What Happens in the Shadows: Streetlights and How They Relate To Crime
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1. Executive Summary

After finding in a previous report, “Streetlights in the City: Understanding the Distribution of Houston Streetlights,” that the city of Houston’s more than 173,000 streetlights were not evenly distributed throughout the city, this next report answers the question: do places with more streetlights have lower crime rates?

The findings complicate the common perception that more streetlights lead to fewer crimes. While there was some evidence that a particularly high density of streetlights can provide protective benefits, excluding those extremes provides a much muddier picture, suggesting that crime is a reflection of other neighborhood contexts. As such, cities should be cautious in expecting direct reductions in crime with the introduction of more streetlights.

Background

Streetlights are an important urban feature, and Houston, like many other cities, has been making changes to its street lighting, namely the ongoing conversion to LED bulbs. Since January 2015, Houston has been working with the city’s electrical provider, CenterPoint Energy, to convert all streetlights to LED bulbs.

Streetlights provide a number of benefits. In some cases, cities look to them as crime deterrents. Crime is a perennial hot topic for urban areas. In this report, we examine reported crime and how it relates to the density of streetlights. Streetlights make people feel safer. But are places with more streetlights actually safer?

Methodology

As in the previous report, the data on the location of streetlights in Houston were obtained from CenterPoint Energy. Streetlight density is measured by dividing the number of streetlights in a census block group by the length of road miles within the block group.

Crime data reflect reported crime in the 2015 calendar year and were obtained from the Houston Police Department. We separate crime into two categories: crimes against property and crimes against persons.

Findings

• Crime rates in Houston have been remarkably stable between 2010 and 2015. The total crime rate has hovered around 60 crimes per 1,000 residents.

• Crimes against property are far more common than crimes against persons. The 1 percentage-point decline in total crime for Houston can be linked to a decline in the crime rate against property.

• Crime rates vary geographically, resulting in several areas with high crime rates and others that have a crime rate of virtually zero. Some of the higher crime rate locations are also sites of higher activity (e.g., the Galleria, Hobby Airport).

• Low crime rates appear throughout the city, in both high- and low-income neighborhoods. This challenges common overgeneralizations connecting poverty and crime.

• Crime rates are actually often higher in areas of the city with higher streetlight densities. While we do not assume that streetlights are causing more crime, they may overlap with areas of greater human activity that can also offer a greater opportunity for crime.

• Given the complicated relationship between streetlights and crime, cities should not expect a direct impact of additional streetlights on reductions in crime.
Introduction

Crime is a perennial hot topic. While not of increasing concern for most Houstonians, crime has remained an important topic to a substantial portion of the population. In recent years, a quarter to a third of Harris County residents report being “very worried” about being a victim of a crime and about 20 percent indicate that crime is the biggest problem facing Houston (see Figure 1). Finding solutions to this problem is on the top of many cities’ priority lists.

One intervention that has been considered for reducing crime in other cities and in recent reports is streetlights. Streetlights make people feel safer, but is the connection between light and safety real? Are places with more streetlights safer?

Streetlights are an important urban feature, and Houston, like many other cities, has been making changes to its street lighting, namely the ongoing conversion to LED bulbs. Since January 2015, Houston has been working with the city’s electrical provider, CenterPoint Energy, to convert all streetlights to LED bulbs. Over half had been replaced as of June 2016. The distribution of streetlights within the city is discussed in more detail in another Kinder report — “Streetlights in the City” — but it’s worth pointing out that the density of streetlights is highly variable across the city. These differences in the density of streetlights could help explain why some places are safer — or are perceived to be safer — than others.

In this report, we examine one aspect of safety — reported crime — and how it is related to the density of streetlights. We investigate several pieces of this relationship. First, we address how streetlight density is related to two types of crime: crimes against property and crimes against persons, which are slightly different than nonviolent and violent crimes (defined further below). Second, we ask whether streetlights have the same relationship with crime regardless of the local neighborhood racial/ethnic composition. Our previous work on streetlights indicates substantial differences in the density of streetlights that are related to racial/ethnic composition, and those differences may translate into a stronger or weaker relationship with crime depending on the neighborhood context.

We find mixed evidence that areas with a higher density of streetlights have lower crime rates. There is some evidence consistent with streetlights being protective against crime, but there is more evidence that any relationship is likely the result of other characteristics of the area. Houston and other cities that are considering ways to reduce crime should not expect a large, direct impact of additional streetlights.

Data

Crime data for the year 2015 were taken from Houston Police Department (HPD) records. These data only reflect crimes reported to the police and specifically reports made to HPD. As a result, they are an underestimate of the actual number of crimes because not all crimes get reported and many crimes that occur within the city may be covered by the Harris County Sheriff’s Office rather than HPD. However, we have no reason to expect that these limitations would bias our analysis unless these aspects of underreporting were related to streetlights.

HPD crime reports are attached to a specific address that indicates the midpoint of the street block on which the crime was reported. The address information was used to match crimes to geographic coordinates, which allows us to map and analyze the crime data. For this report, we aggregate the number of reported crimes to the census block level — the smallest census geography, which is roughly three-fourths of an acre (30,000 square feet) to a full acre (40,000 square feet) at minimum. We aggregated the crime data to this level so that we can create reliable crime rates using the 2010 total population as the denominator. More recent population estimates at the block level were used for the map. Details on how the data was processed can be found in the report’s Appendix.

Figure 1. Houston’s Attitudes Toward Crime: How worried are you about becoming a victim, and is crime Houston’s biggest problem?

Source: Kinder Houston Area Survey. Harris County residents.

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http://performance.houstontx.gov/content/city-houston-sees-savings-led-streetlights
level of geography, and population figures at the street segment level were unavailable.

We analyze two mutually exclusive categories of crime: crimes against property and crimes against persons. Crimes against property are defined as incidents coded by HPD as auto theft, burglary, robbery, and theft. Crimes against persons include incidents coded by HPD as aggravated assault, murder, and rape. While these two categories are closely related to the more common distinction between nonviolent and violent crimes, our focus on crimes against property and crimes against persons emphasizes the target (i.e., property versus persons) rather than the level of violence. The primary change between these two ways of categorizing crimes is that robbery is considered a violent crime, which lumps it together with assault, murder, and rape, but it is also a crime against property, which is similar to thefts and burglary. The two approaches to categorizing the different types of crime are displayed in Figure 2.

Streetlight data were provided by CenterPoint Energy, the utility provider used by the city of Houston. These data indicate the exact location of every streetlight that is maintained by CenterPoint Energy for the city of Houston. As is the case with the crime data, this data source does not cover all sources of light in an area or even all of the streetlights that we see because some streetlights are maintained by the Texas Department of Transportation, especially those found along the highways. However, our data source allows us to speak directly to the impact of lights maintained by the city, and it is the most complete data source that is currently available. See our full report on streetlights, “Streetlights in the City,” for additional details.

The number of city streetlights was aggregated to the census block level in order to correspond to the reported crime rate. We estimate streetlight density using the number of streetlights divided by the total length of road in a census block. In addition to estimating the relationship between the density of lighting in the immediate census block, we include a measure of the density of streetlights in neighboring areas.

Finally, we use the 2010 population estimates for block groups to gauge the racial/ethnic composition of the area surrounding the smaller Census block. More recent population estimates could have been used since the racial/ethnic composition measure is at the block group level. However, we selected the 2010 estimates because they are more robust than American Community Survey estimates and they are consistent with the population data that we use when estimating our crime rates (described above).

For simplicity, we create four binary variables that indicate whether a block group is majority Hispanic (i.e., the total population is greater than 50 percent Hispanic of any reported race), majority non-Hispanic black, majority non-Hispanic white or has no statistical majority. In our analysis, we interact each of these variables with the streetlight variables to determine the extent to which the relationship between streetlight density and crime differs depending on the broader racial/ethnic context.

Our analysis is only for areas located within the city of Houston because these are the areas for which crime and streetlight data are available. We conduct our analysis using regression and spatial data analysis techniques. The coefficients from the full statistical models are available upon request.

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Figure 2. Approaches to Categorizing Crime: Where Property/Persons Distinctions Overlap With Nonviolent/Violent Distinctions

Streetlight density in neighboring areas is defined using a spatial lag variable based on a first order Queen’s contiguity spatial weights matrix.
Results

Crime rates for the city of Houston have been remarkably stable during the time period for which data are available. Based on data from HPD, the total crime rate has hovered around six crimes per 100 residents (i.e., 6 percent) between 2010 and 2015, but may be on the decline. The total rate was 5.3 percent in 2015, which is a 1 percentage-point decline from the 2010 rate of 6.5 percent (see Figure 3). The change over time is primarily driven by the reduction of crimes against property. The trend for crimes against property (e.g., theft) parallels the line for all crime, but the trend for crimes against persons (e.g., murder) is remarkably flat. From the beginning to the end of the time period, the rate of crimes against persons ranges from 0.6 to 0.5 crimes per 100 residents.

Spatial Patterning of Crime

Crime reported in 2015 is clustered geographically resulting in several areas with high crime rates and others that have a crime rate of virtually zero (see Figure 4). In order to improve visibility we display the local crime rates using the larger block group geography rather than the block level that we use in our analysis. However, we also provide detailed maps of specific areas of the city that use the smaller block unit to supplement this broader view (see Figures 5a, 5b, 5c and 5d).

Some of the highest crime rates are found in block groups in the downtown area, as well as in the areas connected to Houston’s major airports (George Bush Intercontinental to the North and Hobby to the South) and malls (e.g., the Galleria). However, there are several areas that have surprisingly high crime rates, including the large westernmost block group, which is located in an area of otherwise low crime rates. The data suggest that this western block group is red due to a small population — the area is mostly covered by George Bush Park — rather than a large number of crimes.

Areas with fewer than four crimes per 100 residents
reported to HPD in 2015 are scattered throughout the city without any clear pattern. We find clear pockets of low crime rates on the edges of the city (e.g., Kingwood) as well as in the heart of the city (e.g., the Heights) and in high-income neighborhoods (e.g., River Oaks) as well as in low-income neighborhoods (e.g., Magnolia Park). We may think that all inner-city, low-income neighborhoods have high crime rates, but our results suggest that this is an inaccurate characterization.

We selected four areas of the city located within the 610 Loop to provide an additional level of detail on the spatial patterning of crime and streetlights (see Figure 5). The selected community areas shown in the reference map cover the major racial/ethnic composition categories included in our analysis: majority Hispanic (Near Northside); no majority (Downtown); majority black (MacGregor); and majority white (River Oaks).

Estimating the Relationship Between Streetlights and Crime

The statistical models that we use provide estimates for two dimensions of crime: the probability that there will be zero reported crime and the number of reported crimes. This approach is necessary because when we move to the smaller block geography half of our observations have zero reported crimes.

The relationship between streetlights and crime is complex. Streetlights are associated with a higher probability that a crime will happen within an average block. This was true for both crimes against property and crimes against persons. This is the opposite of what we expected, but may be reflective of other characteristics of places with streetlights, like high volumes of human activity. High activity places may be attractive for criminal incidents regardless of how well-lit they are.

We see a continuation of this story when looking at the number of crimes against property. Higher streetlight density is related to a larger number of crimes against property. We expect that this counterintuitive finding is related to one of the points made above when describing the maps: the highest crime rates are connected to shopping areas and major airports, which are also places with high streetlight density (see “Streetlights in the City”). Crimes against property may be particularly likely to have a positive relationship with streetlights because of their connection to places of activity.

Crimes against persons show a more mixed relationship with streetlights. Although a higher density of streetlights is related to a higher probability of there being at least one crime within a block, when looking at the number of reported crimes against persons that relationship is reversed.

The number of crimes against persons is the only piece...
of reported crime that has the expected association with streetlights. However, we stress that even this association suggests a limited practical impact of streetlights because it is driven by differences at the highest levels of streetlight density — levels that are not commonly found in the city.

Finally, we look at how the relationship between streetlights and crime differs depending on the racial/ethnic composition of the surrounding neighborhood. We know from a previous Kinder Institute report that the average streetlight density is higher in majority-black and majority-Hispanic neighborhoods than in majority-white neighborhoods (see “Streetlights in the City”). Our results from the current study suggest that there are also differences across racial/ethnic composition in how streetlights are related to crime.

Despite variation in the relationship across racial/ethnic composition, we find no indication in the current study that streetlights are differentially beneficial per se since we find little evidence that streetlights are in fact having an impact on crime. However, the fact that there is variation in the streetlight-crime relationship strongly suggests the importance of context over the physical light itself. Included in our analysis: majority Hispanic (Near Northside); no majority (Downtown); majority black (MacGregor); and majority white (River Oaks).

**Conclusion**

We see limited potential for any impact of improved street lighting on reductions in crime. Higher streetlight density is actually related to higher levels of crime, with the exception of the number of crimes against persons. However, even that association for crime against persons may only be driven by differences at the extreme ends of the streetlight density distribution.

We also found that the relationship between streetlights and crime differs across racial/ethnic composition. This inconsistency suggests that any impact of streetlights is highly context-dependent and likely unrelated to the lights themselves.

The positive relationship between streetlights and crime is contrary to the protective role of lighting that has been suggested previously. However, it is a valuable reminder that well-lit places are also places of high activity that may attract some crime. Alternative crime deterrents need to be considered that are effective in both the light and the shadows.
The mission of the Kinder Institute is to:

- Advance understanding of the most important issues facing Houston and other leading urban centers through rigorous research, policy analysis and public outreach
- Collaborate with civic leaders to implement promising solutions to these critical urban issues