CAPER
Crime And Policy Evaluation Research Group
Department of Sociology

Fact Sheet #18

The Impact of License Plate Readers on Violent Crime in Tigerland, LSU: A Geospatial Case Study

Rebecca Kernahan
Matthew Valasik, Ph.D.

August 2019

INTRODUCTION

The present case study examines the effects a license plate reader employed by the Baton Rouge Police Department in 2017 has on violent crime in both a temporal and spatial framework. License plate readers (LPRS) combine various technologies to capture a picture of the car, locate the license plate, identify the characters, and search databases for each unique sequence. In its purest form, LPRs are used by police to identify stolen cars, however, innovative uses for these systems have been identified recently which may be found to affect crime in different ways. The data was obtained from the Baton Rouge Police Department (BRPD) and includes records of all violent crime incidents (i.e., Assault, Battery, Homicide & Robbery) reported to BRPD between April 2016 and October 2018. Figure 1, plate 1 is a pin map displaying all violent crime events in the targeted spatial area before the license plate reader was installed, while plate 2 depicts the crime events that have occurred since the installation.

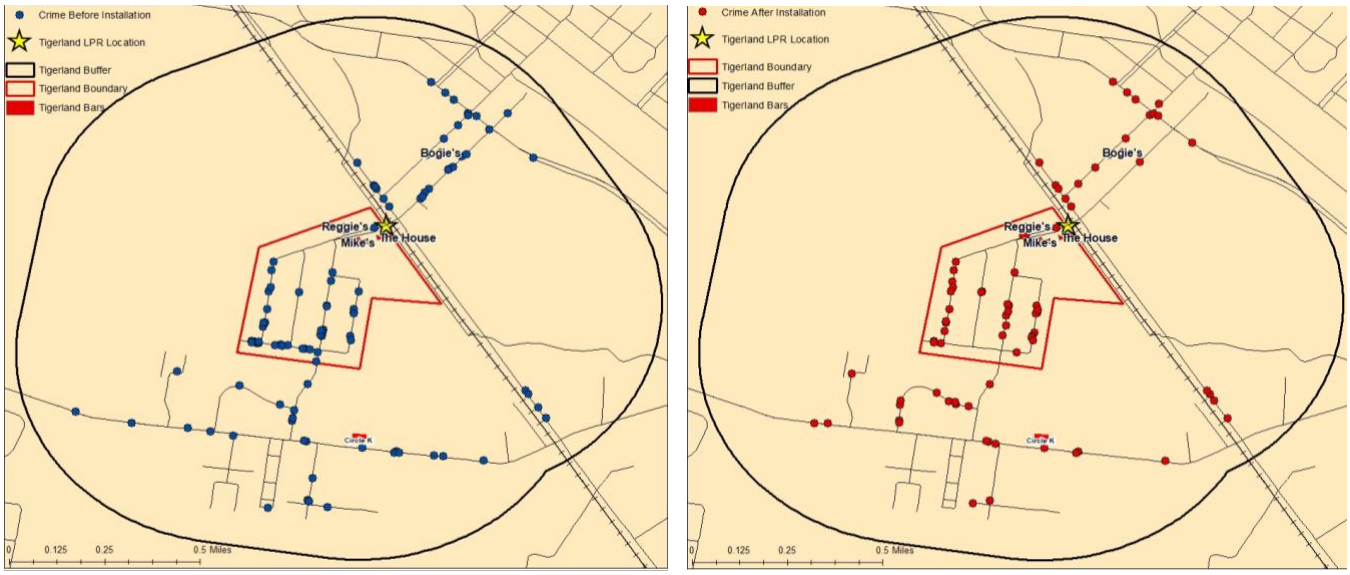

Figure 1. Violent Crime Incidents by Type in Tigerland, Baton Rouge, LA, April 2016-October2018.

LOCATION

The location of the LPR and the target study area is of importance to the BRPD because of the crime problems seen in this area, due in part to the five college bars situated near the entrance of Tigerland. Tigerland is found in one of the southern-most parts of the Baton Rouge city limits (zip code 70820). The entrance to the Tigerland neighborhood is only about a half-mile from the nearest edge of Louisiana State University's campus in Baton Rouge and approximately a two-mile drive from the center of campus. Additionally, the center of these college bars is a five-minute drive from a large quantity of off-campus student housing. The most important streets in this area to note are Bob Petit Boulevard, Tigerland Avenue, Y.A. Tittle Avenue, Alvin Dark Avenue, Earl Gros Avenue, and Jim Taylor Drive. The college bars that have contributed to the crime in the Tigerland area include Fred's, Mike's, Reggie's, JL's, and The House, while Bogie's lies across Nicholson Drive. These streets and landmarks are pictured in Figure 2 below.

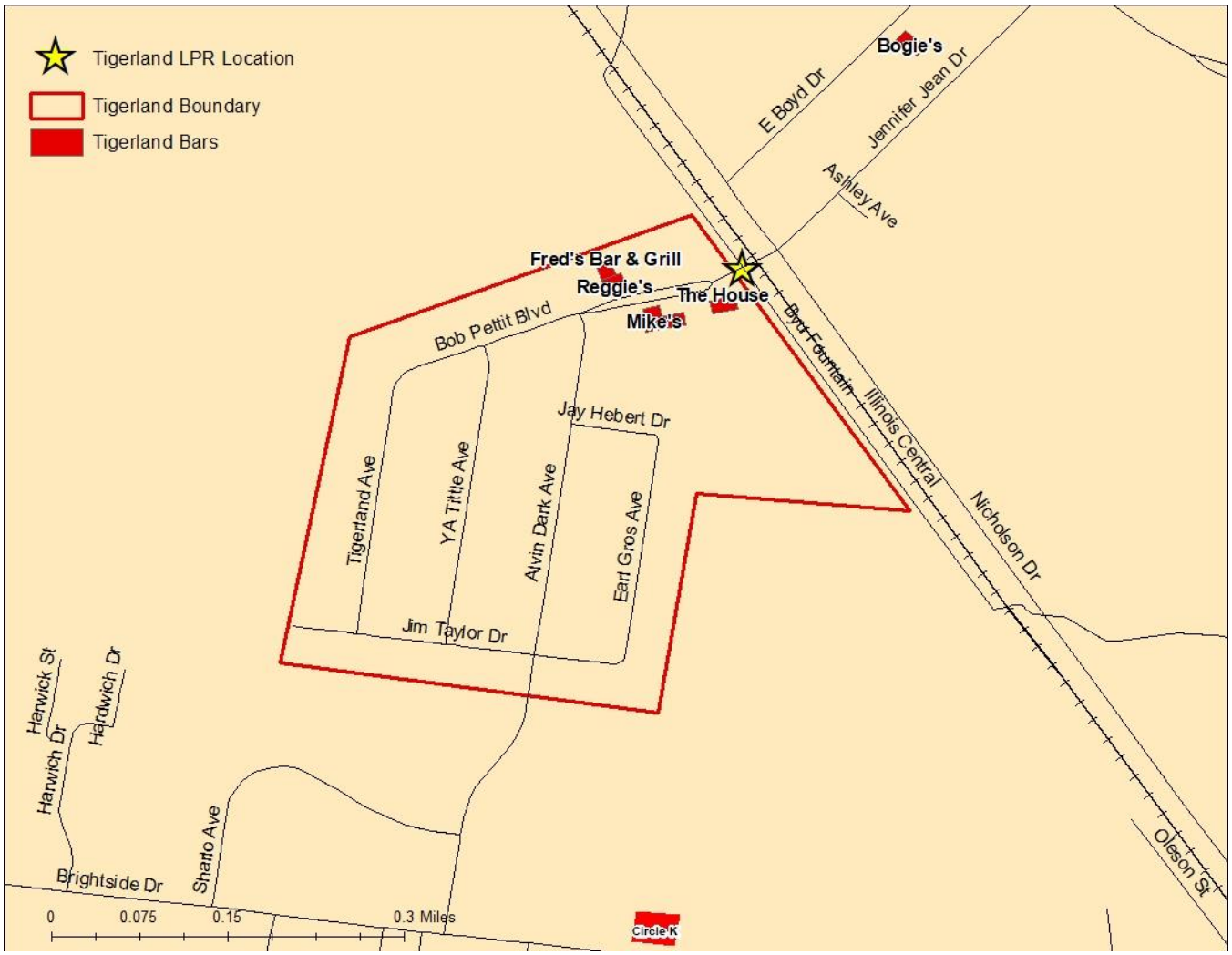

Figure 2. Important Landmarks in Tigerland, Baton Rouge, LA.

TECHNOLOGY

In terms of crime reduction, LPRs are a fairly recent technological development for police departments. As of 2014, nearly 60% of large police departments utilize LPRs to assist in their operations (Willis, Koper & Lum 2018). "They operate as high-speed cameras that scan the license plates of moving or parked vehicles and store a color image of each make and model. Once the alphanumeric pattern of the license plate is "read" … the technology automatically compares the plate to an existing database of plates of interest to law enforcement" (Willis et al. 2018: 615). LPRs can either be externally triggered by using a vehicle detector or internally triggered. However, when an internal trigger is used, it requires constant infrared illumination, which increases power needs (Rossetti & Baker 2001).

SYSTEM DESIGN

Despite the relatively simple usage and results, the technology involved in LPRs in order to be both effective and efficient becomes very detailed. LPRs "contain an illumination source, a camera, a vehicle sensing device, an image processor, a power source, and a host computer for saving images and interpretations" (Rossetti and Baker 2001: 1). The most integral part of a license plate reader is the character recognition software, which uses neural networks to train the system in order to improve accuracy in situations varying from the norm (Rossetti and Baker 2001).

In order to locate the license plate in a captured picture of the back of a car, sobel vertical edge technology is employed. This is accomplished by converting the picture into gray-scale and isolating the area of the image in which the color shifts quickly, thus locating the edges of the license plate. Once this is finished, the Otsu or threshold method is used to identify the top and bottom of the characters and vertical projection is applied which separates each character on the license plate. In order for the characters to be identified, three nodal points are used- end, tri-radiate, and cross; by using these, the location and series of recognition processes. The accuracy of this technology was tested at three levels: plate identification, character separation, and character recognition; 83% of plates were correctly identified at all three levels (Fan and Peng 2009).

ALGORITHMS

Six algorithms are available to use in license plate readers and each have different computational times and accuracy ratings, both of which are important for law enforcement purposes. The Dynamic Programming-Based algorithm does not require the location of the license plate because it automatically separates the characters. This allows it to be accurate despite changes in the environment, such as angles, weather, and lighting, while the quick computational time allows it to be used in real-time applications. The Hough Transform algorithm is the best at detecting lines; however, it requires a large amount of computational time, which makes it unrealistic for use in real-time situations. When altered to improve the time, it affects the accuracy by possibly detecting headlights as license plates. The Gabor Transform algorithm uses texture analysis and is very accurate in outdoor situations, day and night, regardless of angle or distance, which results in an accuracy rate of 95%. The Morphology-Based algorithm processes license plates based on shapes, however the accuracy drops dramatically with complex images. The AdaBoost algorithm is formed from system training based on a large set of varying types of images in which the licenses plates are manually detected. This algorithm is slower than others and is sensitive to angles and distance. Lastly, the Edge-based and Color-aided model is less complex than others and is effective in real-time applications.

Based on these tests, it is concluded that the Dynamic Programming algorithm is the fastest, thus the most effective for real-time applications, while the Gabor Transform is the most accurate (Kolour and Shahbahrami 2011).

FUNCTIONS

Police departments utilize LPRs in both a general and specific manner. In terms of a general approach, LPRs automate a previously manual process that included a large amount of discretion on the officer's part, arguably involving stereotyping and targeted policing. While initially LPRs had a very limited function, new uses are being found; for example, monitoring the locations of registered sex offenders (Lum et al. 2011). This is accomplished through a process called "geofencing" in which a virtual boundary is created to ensure sex offenders or others on probation do not travel into areas that violate their parole (Gordon and Wolf 2007).

In a recent study (Willis et al. 2018), the "reinvention" of LPRs is investigated in Southbury, a police agency noted as using them in innovative ways, which is assisted by their fairly large system of readers and cameras. Three novel uses created by the Southbury agency include real-time rapid response, suspect movements and crime patterns, and investigating alibis. In terms of rapid response, a dedicated team in the Southbury department use LPRs to track suspects fleeing a crime scene, giving officers at the scene areas to search. In identifying crime patterns, license plates can be tracked and identified if they are repeatedly captured in the same area and time frame of crime events. LPRs are also useful for confirming alibis, determined by the location of the suspect's car, whether in agreement with their statements or not (Willis et al. 2018).

EFFECTIVENESS

It should be noted that there have been very few studies investigating how effective LPRs are in general crime deterrence. While we know that they have the potential to improve the efficiency of police departments, it is difficult to evaluate the efficacy both specifically in automobile crime and more generally (Willis et al. 2018). This is further complicated by the above noted innovative uses of LPRs that are unique to different police departments. While it was concluded that LPRs showed no statistical reduction in general or specific crime, they still present themselves as a useful tool in criminal investigations and require further investigation (Lum et al. 2011).

CURRENT STUDY

In order to investigate the impact that LPRs have on violent crime in the Tigerland area and evaluate the change, if any, between pre- and post- conditions, recorded crime event data was downloaded from the BRPD (see data.brla.gov) and categorized according to crime type, address, and date. The crime occurrence date was separated between 15 months pre-installation of the LPR and 15 months post-installation of the LPR, which occurred in July 2017. A half-mile buffer (shown in Figure 3) was placed around the boundaries of Tigerland and addresses falling within this buffer were geocoded and categorized based on crime type. The crime incidents were then analyzed to determine if any statistical difference existed between the two conditions within each of the four violent crime types.

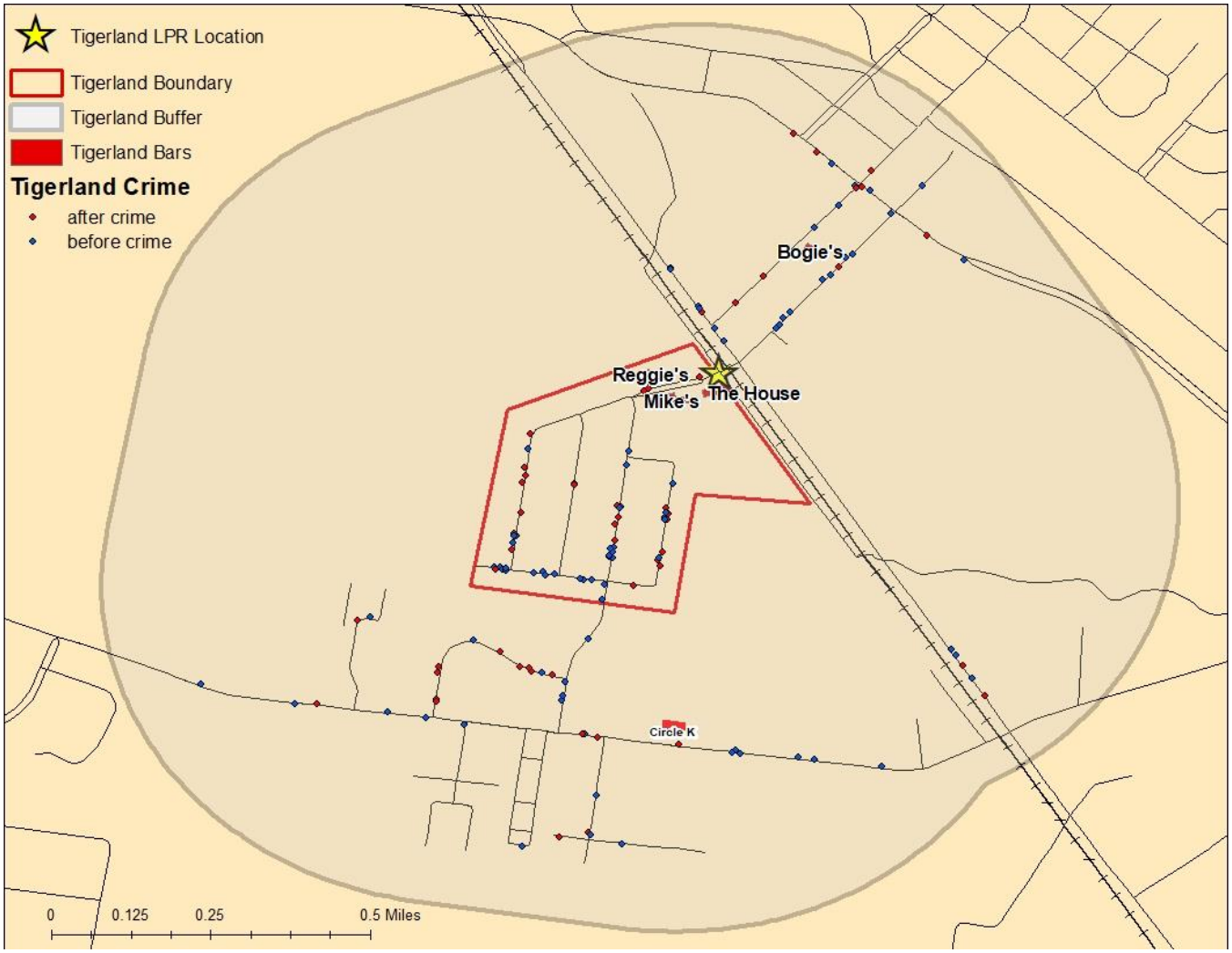

Figure 3. Buffer Around Tigerland, Baton Rouge, LA.

RESULTS

To ascertain if any significant differences exist among the four types of violent crime (i.e., assault, battery, homicide and robbery) before and after the installation of the LPR in Tigerland chi-square tests of independence on a 2x4 contingency table was used. In total, there were 154 crime incidents, with 77 crime events taking place in the 15 months before the installation of the LPR and another 77 crime events taking place in the following 15 months after the LPR installation. As observed in Table 1, there were negligible changes in crime type distribution. The most common violent crime types in this area were battery followed by robbery, which speaks to the prevalence of the bar scene in Tigerland and the influence it has on violent crime. Overall, there was no statistically significant change between the crime rates before and after the installation of the license plate reader. The results are depicted in Table 1.

Table 1. Comparison of Types of Violence Before and After the Installation of the LPR in Tigerland, Baton Rouge, LA.

Type of Violence	Before (N = 77)		After (N = 77)		Association & Significance
	N	%	N	%	
Assault (Simple)	13	16.88%	12	15.88%	**N.S.**
Battery (Agg. Assault)	42	54.55%	41	53.25%	
Homicide	1	1.30%	4	5.19%	
Robbery	21	27.27%	20	25.97%	

DISCUSSION

It cannot be argued that LPRs do not provide the police with a useful tool in criminal investigations and arrests; however, the findings from the current case study suggest that the installation of the LPR in Tigerland had no statistical effect on violent crime. As such, it does not seem that LPRs are a useful tool for crime deterrence. It is important to note that effectiveness of LPRs does depend on how this tool is utilized and how its use is encouraged by the leaders within a police department.

Some limitations are present in this study, such as the length of time available to compare. Since the LPR was employed more recently, there is not enough time in the post-condition to allow for more than a 15-month comparison. Additional time passage may allow for the knowledge of the reader to be further disseminated, which may result in a slight deterrence effect. That being said, it can be argued that the violent crime patterns seen in this area, such as battery and assault, are fueled by the bar scene, which may not be affected by a LPR. As a result, it can be claimed that LPRs may simply be more useful as a tool of crime management rather than of crime deterrence.

Lastly, there may be a serious issue between LPRs and an individual's civil liberties. Many believe that the use of LPRs both by the government and private companies can violate a person's First and Fourth amendment rights in terms of invading the privacy of one's associations and conducting unreasonable searches. However, others argue that there is no expectation of privacy regarding one's license plate number since it is plain view, which in turn makes it constitutional (Dryer and Stroud 2015). We should expect to see more usage and implementation of LPRs, but also more legal issues arising from this increased usage.

REFERENCES

Dryer, Randy L. and S. Shane Stroud. 2015. "Automatic License Plate Readers: An Effective Law Enforcement Tool or Big Brother's Latest Instrument of Mass Surveillance? Some Suggestions for Legislative Action." *Jurimetrics* 55(2): 225.

Fan, Chih-Hai and Yu-Hang Peng. 2009. "Vehicle License Plate Recognition System Design." *Chung Hua Journal of Science and Engineering* 7(2): 47–52.

Gordon, Arthur and Ross Wolf. 2007. "License Plate Recognition Technology: Innovation in Law Enforcement Use." *FBI Law Enforcement Bulletin*.

Kolour, Hadi Sharifi and Asadollah Shahbahrami. 2011. "An Evaluation of License Plate Recognition Algorithms." *International Journal of Digital Information and Wireless Communications* 1(1): 247–43.

Lum, Cynthia, Julie Hibdon, Breanne Cave, Christopher S. Koper, and Linda Merola. 2011. "License Plate Reader (LPR) Police Patrols in Crime Hot Spots: an Experimental Evaluation in Two Adjacent Jurisdictions." *Journal of Experimental Criminology* 7(4): 321–45.

Rossetti, Manuel D. and Jeff Baker. 2001. "Applications and Evaluation of Automated License Plate Reading Systems." *Intelligent Transportation Society of America*.

Willis, James J., Christopher Koper, and Cynthia Lum. 2018. "The Adaptation of License-Plate Readers for Investigative Purposes: Police Technology and Innovation Re-Invention." *Justice Quarterly* 35(4): 614–38.

AUTHORS

Rebecca Kernahan graduated from Louisiana State University in 2019 with a B.S. in Psychology and is pursuing a Master's Degree in Strategic Intelligence and Analysis at Northeastern Univeristy.

Matthew Valasik is an Assistant Professor in the Department of Sociology at Louisiana State University and a CAPER Research Fellow. He can be reached at mvalasik@lsu.edu.