

ASSESSING THE GENERALIZABILITY OF THE NEAR REPEAT PHENOMENON

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The “near repeat” phenomenon suggests that when a crime occurs in a given area, the surrounding area may exhibit an increased risk for subsequent crime in the days following the original incident. The present study assesses the extent to which near repeats generalize across three different crimes, including shootings, robbery, and auto theft. A series of near repeat models was estimated to further specify the temporal proximity of near repeats for each crime type under investigation. Results showed that a near repeat pattern exists across crime types; however, each crime type has a unique spatiotemporal pattern. Implications for police strategies, such as geographical profiling and future research connecting near repeat patterns to repeat offenders, are discussed.

Keywords: spatial analysis; temporal analysis; crime mapping; near repeat crime; repeat victimization

In an effort to both better understand patterns of crime and provide police with practical information to aid resource deployment strategies, researchers have recently begun to focus on the “near repeat” phenomenon. This phenomenon, which is a special type of repeat victimization, suggests that when a crime occurs in a specific location, the area surrounding that location may experience an increased risk of a similar crime occurring for a distinct period of time (Ratcliffe & Rengert, 2008). Thus, *near repeat crime* refers to trends in spatiotemporal proximity (i.e., trends in both space and time). The near repeat phenomenon originated in literature on burglaries and has been used thus far for independent investigations into the spatiotemporal clustering of shootings, theft of belongings from vehicles, and insurgent activity in Iraq (Johnson, Bowers, & Hirschfield, 1997; Johnson, Summers, & Pease, 2009; Ratcliffe & Rengert, 2008; Townsley, Johnson, & Ratcliffe, 2008). Although this small but growing body of research has helped to promote near repeat crime as a contemporary topic for crime-fighting policy, there are still several important empirical questions requiring attention before widespread adoption of near repeat policing is warranted.

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To increase current knowledge of near repeat victimization, the present study addressed three critical areas related to the generalizability as well as the validity of the near repeat phenomenon. First, this study aimed to reexamine the near repeat pattern of shootings found by Ratcliffe and Rengert (2008) by using data from an alternate city to determine whether the near repeat pattern found originally is a global or a local phenomenon. The independent verification of research findings is important to the scientific field, and establishing whether near repeat patterns for shootings occur in different areas is essential to understanding the ubiquity of the phenomenon. Second, the study extended research on the near repeat phenomenon by analyzing alternate crime types, including robbery and auto theft. Research has shown thus far that different crime types result in different near repeat patterns, and it was expected that robbery and auto theft would also have their own repeat patterns. Prior spatiotemporal analysis suggests that near repeats of the crime of robbery might occur within a day and in the surrounding area, albeit not the immediately surrounding 500 or so meters, of the initial incident (Grubestic & Mack, 2008). Although research on offenders' travel patterns suggests that they tend to not travel far to commit their crimes, auto theft near repeat patterns may be more widespread spatially since specific cars may be targeted as part of a chop shop operation (Wiles & Costello, 2000). By investigating multiple crime types within one jurisdiction in the same study, one can better assess similarities and dissimilarities in near repeats across crime types that are not merely functions of local town characteristics or policing styles. In short, empirical research on both of these aspects of generalizability for the near repeat phenomenon (i.e., locality and crime type) is critical for determining whether near repeat patterns can be attributed to a common, underlying cause or whether its etiology is crime and/or location specific.

Finally, spree crime, which is a pattern characterized by a high frequency of criminal activity involving the same offender across a short time span, such as hours or days (Boba, 2005), may provide a rival explanation for the observation of near repeat crime. Therefore, the analysis was performed using various temporal bands in an effort to more closely examine the spatiotemporal relationship of several crime types to determine the most salient (condensed) near repeat patterns. Although larger near repeat patterns may align with theoretical hypotheses regarding motivation, it is possible that observed patterns in the literature are the result of spree crime or more condensed spatiotemporal patterns that would be discovered only by analyzing near repeat patterns using shorter temporal bands. Near repeat patterns that occur at larger temporal bands may be empirical artifacts (e.g., significant 7-day temporal effects may be observed even though they are being driven exclusively by 1-day temporal effects in reality), which directly call into question the validity of the near repeat phenomenon. Discovering the true duration of spatiotemporal patterns of near repeat crime is critical to the efficient use of this information for crime-fighting strategies. The current study takes an important step toward advancing the field of knowledge surrounding the generalizability and validity of the near repeat phenomenon.

Although we recognize that many psychological theories relating to repeat or serial offenders are relevant to the study of near repeat crime, our purpose for the current study is to examine specific empirical properties, such as the generalizability of the phenomenon across multiple crime types and the effect of various temporal bands on near repeat patterns. Unfortunately, as we lack the appropriate data to provide empirical tests of any hypotheses connecting serial offenders to near repeat patterns, we view these topics as

beyond the scope of the current study. We, however, do believe that the theoretical link between repeat offenders and near repeat patterns is ripe for future investigation.

REPEAT VICTIMIZATION

In recent decades, criminologists have lent their attention to repeat victimization in an effort to better understand crime patterns as well as to facilitate the prevention of future crimes. Weisel (2005) has identified four unique types of repeat victimization: true repeat victimization, virtual repeat victimization, near repeat victimization, and chronic repeat victimization. True repeat victimization occurs when the victim of a previous crime is targeted again for the same type of crime (i.e., same victim and crime). Virtual repeat victimization occurs when victims of the same type of crime are virtually identical to one another. For example, a chain of stores may be targeted for robbery because they have identical layouts. Near repeat victimization occurs when a victim is targeted that is in close spatial proximity to a previous victim. Finally, chronic repeat victimization is identified when the same victim is targeted for a variety of crimes. Although these four unique types of victimization have been identified, most research on repeat victimization generally refers to the repeated criminal victimization of a person or place (Farrell, 1995) and focuses on true or chronic victimization.

Research has shown that being the victim of a crime one time significantly increases the likelihood of being victimized again in the future and that a small proportion of victims account for a large proportion of victimization incidents (Ellingworth, Farrell & Pease, 1995; Farrell, 1992; Farrell & Pease, 1993; Feinberg, 1980; Gottfredson, 1984; Hindelang, Gottfredson, & Garafalo, 1978; Lauritsen & Quinet, 1995; Menard, 2000; Osborn, Ellingworth, Hope, & Trickett, 1996; Reiss, 1980; Sparks, Genn, & Dodd, 1977). Researchers have also shown that specific geographic areas can be the location of a disproportionate amount of crime (Farrell & Sousa, 2001; Sherman, Gartin, & Buerger, 1989; Sherman & Weisburd, 1995). These high-crime areas have been identified as "hot spots" because they have a greater-than-average number of criminal or disorder events or have a higher-than-average risk of victimization (Eck, Chainey, Cameron, Leitner, & Wilson, 2005, p. 2). These areas vary in size but are generally smaller than neighborhoods and include blocks or street segments (Anselin, Griffiths, & Tita, 2008). Identifying these areas has enabled law enforcement to target its resources more effectively by understanding where crimes are most likely to take place. However, hot spots differ from most repeat victimization because hot spots generally include multiple targets and crime types, and although they are concentrated in space, they are not concentrated in a specific amount of time.

Much of the extant research investigating repeat victimization has focused on the specific crime of burglary, although virtually all crime types except for murder or manslaughter have a component of repeat victimization (Townesley, Homel, & Chaseling, 2003). One general finding is that homes that are burglarized have a higher likelihood of being burglarized again in the future (Forrester, Chatterton, & Pease, 1988). Polvi, Looman, Humpharies, and Pease (1990) established temporal patterns for increased risk of revictimization, determining that a victimized residence was 12.42 times more likely to be revictimized in the month following victimization, with risk dropping dramatically in the

months that followed. Johnson et al. (1997) also found risk of revictimization to be elevated in the month following an original burglary. Suggesting a highly important crime reduction strategy, Townsley, Homel, and Chaseling (2000) found that preventing repeat victimization could reduce the overall burglary rate by 25% in their study area. Morgan (2001) also found that revictimization was most likely to occur in the month following a burglary, although the data showed that the likelihood of repeat victimization was more stable in areas of higher overall burglary rates. More importantly, however, was Morgan's discovery of a pattern that showed that dwellings in the surrounding area were also at an increased risk of victimization. Morgan coined the term "near repeats" to refer to these incidents (Morgan, 2001, p. 112).

NEAR REPEAT VICTIMIZATION

Extending from research on repeat victimization, which itself can be considered a special case of space–time clustering, near repeat victimization contends that risk is communicable. Unlike true repeat victimization, which occurs against the exact same target as the original crime, near repeat victimization occurs in close spatial and temporal proximity to the original target. For example, a true repeat victimization pattern involves a single house that is burglarized more than once, whereas a near repeat victimization pattern originates when one house is burglarized and involves subsequent burglaries at one or more homes in the surrounding area for a given period of time. With the crime of burglary in particular, near repeat victimization and virtual repeat victimization may naturally be interlaced, given similarities in neighborhood dwellings.

Research has shown general support for the idea that victimization risk may be communicable, although most research on near repeats has focused specifically on the crime of burglary. Using epidemiological methods used to study infectious diseases, Townsley et al. (2003) found that there was an increase in burglary incidents within 200 m (approximately 650 feet) and 2 months of an original burglary. Similarly, Johnson and Bowers (2004) found increased risk of burglaries for dwellings within 400 feet of a previously burgled home for 1 to 2 months following the incident, especially on the same side of the road. Bowers and Johnson (2005) determined that homes next to a burgled home were at an increased risk of burglary particularly in the week following the incident. Additionally, the authors determined that space–time clustering was more evident in affluent areas as opposed to deprived areas. Johnson et al. (2007) examined 10 areas in five countries and found that a near repeat pattern for burglaries did exist in all of the study locations. Although patterns differed in the geographic areas, a pattern extending at least 200 m for 2 weeks existed across all locations. Johnson et al. (2009) looked at spatiotemporal relationship of theft from motor vehicles (similar to burglary) and found evidence of near repeat crimes occurring within 800 m of the original incident for 2 weeks.

In an effort to extend research on near repeat patterns from property crimes (burglaries) to violent crimes, Townsley et al. (2008) explored the spatiotemporal relationship of insurgent activity in Iraq. The authors found that there was a near repeat pattern that indicated an increased risk of a subsequent attack within 1 km of the original attack location for 2 days following the original event. Also exploring the near repeat phenomenon for "traditional" violent crime, Ratcliffe and Rengert (2008) analyzed the spatial and temporal distributions of shooting incidents in Philadelphia. Their analysis supported a

near repeat pattern for violent crime (shootings); specifically, there was a significant increased likelihood of another shooting within one block of the initial shooting for a period of 14 days after the initial incident. Given that this was the first study to examine shootings, however, it is not yet clear whether a near repeat pattern for shootings is common to all geographic areas or whether characteristics specific to the location of the study (Philadelphia) influenced the pattern.¹ The latter would imply that individual locations would need to identify their own unique near repeat patterns, if they existed at all. However, if evidence shows that the Philadelphia pattern is exhibited in different geographical areas, it may support the existence of a global near repeat phenomenon for shootings. The current study used theoretical information provided by Ratcliffe and Rengert on shootings to partially guide the analysis for that crime type.

As research has not yet explicitly examined the existence of near repeat patterns for robbery or auto theft, there is limited direct guidance concerning what near repeat patterns to expect for these crimes. Still, some basic hypotheses can be formed by considering who commits near repeat crimes. Extant research suggests that it is likely that crimes committed in close spatial and temporal proximity (near repeat crimes) are the result of the same repeat offender. Bernasco (2008), using data from 1996 to 2004 in the Netherlands, found that burglary events occurring in close spatiotemporal proximity were more likely to involve the same offenders. Bowers and Johnson (2004) discovered evidence that near repeat crimes might be committed by the same offender or groups of offenders; burglaries identified as near repeats had more similar *modus operandi* than those that were not identified as near repeats. Additionally, the distance between crime locations has been shown to be a predictive variable linking car thefts committed by the same perpetrator (Tonkin, Grant, & Bond, 2008). If it is assumed that near repeat patterns are the result of repeat offenders, several general hypotheses can be made on the basis of prior research regarding offender behavior for auto theft and robbery. More specifically, given research indicating that offenders committing motor vehicle theft travel farther to commit their crimes—likely attributed to the goal of stealing specific vehicles (Wiles & Costello, 2000)—it is hypothesized that the near repeat pattern for auto theft will span a greater spatial distance than the other crimes analyzed herein. However, it should be noted that there are many different motivations for auto theft, including joyriding, obtaining temporary transportation, and the monetary value of the car or car parts if resold, to name a few (Devery, 1993), and it is likely that patterns of offending will vary according to motivation.

When hypothesizing about patterns for robbery, prior research illustrates that robbers report little planning before their crimes, often deciding to commit a robbery after crossing paths with a suitable target (Barker, Geraghty, Webb, & Key, 1993; Jacobs, 2010). Additionally, prior research has shown robbery to cluster temporally, within 1 to 2 days, and spatially, close to the original incident but not within the immediate 500 m (Grubestic & Mack, 2008). Because of these prior findings, and the assumed spontaneity of robbery, it is hypothesized that any near repeat pattern for robbery in this analysis will occur with small spatial and temporal bands and will exhibit a small, doughnut-like spatial pattern. Unfortunately, the data used for the current study do not feature details on offender identities and therefore cannot actually test whether observed near repeat patterns are the result of repeat offenders; however, the current study examines near repeat crimes using 1-day temporal bands, which could be indicative of spree offending by repeat offenders.

THEORIES ON REPEAT AND NEAR REPEAT VICTIMIZATION

In trying to explain why repeat victimization occurs, two main explanations have been offered: the boost hypothesis and the flag hypothesis (Johnson, 2008). The *boost* hypothesis (also known as state or event dependency) suggests that repeat victimization is the result of a contagion-like process (Johnson, 2008, p. 216). According to this hypothesis, a change can occur either in the individual or place or in the perceptions of those around the individual or place, increasing the likelihood for revictimization. For example, if an offender burgles a home, he or she may burgle it again at a later date since the initial crime leads to the conclusion that the home can be successfully burgled. In other words, the home goes from being a presumed suitable target to a known suitable target. As such, one event increases the probability of another event. An alternative explanation is the *flag* hypothesis (also known as risk heterogeneity), in which a target maintains qualities that make it more attractive for victimization. This theory suggests that different targets maintain different characteristics that make them more or less attractive to potential offenders, and attractive targets are “flagged” by offenders and subsequently victimized. Therefore, the qualities that contributed to the first victimization will also lead to other victimizations. Johnson (2008) found that target attractiveness in specific areas can generate spatial concentrations of crime (flag), and a contagion-like process (boost) is necessary to achieve temporal dimensions to increased risk, supporting both theories. Finding support for both theories is not unexpected, as the two theories are not incompatible (Nagin & Paternoster, 2000). In fact, research has yet to find conclusive support for one theory versus another (Farrell, Phillips, & Pease, 1995), and studies have found support for both (Lauritsen & Quinet, 1995; Schwartz, Dodge, & Coie, 1993).

The idea that offenders “forage” (Johnson et al., 2009) has been used to explain near repeat crimes, with the assumption that near repeat crimes are likely the result of repeat offending. The aim of foraging is to optimize resources while limiting energy expended and limiting risks. After the initial offense has been committed, the knowledge of the geographic area gained by an offender decreases the amount of energy expended in committing another offense in the same area, because that space is no longer unfamiliar. Johnson et al. (2009) suggest that offender foraging may involve spatial drift, as revictimization of the same location may result in limited resources and an increase in risk of identification. Although the current study does not explicitly test these theories of repeat victimization, it is important to understand their applicability as potential theoretical explanations for the near repeat phenomenon.

CURRENT STUDY

The current study sought to extend the empirical research on near repeat crime patterns by addressing issues of generalizability across geographic locations, the effects observed using different spatial bandwidths, and the effects observed using different temporal bandwidths. In accordance with these core objectives, we offer three hypotheses:

1. Near repeat patterns observed in the current study will be similar, in general, to those previously reported in other geographic areas for the same crime type (in this case, shootings);

2. Consistent with prior research that has illustrated unique near repeat patterns for different crimes (Johnson et al., 1997, 2009; Ratcliffe & Rengert, 2008; Townsley et al., 2008), near repeat patterns observed in the current study will be unique, in general, across several crime types, including shootings, robberies, and motor vehicle thefts; and
3. Near repeat patterns observed in the current study will be influenced, in general, by subjective decisions regarding the use of different temporal bandwidths.

Testing these hypotheses holds substantial import for this field of study. Understanding how near repeat patterns vary, if at all, by geographic region can help to address problems with generalizing findings and may eventually aid in further identifying the root causes of near repeat crimes. Additionally, examining the extent to which observed near repeat patterns can be influenced by researchers' decisions regarding temporal band specification is important for establishing the validity of near repeat patterns across jurisdictions. These analyses will aid in determining the most concise near repeat patterns, which is critical to the efficient use of this information for crime prevention strategies, offering clear policy implications.

METHOD

The data used in this study included a complete listing of police incident data for Jacksonville, Florida, for the 37-month span ranging from January 1, 2006, through December 4, 2008. The city consolidated with Duval County in 1968, and the two entities share largely congruent borders except for four small beach towns that maintain their own municipal governments. Because of this consolidation, Jacksonville is the largest city by land area in the 48 contiguous states. Jacksonville–Duval County spans approximately 745.85 square miles, providing an interesting study area, given the high degree of geographic variability. More specifically, Jacksonville features both dense urban areas and less populated semirural areas. Incorporating variability in geography aids in the assessment of the generalizability of near repeat crimes across different urban and rural contexts. Importantly, Jacksonville benefits from a merged city and county government, which eliminates problems that may arise in other study areas related to jurisdictional issues, such as local ordinances (i.e., differences in local laws that might affect patrols or other activities), police practices (i.e., incomplete data arising from different administrative recordkeeping and overlapping responses to calls for service), zoning restrictions, and codes enforcement (i.e., different standards for noise, building maintenance, and other structural indicators in bordering neighborhoods). Collectively, these issues could introduce sources of measurement error into data sets where spatial and temporal phenomena are being studied in areas with border effects. Moreover, several characteristics for Jacksonville, such as mean household income, median age, percentage of the population 18 years and older, and families below the poverty line, closely resemble that of national characteristics (see Table 1). Some variation in racial characteristics exist, but the percentage of Black residents in Jacksonville (30.2%) according to the 2000 census is relatively close to other metropolitan cities regionally and nationally, including Boston (25.3%), Chicago (36.8%), Houston (25.3%), Miami (22.3%), Orlando (26.9%), and Tampa (26.1%) (U.S. Census Bureau, 2008).

TABLE 1: Demographic Characteristics for Jacksonville, Florida

<i>Demographic</i>	<i>Estimate: Jacksonville Residents</i>	<i>Percentage of Jacksonville Residents</i>	<i>Estimate: U.S. Residents</i>
Population	797,699	—	298,757,310
Mean household income	\$47,381	—	\$50,007
Families below poverty level	74,186 ^a	9.3	9.8%
Median age	35.6	—	36.4
18 years and older	589,361	73.9	75.3%
White	497,020	62.3	74.1%
Black	241,119	30.2	12.4%
Asian	27,342	3.4	4.3%
Hispanic	47,006	5.9	14.7%

SOURCE: U.S. Census Bureau (2008).

a. Data missing from U.S. Census Bureau (2008); estimate calculated by dividing percentage (9.3) by total Jacksonville population (797,699).

DATA AND PROCEDURE

The available data provided information for approximately 344,000 incidents in the given time period, including dates, locations, and offense descriptions. Using ArcGIS 9.2, we created *x*- and *y*-coordinates for all incidents. Although *x*- and *y*-coordinates themselves are highly precise, the overall accuracy of spatial associations between event pairs in this study, as in any study using mapped crime data, depends on the general representativeness of geocoded incidents. Geocoding is a process of locating incidents using physical address data to “match” a reference map that features known addresses, house numbers, street names, or other authenticated sources. In this case, incidents were originally geocoded by the Jacksonville Sheriff’s Office using a tiered strategy in which incidents are matched using different techniques to maximize accuracy and precision. Incidents were first matched to GPS coordinates for a building power meter (most precise), then to parcel centroid, and finally to a reference street centerline with an offset (less precise). This resulted in a high overall geocoding rate and the most accurate possible locations for specific events.

The *x*- and *y*- coordinates for incident data were separated into individual files for the three types of crime analyzed in this study: shootings, auto theft, and robberies. Auto theft was identified in the incident data by the official (Uniform Crime Report, or UCR) description. The set of incidents identified by this study as robberies included only robberies of individuals and excluded robberies of businesses (e.g., holding up a liquor store), homes (e.g., home invasion), or individuals situated in cars (e.g., carjacking), as they likely represent different motivations and behavior and, subsequently, different expected near repeat patterns. We identified the set of incidents labeled as shootings by first selecting the UCR categories of aggravated assault or murder-homicide and then including incidents that had a known weapon type of rifle, shotgun, other firearm, or handgun. Importantly, this approach to operationalize nonfatal shootings mirrors the technique used in the UCR and is consistent with reporting practices for several states, including Florida. Furthermore, it mirrors the methodology described by Ratcliffe and Rengert (2008), who used “confirmed shootings where a victim was struck (classified as either aggravated assaults or homicides)” (p. 63).

TABLE 2: Number of Incidents by Crime Type

<i>Crime Type</i>	<i>Total Incidents (1/1/06 to 12/4/08)</i>	<i>Unmatched Incidents (removed from analysis)</i>	<i>Final Total Incidents</i>
Auto theft	11,882	142	11,740 (98.8%)
Robberies	5,591	90	5,501 (98.4%)
Shootings	3,038	59	2,979 (98.1%)

The data used in the analysis consisted of three values: the x -coordinate, the y -coordinate, and the date of the incident. Not all incidents had all three attributes; therefore, incidents without addresses were removed from the final data files. However, at least 98% of crimes for each crime type were successfully geocoded and had valid date information, resulting in minimal exclusion of cases for the near repeat analysis. The total number of incidents and final counts of incidents for each crime type included in the analysis can be found in Table 2.

ANALYSIS

This study performed the necessary analyses using the Near Repeat Calculator Version 1.1 (Ratcliffe, 2007a) and follows from a method developed by Johnson et al. (2007). This software builds on the Knox method (Knox, 1964), which analyzes space–time clustering to determine whether there are more event pairs that occur in close spatiotemporal proximity than would be expected if the incidents had a random distribution, taking into account that some areas have more crime than others. The Near Repeat Calculator creates an observed pattern of event pairs within a spatiotemporal matrix (also called a Knox table) defined by the temporal and spatial bands selected by the user. For example, a user may request an analysis of all near repeat event pairs within 1,000 feet and 21 days. The observed frequency of each cell of the matrix is determined by the number of event pairs that occurs within that cell. Observed event pairs are based on the actual data provided by the user, and each incident in the data is paired with every other incident in the data, resulting in $[n(n-1)]/2$ event pairs, where n is the number of crime incidents. The spatial and temporal distance between each event pair is recorded, and the event pair is assigned to a specific spatiotemporal cell within the matrix. The spatial distance between events was calculated using Manhattan distances, consistent with near repeat analyses by Ratcliffe and Rengert (2008). Manhattan distances more accurately depict the actual distance traveled by an urban resident moving left or right and then up or down from Point A to Point B, as opposed to Euclidean distances, which are measured by straight lines (as the crow flies). As Ratcliffe and Rengert (2008) note, “Manhattan distance most accurately replicates the actual distance traveled by urban residents to get from point to point without the need for measurement software” (p. 65). Chainey and Ratcliffe (2005) observe that using network distances, in which the distance calculation is bounded to existing street networks, often require “specialist street routing data and quite often specialist software” (p. 299), a limitation that prevents widespread use.

After the spatiotemporal distance between events is recorded and event pairs are placed into cells in the spatiotemporal matrix (providing the observed frequency of event pairs), the observed frequency is then compared against the expected frequency, as established by Monte Carlo iterations, which take the actual location of each crime incident from the

observed data and randomly assign actual incident dates to those locations. Because the Monte Carlo iterations randomly pair actual incident dates with actual incident locations, the process creates a random distribution that takes into account that more crime occurs in certain areas and at certain times. Event pairs are created once again, and the resulting “expected” frequencies fill the same spatiotemporal matrix, creating a null hypothesis scenario (Mooney, 1997). This process is repeated for each Monte Carlo iteration, and the expected frequencies are then compared against the observed frequencies to create pseudo p values (based on a pseudorandom sample) and observed-to-expected (O-E) ratios for each cell (also known as Knox ratios).

As the number of iterations increases, the predictive power of the model increases. Selecting the maximum number of 999 Monte Carlo iterations supported by the software allows for a possible pseudo p value of .001. If the observed frequency in a given cell of the matrix exceeds the expected value of every Monte Carlo iteration (in this case, 999 total iterations), the resulting pseudo p value will be .001. If the observed frequency exceeds the expected frequency 998 of 999 times, the resulting pseudo p value will be .002, and so on. The O-E ratios are created by dividing the observed frequency by the mean expected frequency as determined by the Monte Carlo iterations. So, although the pseudo p values and O-E ratios are related, they are not directly analogous. A near repeat pattern occurs when the cells that are closer to the origination point in the matrix are significant (i.e., the upper-left part of the matrix). This pattern indicates that there is an increased risk that another crime will occur within close spatiotemporal proximity to the original incident. Typically, a space–time pattern is observed in which the O-E ratios are strongest in the cells with the closest spatial–temporal bands and then decay as the spatial and temporal distances increase, eventually reaching nonsignificance. It is important to note that some cells in other areas of the matrix may be statistically significant by chance (e.g., lower-right part of the matrix). By themselves, these cells do not indicate a near repeat crime unless they are part of the gradient-like decay pattern just described. In identifying near repeat patterns, cells must have an overrepresentation of events as evidenced by a pseudo p value of .05 or lower and an odds ratio of 1.20 or higher and be close to the originating incident in time and space (Ratcliffe, 2007b).²

Before performing the analysis with the Near Repeat Calculator, it was necessary to determine what temporal and spatial bandwidths to use. Although bandwidths can be arbitrary, they should reflect some features of the underlying geography and temporal parameters appropriate for the study. For their study examining shootings, Ratcliffe and Rengert (2008) selected a spatial bandwidth of 400 feet, which represented an average city block in Philadelphia. Hypothesizing about the motivation for near repeat shootings (e.g., retaliation), they selected 14 days for their temporal period. Following suit, the spatial bandwidth selected for this analysis was the average length of one block in Jacksonville, which was calculated using the street centerline layer (a reference map detailing all street segments and their properties, including their exact length) for Jacksonville using ArcGIS 9.2 and was found to be 575 feet ($SD = 244$ feet).

Although research on near repeat patterns has used temporal periods of up to 2 months, the temporal bands selected for this analysis were 14 days, 7 days, 4 days, and 1 day. The decision to use temporal bands of this length was reached for a number of reasons. One of the goals of this research was to help make the leap from theory to practice by establishing patterns that would be of the greatest utility for local police. It may be reasonable to assign

additional police officers to an area for 1 to 4 days after an incident; however, police may not have the resources to increase patrol consecutively for 2 months. In addition to the practical policing reasons for examining several temporal bands, the limited empirical evidence suggests the temporal dimension of near repeat crime may vary across different types of offenses. Research on shootings established a pattern for 14 days in Philadelphia, which was the largest temporal band examined herein (Ratcliffe & Rengert, 2008). Research on robbery suggests that events may occur within a very short amount of time, such as days or hours (Grubestic & Mack, 2008). In contrast, somewhat larger patterns are expected for auto theft (Wiles & Costello, 2000). Thus, all four temporal bands were used for each crime type to facilitate comparisons. Finally, if patterns extend for a greater temporal distance, they will be evident in the spatiotemporal matrix (cells in columns 2 and 3 may be significant as well). However, if patterns are driven by shorter temporal increases in risk, the only way to uncover this is to explore shorter temporal bands. Temporal bands of 1 day were analyzed to examine the possibility that spree offending may drive resulting near repeat patterns. In sum, the near repeat analysis was performed four times for each of the three crime types analyzed to compare the results using a 14-day, 7-day, 4-day, and 1-day temporal band. Throughout the analysis, no cells in any Knox table had an observed frequency of zero, which would prevent the creation of a pseudo *p* value or a Knox ratio for that cell. In fact, the lowest cell frequency was 7, found in a cell of the Knox table for shootings using a 1-day temporal band. The observed frequencies ranged from a low of 7 to a high of 198. Observed cell frequencies in themselves are not meaningful, as it is the comparison of the observed frequency to the expected frequency that determines whether there is an overrepresentation of event pairs.

RESULTS

SHOOTINGS

The results of the near repeat analysis for shootings using a spatial band of one city block (575 feet) and a temporal band of 14 days are shown in Table 3.³ The results here indicate a pattern that extended four blocks from the original shooting location (2,300 feet) for the 14 days following a shooting incident. Additional analyses were performed employing temporal bands of 7 days, 4 days, and 1 day, and the resulting patterns are also displayed in Table 3. Although repeat patterns could be identified with each temporal band, the most salient repeat pattern was seen using a 4-day temporal band, which displays an increased likelihood of a subsequent shooting within three blocks (1,725 ft) of the original location. Although the near repeat pattern using the 1-day temporal band did not extend across all cells, the number of cells significant up to 4 days indicated that the 4-day near repeat pattern was not driven solely by spree offending, although clearly there is evidence of spree offending when considering the 1-day analysis, as the cells for 1 day indicate a particularly strong risk that a subsequent crime will occur.

AUTO THEFT

The analysis of the auto theft incident data revealed a slightly larger near repeat pattern than that of shootings, extending farther spatially from three blocks for shootings to six blocks

TABLE 3: Observed-to-Expected Mean Frequencies for Shootings With Temporal Bands of 14 Days, 7 Days, and 4 Days

Location	Days			
	0 to 14	15 to 28	29 to 42	43 to 56
Same location	2.732***	2.309***	1.774***	1.613***
0-1 block (1-575 ft)	1.394**	1.242*	0.733	0.903
1-2 blocks (576-1,150 ft)	1.291**	0.974	0.986	0.822
2-3 blocks (1,151-1,725 ft)	1.055	0.95	0.942	1.032
3-4 blocks (1,726-2,300 ft)	1.156**	0.958	1.111	1.064
4-5 blocks (2,301-2,875 ft)	1.022	1.07	0.998	1.061
5-6 blocks (2,876-3,450 ft)	0.979	1.023	1.019	0.976
Location	0 to 7	8 to 14	15 to 21	22 to 28
Same location	4.448***	1.128	2.716***	1.882**
0-1 block (1-575 ft)	1.847***	0.96	1.273	1.209
1-2 blocks (576-1,150 ft)	1.354***	1.224*	1.045	0.907
2-3 blocks (1,151-1,725 ft)	1.215*	0.902	0.974	0.924
3-4 blocks (1,726-2,300 ft)	1.24*	1.064	1.048	0.872
4-5 blocks (2,301-2,875 ft)	1.069	0.986	1.061	1.069
5-6 blocks (2,876-3,450 ft)	1.061	0.904	1.083	0.968
Location	0 to 4	5 to 8	9 to 12	13 to 16
Same location	6.28***	1.622	1.477	1.627
0-1 block (1-575 ft)	2.333***	1.122	0.934	1.124
1-2 blocks (576-1,150 ft)	1.627***	1.118	1.14	1.188
2-3 blocks (1,151-1,725 ft)	1.417**	0.89	0.926	1.041
3-4 blocks (1,726-2,300 ft)	1.092	1.44***	0.953	0.991
4-5 blocks (2,301-2,875 ft)	1.023	1.129	0.98	1.011
5-6 blocks (2,876-3,450 ft)	1.06	1.012	0.941	1.06
Location	0 to 1	2 to 2	3 to 3	4 to 4
Same location	15.911***	7.586***	2.355	4.145***
0-1 block (1-575 ft)	4.256***	1.3	2.628**	2.015*
1-2 blocks (576-1,150 ft)	2.524**	1.814**	1.212	1.41
2-3 blocks (1,151-1,725 ft)	1.75	1.486	1.075	1.544*
3-4 blocks (1,726-2,300 ft)	1.259	1.119	1.129	0.951
4-5 blocks (2,301-2,875 ft)	0.836	0.913	0.966	1.256
5-6 blocks (2,876-3,450 ft)	1.543	0.997	1.108	0.817

Note. Light gray indicates repeat victimization; dark gray indicates near repeat victimization.

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

for auto theft. The 14-day temporal band analysis showed an increased risk of subsequent victimization extending from one to three blocks from the initial incident location for 0 to 14 days following the incident (see Table 4). However, performing the analysis using smaller temporal bands showed that the majority of elevated risk disappeared after 4 days, illustrating the potential for near repeat patterns to be empirical artifacts. Though the analysis using 7-day temporal bands revealed a near repeat pattern extending four blocks for 7 days following the original incident, the 4-day temporal band analysis revealed little overrepresentation of event pairs in the 5- to 8-day range. Again, there is evidence for spree crime when exploring the 1-day temporal band, although this does not appear to be the driving force behind the larger near repeat pattern found using the 4-day temporal band. Based on an examination of the various temporal bands, the most salient near repeat pattern would appear to be within 4 days

TABLE 4: Observed-to-Expected Mean Frequencies for Auto Theft With Temporal Bands of 14 Days, 7 Days, and 4 Days

Location	Days			
	0 to 14	15 to 28	29 to 42	43 to 56
Same location	3.138***	2.105***	1.892***	1.69***
0-1 block (1-575 ft)	1.256***	0.946	0.844	0.952
1-2 blocks (576-1,150 ft)	1.238***	1.025	1.024	0.944
2-3 blocks (1,151-1,725 ft)	1.216***	1.08**	1.073**	1.04
3-4 blocks (1,726-2,300 ft)	1.162***	1.05**	1.055**	1.043*
4-5 blocks (2,301-2,875 ft)	1.122***	1.06**	1.048*	1.004
5-6 blocks (2,876-3,450 ft)	1.13***	1.069**	1.038*	1.035*
6-7 blocks (3,451-4,025 ft)	1.118***	1.061***	1.052**	1.035*
Location	Days			
	0 to 7	8 to 14	15 to 21	22 to 28
Same location	3.901***	2.422***	2.129***	2.081***
0-1 block (1-575 ft)	1.421***	1.102	1.01	0.882
1-2 blocks (576-1,150 ft)	1.348***	1.135**	1.03	1.021
2-3 blocks (1,151-1,725 ft)	1.273***	1.163***	1.066*	1.093**
3-4 blocks (1,726-2,300 ft)	1.257***	1.073*	1.03	1.07*
4-5 blocks (2,301-2,875 ft)	1.178***	1.07*	1.081**	1.038
5-6 blocks (2,876-3,450 ft)	1.2***	1.065**	1.081**	1.056*
6-7 blocks (3,451-4,025 ft)	1.161***	1.078**	1.078***	1.044
Location	Days			
	0 to 4	5 to 8	9 to 12	13 to 16
Same location	5.055***	2.654***	2.41***	2.132***
0-1 block (1-575 ft)	1.702***	1.157*	1.086	1.001
1-2 blocks (576-1,150 ft)	1.492***	1.2***	1.114*	1.056
2-3 blocks (1,151-1,725 ft)	1.369***	1.168**	1.13**	1.098*
3-4 blocks (1,726-2,300 ft)	1.315***	1.139***	1.041	1.142***
4-5 blocks (2,301-2,875 ft)	1.21***	1.152***	1.039	1.093**
5-6 blocks (2,876-3,450 ft)	1.249***	1.175***	1.006	1.108**
6-7 blocks (3,451-4,025 ft)	1.16***	1.15***	1.039	1.099***
Location	Days			
	0 to 1	2 to 2	3 to 3	4 to 4
Same location	13.259***	4.56***	3.26***	3.16***
0-1 block (1-575 ft)	2.641***	2.062***	1.385*	1.17
1-2 blocks (576-1,150 ft)	2.491***	1.474***	1.231*	1.262*
2-3 blocks (1,151-1,725 ft)	1.905***	1.571***	1.204*	1.056
3-4 blocks (1,726-2,300 ft)	1.592***	1.355***	1.23**	1.217**
4-5 blocks (2,301-2,875 ft)	1.74***	1.26***	1.007	1.095
5-6 blocks (2,876-3,450 ft)	1.371***	1.21**	1.253***	1.221***
6-7 blocks (3,451-4,025 ft)	1.422***	1.075	1.109	1.165*
7-8 blocks (4,026-4,600 ft)	1.305***	1.25***	1.086***	1.148*
8-9 blocks (4,601-5,175 ft)	1.253**	1.153**	1.093	1.104

Note. Light gray indicates repeat victimization; dark gray indicates near repeat victimization.

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

of the original incident, extending six blocks from the original location, with a slight increase in risk from one to two blocks from the original incident for up to 8 days. As we would expect by looking at the O-E ratios, the risk of an additional auto theft is 70.2% greater within one block of the original incident for 4 days following the original auto theft. That risk drops to 49.2% greater from one to two blocks away in the same time period, and the level of risk continues to drop when moving farther away from the original location.

TABLE 5: Observed-to-Expected Mean Frequencies for Individual Robbery With Temporal Bands of 14 Days, 7 Days, and 4 Days

Location	Days			
	0 to 14	15 to 28	29 to 42	43 to 56
Same location	2.52***	1.71***	1.733***	1.585***
0-1 block (1-575 ft)	1.026	1.037	0.925	0.855
1-2 blocks (576-1,150 ft)	1.081	1.051	1.028	1.033
2-3 blocks (1,151-1,725 ft)	1.098**	1.008	1.027	1.004
3-4 blocks (1,726-2,300 ft)	1.064*	1.061	1.023	0.909
4-5 blocks (2,301-2,875 ft)	1.076*	1.049	1.069*	1.01
5-6 blocks (2,876-3,450 ft)	1.075*	1.019	0.979	0.984
Location	0 to 7	8 to 14	15 to 21	22 to 28
	0 to 7	8 to 14	15 to 21	22 to 28
Same location	3.105***	2.023***	2.03***	1.386**
0-1 block (1-575 ft)	1.15	0.899	1.057	1.01
1-2 blocks (576-1,150 ft)	1.077	1.078	1.005	1.095
2-3 blocks (1,151-1,725 ft)	1.065	1.13*	1.047	0.975
3-4 blocks (1,726-2,300 ft)	1.079	1.043	1.116*	1.005
4-5 blocks (2,301-2,875 ft)	1.11*	1.045	0.998	1.098*
5-6 blocks (2,876-3,450 ft)	1.085	1.069	1.013	1.024
Location	0 to 4	5 to 8	9 to 12	13 to 16
	0 to 4	5 to 8	9 to 12	13 to 16
Same location	3.843***	2.137***	2.004***	2.277***
0-1 block (1-575 ft)	1.048	1.161	0.931	1.054
1-2 blocks (576-1,150 ft)	1.125	1.128	1.03	1.001
2-3 blocks (1,151-1,725 ft)	1.182*	0.956	1.087	1.275***
3-4 blocks (1,726-2,300 ft)	1.095	1.017	1.088	1.182**
4-5 blocks (2,301-2,875 ft)	1.129*	1.059	1.098	0.927
5-6 blocks (2,876-3,450 ft)	1.092	1.078	1.098	1.039
Location	0 to 1	2 to 2	3 to 3	4 to 4
	0 to 1	2 to 2	3 to 3	4 to 4
Same location	9.075***	3.49***	3.217***	2.14***
0-1 block (1-575 ft)	1.21	0.963	0.911	1.199
1-2 blocks (576-1,150 ft)	1.673**	1.085	1.034	0.989
2-3 blocks (1,151-1,725 ft)	1.579**	1.175	1.215	0.943
3-4 blocks (1,726-2,300 ft)	1.534*	1.115	0.958	0.994
4-5 blocks (2,301-2,875 ft)	1.663**	1.052	0.983	1.077
5-6 blocks (2,876-3,450 ft)	1.27	1.038	0.93	1.223*

Note. Light gray indicates repeat victimization; dark gray indicates near repeat victimization.

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

ROBBERY

The analysis for individual robbery did not show a near repeat pattern at the 14-day, 7-day, or 4-day temporal bands. The 1-day temporal band did reveal a spatiotemporal pattern indicative of spree offending, although the increased risk of offending was not directly connected to the original location (the zero- to one-block cell was not significant). Instead, increased risk was present from two to five blocks from the original incident within 1 day from the incident. Thus, these findings suggest spree offending to be responsible for the observed near repeat crime pattern for robbery. Results are shown in Table 5.

DISCUSSION

The current study addressed three key issues in the near repeat crime literature that have received little attention to date. First, we examined the generalizability of the near repeat phenomenon for shootings using an alternative geographic location; next, we determined the extent to which the near repeat phenomenon extends across two as-yet-unexplored crime types within the same jurisdiction; and finally, we assessed near repeat patterns using several temporal bands, increasing the policy relevance of near repeat research and informing the theoretical debate between near repeat crime and spree offending. The examination of these issues not only furthers the limited academic research on near repeat crime but also leads to important policy relevant information for police.

With respect to the first objective, results from the analysis showed that near repeat patterns were generally consistent for shootings in both locations, but that the exact parameters of near repeats differed across the two study areas (Philadelphia and Jacksonville). Similar to Ratcliffe and Rengert's (2008) findings, results of the Jacksonville near repeat pattern for shootings employing the same 14-day temporal band showed an elevated risk of additional shooting incidents radiating two blocks from the initial location in the 14 days following the incident. However, additional analyses with other temporal bands revealed that the most salient near repeat pattern for shootings in Jacksonville appeared to occur for 4 days within three blocks of the original incident. Different cities have their own population distributions, with some areas that are more compact and others that are more geographically disbursed. The fact that Jacksonville is the largest city in the 48 contiguous states may be the reason why the near repeat pattern for shootings extends farther spatially in Jacksonville than in Philadelphia. Other location-specific factors may play a part in the different patterns as well. For example, if near repeat shootings are driven by retaliation or gang disputes, the locations of the perpetrators will play a crucial role in the development of subsequent near repeat patterns. If rival gangs are located closer together in Philadelphia than in Jacksonville, this fact may account for the differential. In short, near repeat shootings appear to occur in different cities, but agencies should be cognizant that location-specific variation in space–time crime clustering is a possibility.

A more substantial contribution from the present study comes from the discovery of a near repeat pattern among all of the crime types examined, ranging from 1 day within two to four blocks of the original location for individual robbery to 4 days within zero to six blocks for auto theft. However, the near repeat pattern for robbery appears to be driven entirely by spree offending. Collectively, the near repeat results not only provide officers with a map of *where* additional incidents may occur but also provide invaluable information on *when* these incidents are most likely to occur. Importantly, these space and time features may vary across crime types, suggesting police and place managers may need to develop crime-specific response strategies. Since the results also supported a repeat victimization pattern, the original location should be included in crime reduction efforts.

The current finding that there is an increased likelihood of a subsequent robbery within a very short amount of time following the initial incident (1 day) supports prior research (Grubestic & Mack, 2008) and is expected, given research suggesting robbers spontaneously choose to commit robberies (Jacobs, 2010). However, the near repeat pattern found for individual robbery warrants further discussion. Recall that there was an increased risk

within two to five blocks and within 1 day of the initial incident. Although the cell adjoining the place and time of the originating incident was not significant (within one block for 1 day), the pattern formed can be intuitively explained. If robberies tend to involve spree offending, a rational offender committing multiple crimes in a day would likely not wait on the same block to commit another robbery. The results suggest that police will be most likely to catch an offender in the act or deter another crime if they heavily patrol a five-block area surrounding the initial incident for 1 day. Then, given robbery's spree offending patterns, both rapid reporting and mobilization are of the utmost importance to preventing additional robberies linked spatiotemporally to the original incident.

The analyses using the various temporal bands for auto theft raises the importance of considering statistical and practical significance when employing crime reduction strategies. Although it is possible to conclude that the 7-day temporal pattern was the most salient, the conclusion for this study is that the 4-day pattern for six blocks was the most relevant pattern. This was determined by examining each matrix for not only significant cells but also nonsignificant cells as well as a comparison of the O-E ratios. Since auto theft had a large number of cases, cells were statistically significant although perhaps not practically significant from a policy point of view. Cells were included as part of a near repeat pattern only if they were significant at the .05 level and had a Knox ratio above 1.2, indicating at least a 20% increase in the likelihood of another event. As research has shown that offenders who commit thefts of motor vehicles may travel farther than other offenders to commit their crime (Wiles & Costello, 2000), it was expected that near repeat patterns for auto theft would cover a larger area than those for robbery. However, the current findings show that the near repeat patterns for auto theft are larger temporally but not spatially when compared to robbery. If near repeats are the result of repeat offenders, this finding may give support to the idea that offenders forage, moving from one condensed area to the next, as discussed below. It appears as though auto theft perpetrators target distinct areas (six blocks) but generally for less than 1 week. Additionally, as there is a substantial pattern uncovered when looking at the 1-day temporal bands, the results may indicate groups of offenders working together to cover large areas in a short amount of time.

Examining the near repeat patterns at various temporal bands illustrated how larger repeat patterns can be an empirical artifact. For example, when comparing the near repeat pattern for shootings using 7-day and 4-day temporal bands, it is clear that while the 7-day temporal band shows an elevated risk of another shooting for up to four blocks; however, the 4-day pattern clearly shows no increase in risk from 5 to 8 days for zero to three blocks. Thus, the 0- to 7-day cells are significant from zero to three blocks because they are generally combining the 0- to 4-day and the 5- to 8-day cells for those blocks. As such, near repeat patterns identified using different temporal bands revealed that police departments may benefit from examining several time periods to create the most cost-effective strategies. The current analysis revealed that increasing patrol in the three blocks surrounding the initial location for only 4 days following the original incident, as opposed to 7 days or 14 days, should be equally effective in preventing near repeat crime while offering superior efficiency.

Using new techniques for any analysis sometimes invites skepticism (Townesley et al., 2003). There is concern that Knox models cannot account for small areas of enduring high crime levels (hot spots). It is important to note that while crimes in hot spots may be

concentrated in space, they are not necessarily concentrated in time. Instead, hot spots are characterized by steady high crime rates. High levels of crime concentrated in space would affect not only observed patterns but expected patterns as well and should not lead to false conclusions about spatiotemporal clustering. Further replication in other jurisdictions will aid in establishing the relative veracity of the Knox method for testing patterns of crime.

Three additional problems have been raised specifically about the Knox model: arbitrary cutoffs, fluctuating population densities, and edge effects. To avoid these problems, Townsley et al. (2003) suggest linking temporal and spatial bands to prior research. This suggestion has been employed and extended for the current study by examining near repeat patterns using four different temporal bands. Additionally, the issue of population fluctuation should not be of great concern here, as there is no evidence to suggest that the population in Jacksonville saw any sudden or abnormal growth or decline in population density throughout the data collection period. Edge effects occur when administrative or political boundaries are imposed on arbitrary areas that do not reflect the natural geography or the social phenomena characteristic of that area. The merged city and county government in Jacksonville leads us to expect that edge effects will be minimal. Also, potential edge effects from neighboring counties would be minimal since Jacksonville is bordered by predominately rural areas and an ocean.

LIMITATIONS

Although this analysis provides important contributions to what is known about the near repeat phenomenon and the communicability of risk, it was not without limitations. Unfortunately, the issue of edge effects prevents the current analysis from examining the effects of sociodemographic and environmental factors on near repeat patterns for smaller geographic zones within the study area, such as an analysis at the census block group level. Theoretically, factors such as population density and crime rates should not have an effect on near repeat patterns because the Knox method compares the observed frequency of event pairs against the expected frequency of event pairs, and an area with more crimes in general attributed to increased population density would naturally have a higher expected frequency of event pairs (Johnson et al., 2007). Nevertheless, as one of the main reasons for this research is to help police identify specific response strategies to deter future crime, and it is clear that near repeat patterns differ by geographic area, future research should examine the potential effects of a variety of factors on near repeat patterns.

Additionally, although using data acquired from an official source, this analysis naturally could not account for crimes that go unreported or undetected by police. The issue of missing cases is of some concern when exploring spatiotemporal relationships but should be minimized in the current analysis because auto theft and robbery are crimes that have higher-than-average reporting rates (85% and 68%, respectively; Truman & Rand, 2010). Additionally, it is anticipated that shootings would be a highly reported crime as well because of the severity of the act, although the actual reporting rate is unknown. Third, the analysis could not feature incidents that did not have geocodable addresses, although only a very small percentage of incidents were omitted from the data set. However, although techniques for geocoding vary, thus potentially affecting policy-relevant issues (see Zandbergen & Hart, 2009), there is good evidence to suggest that geocoding in this case

was highly accurate. Specifically, following the example of Johnson, Summers, and Pease (2006, p. 12), we determined that incidents for each crime type that share *x*- and *y*-coordinates with at least one other incident in the same category also share identical address information in an overwhelming majority of cases (98.1% for auto theft, 96.3% for individual robbery, and 94.9% for shootings). Additionally, “large” addresses, such as apartment buildings or shopping malls, may inflate repeat patterns and take away from near repeat patterns. For example, cars stolen from opposite ends of a shopping mall may be geocoded to the same address. However, this issue raises the theoretical question of whether two vehicles stolen from a very large address represent a repeat or near repeat pattern. Irrespective of this theoretical issue, this concern has negligent practical implications for the crimes of auto theft and shootings, as the first spatiotemporal band was still identified as the most at risk for near repeat victimization. However, this issue has potentially greater relevance for the crime of robbery since it exhibited a doughnut-like spatial pattern in which the zero- to one-block band was not significant (i.e., the band into which any incorrectly classified same location crimes would fall) but several surrounding bands were significantly more likely to be victimized within 1 day following the initial incident. Although the geocoding scheme used by the Jacksonville Sheriff’s Office is designed to minimize geocoding inaccuracies and our findings are consistent with prior research (see Grubestic & Mack, 2008), future research might nevertheless further explore whether spatial patterns that resemble doughnut shapes are driven by assignment error or are substantively meaningful realities. Another limitation is that there are no guidelines for the appropriate time span that should be analyzed when examining near repeats; the overall period for this study was almost 3 years. Analyses of near repeat patterns using a shorter time period (the first 23 months available) with the same data provided spatiotemporal patterns that were somewhat larger for the analyzed crimes, suggesting that near repeat patterns may be dynamic, changing with various time spans for the analyzed data. For this analysis, the decision was made to use all data currently available, and the resulting patterns provide general long-term trends. However, researchers should explore optimal periods for data when assessing near repeat patterns in the future and tie these analyses to potentially meaningful trends.

CONCLUSIONS

Two main theories have been offered to explain the occurrence of true and chronic repeat victimization: the boost and flag hypotheses. Recently, researchers have tried to link these explanations to near repeat victimization as well. In light of these theoretical perspectives, it might seem logical that the discovery of near repeat patterns would naturally support a boost explanation as opposed to a flag explanation, as the inherent target attractiveness of one location should not cause nearby locations to be perceived as attractive as well. However, that may not be the case. Research has shown that near repeat crimes may be the products of repeat offenders. Bowers and Johnson (2004) found that near repeat burglaries exhibited the same modus operandi as the original crimes, indicating that near repeat burglaries were likely being committed by the same offenders or groups of offenders. Bernasco (2008) found that same-offender involvement is directly tied to spatial and temporal distances between burglaries. Additionally, Johnson et al. (2009) found that crimes occurring

closest to one another in space and time were most likely to be attributed to the same offender. The presence of spree offending found in the current analysis, most evident for individual robbery, also supports the idea that repeat offenders are responsible for near repeat patterns, as it is likely that spree offending can be attributed to the same offender. If near repeat crimes are the products of repeat offending, then near repeat patterns may not inherently support a boost explanation. Instead, it is possible that as offenders make decisions to commit crime, from a foraging or a rational choice perspective, they may visit a larger area with many targets and simply select one (Johnson et al., 2009). As such, when an offender successfully completes a crime, he or she may realize that the general area is suitable for his or her needs and may revisit the area to complete another offense but not necessarily revictimize the same exact location. If multiple suitable targets are in the same general area, near repeat patterns may support a flag explanation. However, if an offender determines a larger general area is appropriate for subsequent crime after the commission of the first offense, support could be given for a boost explanation, as the first successful offense boosts the likelihood of repeated offending in the general area because the offender now perceives the entire area to be filled with suitable targets. Although the current data set did not allow for an in-depth analysis into the relationship of repeat offending and near repeat crimes to address the plausible idea of foraging (Johnson et al., 2009), future research should explore this possible explanation. However, the results of the current study, which showed a distinct near repeat pattern for each crime type, can possibly be interpreted as support for that theory.

The spatial similarity of near repeat patterns for robbery and auto theft may illustrate that offenders committing different crimes may still share a comparable decision making process, and regardless of crime type, offenders may still work within distinct reference areas. This idea has long been the basis for offender identification through theories such as circle theory (Canter & Larkin, 1993) and techniques such as geographic profiling (Rossmo, 2000). Both of these conceptualizations assume that repeat offenders select their targets in familiar areas that tend to be closer to the offender's residence. The result is that geographic patterns can be found in crimes that are linked to the same perpetrator, which can then be used to identify the probable location of the offender's residence. As discussed previously, research has shown that crimes involved in near repeat patterns are likely the result of the same offender. With this in mind, perhaps future applications of the current analytical technique will be joined with more established techniques, such as geographic profiling, to take the investigative process of solving crimes one step further.

Near repeat patterns of crime have the potential to guide crime prevention strategies that may outperform those currently in use. Although discussions of crime prevention generally focus on police patrol, place managers, neighbors, or other individuals may play an important role in crime prevention efforts as well. Simply informing residents about patterns and then alerting them when crimes occur in their area may help prevent large portions of future crimes by placing more eyes on the street, causing offenders to increase the amount of energy necessary to successfully commit a crime, possibly deterring them. Knowing where and when crimes are likely to occur can lead to the creation of formal and informal social control strategies that should aid in the apprehension of offenders and prevent future victimizations. In short, our results suggest that there is likely important utility in addressing near repeat crime as a major crime reduction strategy across different

localities and for different crime types. At the same time, it should be kept in mind that there may be key differences in the temporal and spatial dimensions of near repeat crimes across areas and offenses. Rather than taking a wholesale crime-fighting approach, our research suggests that efforts to control near repeat crime will be most fruitful with a basic understanding of the specific trends that characterize each crime in a certain locality.

NOTES

1. Evidence from the Uniform Crime Report suggests that Philadelphia exhibits both property and violent crime rates that have increased in recent years, particularly with respect to violent crime involving firearms (see Ratcliffe & Rengert, 2008, p. 63). These trends are a clear contrast to other large U.S. cities, such as Chicago, Los Angeles, and New York, where crime has been generally declining since the 1990s. Although the causal factors contributing to Philadelphia's crime problem are complex, the resultant abnormality in trends may cast some doubt on the generalizability of findings from Philadelphia and reinforces the need to replicate and extend scholarship originating there.

2. For more information on the near repeat calculator or method or to view sample output, please see Ratcliffe (2007b).

3. To ensure the results are as parsimonious as possible, all tables report only spatial and temporal bands in the repeat and near repeat region. That is, all tables report the "same-location" spatial band to indicate true repeat victimization and the first six spatial and four temporal bands to indicate near repeat victimization. The table for auto theft was extended to display the larger near repeat pattern. Spatial and temporal bands not displayed were generally nonsignificant and did not contribute to near repeat patterns. In all of the crime types analyzed, the observed-to-expected ratios generally decrease when moving away from the original incident in the matrix to a point of nonsignificance, where ratios then fluctuate around 1.

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