability for assault (Model 7; Fig. 3) and robbery (Model 10; Fig. 5). A negative interaction emerges between stranger victim-offender relationship when examining assault (Model 8; Fig. 4).²⁰ These models indicate that the clearance of

²⁰ Interactions between Black victim race and case solvability, and Black victim race and victim-offender relationship are non-significant in homicide models, as is the interaction between Black victim race and victim-offender relationship in robbery models.

Table 4
Crime type multilevel linear probability models (St. Louis, MO; 2010–2013).

Predictor	Model 5: Homicide			Models 6–8: Assault			Models 9–10: Robbery					
	L1 N = 457; L2 N = 189 (9 police district clusters)			L1 N = 6826; L2 N = 346 (9 police district clusters)			L1 N = 6445; L2 N = 350 (9 police district clusters)					
	β	Robust SE	β	Robust SE	β	Robust SE	β	Robust SE	Robust SE			
All male victim(s)	-0.045	0.079	-0.048	0.02	-0.048	0.020	-0.026	0.016	-0.024	0.018	-0.026	0.018
Victims of multiple sexes	-0.113	0.094	-0.067	0.023	-0.068	0.023	-0.101	0.021	-0.055	0.035	-0.060	0.036
All Black victim(s)	-0.104	0.085	-0.051	0.024	-0.060	0.024	-0.008	0.021	-0.03	0.017	-0.037	0.015
Victims of multiple races	-0.053	0.123	0.091	0.028	0.090	0.029	0.066	0.023	0.034	0.025	0.029	0.023
Victim age	0.006	0.011	0.004	0.002	0.004	0.002	0.004	0.001	-0.001	0.002	-0.001	0.002
Victim age squared	-0.000	0.000	-0.000	0.000	-0.000	0.000	-0.000	0.000	-0.000	0.000	0.000	0
Victims of multiple ages	0.001	0.084	0.033	0.012	0.032	0.011	0.052	0.015	0.008	0.028	0.007	0.027
Multiple crime types	0.019	0.066	0.063	0.014	0.064	0.014	0.073	0.013	0.218	0.016	0.219	0.018
Number of victims	0.001	0.018	-0.003	0.005	-0.003	0.005	-0.001	0.007	-0.001	0.013	0.004	0.011
Only gun	-0.246	0.071	-0.169	0.020	-0.167	0.020	-0.086	0.018	-0.054	0.016	-0.047	0.015
Only knife	0.017	0.093	0.043	0.019	0.047	0.018	0.034	0.025	-0.057	0.044	-0.079	0.043
Only unknown/other weapon	-0.121	0.108	-0.186	0.033	-0.185	0.035	-0.060	0.066	-0.021	0.019	-0.032	0.019
Multiple weapon types	0.216	0.056	0.250	0.017	0.249	0.017	0.188	0.017	0.112	0.016	0.113	0.017
No weapon	-	-0.220	-0.209	0.094	-0.226	0.094	-0.226	0.113	0.013	0.266	0.014	0.028
Minor victim injury	-	-0.124	-0.120	0.011	-0.125	0.010	-0.091	0.013	-0.022	0.019	-0.020	0.019
Major victim injury	-	-0.107	-0.105	0.016	-0.109	0.016	-0.064	0.015	-0.056	0.026	-0.045	0.026
Multiple victim injury types	0.009	-0.128	-0.107	0.042	-0.127	0.041	-0.090	0.042	-0.264	0.157	-0.270	0.157
Within-family relationship	0.187	0.353	0.354	0.029	0.347	0.028	0.293	0.016	0.347	0.069	0.334	0.069
Outside of family relationship	0.290	0.299	0.307	0.016	0.299	0.016	0.235	0.017	0.339	0.025	0.342	0.026
Relationship unknown	-0.209	-0.193	-0.187	0.023	-0.197	0.023	-0.297	0.022	-0.126	0.021	-0.124	0.021
Relationship not applicable	0.046	0.111	0.080	0.025	0.110	0.027	0.066	0.024	0.128	0.030	0.063	0.025
Other relationship	0.347	0.038	0.048	0.056	0.038	0.056	-0.011	0.036	0.113	0.235	0.116	0.235
Multiple relationships	0.456	0.337	0.229	0.017	0.338	0.017	0.168	0.018	0.353	0.039	0.359	0.038
Second shift	-0.054	0.066	-0.054	0.013	-0.053	0.013	-0.016	0.013	-0.052	0.008	-0.044	0.008
Third shift	-0.082	0.059	-0.123	0.025	-0.124	0.025	-0.085	0.026	-0.097	0.018	-0.086	0.017
Weekday	0.043	0.044	0.017	0.010	0.017	0.009	0.014	0.012	0.03	0.012	0.025	0.011
Attempted	-	-	-	-	-	-	-	-	-	-	-	-
Witness(es)	-0.058	0.063	0.066	0.021	-0.063	0.053	0.042	0.024	-0.015	0.025	-0.026	0.024
Concentrated disadvantage	-0.066	-0.002	-0.002	0.003	-0.003	0.003	-0.009	0.004	0.029	0.055	-0.047	0.059
Racial composition	-0.000	-0.001	-0.001	0.000	-0.001	0.000	-0.000	0.000	-0.003	0.007	-0.003	0.006
Area population	0.057	-0.014	-0.014	0.013	-0.013	0.013	-0.008	0.019	-0.008	0.000	-0.001	0
Cross-classified	0.037	-0.008	-0.010	0.012	-0.007	0.012	-0.017	0.014	-0.018	0.015	-0.009	0.016
Neighborhood crime rate	0.022	0.403	0.410	0.111	0.388	0.113	0.426	0.181	0.018	0.111	0.007	0.093
District crime rate	-0.021	-0.016	-0.017	0.007	-0.019	0.007	-0.022	0.009	-0.019	0.011	-0.019	0.011
Detective workload	0.000	-0.000	-0.000	0.000	-0.000	0.000	-0.000	0.000	-0.000	0.000	-0.000	0
Witness(es) x Black victim	-	-	-	-	-	-	-	-	-	-	-	-
Stranger x Black victim	-	-	-	-	-	-	-	-	-	-	-	-
Constant	0.230	0.635	0.588	0.098	0.651	0.094	-0.126	0.014	0.499	0.128	0.490	0.126
Level 2 (τ_{1j})	0.000(0.000)		0.040(0.010)		0.040(0.010)		0.047(0.009)		0.041(0.006)		0.036(0.007)	
Level 1 residual variance (τ_{ij})	0.421(0.014)		0.414(0.007)		0.414(0.007)		0.421(0.004)		0.402(0.007)		0.398(0.007)	

* Indicates $p < .05$.
 ** Indicates $p < .01$.
 *** Indicates $p < .001$.

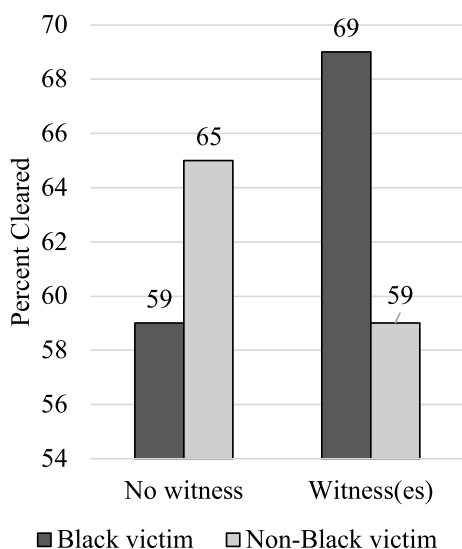


Fig. 3. Predicted clearance for assault: Moderation effects for complaint victim race and case solvability.

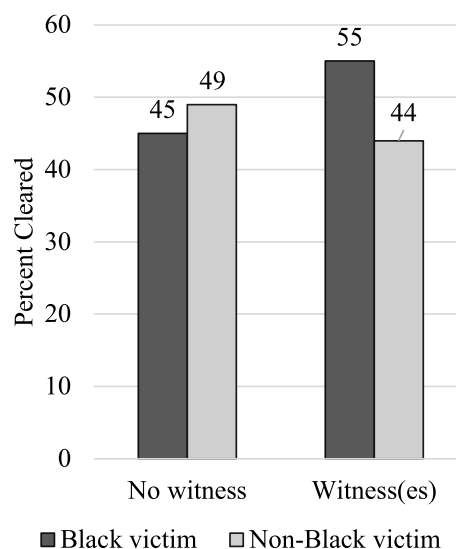


Fig. 5. Predicted clearance for robbery: Moderation effects for complaint victim race and case solvability.

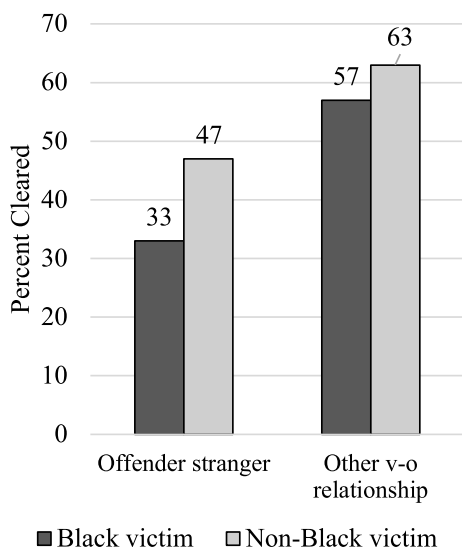


Fig. 4. Predicted clearance for assault: Moderation effects for complaint victim race and victim-offender relationship.

assault and robbery crimes involving Black victims might depend on witness involvement, and that assaults involving Black victims are particularly less likely to be solved when they involve stranger relationships compared to other relationship categories.

8. Sensitivity tests

It is important to check the robustness of results across different model specifications. First, offenses within complaints are collapsed and categorized according to their crime type combinations (only homicide, only assault, only robbery, and multiple crime types).²¹ Thus, a complaint is coded as “only homicide” if it contains one or more homicides and no other crime types.²² The results presented in Table 5 are

²¹ Importantly, number of charges is taken out of analyses due to its high correlation with multiple crime types.

²² Two hundred and forty-three complaints (1.77%) contain only homicides. Almost 34% of complaints include only assault charges, and 39.2% of complaints include only robbery charges.

consistent with those in the original models with a few notable exceptions. Complaints coded as “only robbery” have low probabilities of clearance ($\beta = -0.05$), and complaints involving multiple crime types are about 9% more likely to be cleared than assault-only complaints. Complaints involving victims of multiple races become significantly more likely than ones involving non-Black victims to be cleared ($\beta = 0.08$), and number of victims is no longer significant.

Next, offenses from each complaint are examined separately to determine whether coefficients differ from those in the original models.²³ Thus, a complaint containing robbery and homicide offenses would be assigned to both categories. Revised coefficients are largely consistent with those in the original models, with the exception of robbery emerging as negatively and significantly related to clearance, multiple victim-offender relationships having a large effect size, and otherwise small effect size changes.²⁴

9. Discussion and future directions

One aim of this study is to operationalize existing hypotheses in a way that they can be clearly distinguished. The project then investigates a diverse range of predictors and potential interactions that have been hypothesized to influence violent crime case clearance, and additional characteristics that have previously been tested empirically. It presents a clear framework from which we might study case clearance, examines combinations of factors and their interactions, and explores how case clearance differs by crime type. By recognizing the importance of distinguishing between various aspects of devaluation and solvability, and by investigating their relationships to clearance and to one another, we come closer to pinpointing the sources of clearance disparities.

The findings suggest that the police disproportionately solve crimes based on particular characteristics of victim, situations, neighborhoods, and police districts, and that clearance is largely based on crime type. Homicides appear to have high probabilities of clearance ($\beta = 0.41$), a finding that is consistent with prior research and substantively interesting when we consider clearance studies that limit their samples to homicide offenses (e.g., Litwin & Xu, 2007). The evidence largely

²³ An “other crime” variable is added, and 2475 (18.02%) of complaints contain this type of offense.

²⁴ Although number of victims becomes significant in both sensitivity models, effect sizes are small.

Table 5
Sensitivity models: Linear probability models (St. Louis, MO, 2010–2013).

Predictor	Model 11		Model 12				
	Separated offenses		Collapsed offenses				
	β	Robust SE	β	Robust SE			
All male victim(s)	-0.033	*	0.017	All male victim(s)	-0.036	*	0.017
Victims of multiple sexes	-0.060	**	0.019	Victims of multiple sexes	-0.060	**	0.019
All Black victim(s)	-0.040	**	0.015	All Black victim(s)	-0.035	*	0.014
Victims of multiple races	0.076	**	0.024	Victims of multiple races	0.042		0.023
Victim age	0.002		0.001	Victim age	0.001		0.001
Victim age squared	-0.000		0.000	Victim age squared	-0.000		0.000
Victims of multiple ages	0.024		0.015	Victims of multiple ages	0.025		0.013
Only homicide	0.176	***	0.029	Homicide crime	0.156	***	0.019
Only robbery	-0.045	**	0.014	Robbery crime	-0.028	*	0.013
Multiple crime types	0.093	***	0.013	Other crime	-0.003		0.015
Number of victims	-0.002		0.004	Number of charges	0.087	***	0.007
Only gun	-0.120	***	0.012	Number of victims	-0.011	**	0.003
Only knife	0.027	*	0.013	Only gun	-0.108	***	0.012
Only unknown/other weapon	-0.111	***	0.016	Only knife	0.043	***	0.012
Multiple weapon types	0.227	***	0.018	Only unknown/other weapon	-0.107	***	0.016
No weapon	-0.044		0.025	Multiple weapon types	0.167	***	0.013
Minor victim injury	-0.079	***	0.012	No weapon	-0.046		0.025
Major victim injury	-0.080	***	0.011	Minor victim injury	-0.075	***	0.011
Multiple victim injuries	-0.093	*	0.036	Major victim injury	-0.083	***	0.012
Within-family relationship	0.349	***	0.027	Multiple victim injuries	-0.092	***	0.034
Outside of family relationship	0.321	***	0.015	Within-family relationship	0.354	***	0.027
Relationship unknown	-0.168	***	0.018	Outside of family relationship	0.326	***	0.016
Relationship not applicable	0.102	***	0.024	Relationship unknown	-0.165	***	0.018
Other relationship	0.050		0.046	Not applicable	0.094	***	0.022
Multiple relationships	0.361	***	0.017	Other relationship	0.053		0.053
Second shift	-0.055	***	0.010	Multiple relationships	0.354	***	0.019
Third shift	-0.106	***	0.020	Second shift	-0.053	***	0.009
Weekday	0.023	*	0.010	Third shift	-0.105	***	0.020
Attempted	-0.015		0.025	Weekday	0.021	*	0.010
Witness(es)	0.036		0.032	Attempted	-0.012		0.025
Concentrated disadvantage	-0.004		0.003	Witness(es)	0.033		0.031
Racial composition	-0.001	***	0.000	Concentrated disadvantage	-0.003		0.003
Area population	-0.006		0.009	Racial composition	-0.001	***	0.000
Cross-classified	0.005		0.012	Area population	-0.007		0.009
Neighborhood crime rate	0.199	*	0.083	Cross-classified	0.005		0.012
District crime rate	-0.019	*	0.008	Neighborhood crime rate	0.233	**	0.082
Detective workload	-0.000		0.000	District crime rate	-0.020	**	0.008
Constant	0.548	***	0.066	Detective workload	-0.000		0.000
Level 2 (μ_{1j})	0.032(0.004)			Constant	0.479	***	0.065
Level 1 residual variance (r_{1j})	0.412(0.006)			Level 2 (μ_{1j})	0.031(0.004)		
				Level 1 residual variance (r_{1j})	0.410(0.006)		

L1 N = 13,729 offenses; L2 N = 353 block groups; clustered in 9 police districts.

* Indicates p < .05.

** Indicates p < .01.

*** Indicates p < .001.

supports the situational thesis (Addington, 2006; Litwin, 2004; Litwin & Xu, 2007), and partial support is found for victim devaluation (Regoeczi et al., 2008; Roberts & Lyons, 2009), and neighborhood devaluation (Litwin & Xu, 2007; Paré et al., 2007; Petersen, 2017). While victim and neighborhood race remain significant predictors across most models and suggest that the police devalue Black victims and communities, the significant effect of situational characteristics, such as weapon type and officer shift, on crime clearance suggest that the police are largely affected by circumstances (such as time of day and lack of physical evidence) that are out of their control.

Partial support is found for the case solvability thesis (Litwin, 2004; Roberts, 2007). Perhaps the most surprising result in this study, and one that goes against conventional wisdom is the non-significant association between case solvability and clearance when controlling for other predictors. While this may demonstrate that case solvability does not impact crime clearance, more sophisticated models suggest that victim race operates as a moderator between the two. Positive interactions between victim race and case solvability suggest that witnesses significantly matter in cases involving Black victims, particularly for

assault and robbery cases. The current study results suggest that witnesses seem to matter most in cases and communities that may be especially unlikely to involve witness cooperation. This may suggest that, in cases involving Black victims, witnesses are more knowledgeable about the crimes that occur, and therefore more useful to the police when they are present in cases. These interactions, and the significant interactions found between victim race and victim-offender relationship, suggest that the clearance of crimes involving Black victims may depend on detectives' ability to secure compliance from victims and witnesses. These findings are in line with recent investigative journalism findings (Leovy, 2015; Lowery, Kelly, & Mellnik, 2018) and scholarship highlighting racial differences in willingness to come forward to police, cooperate as witnesses, and provide the police with information (Hagan, McCarthy, Herda, & Chandrasekher, 2018; Tyler, 2004). Though qualitative research will be key in discerning why witnesses and particular victim-offender relationships are vital for particular investigations, by disentangling victim race and situational aspects theoretically and in analyses, this study contributes to literature on crime clearance.

The current study suggests that police districts experiencing high workload volumes may be less able to clear crimes (Klinger, 1997; Lipsky, 2010), but, in contrast to the association devaluation hypothesis (Borg & Parker, 2001), it also suggests that crimes committed in high-crime neighborhoods have significantly higher clearance likelihoods than ones committed in neighborhoods with low levels of crime. Future research should continue to examine clearance in relation to neighborhood and police district differences.

One limitation of the dataset used in this study is that it does not include important offender characteristics, situational characteristics of crime incidents (e.g., motives such as drugs or gang), and case solvability characteristics (e.g., time spent on cases; search for physical evidence conducted) that have the potential to impact clearance (Regoeczi et al., 2000; Wellford & Cronin, 1999). It may be the case, for instance, that crimes motivated by drugs or gangs are especially more difficult to solve because they lack physical evidence and may also be closely intertwined with other measured solvability factors, such as witness cooperation and times that crimes are likely to occur. It will also be vital to capture and carefully measure concepts relating to evidence and specific actions taken during investigation. Of particular importance will be distinguishing between actions that can be influenced by the police (e.g., number of hours spent investigating a crime scene) and features of cases that cannot be influenced by officers (Wellford & Cronin, 1999). The analyses also fail to capture important neighborhood characteristics, such as police-community relations (Regoeczi, 2018) and neighborhood collective efficacy (Mancik et al., 2018), which may also inform how police employ devaluation as well as how community members cooperate or fail to cooperate in investigations. Furthermore, although available, offender characteristics were excluded from analyses. A large amount of offender information was missing for complaints that were not cleared, and it has been suggested that the presence of such information is a function of a complaint's clearance status (see Regoeczi & Jarvis, 2013). Importantly, since the victim-offender relationship construct contains important offender information, it might suggest an interaction between solvability and the situational thesis. Future research should look into this issue. Finally, since this study focuses on a single police department within a single city, its external validity is limited. The study location may explain surprising findings, such as why cases involving injuries are less likely to be cleared than ones not involving injury. Police departments have different practices regarding investigation. In Phoenix, for example, responding patrol officers immediately notify field sergeants when an individual has been seriously injured or killed (McEwen, 2013). Further, to the extent that issues of race, segregation, and crime remain intractable in many American cities, this study suggests that more work should be done to disentangle the myriad of contributing factors to clearance disparities.

Thus, future research should more comprehensively analyze case solvability characteristics, and should consider additional case, person, neighborhood, and police district characteristics in relation to clearance and other criminal justice system indicators. Qualitative examinations of case narratives would be particularly useful because they would allow for researchers to complete a more thorough analysis of detailed information pertaining to victims, suspects (when known), incidents, and areas (Geberth, 1996; Litwin, 2004; Riedel & Rinehart, 1996), and would provide a better understanding of police officers' responses to crime. Future research should look more closely at case solvability (e.g., whether witnesses and/or victims cooperate in investigations; forensic evidence), and constructs regarding police resource deployment across neighborhoods (e.g., number of hours and/or months spent on cases) to test whether such factors affect clearance or mediate or moderate the relationship between incident-level and/or neighborhood-level characteristics and clearance. The current study's focus on serious violent crimes most likely means that the effects reported here are conservative estimates. Future research should also comprehensively examine the clearance of property and other less serious crimes, as officers may have

more difficulty in solving such crimes, but also more discretion and flexibility in handling them (Cordner, 1989; Coupe, 2014; Paré et al., 2007).

Overall, the tests that were conducted in this study demonstrate significant and substantive relationships that are worth further examining. It is vital that larger studies of crime-solving practices be conducted to determine the extensiveness of clearance disparities, why they persist, and how they can be lowered. The working framework developed in this paper is the first step toward building a refined theoretical framework that has the potential to clearly and more accurately test various clearance explanations.

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Declaration of Competing Interest

None.

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References

- Abrahams, N., Jewkes, R., Martin, L. J., & Mathews, S. (2011). Forensic medicine in South Africa: Associations between medical practice and legal case progression and outcomes in female murders. *PLoS one*, 6(12).
- Addington, L. A. (2006). Using National Incident-Based Reporting System murder data to evaluate clearance predictors. *Homicide Studies*, 10(2), 140–152.
- Addington, L. A. (2007). Hot vs. cold cases: Examining time to clearance for homicides using NIBRS data. *Justice Research and Policy*, 9(2), 87–112.
- Alderden, M. A., & Lavery, T. A. (2007). Predicting homicide clearances in Chicago: Investigating disparities in predictors across different types of homicide. *Homicide Studies*, 11(2), 115–132.
- Allison, P. D. (2001). *Missing data* (Vol. 136). Sage publications.
- Black, D. J. (1976). *The behavior of law*. New York: Academic Press.
- Black, D. J. (1983). Crime as social control. *American Sociological Review*, 48(1), 34–45.
- Borg, M. J., & Parker, K. F. (2001). Mobilizing law in urban areas: The social structure of homicide clearance rates. *Law and Society Review*, 35(2), 435–466.
- Braga, A. A., & Dusseault, D. (2018). Can homicide detectives improve homicide clearance rates? *Crime & Delinquency*, 64(3), 283–315.
- Braga, A. A., Turchan, B., & Barao, L. (2019). The influence of investigative resources on homicide clearances. *Journal of Quantitative Criminology*, 35(2), 337–364.
- Briggs, S., & Opsal, T. (2012). The influence of victim ethnicity on arrest in violent crimes. *Criminal Justice Studies*, 25(2), 177–189.
- Brunson, R. K., & Weitzer, R. (2009). Police relations with black and white youths in different urban neighborhoods. *Urban Affairs Review*, 44(6), 858–885.
- Bryk, A. S., & Raudenbush, S. W. (1992). *Hierarchical linear models for social and behavioral research: Applications and data analysis methods*. Thousand Oaks, CA: Sage.
- Bynum, T. S., Cordner, G. W., & Green, J. R. (1982). Victim and offense characteristics: Impact on police investigative decision-making. *Criminology*, 20(3–4), 301–318.
- Cardarelli, A. P., & Cavanagh, D. (1992, November). Uncleared homicides in the United States: An exploratory study of trends and patterns. Paper presented at the annual meeting of the American Society of Criminology, New Orleans, LA.
- Chaiken, J. M. (1975). *The criminal investigation process: Survey of municipal and county police departments*. Vol. 2. Santa Monica, CA: RAND Corporation.
- Chaiken, J. M., Greenwood, P. W., & Petersilia, J. R. (1977). The criminal investigation process: A summary report. *Policy Analysis*, 3(2), 187–217.
- Christie, N. (1986). The ideal victim. In E. A. Fattah (Ed.). *From crime policy to victim policy* (pp. 17–30). London: Palgrave Macmillan.
- Cook, P. J., Braga, A. A., Turchan, B. S., & Barao, L. M. (2019). Why do gun murders have a higher clearance rate than gunshot assaults? *Criminology & Public Policy*, 18(3), 525–551.
- Cordner, G. W. (1989). Police agency size and investigative effectiveness. *Journal of Criminal Justice*, 17(3), 145–155.
- Coupe, R. (2014). *An evaluation of the effects of police resources and incident solvability on*

- crime detection. 46. University of Cambridge Faculty of Law Research Paper1–23.
- D'Alessio, S. J., & Stolzenberg, L. (2003). Race and the probability of arrest. *Social Forces*, 81(4), 1381–1397.
- Dean, M. M. (2019, February 19). In Philly, most armed robbers remain beyond the long arm of the law. *Philly.com*. Retrieved from <https://www.philly.com/news/philadelphia-armed-robberies-unsolved-police-glenn-hudson-20190203.html>.
- Eck, J. E. (1983). *Solving crimes: The investigation of burglary and robbery*. Washington, DC: Police Executive Research Forum.
- Fallik, S. W. (2017). Detective effort: What contributes to arrests during retrospective criminal investigations? *Policing & Society*.
- Federal Bureau of Investigation (2017). *Crime in the United States, 2017*. Washington, DC: U.S. Department of Justice.
- Geberth, V. J. (1996). *Practical homicide investigation: Tactics, procedures, and forensic techniques*. Boca Raton, FL: CRC Press.
- Gordon, C. (2009). *Mapping decline: St. Louis and the fate of the American city*. Philadelphia, PA: University of Pennsylvania Press.
- Gottfredson, M. R., & Hindelang, M. J. (1979). A study of behavior of law. *American Sociological Review*, 44(1), 3–18.
- Greenwood, P. W., Chaiken, J. M., Petersilia, J., Prusoff, L. L., Castro, R. P., Kellen, K., & Wildhorn, S. (1975). *The criminal investigation process: Volume III: Observations and analysis*. Santa Monica, CA: RAND Corporation.
- Greenwood, P. W., & Petersilia, J. (1975). *The criminal investigation process: Volume I: Summary and policy implications*. Santa Monica, CA: RAND Corporation.
- Guo, G., & Zhao, H. (2000). Multilevel modeling for binary data. *Annual Review of Sociology*, 26(1), 441–462.
- Hagan, J., McCarthy, B., Herda, D., & Chandrasekher, A. C. (2018). Dual-process theory of racial isolation, legal cynicism, and reported crime. *Proceedings of the National Academy of Sciences*, 115(28), 7190–7199.
- Hawk, S. R. (2015). *A multi-method examination of homicide investigations on case outcomes (Unpublished Ph.D. dissertation)*. Atlanta, GA: George State University.
- Hawley, A. (1950). *Human ecology: A theory of community structure*. NY, New York: Ronald Press Co.
- Hipple, N. K., Thompson, K. J., Huebner, B. M., & Magee, L. A. (2019). Understanding victim cooperation in cases of nonfatal gun assaults. *Criminal Justice and Behavior* 0093854819848806.
- Horvath, F., Meesig, R. T., & Lee, Y. H. (2001). *A national survey of police policies and practices regarding the criminal investigation process: Twenty-five years after Rand*. Washington, DC: The National Institute of Justice.
- Jarvis, J. P., Mancik, A., & Regoeczi, W. C. (2017). Police responses to violent crime: Reconsidering the mobilization of law. *Criminal Justice Review*, 42(1), 5–25.
- Jarvis, J. P., & Regoeczi, W. C. (2009). Homicide clearances: An analysis of arrest versus exceptional outcomes. *Homicide Studies*, 13(2), 174–188.
- Jiao, A. Y. (2007). Explaining homicide clearance: An analysis of Chicago homicide data 1965–1995. *Criminal Justice Studies*, 20(1), 3–14.
- Johnson, B. D. (2010). Multilevel analysis in the study of crime and justice. In A. R. Piquero, & D. Weisburd (Eds.). *Handbook of quantitative criminology* (1st ed.). New York: Springer.
- Keel, T. G., Jarvis, J. P., & Muirhead, Y. E. (2009). An exploratory analysis of factors affecting homicide investigations: Examining the dynamics of murder clearance rates. *Homicide Studies*, 13(1), 50–68.
- Klinger, D. A. (1997). Negotiating order in patrol work: An ecological theory of police response to deviance. *Criminology*, 35(2), 277–306.
- Kubrin, C. E., & Weitzer, R. (2003). Retaliatory homicide: Concentrated disadvantage and neighborhood culture. *Social Problems*, 50(2), 157–180.
- LaFree, G., Baumer, E., & O'Brien, B. (2010). Social context and the racial gap in violence: A city-level analysis of changes in black-white homicide arrest ratios, 1960–2000. *American Sociological Review*, 75(1), 75–100.
- Lee, C. (2005). The value of life in death: Multiple regression and event history analyses of homicide clearance in Los Angeles County. *Journal of Criminal Justice*, 33(6), 527–553.
- Leovy, J. (2015). *Ghettoside: A true story of murder in America*. New York, NY: Spiegel & Grau.
- Lipsky, M. (2010). *Street-level bureaucracy: Dilemmas of the individual in public services* (expanded ed.). New York: Russell Sage Foundation.
- Liska, A. E., Chamlin, M. B., & Reed, M. B. (1985). Testing the economic production and conflict models of crime control. *Social Forces*, 64(1), 119–138.
- Litwin, K. J. (2004). A multilevel multivariate analysis of factors affecting homicide clearance. *Journal of Research in Crime and Delinquency*, 41(4), 327–351.
- Litwin, K. J., & Xu, Y. (2007). The dynamic nature of homicide clearances: A multilevel model comparison of three time periods. *Homicide Studies*, 11(2), 94–114.
- Lowery, W., Kelly, K., & Mellnik, T. (2018, July 25). Killings of black people lead to arrests less often than when victims are white. *WashingtonPost.com*. Retrieved from https://www.washingtonpost.com/graphics/2018/investigations/black-homicides-arrests/?utm_term=.00c23b7284a9.
- Lowery, W., Kelly, K., Mellnik, T., & Rich, S. (2018, June 6). Murder with impunity: Where killings go unsolved. *WashingtonPost.com*. Retrieved from <https://onlinelibrary.wiley.com/page/journal/17459125/homepage/forauthors.html>.
- Lum, C., Wellford, C., Scott, T., & Vovak, H. (2016). Trajectories of U. S. crime clearance rates. *Report for the Laura and John Arnold Foundation*. Fairfax, VA: Center for Evidence-Based Crime Policy, George Mason University.
- Mancik, A. M., Parker, K. F., & Williams, K. R. (2018). Neighborhood context and homicide clearance: Estimating the effects of collective efficacy. *Homicide Studies*, 22(2), 188–213.
- Marché, G. E. (1994). The production of homicide solutions: An empirical analysis. *American Journal of Economics and Sociology*, 53(4), 385–401.
- McEwen, T. (2013). *Executive summary evaluation of the phoenix homicide clearance project*. Washington, DC: US Department of Justice.
- McEwen, T., & Regoeczi, W. (2015). Forensic evidence in homicide investigations and prosecutions. *Journal of Forensic Science*, 60(5), 1188–1198.
- Mouzos, J., & Muller, D. (2001). *Solvability factors of homicide in Australia: An exploratory analysis* (216th ed.). Canberra: Australian Institute of Criminology.
- Natapoff, A. (2009). *Snitching: Criminal informants and the erosion of American justice*. New York: NYU Press.
- Ousey, G. C., & Lee, M. R. (2010). To know the unknown: The decline in homicide clearance rates, 1980–2000. *Criminal Justice Review*, 35(2), 141–158.
- Paré, P., Felson, R. B., & Ouimet, M. (2007). Community variation in crime clearance: A multilevel analysis with comments on assessing police performance. *Journal of Quantitative Criminology*, 23(3), 243–258.
- Petersen, N. (2017). Neighbourhood context and unsolved murders: The social ecology of homicide investigations. *Policing and Society*, 27(4), 372–392.
- Puckett, J. L., & Lundman, R. J. (2003). Factors affecting homicide clearance: Multivariate analysis of a more complete conceptual framework. *Journal of Research in Crime and Delinquency*, 40(2), 171–193.
- Quinney, R. (1977). *Class, state, and crime: On the practice of criminal justice*. Nova Iorque: David MacKay Company.
- Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods*. Thousand Oaks, CA: Sage.
- Regoeczi, W. C. (2018). Solving homicides: Understanding trends and patterns in police clearances of lethal violence. In M. Deflem (Ed.), *Homicide and violent crime* (pp. 121–138). (23 ed.). Bingley, United Kingdom: Emerald Publishing.
- Regoeczi, W. C., & Jarvis, J. P. (2013). Beyond the social production of homicide rates: Extending social disorganization theory to explain homicide case outcomes. *Justice Quarterly*, 30(6), 983–1014.
- Regoeczi, W. C., Jarvis, J. P., & Riedel, M. (2008). Clearing murders: Is it about time? *Journal of Research in Crime and Delinquency*, 45(2), 142–162.
- Regoeczi, W. C., Kennedy, L. W., & Silverman, R. A. (2000). Uncleared homicides: A Canadian/United States comparison. *Homicide Studies*, 4(2), 135–161.
- Regoeczi, W. C., & Riedel, M. (2003). The application of missing data estimation models to the problem of unknown victim/offender relationships in homicide cases. *Journal of Quantitative Criminology*, 19(2), 155–183.
- Riedel, M., & Boulahanis, J. G. (2007). Homicides exceptionally cleared and cleared by arrest: An exploratory study of police/prosecutor outcomes. *Homicide Studies*, 11(2), 151–164.
- Riedel, M., & Rinehart, T. A. (1996). Murder clearances and missing data. *Journal of Criminal Justice*, 19(2), 83–102.
- Rinehart, T. A. (1994). *An analysis of murder clearances in Chicago: 1981–1991*. Doctoral dissertation/Carbondale: Southern Illinois University.
- Rios, V. M. (2011). *Punished: Policing the lives of Black and Latino boys*. New York: NYU Press.
- Roberts, A. (2007). Predictors of homicide clearance by arrest: An event history analysis of NIBRS incidents. *Homicide Studies*, 11(2), 82–93.
- Roberts, A. (2008). The influences of incident and contextual characteristics on crime clearance of nonlethal violence: A multilevel event history analysis. *Journal of Criminal Justice*, 36(1), 61–71.
- Roberts, A. (2015). Adjusting rates of homicide clearance by arrest for investigation difficulty: Modeling incident-and jurisdiction-level obstacles. *Homicide Studies*, 19(3), 273–300.
- Roberts, A., & Lyons, C. J. (2009). Victim-offender dyads and clearance of lethal and nonlethal assault. *Journal of Research in Crime and Delinquency*, 46(3), 301–326.
- Royston, P. (2004). Multiple imputation of missing values. *Stata Journal*, 4, 227–241.
- Rubin, D. B. (1987). *Multiple imputation for nonresponse in surveys*. New York, NY: Wiley.
- Rydberg, J., & Pizarro, J. M. (2014). Victim lifestyle as a correlate of homicide clearance. *Homicide Studies*, 18(4), 342–362.
- Ryley, S., Singer-Vine, J., & Campbell, S. (2019, January 24). Shoot someone in a major U.S. city, and odds are you'll get away with it. *TheTrace.org*. Retrieved from <https://www.thetrace.org/features/murder-solve-rate-gun-violence-baltimore-shootings/>.
- Sampson, R. J., & Raudenbush, S. W. (2004). Seeing disorder: Neighborhood stigma and the social construction of “broken windows.” *Social Psychology Quarterly*, 67(4), 319–342.
- Schafer, J. L. (1999). Multiple imputation: A primer. *Statistical Methods in Medical Research*, 8, 3–15.
- Schroeder, D. A., & White, M. D. (2009). Exploring the use of DNA evidence in homicide investigations: Implications for detective work and case clearance. *Police Quarterly*, 12(3), 319–342.
- Scott Long, J. (1997). Regression models for categorical and limited dependent variables. *Advanced quantitative techniques in the social sciences. Vol. 7*. Thousand Oaks, CA: Sage.
- Snyder, H. N. (1999). The overrepresentation of juvenile crime proportions in robbery clearance statistics. *Journal of Quantitative Criminology*, 15(2), 151–161.
- Taylor, T. J., Holleran, D., & Topalli, V. (2009). Racial bias in case processing: Does victim race affect police clearance of violent crime incidents? *Justice Quarterly*, 26(3), 562–591.
- Tyler, T. R. (2004). Enhancing police legitimacy. *The Annals of the American Academy of Political and Social Science*, 593(1), 84–99.
- Walfield, S. M. (2016). When a cleared rape is not cleared: A multilevel study of arrest and exceptional clearance. *Journal of Interpersonal Violence*, 31(9), 1767–1792.
- Wellford, C., & Cronin, J. (1999). *An analysis of variables affecting the clearance of homicides: A multivariate study*. Washington, DC: Justice Research Statistics Association.
- Wellford, C. F., Lum, C., Scott, T., Vovak, H., & Scherer, J. A. (2019). *Clearing homicides: Role of organizational, case, and investigative dimensions*. Criminology & Public Policy.
- Wilson, W. J. (1987). *The truly disadvantaged*. Chicago, IL: University of Chicago.
- Wolfgang, M. E. (1958). *Patterns in criminal homicide*. Oxford, England: University of Pennsylvania Press.