

Arson in Chicago: Patterns and Correlates



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Abstract

Arson involves the criminal willful act of setting fires. Previous arson research has been more common in the discipline of psychology, while the topic has not been a serious focus in the areas of sociology and criminology. The purpose of this study is two-fold. First, we take individual-level data from cases of arson in Chicago from a three-year period and analyze specific details from these cases, including types of arson that were committed and location. Second, we aggregate the data to the census-tract level (N=795) and test if arson holds any relationship with social disorganization centered and previously tested measures from previous research. Through these methods, the current study takes a detailed and comprehensive approach as we both analyze patterns and test correlates of arson rates in Chicago. Our findings show that the most frequent arson targets in Chicago include motor vehicles and residences. Furthermore, utilizing measures from previous studies and common social disorganization measures, we find both socioeconomic and demographic relationships with arson rates are uncovered at the census tract level for Chicago.

Introduction

The Federal Bureau of Investigation defines arson as “any willful or malicious burning or attempting to burn, with or without intent to defraud, a dwelling house, public building, motor vehicle or aircraft, personal property of another, etc.” (United States Department of Justice, 2012). Arson can be a property and/or violent crime. For this reason, it is unique as there seem to be multiple motivations for arson. From a

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general standpoint, arson may be committed for the destruction of evidence, violence, and monetary gain. Arson fires in the United States are costly, with approximated annual losses of 420 civilian deaths, 1,360 civilian injuries, and \$1.3 billion in property damage reported between 2007 and 2011 (National Fire Protection Association, 2014). The human and financial toll of arson crimes alone merits scholarly interest and study.

Arson is conspicuously mostly absent from most sociological and criminological literature. The exceptions are those studies that group all felonies, including arson, into one variable or category. Much of the literature that focuses on arson examines motivations for the crime. Most extant arson literature concerns psychological characteristics and attributes of both juvenile and adult firesetters (Lowenstein, 2003; Hickie and Roe-Sepowitz, 2010). Disciplines such as agriculture (Prestemon and Butry, 2005) focus on wildfire arsons.

Fewer studies have looked at the socioeconomic characteristics of arson fires (Horley and Bowlby 2011; Pettitway, 1983; Goebel and Harrison, 2012; Stahura and Hollinger, 1988). There are more studies that lay a foundation for socioeconomic and environmental factors as significant predictors of non-arson fire risk (Jennings, 1999, 2013). These studies support this relationship as socioeconomic factors such as family stability, poverty, and education were found to be most significant in explaining variance for non-arson fire rates (Schaenman, et. al, 1977; Karter and Donner, 1978; Gunther, 1981; Jennings, 2013). As noted before, the majority of studies focus on the psychological and individual-level aspects of arson. The current study is a macro-level analysis of arson rates. In the following sections, we briefly discuss the psychological literature on arson, as it represents much of the research in this area. We then turn our focus on more, yet limited analyses of macro-level studies of arson.

Psychology and Arson

Individual-level studies tend to show the consistent finding that arsonists tend to lack social control and social skills (Vreeland and Waller, 1979; Lowenstein, 2003). Additionally, recommended treatment interventions include managing social and communication skills, as well as anger control management (Lowenstein, 2003). Revenge is a consistent motive for both juveniles and adults who commit the crime of arson. Yet, juvenile arson interest seems to be more embedded in excitement or vandalism than for adults (Icove and Estep, 1987). These factors are present for both juvenile male and female arsonists. For juvenile female arsonists, such risk factors include instability in the home and difficulty with behavior. Furthermore, female juveniles who commit the crime of arson in a group varied and present fewer severe risk factors than those that act out individually (Hickie and Roe-Sepowitz, 2010). Other research has added that individual-level measures that are used to predict violent and general recidivism do not always align with measures to predict arson recidivism (Edwards and Grace, 2014). This finding supports the use of different assessments and models to predict arson recidivism as compared to other types of recidivism.

Importantly, macro-level patterns have been uncovered for arsonists as mapping has led to support of a commuter pattern for serial arsonists (Kocsis and Irwin, 2009). Consistent with both pattern theory and the journey to crime findings from Fritzon (2001) show arsonists tend to offend closer to home; with the exception of more passionate arsonists who are more likely to travel further distances (Harries, 1980; Rattner and Portnov, 2007).

Social Correlates, Social Disorganization, and Arson

The most prominent researcher to focus on arson incidence has been Leon Pettiway (1983, 1985a, 1985b, 1987, 1988). Pettiway (1983) first studied arson with respect to urbanization across 727 American cities using Unified Crime Reports and County and City Data Book data. Pettiway derived five types of cities and observed arson rates within these types. Pettiway found that “low arson rates occur under a number of environmental conditions” (p. 172). Most telling, however, was the finding that “high arson rates do not vary across dimensions. Low [socioeconomic status], high crime rates, low taxes, and low age (young populations) are environmental conditions that foster high arson rates” (p. 172).

Pettiway (1985b) also examined arson within a framework of social disorganization. This is a paradigm that is central ontologically to much of his work in the area. For this reason, we discuss social disorganization here. Briefly, Sampson and Groves defined social disorganization “as the inability of a community to realize the common values of its residents and maintain effective social controls” (p. 776). Social factors lead to increases or decreases in social capital. The concept of collective efficacy has been defined as a neighborhood’s ability or inability to establish and keep order throughout the area (Shaw and McKay, 1942; Sampson, Raudenbush, & Earls, 1997). Neighborhoods with decreased collective efficacy may provide less social control. Sampson, Raudenbush, & Earls, (1997) find that neighborhoods with high collective efficacy have lower crime rates overall. One way to demonstrate the concept of collective efficacy is through the measure of a resident’s involvement in public affairs of the community (Morenoff, Sampson, & Raudenbush, 2001; Sampson et al., 1997). Typical contemporary measures of social disorganization include concentrated poverty, dilapidated buildings, family disruption, and decreased home ownership, among others (Sampson, et al., 1997).

Pettiway (1985b) utilized such measures to find such a neighborhood effect in Houston as his study showed that some social and physical characteristics of different areas interact with respect to arson rates. (Pettiway, 1985b, p. 155). Pettiway (1988) also uncovered support for a relationship between the incidence of arson and residential vacancy and low income, especially in black residential communities. When researching revenge and retaliation arson, Pettiway (1987) uncovered that age and racial differences, as well as environmental situation, are significant predictors in determining the likelihood of using arson as a weapon of retaliation and revenge (p. 169). Overall Pettiway’s focus in arson research was examining social and environmental contexts, using a basic framework of social disorganization, in relation to arson rates and incidents, which makes his work important to our analysis.

Macro-level work on arson outside of Pettiway is limited. Research conducted before and after Pettiway has provided varied results. Utilizing multivariate analysis with data available at the time: quarterly incendiary fire rate data from Nashville – Davidson County, TN from 1963 to 1976, Spillman and Zak (1979) show no link between economics, other criminal activity, and unemployment with arson. Corrigan and Siegfried (2011) completed a follow-up study which used Nashville, TN data and found similar results using labor market data. They did, however, expand their research to include property values and found them to be “highly correlated with arson” (Corrigan and Siegfried, 2011, p. 5). Horley and Bowlby (2011) exhibit the influence of demographic and economic characteristics on arson. Additionally, the most common correlates of arson rates include unemployment and minority residents (Goebel and Harrison, 2012; Stahura and Hollinger, 1988). A more recent article by Grubb and Nobles (2015) shows the existence of spatiotemporal patterns in the city of Los Angeles. Such autocorrelation demonstrates patterning or arsons in a dense urban area. Prestemon and Butry (2013) explored factors affecting arson forecasting in the urban environment.

Much of the previous macro-level research in this area utilized full city data, hence the need to examine lower-level aggregates. Additionally, much of this type of research on arson is inconsistent and dated as it

has not been a focus of research in the past 30 years. More attention should be turned to this area as arson is both a costly and dangerous crime. Previous research at the macro-level on arson has been extremely limited. Furthermore, there is limited knowledge of the most common locations of arson and types of arson. Arson has been included in both violent crime and property rate calculation due to its uniqueness as it can both be a method of crime violation or the act itself. Furthermore, its status as a Part 1 crime offense calls for further examination of arson.

There are many questions that remain about both details and correlates of arson. What locations are more popular arson targets? What types of arson are most prevalent? What are some societal correlates of arson? Are there societal factors that are predictive of arson rates at the census tract level? In this exploratory study, we try to answer these questions as we begin filling a significant gap in the literature. We utilize both individual-level case data, as well as census-tract level data for the city of Chicago to assist in answering these questions.

Methods

The units of analysis for this study are individual cases of arson that are aggregated to the census tract level in the city of Chicago (N=795). As shown in Figure 1, we utilize the 2010 census tracts for Chicago. Census tracts that can be described as industrial areas of Chicago are dropped due to insufficient data. The city utilizes a web contractor called Socrata to publish their data online. The Chicago Data Portal developed by Socrata is the source of the data utilized in the current study. Using the City Data Portal of Chicago one can obtain various types of crime data as far back as 2001. An important feature of this database is its GPS coordinate variable. Once filtered and downloaded we geocode each arson in Chicago between 2010 and 2013.

Description of Arson Cases

In addition to the number of arson cases, we gather more detailed data, such as location type, which is made available through this data portal. Before we aggregate the data to the census-tract level we analyze two descriptive variables given as part of this database, type of arson and location. As shown in Table 1 a total of 8 types of arson are provided in the data, including possession of an incendiary device, possession of chemical dry ice device, fire, and explosive. Furthermore, location type/description of the arson is provided. There are a total of 56 types of locations where arson was listed to occur from 2010-2013. As shown in Table 2, we recode the location description to be consistent with the FBI and for interpretation purposes. This provides more options for comparison and analysis.

Aggregation for Modeling

After summary statistics have been conducted we then move to the preparation for the modeling portion of the analysis. We download the 2010 Census Tract Shapefile of Chicago from the U.S Census' Tigerfiles. We aggregate the geocoded arson cases into census tracts using ArcGIS 10.2.1 (N=795). Aggregating the data at this level provides further opportunities to test relationships between arson and census variables. All demographic and economic data are gathered from the U.S. Census 2010. Data are then matched in SPSS 21 using the census tract identification number.

Variables for Multivariate Analysis

As our review of arson literature suggests, there have been very limited findings in the area. Utilizing the work that has been previously done on arson (Pettitway, 1983, 1985, 1988) we gather demographic, social,

and economic data, which is gathered from the U.S. Census 5-year American Community Survey and is also consistent with some common social disorganization measures. As the current study is exploratory we utilize the previous limited literature to inform our data collection. In this way, our findings are much more data-driven. Economic data is often used as a predictor in arson and even fire rate studies (Karter & Donner, 1977; Gunther, 1980). We use the measure of percent in poverty taken from the U.S. Census to gain insight of economic conditions in census tracts for Chicago.

Dependent Variable

The arson rate is taken from four years of the Chicago City Data Portal arsons (2010-2013). As mentioned before, once the variable is filtered down and downloaded it is then uploaded into ArcGIS 10.2.1. Using the GPS coordinates of the arson incidents we map arsons and aggregate cases to the census tract level. Once this process is completed the arson rate per census tract is computed and exported into an SPSS 21 database.

Economics and Family Structure

As discussed earlier, previous literature suggests economic factors have been shown to be related to arson. Utilizing the framework provided by Pettitway (1983, 1985, 1988) we bring in such economic and social characteristics. We bring in the measure of poverty to test if a relationship exists in the current analysis. The percent of those in poverty is taken from the 2010 U.S. Census to estimate the effect economic deprivation has on arson. Family structure has also been considered and found to be related in previous studies of arson. We use female-headed households with a child under the age of 18 to gain a measure of family structure from the 2010 U.S. Census.

Race and Ethnicity

Previous studies that focus on Part 1 crimes often utilize a measure of race to gain a perspective of how some demographic factors effect crime (Pettitway, 1983). We measure race using the percent of African-Americans or Black who reside in Chicago. Additionally, we provide an ethnicity measure of percent Hispanic for the analysis that is taken from the U.S. Census.

Vacant Buildings

Lastly, we bring in the structural measure of vacant residences in the area. Discussed earlier, previous research (Pettitway, 1983, 1985, 1988) has utilized measures of residential and business vacancy in relation to arson. Vacancy rate is taken from the 2010 U.S. Census to provide this measure of environmental structure, which is also tied to social disorganization, to the current analysis.

Analysis Strategy

The objective of this study is to uncover patterns, correlations, and relationships with the occurrence of arson. For this reason we provide both univariate and multivariate analyses. Therefore, our analysis is two-fold: we utilize individual-level data to show both the method of arson and location type. Table 1 shows frequencies of the method or type of arson that occurred. Next, in Table 2, we examine location of the arson offenses that happened in Chicago. The original coding from the Chicago City Data Portal had 56 location types. For the sake of interpretation we recode arson location into 12 categories. The categorization is based on the framework set by the FBI, but changes are made as necessary. For instance, the FBI categorization system does not allow for places of worship. For the crime of arson it was important for us to be more descriptive on location especially since there have not been a large proportion of studies with a focus on arson. It is important that information is not lost in the collapsing of categories.

Another method we utilize is mapping. As shown in Figure 1, using ArcGIS 10.1 we observe the patterns and prevalence of arson at the census tract level. A 2010 Census Tract shapefile for Chicago, taken from the U.S. Census Tigerfiles database, is layered over arson incidents. Once the shapefile and the arson data are joined, arson counts per census tract are created. Population from the U.S. Census is then used to calculate a rate per census tract. The arson rates are then mapped at the census tract to better uncover patterns of arson in the Chicago community.

Another important aspect of the current study is understanding correlations and relationships arson may hold with other key social factors. As shown in Table 1, we provide descriptive statistics of social variables with arson. Understanding how social factors relate to the arson rate is another way we can better understand the occurrence of arson. Lastly, we estimate the effect of social factors on the arson rate using an OLS regression. All of these strategies represent an effort to better understand arson in the city of Chicago. All data are analyzed using both ArcGIS 10.1 and SPSS Statistics 21.

Results

Table 1 includes the counts and percent breakdowns for types of arson that were committed. Arson committed by fire is the most common type (67%). Possession of both incendiary and dry ice devices make up approximately 1.5 percent of all cases. Arson by explosive represents the least number of cases (17). Unfortunately, these results are marginalized by problematic initial coding. Not included in the table are 30 percent of cases that were erroneously categorized. These 765 cases were lost for this specific descriptive analysis due to original coding error. Legal definitions of attempted (426) and aggravated (339) offenses were coded with type of arson. The coding reflects the legal code in Illinois. Aggravated arson is when person “knowingly damages any real property, or any personal property having a value of \$150 or more (720 ILCS 5/20 1) (from Ch. 38, par. 20 1).” This definition applies to insurance fraud damages, residential housing, and places of worship. Additionally, for the attempt of the crime all of these apply. Analysts can surmise given the information that aggravated offenses exclude possession offenses. Attempted offenses could include all other four types. In short initial coding makes these results questionable.

Table 1 Arson by Type in Chicago (2010-2013)

Variable	Count	Percent
By Explosive	17	70%
By Fire	1,651	6700%
Possession of Chemical/Dry Ice Device	7	30%
Possession of Explosive/Incendiary Device	26	110%

Table 2 shows the location or target of the arson. Mobile vehicles were subject to most arsons, 34.91 percent. Second were residential locations with 34.14 percent. Interestingly, businesses only represent 3.89 percent of all cases. This runs counter to the public notion that a majority of arsons are related to private business insurance fraud. There were a total of 11 churches that were subject to arson. Lastly, the grouping of private and public land included streets, vacant property, and parking decks. These areas could be locations where different objects were burnt, such as dumpsters. Importantly, out of the 31 school arsons two were reported at private schools; all other incidents occurred at public school.

Table 2 Arson by Location in Chicago (2010-2013)

Variable	Count	Percent
Residential	842	34.14
Multi-Residential	240	9.73
Public of Private Land	300	12.17
Business	96	3.89
Medical Facility	4	.16
Manufacturing	9	.36
Churches	11	.45
Federal Building	5	.20
Transportation Hub	5	.20
Mobile Vehicle	861	34.91
School	31	1.26
Other	62	2.51

Figure 1 shows the results of the aggregation procedure for Chicago census tracts. Arson rates are uploaded into the map to calculate the standard deviation. The map visually shows similarities between adjacent census tracts as it comes to standard deviation scores. This map appears to demonstrate that arsons are geographically patterned throughout the city of Chicago. Furthermore, descriptive statistics are taken after this procedure and are detailed in Table 3. Lastly, areas of Chicago that hold higher arson rates also hold higher levels of poverty, female-headed households with a child under 18, and vacant housing. These correlations can be seen in the correlation matrix, Table 4.

Figure 1: Chicago Standard Deviation Arson Map

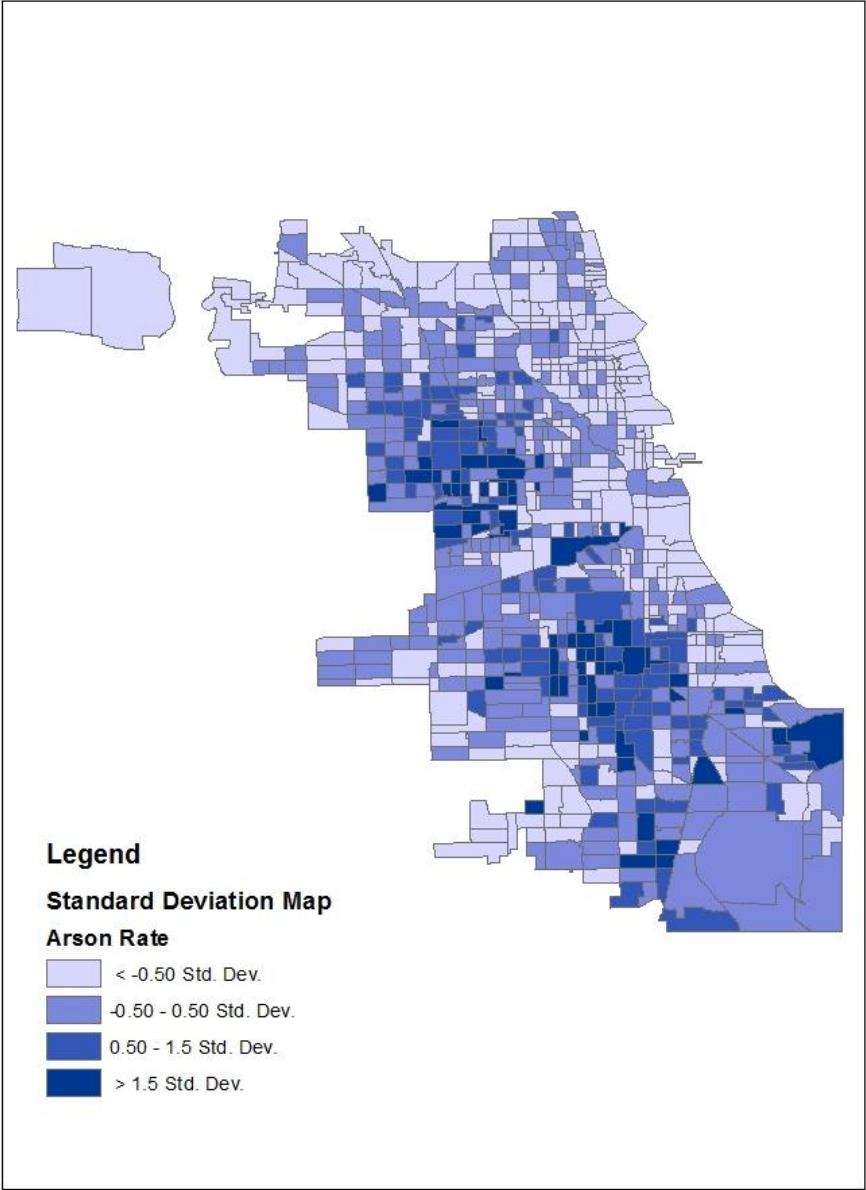


Table 3: Descriptive Statistics for Chicago Census Tracts (N=795)

Variable	Mean	SD	Minimum	Maximum
<i>Dependent Variable</i>				
Arson Rate*	74.97	89.01	0	660.79
<i>Explanatory Variables</i>				
Proportion in Poverty	23.52	14.39	0	74
Vacancy Percent	14.65	9.43	0	60.10
Percent FHH with Child Under 18	10.84	9.49	0	63.91
Percent Hispanic	25.23	29.42	0	98.52
Percent Black	37.79	41.12	0	100.00

*Rate is per 100,000 residents

Table 4 shows the correlations present between the outcome variable, arson rate and other social and environmental factors. The arson rate is shown to be significantly related to all variables in the analysis, with the exception of percent Hispanic. The highest correlation is between female-headed households with a child under the age of 18 and poverty. Importantly, female-headed households with a child under the age of 18, holds the strongest correlation with the arson rate. Lastly, vacant housing is significantly correlated with all measures in the analysis.

Table 4: Arson Rate Correlation Matrix (N=795)

Variable	Arson	Vacant Housing	FHH 18	Percent Black	Percent Hispanic	Poverty
Arson	1.00					
Vacant Housing	.45**	1.00				
FHH 18	.46**	.55**	1.00			
Black	.40**	.51**	.67**	1.00		
Hispanic	.03*	-.15**	-.10**	-.55**	1.00	
Poverty	.44**	.55**	.73**	.60**	-.06	1.00

Regression analysis was used to estimate the impact of race, family structure, economic, and environmental variables on arson rates. The results of the regression equations are shown in Table 5. The measures variables combine to explain 31 percent of the variation in arson rates ($R^2 = .31$). All measures except for poverty are shown to be positively related to the arson rate in Chicago. As shown in Table 5 poverty is the only measure that does not hold a significant relationship with arson. In Table 4 the measure of poverty is shown to be highly collinear² with female-headed households with a child under the age of 18. The strongest positive coefficient and relationship in this analysis is the measure of vacant residences 2.22 ($p < .001$).

Table 5: OLS Regression of Arson Rate (N=795)

Arson Rate	<i>b</i>	SE	t
<i>Explanatory variable</i>			
Poverty	.39	.29	1.36
Vacant	2.22***	.35	6.29
FHH with Children under 18	.99**	.47	2.11
Percent Black	.67***	.12	5.49
Hispanic	.75***	.12	6.15

R-Squared=.3135

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

Discussion

As discussed above, understanding the occurrence and patterns of arson provides further insight into socio-demographic correlations and location vulnerability. Previous perceptions of arson have been focused mostly on psychological patterns of youths and insurance fraud (Hickle and Roe-Sepowitz, 2010; Edwards and Grace, 2014; Eriksen and Carson, 2015). Data from the Chicago City Data Portal and the U.S. Census show patterns and a level of predictability exist between arson and social factors at macro-level as well. Public, private, and recreational transportation targets were more vulnerable to arson. This included all vehicles from boats to buses. The second most targeted were residential location, although it is unclear on whether the home itself was the target or if another object on the property was burnt. Private businesses represented 3.89 percent of all arsons, which was fifth most in Chicago.

Race, ethnicity, the vacancy rate, and family structure were all related to the arson rate. Here we see arson crime is very much similar to other types of crime, such as homicide. This may seem to go against the mainstream narrative that arson commission is a psychological disposition diagnosed as fire-setting behavior (Vreeland and Waller, 1979; Fritzon, 2001; Edwards, and Grace, 2014). Yes, it is clear that at the census tract level the crime of arson is associated with social factors, but we also know that many such key factors have been shown in previous research to be related to poor mental health at the individual-level

² Poverty becomes significantly related to arson once female-headed households with a child under 18, is removed from the model.

(McCleod and Shanahan, 1993, 1996; Chow, Jaffee, and Snowden, 2003). So, more clearly, the data does not minimize the importance of mental health as it comes to arson crimes. Instead, we suggest our findings indirectly support previous literature as environments with high poverty and low family structure contribute to other types of resource and health disadvantages that have been shown to be related to mental health of youths (McCleod and Shanahan, 1993, 1996; Chow, Jaffee, and Snowden, 2003). Additionally, more positive environments may hold more advantages as it comes to mental health. These environments thus create more opportunities for various types of crime commission, including arson (McCleod and Shanahan, 1993, 1996; Lowenstein, 2003).

Possible intervention strategies can be informed by both the context and knowledge of common targets. After analysis the data demonstrate that arson is not dispersed throughout the city; instead, there are certain parts of the city where rates are higher. Increasing fire intervention services to those areas that have a higher rate of arson is one strategy that can help reduce the toll of the damage. Importantly, vacant housing is also related to arsons. As this is the case, just as there are controlled burns in wildlife areas, it may reduce further damage to demolish dilapidated houses and businesses that present a potential arson target once a certain period of time has passed. Additionally, those households with children under 18 where there was a single female present were also predictive of arson.

Limitations and Future Directions

Data was constrictive to this analysis as some of the legal terminology overlapped with specifics on how the arson was committed. Choosing social factors for this study was difficult as a criminological theory on arson has not been very well developed yet. The researchers for this analysis depended on a mix of previous studies on arson and other crimes. Missing in our analysis are measures of mental health, educational attainment, as well as a bevy of social and demographic measures that are often seen in criminological studies. For this study, we made an effort to bring in measures that had been used in previous studies in both arson and criminology. Researchers in future studies should look to diversify measures that are further tied to theory-driven explanation. Perhaps the focus should be on theories that take into account how environments contribute to opportunity.

Theoretically, an explanation of arson is difficult and may not be 'one size fits all,' as there are several reasons one may commit arson. At the macro-level, there are patterns, correlates, and relationships with arson. This is not unique to arson. Several types of crimes hold similar macro-level patterns but may come by various individual intentions. For instance, there are several reasons for one to commit a homicide, yet the final product remains the same. This is the same case for arson. Theoretically, at a higher aggregated-level, the current study does not discern between arsons committed for insurance or fire-setting behavior, much like the majority of homicide studies do not extrapolate differences between mass victimizations in a mall and a mass event between two rival gangs. Future research should treat arson theoretically similar to other types of crimes. Although individual intent may differ at the macro-level, correlates and relationships provide a larger scope and potential path to understanding. Once we understand the context of these events, intent and specific differences can further any theoretical explanations.

The current study is an exploratory analysis of arson. The crime of arson is one of the least studied felonies in the field. Previous limited research had shown that arson is related to various social factors. Our findings support previous studies as environments with low family structure and high poverty have a positive effect on arson, just as they do for other types of crime. Future studies need to continue to examine social factors in relation to arson to better understand differences and similarities between arson and other types of crime.

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