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Measuring perceived racial heterogeneity and its impact on crime: An ambient population-based approach

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Highlights

- Proposed a new racial heterogeneity index based on ambient population
- Illustrated the calculation and implication of the new index
- Examined the effectiveness of the new index in explaining street robbery
- Revealed that the visitors to an area are mainly from the neighboring areas
- Discussed the broader application of this index

Abstract

Social disorganization theory has significantly contributed to understanding the relationship between community characteristics and crime. It is based on the assumption that the residents of a community define the characteristics of the community. In particular, Shaw and McKay discover that racial heterogeneity could disrupt the local community's social organization and account for crime and delinquency. While residents play the most important role in defining the characteristics of a community, non-residents who frequent a community could also affect the community. The perceived racial composition is likely to be different from the makeup of the residential population. Drawing from the recent big data which could capture residents and non-residents, this paper proposes an innovative racial heterogeneity index based on the ambient population. The effectiveness of the new index is illustrated by using negative binomial models, to explain street crime. The findings show that the ambient population-based racial heterogeneity index outperforms the traditional one in explaining street robbery. Further, the new index positively impacts street robbery in a statistically significant fashion. Conversely, the traditional index shows no statistically significant influence. The study also reveals that the racial heterogeneity of ambient population in an area is mostly contributed by the visitors from the neighboring areas. Overall, the proposed ambient population-based racial heterogeneity is theoretically sound and effective in explaining street crimes such as street robbery. The novel approach and findings add new contributions to social disorganization and routine activity theories.

Introduction

Shaw and McKay (1942) directly linked crime rates to neighborhood ecological characteristics, including ethnic/racial heterogeneity (Shaw & McKay, 1942). In their social disorganization theory, racial heterogeneity of people's residential location is a substantial factor shaping the differential neighborhood characteristics and thus influencing the likelihood of people's illegal activity involvement, including street crimes. They argue that communities with diverse race/ethnicity have limited capacity for communication, collective action, problem-solving, and common value achieving (Kornhauser, 1978; Bursik Jr., 1988, Sampson et al., 1997; Bursik Jr. & Grasmick, 1993). Many empirical studies have found a crime-producing effect of racial/ethnic heterogeneity and examined the relationship between racial/ethnic heterogeneity and community crime (Hipp, 2007, Hipp, 2010; Sampson & Groves, 1989; Smith & Jarjoura, 1988; Warner & Pierce, 1993; Warner & Rountree, 1997. They posit that individuals from ethnically diverse backgrounds follow differential and unique normative systems that often produce conflict owing to disagreement over these norms (Kubrin, 2000). These conflicts, displayed in both direct and indirect ways, impede community integration, and weaken the formal and informal social control of the local community's salience and thus affect crime rates (Sampson, 2012; Sampson & Wilson, 1995). In support of social disorganization theory, research has long found that racial/ethnic heterogeneity is associated with higher levels of crime. For instance, Sampson and Groves (1989) found the neighborhoods with more racial/ethnic heterogeneity were likely to occur more violent crimes, such as robbery and assault. A recent study conducted by Wenger (2019) also uncovered that the racial heterogeneity at the neighborhood level had a positive relationship with robbery. Smith and Jarjoura (1988) used victimization data from 57 neighborhoods in Rochester, NY, Tampa-St. Petersburg, Florida, and St. Louis, Missouri, to explore the relationship between neighborhood characteristics and rates of violent crime and burglary. They found that the racial heterogeneity of Shaw and McKay's theory played an essential role in explaining the neighborhood victimization rates. Warner and Pierce (1993) analyzed the calls to police data during 1980 in 60 Boston neighborhoods. They concluded that the degree of racial heterogeneity positively affected the burglary rate. Even after controlling family and structural density measurements, the effect remained significant even after controlling family and structural density measurements, though its effects were conditional on the poverty level. Warner and Rountree (1997) showed that ethnic/racial heterogeneity reduced local social ties and influenced crime rates in a study in Seattle, Washington. Kubrin (2000) conducted another study in the same city and found a strong association between racial heterogeneity and violent crime rates. Besides, Blau and Blau (1982) found that the inequality between White people and Black people increased criminal violence rates when ignoring economic inequalities. Nevertheless, even controlling for the effects of income inequality, Hipp (2007) claimed that the factor of racial/ethnic heterogeneity accounted for all types of crime generally committed by strangers (Hipp, 2007). Indeed, at least from the short-term perspective, racial heterogeneity disrupts the solidarity of communities and leads to lower levels of trust and cohesion (Putnam, 2007). Furthermore, Hipp (2011) found that an increase in racial heterogeneity over time was associated with the increase of street crimes, including aggravated assault and robbery. The aforementioned literature based on the residential characteristics of race composition has theoretically and empirically illustrated that the racial/ethnic heterogeneity positively relates to crime. In addition, immigration is typically part of the social disorganization discussion (Kim et al., 2019). However, there are not many immigrants in the study area. The U.S. Census Bureau (2021) showed that the Hispanic/Latino and Asian account for 4.2% and 2.2% in Cincinnati, which were much lower than the national averages of 18.9%, and 6.1%, respectively. Therefore, immigration is not considered in this study.

While the social disorganization theory explains the long-term patterns of neighborhood changes based on the conditions and investments of residents, recent studies uncover that people's daily activities and ambient population have a significant impact on crime (Andresen, 2006, Andresen, 2007, Andresen, 2011; Andresen & Jenion, 2010; Felson &

Boivin, 2015; Lan et al., 2019, Lan et al., 2021; Song et al., 2019, Song et al., 2021; Hipp et al., 2019). Candipan et al. (2021) explored the impact of the race of ambient population on crime and suggested that racial composition is a dynamic process, affected by the activities and interactions of people at places where they reside, work, and visit. However, the traditional studies on race/ethnicity and crime only consider the residential population. They consider the residential neighborhoods to be the most relevant area affecting people's behaviors or outcomes (Kwan, 2009). Such practices assume that people's environmental exposures and the neighborhood effect operate only through interaction among those living in the same residential area, ignoring the critical role of human mobility in people's exposure to environmental influences (Kwan, 2018a, Kwan, 2018b). This uncertain geographic context problem (UGCoP) deserves great attention from social science perspectives (Kwan, 2012a). Considering the principle of the routine activity theory (Cohen & Felson, 1979; Felson, 1987), we should conceptualize an alternative approach to measure the perceived racial heterogeneity, which considers not only those who reside in a neighborhood but also the people who travel to the neighborhood for work, shopping, play, or other purposes, as they may also be involved in crime incidents. The makeup of these visitors can contribute to the perceived racial heterogeneity of local neighborhoods, thus potentially affecting local crime.

Previous studies focus on exploring the spatial distributions and patterns of crime (Andresen, 2022; Boessen, 2014; Browning et al., 2010; Hipp, 2007; Weisburd et al., 2012). A growing and substantial research in recent years show that the spatial heterogeneity or local effects coupled with the built environment, social ecology, and spatial proximity could play an essential role in explaining crime variation (Ahmad et al., 2018; Andresen & Ha, 2020; Bunting et al., 2018; Clancy et al., 2022; Liu & Ma, 2020; Nielsen et al., 2005; Vildosola et al., 2020; Wang & Zhang, 2019). Based on the crime opportunity theories, such as routine activity (Cohen & Felson, 1979) and crime pattern (Brantingham & Brantingham, 2013), Hipp (2016) proposed a general theory for examining the spatial distribution of the residing places of offenders, targets, guardians, and their expected daily mobility across space and time. Besides, he considered how people's travel distances and travel propensities, and their willingness of travel also affected where and how the occurrence of crime.

Since crime opportunity theories have illustrated how people's routine activities out of their residences may bring together the potential offenders and the population at risk, thus increasing street crimes (Brantingham and Brantingham, 1995, Brantingham and Brantingham, 2013; Felson, 1987). Various studies adopt the ambient population as an alternative measurement of the population at risk (Andresen, 2006, Andresen, 2007, Andresen, 2011; Andresen & Jenion, 2010; Felson & Boivin, 2015). The ambient population is referred to as the number of people in a given area engaged in their day-to-day activities (Johnson et al., 2021). Because both residents and visitors can have routine activities in the same area, ambient population counts both residents and visitors in the area. Most recently, benefiting from the advances of modern telecommunication technologies, some researchers have used social media data (e.g., Twitter data) and other mobility data to measure the ambient population and its effect on crime. Lan et al. (2019) argued that the tweet counts, as an ambient population measure, showed a significant spillover effect and effectively suggested theft patterns in Cincinnati, OH. They concluded that the tweets count outperformed the Census population for theft analysis (Lan et al., 2019). Ristea et al. (2018) explored the spatial relationship between crime events and nearby tweets around a football stadium in the United Kingdom. They found a significant relationship between crime events and tweets. Besides, Hipp et al. (2019) and Lan et al. (2019) found that the measurement of geotagged tweets as ambient population helped explain the level of crime, including robbery in the Southern California region and Cincinnati, respectively. By tracking mobile phone users' trajectories, Song et al. (2019) uncovered a strong connection between offenders and potential victims represented by phone user-based ambient population. Another study in Xi'an, China, also generated a similar result using mobile phone data (He et al., 2020). Lately, Song et al. (2021) further investigated the makeup of the ambient population by classifying it into residents, employees, and visitors in Beijing, China. They found varied effects of these three types of the ambient population on thefts. Other human mobility data, like smart bus cards, were also used to study crime, and the results showed that the presence of bus passengers was positively related to interpersonal crime but not property damage crime (Zahnow & Corcoran, 2021). Discerning potential guardians and victims from ambient population has been challenging (Boessen, 2014; Hipp, 2016). Zahnow et al. (2021) demonstrated that familiar strangers who board and alight bus together might serve a weak or passive guardianship role, however it takes time for strangers to develop familiarity. It is reasonable to assume that the ambient population from the outside neighborhoods is most likely to be unfamiliar strangers. Any potential increase in guardianship is likely to be limited. It is more likely to increase potential victims, rather than guardians.

With the advancement of using ambient population to explain crime, it has become essential to evaluate how dynamic social characteristics may be affected by the ambient population and how it can impact crime. In particular, the ambient population could change the dynamic composition of racial heterogeneity in a community. In this study, we propose an ambient population-based racial heterogeneity index. This new index differs from the traditional ethnic heterogeneity index (Bernasco & Block, 2011; Bernasco & Nieuwbeerta, 2005;Groff & Lockwood, 2014; Lan et al., 2021; Patsiurko et al., 2012; Zhou et al., 2021) because it innovatively includes the racial composition of non-residents, including visitors and those who work there, in addition to the residents. We will compare the ambient population-based ethnic heterogeneity index with the traditional ethnic/racial heterogeneity index based on census population and assess their capabilities in explaining street crime.

Section snippets

Traditional racial heterogeneity index

For a long time, research on race and crime measured racial diversities as percentages of Whites and Blacks (Blau & Golden, 1986; Messner, 1982), perhaps because African Americans were the single dominant minority group. Gibbs and Martin (1962) proposed an empirical measurement of heterogeneity for social-related research. Blau (1977) later introduced this heterogeneity index to crime studies, arguing that ethnic heterogeneity can produce many social effects and modify social bonds (Sampson,…

Study area

We choose the City of Cincinnati, OH, as our study area to test the performance of the new index for crime analysis. Cincinnati is located at the intersection of Ohio, Kentucky, and Indiana. It is also the center of the Greater Cincinnati Metropolitan Area and the third-largest city in Ohio. The city occupies 205.98 km^2, includes 50 neighborhoods and 287 census block groups (CBGs), and has an estimated total population of 300,357 in 2018. In terms of the makeup of the population, white people…

Correlation matrix and descriptive statistics

Table 2 shows the Pearson correlation coefficient matrix among the traditional H indices (w/o spatial lag), and the ambient population-based H index. The Pearson correlation coefficient between the traditional and ambient population-based racial heterogeneity index is 0.28, implying some correlation between the two indices. The Pearson correlation coefficient between the traditional (with the spatial lag) and ambient population-based racial heterogeneity index is 0.36, which is higher than that …

Discussions

The social disorganization theory argues that the criminogenic effect of racial diversity relies on a long-term neighborhood process (Shaw & McKay, 1942). The underlying process is built on the assumption that the social structure of a community shapes levels of social solidarity and develops ways of formal and informal social controls among local residents of the community. It does not consider that daily mobility and social interaction of people across communities could affect a community's…

Conclusions

In conclusion, this study develops an innovative approach for measuring racial heterogeneity based on the ambient population. The application of such an ambient population-based approach is examined by studying street robbery in Cincinnati, OH, and demonstrates its effectiveness and superior performance than the traditional census population-based racial heterogeneity index. The ambient population-based racial heterogeneity index positively impacts street robbery in a statistically significant…

CRediT authorship contribution statement

Xin Gu: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. **Lin Liu:** Conceptualization, Formal analysis, Methodology, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Minxuan Lan:** Conceptualization, Methodology, Validation, Writing – review & editing. **Hanlin Zhou:** Data curation, Methodology, Validation, Writing – review & editing.…

Declaration of competing interest

All authors declare that the declaration of interest is none.…

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