



Impact of public bus system on spatial burglary patterns in a Chinese urban context

Lin Liu^{a,b,*}, Chao Jiang^{c,d}, Suhong Zhou^{c,d}, Kai Liu^{c,d}, Fangye Du^{c,d}

^a School of Geographic Sciences, Center of Geographic Information Analysis for Public Security, Guangzhou University, China

^b Department of Geography, University of Cincinnati, Cincinnati, OH 45221-0131, USA

^c Center of Integrated Geographic Information Analysis, School of Geography and Planning, Sun Yat-sen University, Guangzhou 510275, China

^d Guangdong Key Laboratory for Urbanization and Geo-simulation, Guangzhou 510275, China

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ABSTRACT

Purpose: To examine the impact of public bus system on spatial burglary pattern in a Chinese urban context, as well as the spatial variation of this impact.

Methods: Local Moran's I, boxplot-based classification, geo-visualization, Chi-square test, and correlation analysis are used to explore the spatial coupling relationships between bus stops and burglary. Guided by routine activity approach, negative binomial regressions are performed for the developed and developing parts of the DP peninsula, as well as the whole peninsula based on proxies of potential offenders, guardians, targets, and spatial dependence.

Results: Statistically positive correlations are observed between burglary count and bus stop service capability. However, net of other factors, one more unidirectional bus route is expected to reduce burglary by nearly 2 percent for the whole area, and 4 percent for the developed area, while no statistically significant relationship is found for the developing area.

Conclusions: The bus-burglary relationships differ between the developed and developing urban areas. For the former, although burglaries concentrate around bus stops with higher service capability, the increase of bus service capability has a net impact of slightly depressing the occurrence of burglaries. Four possible mechanisms explaining this negative bus-burglary relationship in the DP peninsula are presented.

1. Introduction

Public transit is important in urban systems, yet one serious concern for its possible cost is crime. As a main means of moving citizens and building compact cities, the development of public transit is expected to ameliorate many urban problems, such as traffic congestion, environmental degradation, and social-spatial segregations (Sung & Oh, 2011; Zhang, 2007). However, in spite of these environmental and social benefits, public transit has also been found to be related to crime. In an observational before-after case study involving maintenance-related closures of rail transit stations in Washington DC, USA, Phillips and Sandler (2015) found suggestive evidence that public transit could spread crime as criminals were sensitive to transportation cost. In Merseyside, UK, a policing operation along a single bus corridor successfully reduced the crime levels around the bus route (Newton, Johnson, & Bowers, 2004). Other empirical studies also found evidences for the diffusion of crime through public transit (Ihlanfeldt,

2003; Newton, Partridge, & Gill, 2015; Tay, Azad, Wirasinghe, & Hansen, 2013). As potential criminals most likely take public transit for routine or criminal activities, how the spatial organization of public transit system affects the spatial crime pattern becomes a critical question for both urban planners and crime fighters.

Based on where crime happens, studies on transit and crime can be roughly divided into two clusters. The first cluster, occupying the majority, focuses on the crime that occurs on buses/trains or at transit stops/stations (Clarke, 1996; Smith & Clarke, 2000). For example, the personal exposure to bus crime is found to be influenced the most by the frequency of bus use (Levine & Wachs, 1986), and serious crimes on public transit including robbery, hijack, bomb and other threats are found to have a strong positive linear relationship with bus ridership for a long temporal period (Pearlstein & Wachs, 1982). In addition, transit crimes containing pickpocketing, snatch, robbery, assault, etc. are found to be affected by the microenvironment, and they are more serious in areas with certain activity facilities such as liquor stores and

* Corresponding author. Department of Geography, University of Cincinnati, Cincinnati, OH 45221-0131, USA.

E-mail addresses: lin.liu@uc.edu (L. Liu), jchao@mail3.sysu.edu.cn (C. Jiang), eeszsh@mail.sysu.edu.cn (S. Zhou), liuk6@mail.sysu.edu.cn (K. Liu), dufangy@mail2.sysu.edu.cn (F. Du).

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check-cashing shops than residential areas (Liggett, Loukaitou-Sideris, & Iseki, 2001; Loukaitou-Sideris, Liggett, Iseki, & Thurlow, 2001; Newton, 2008). Overall, the volume of public transit use seems to be a powerful indicator of personal, temporal, and spatial patterns of transit crime. The second cluster of studies focuses on the crime occurred outside of the transit system, mainly including general property/violent crime and certain types of crime such as robbery, assault, and auto theft (Ihlanfeldt, 2003; Kooi, 2013; Qin & Liu, 2015). The comparison of crime levels in areas with and without transit station reveals that the presence of transit station does not necessarily increase crime around the station (Billings, Leland, & Swindell, 2011; Tay et al., 2013). However, robbery crime level tends to be high around bus stop locations in commercial and industrial areas (Hart & Miethe, 2014; Poister, 1996; Stucky & Smith, 2014). This may be because that there are more bus routes at each bus stop location in these areas than non-commercial/industrial areas. Thus, not only the transit stop/station locations but also their service capability reflecting the number of bus routes serviced by the stop should be taken into account when analyzing the transit-crime relationship.

Albeit a set of crime has been extensively investigated, burglary has rarely been the focus of transit-crime research and contradictory bus-burglary relationships were found in previous empirical studies. Burglary is a type of crime frequently happened at fixed houses, causing great property loss and serious psychological stress (Budd, 1999; Shover, 1991). In theory, the examination of transit-burglary relationship can shed light upon how mobility shapes spatial crime patterns (Brantingham & Brantingham, 1981). Despite its seriousness and importance, burglary has been referred to by only a few empirical case studies of bus-crime relationship. In Indianapolis, Indiana, USA, Stucky and Smith (2014) examined the effects of bus stops on crime rates with regards to land use and socioeconomic factors. Net of other factors, a positive relationship has been found between the number of bus stop locations and the number of burglary events. However, the effect of service capability of bus stops on burglary was not accounted for in this research. In another case study out of Newark, New Jersey in the United States, the service capability of bus stops was measured by the number of bus lines calling at the particular locations (Yu, 2009). Once again, a positive relationship of statistical significance was found between bus stops and burglary incidents. As the majority of burglary are residential (917 out of 1207), the author anticipated that “the results of data analysis using the burglary as a whole and the residential burglary were virtually identical” (Yu, 2009). Unexpectedly, after further distinguishing residential from commercial burglary in the same area, a negative relationship was found between bus stops and residential burglary (Yu & Maxfield, 2014). One possible reason for this contradiction may be that the variable measuring the volume of potential targets was not included in the first study, while included in the second study.

Not only the contradictory findings mentioned above, but also several limitations in previous literature call for further examinations of bus-burglary relationship. First, previous studies did not take the variable measuring guardianship levels into the model, which may produce biased empirical findings. According to the routine activity approach, motivated offenders, suitable targets, and lack of capable guardians are three indispensable elements for the occurrence of a crime event (Cohen & Felson, 1979). Thus, without incorporating the measures of these three elements in a single model, the estimated bus-burglary relationship would not be unbiased. Second, the measurement of activity facilities needs to be improved. In previous studies, the YellowBook data was used as an alternative for measuring activity facilities due to the difficulty in obtaining official records (Yu & Maxfield, 2014; Yu, 2009). Several problems acknowledged by the authors, such as the accuracy and representativeness of the data, trigger concerns over the empirical findings. Third, previous studies on bus-burglary relationship were all conducted in Western countries, leaving it to be further examined in a non-Western context. For example, because of the lack of enforceable zoning ordinance, the land use of most Chinese cities is

much more mixed than that of most Western cities. Other differences can also be found in population density and public bus system. Whether the research findings about the bus-burglary relationship can be applied to the Chinese context remains unknown.

In this light, this research attempts to contribute to the literature by examining the bus-burglary relationship with an improved research design in a Chinese context. In line with previous studies (Stucky & Smith, 2014; Yu & Maxfield, 2014; Yu, 2009), the bus stop is conceptualized as one kind of activity nodes, and their diverse service capabilities will be taken into consideration. Also, activity facilities will be measured with a better data source, and guardianship levels will be obtained through field investigations. As citizens are commonly attracted to establishments in the vicinity, bus stops are not their final destinations. The unique impacts of public bus transit and adjacent establishments on burglary occurrence need to be distinguished. With this in mind, the main research questions are: (1) Does the spatial burglary pattern follow the spatial organization pattern of public bus system in this Chinese context? (2) With the potential impact of other variables controlled, what is the impact of bus transit on burglary? (3) Does the bus-burglary relationship vary between the developed and developing urban areas? The last question is specifically added as Chinese cities are experiencing rapid development, and vast differences exist between the developed and developing urban areas. To answer these questions, the context of research case, related data, and analysis methods are described in the next section. Thereafter, key research findings from the exploratory spatial coupling analysis and confirmatory multivariate regressions are provided. At last, we conclude and discuss possible mechanisms for explaining the bus-burglary relationship in this Chinese context.

2. Material and methods

2.1. The context: DP peninsula in south China¹

The DP peninsula at the center of H city in South China was chosen as the empirical research case for three reasons: (1) The DP peninsula has a natural boundary, which alleviates the influence of neighboring urban areas. It is surrounded by rivers, and accessible via 7 bridges and 1 small dirt path. (2) The DP peninsula's area of 4.2 square kilometers is relatively small, thus enabling us conduct extensive and in-depth field survey needed by the study. (3) The DP peninsula is a microcosm of a typical Chinese city, as it has a high population density, a mixed land use, and a highly-developed bus system.

During the past 1500 years, the DP peninsula has kept being one of the most densely inhabited areas in H city. As of year 2011, about 95,000 individuals lived on the peninsula. This translates into a population density of 22,600 residents per km², which is nearly six times the population density of Newark city, USA, of 3960 residents per km² in 2007 (Yu & Maxfield, 2014). As depicted in Fig. 1, a green park is located in the center, with several shopping malls in the vicinity. There are no purely commercial buildings in the DP peninsula. Most buildings are purely residential, while other buildings have multiple functions. The most common situation is that the bottom one or two floors are for commercial use, while the upper floors are for residential use. Traditional communities and *Danwei* communities, whose buildings tend to be older and shorter (no more than six floors), are mainly distributed in the west of the peninsula. Commercial and gated communities, whose buildings are relatively new and tall (at least seven floors), are concentrated in the south. The areas in the east and northeast are primarily urban villages and currently in a state of real estate development. In addition to commercial and residential facilities, several factories are scattered on the peninsula. Some factories are located within the

¹ Abbreviations are used to indicate the real names of both the peninsula and the city because of the confidentiality agreement with the Public Security Bureau of H city.

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