Urban Resilience Against Crimes Upon Pandemic

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Summary

Since early 2020, urban areas across the world had been affected by the COVID-19 pandemic, when social distancing and lockdowns measures had been widely deployed to restrict citizens' mobility, which induced dramatic changes on urban crimes and delinquency among cities. Drawing on crime data of London and New York in 2019, 2020 and 2021, this study attempts the two-year "look back" on the impact of massive lockdowns on crime trends and corresponding resilience, to evaluate the crime "vulnerability" and "recovery" capability against pandemic incurred lockdowns. In the assistance of criminological theories, routine activity, and general strain; and cutting-edge machine learning techniques on relating the community-level "preparedness" on geodemographics, socio-economic profiles (SES indicators) and "recovery" indicator for mobility changes, this research had proposed PROP-C model to evaluate urban crime resilience capability in comparing the crime changes pre-para the lockdown (2019 vs. 2020) and para-post lockdown (2020 vs.2021). The research findings suggest a general crime reduction upon mobility changes during lockdowns in 2020 among the metropolitan cities, but sharp "recovery" in 2021 since the measures had been lifted with regional resilience features. In general, the holistic mobility change had been found the most crime-influential factor rather than any fine-scaled SES characteristics, echoing with the commonly off-site criminal behaviors rather than committing crimes locally; the data-driven evidence could be further utilized for city-wide crime prediction and prevention strategies towards a promising post-pandemic recovery.

KEYWORDS: city; crime change; lockdown; resilience; mobility change

1. Introduction

The COVID-19 pandemic has been wreaking havoc on global health, human wellbeing, economics, crime, and social interactions among urban entities, making significant impacts throughout 2020 and 2021 (Clemens, 2020; Liu et al., 2021; Stickle and Felson, 2020). To contain the rapid spread of the virus and in response to the pandemic, governments around the world began to impose policies and measures, for example lockdown, to demobilize people's activities, which simultaneously affected the social interactions of millions of people (Stickle and Felson, 2020), followed by local significant crime changes. However, most of the up-to-date studies focused on single target city or nation, with an relatively short observation period, i.e., several weeks (see, e.g. Balmori de la Miyar et al., 2020; Felson et al., 2020; Kim and Phillips, 2021), three months (see, e.g. Mccarthy et al., 2021; Mohler et al., 2020), or six months (see, e.g. Langton et al., 2021; Nivette et al., 2021; Rashid, 2021), which were incapable to capture the nature of lockdowns' impacts in varied city contexts with year-long observation.

This article tried to draw on the monthly data from March 2019 to December 2021 in London and New York, to explore how the lockdowns have impacted major types of crime throughout typical pre-, para- and post- months; to compare the city-featured most-hit crime hotspot regions' resilience; and to

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contribute to the field from such a comparative understanding of the unprecedented crime situations imposed by COVID-19 lockdowns in three aspects:
(1) to deliver more comparative insights and solid evidence to the existing literature, by observing crime patterns in metropolitan cities, on year-on-year basis.
(2) to apply classic criminological theories (routine activity and general strain) and PROP-C model (Figure 1 below) onto different cities, to identify whether some urban areas have been disproportionately affected by mobility change during lockdowns and the areas with higher resilience against lockdown-affected crime changes.
(3) to explore how the trends and patterns in urban crimes will recover in the future, assisted by machine learning techniques and spatial predictive models, as a result, to provide references for efficient crime prevention and policing strategies.

2. Theories and Methods

In the hope of containing the outbreak of the COVID-19 contagion, governments around the world have deployed non-pharmaceutical intervention (NPI) strategies of social distancing and mandatory lockdowns to restrict citizens' activities, which had dramatically changed the social orders and controls (Liu et al., 2021; Stickle and Felson, 2020). For example, the individual citizen's routine activities had been affected to account for the changes of inclinations, patterns, distributions, and trends in criminal activities amid lockdowns, which could find support from a prominent criminological theory: routine activity theory (RAT) (Cohen and Felson, 1979); the intensified social isolation and lack of social communication, in together with the worsening financial conditions, and the uncertainty and anxiety caused by lockdowns, aggregated general strain (Agnew, 1992) for crime committing theorised by general strain theory (GST). Empirical studies on the impacts from lockdowns onto urban crimes had provided sufficient evidence during the limited periods as: with the introduction of COVID-19 containment measures, people have had to stay at home hereafter strengthened the guardianship over personal property and space, resulting in a significant decrease in residential burglary and theft (Ashby, 2020; Campedelli et al., 2020; Halford et al., 2020); a substantial level of decline on violent crimes and crimes against persons immediately following COVID-19 containment measures (Abrams, 2021; Langton et al., 2021; Payne et al., 2020), thanks to the reduced chances of contacts from potential offenders and victims in a public place.

This study would like to relate the crime changes pre-, para-, and post- the lockdown to fine-scaled mobility changes and local SES characteristics, on basis of the Pandemic Resilience of Place-Crime (PROP-C) model as shown in **Error! Reference source not found.**, adapted from the PROP Model (Li, 2021a). The city's resilience (R) against lockdown-influenced crime changes was designed as a function of city's vulnerability (V), preparedness (P) and recovery (R) capability as depicted in equation (1):

$$R = V * P * R \tag{1}$$

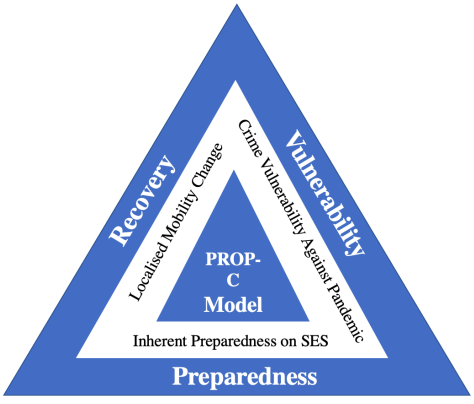


Figure 1 PROP-C model

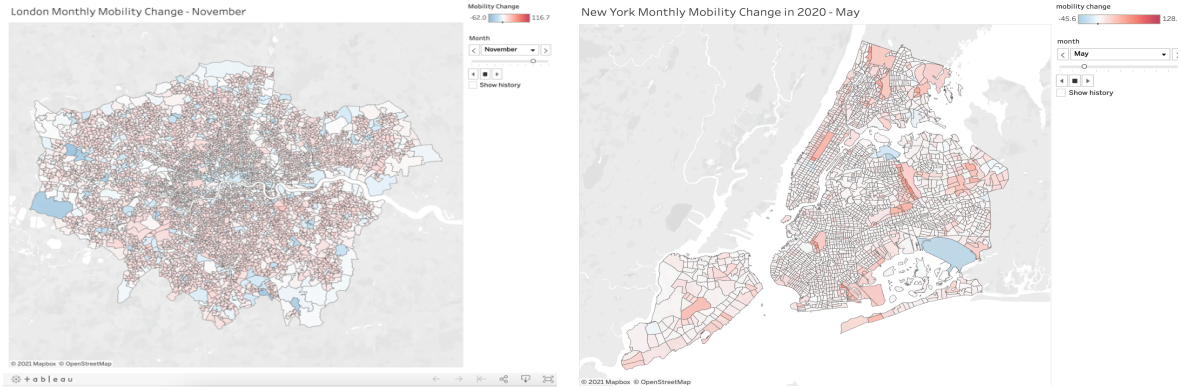
Data on fine-scaled mobility change during the observation lockdown months (e.g., April and November) had been simulated using city-wide land use functioning data derived from Open Street Map on six land use categories - recreation, grocery, work, transit, residential and parks - to calculate monthly average mobility change in space (detailed visualisation on project website: http://www.comparecitycome.com) further relating to inner-city crime changes on monthly basis (equation 2).

$$Mob_{ik} = \sum_{j=1}^{6} Mob_{jk} * (\frac{Area_{ij}}{Area_i}) \quad (2)$$

where i is the index for fine geographical unit (i.e., i=1,2,3, …, 4835 LSOA in London, and i=1,2,3,…,2195 TRACT in New York City), j is the land use category (j =1,2,3,4,5,6), and k is the index for consecutive months (February to December 2020, January to December 2021). Against the context of each target city, this study will investigate the associations between land use related mobility change and crime change on comparing the: (1) time series trends on monthly crime rate change (2019 vs. 2020 and 2020 vs.2021) and mobility change in each city during the selected lockdown months (April and November); (2) spatial hot spots of crime changes during selected months at the finest geographical units; and (3) spatial regression analysis considering socio-economic contextual features' influence, to evaluate the regional resilience at finest scale on basis of equation 1, where the preparedness will be measured by the city's socio-economic status (SES) profile upon clustering operation using machine learning *KMeans* algorithm.

3. Results

Taking the mobility index of 13th January 2020 as the benchmark for each city, it was obvious that mobility dropped significantly during lockdown months. This same trend is noticeable regardless of the mobility mode or the city, as snapshot in **Figure 2** from the hyperlinked repository.

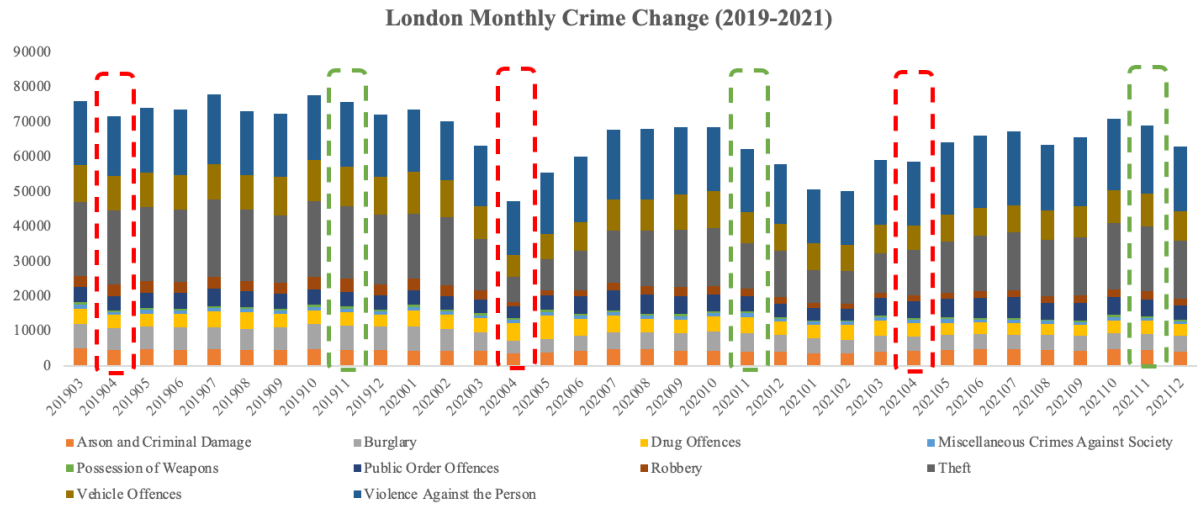


https://comparecitycrime.com/london/ldn_monthly_mobility.html; https://comparecitycrime.com/newyork/newyork_month_mobility.html

Figure 2 Monthly Mobility Changes

3.1 Crime Reactions (2020 vs. 2019) and Recoveries (2021 vs. 2020) in selected months

To further investigate the year-on-year variance in crime rate according to crime type throughout the observation years, results in Figure 4 had presented below (April in red dash-lined frames and November in green dash-lined frames):



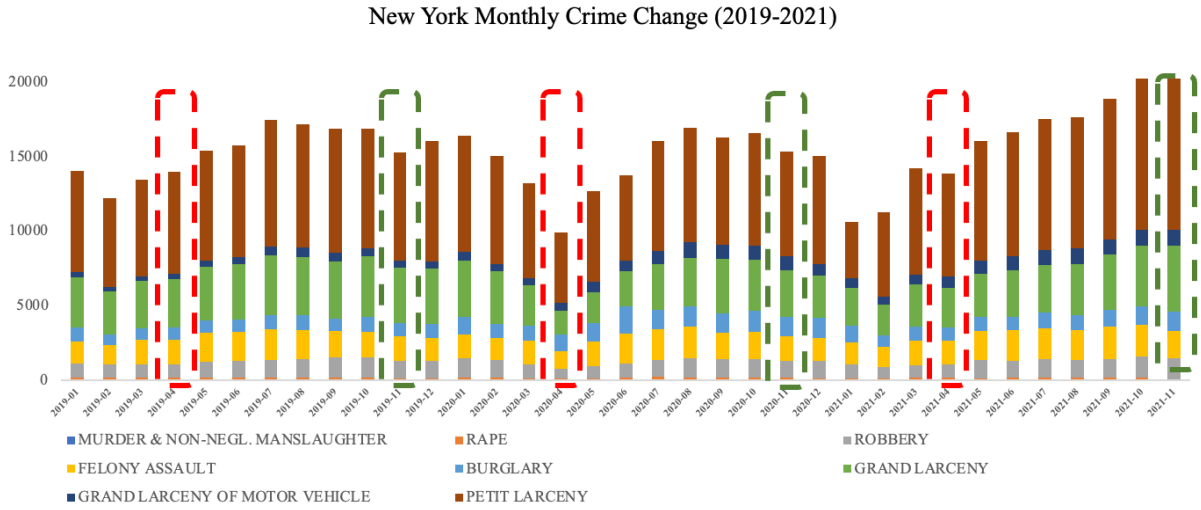


Figure 4 Monthly Crime Trends in London and New York City from 2019 to 2021

It was apparent that during the first lockdown in April 2020, crimes experienced cliff drops in both London and New York comparing to 2019, but New York had recovered in 2021 more swiftly than London; the second lockdown month November witnessed milder crime decreases in both cities in 2020 and rebounded back to the level of 2019 or even higher in 2021.

Further investigation into the impacts on crime changes during lockdown months (i.e., April and November) over space had been presented in Figure 5 and Figure 6. The most significant crime changes had been witnessed in city centers and transit hubs (i.e., the international airports and rail stations), which is consistent with the hypothesis that mobility-related crime decreases during periods of national lockdown and quicker bounce back for recovery.

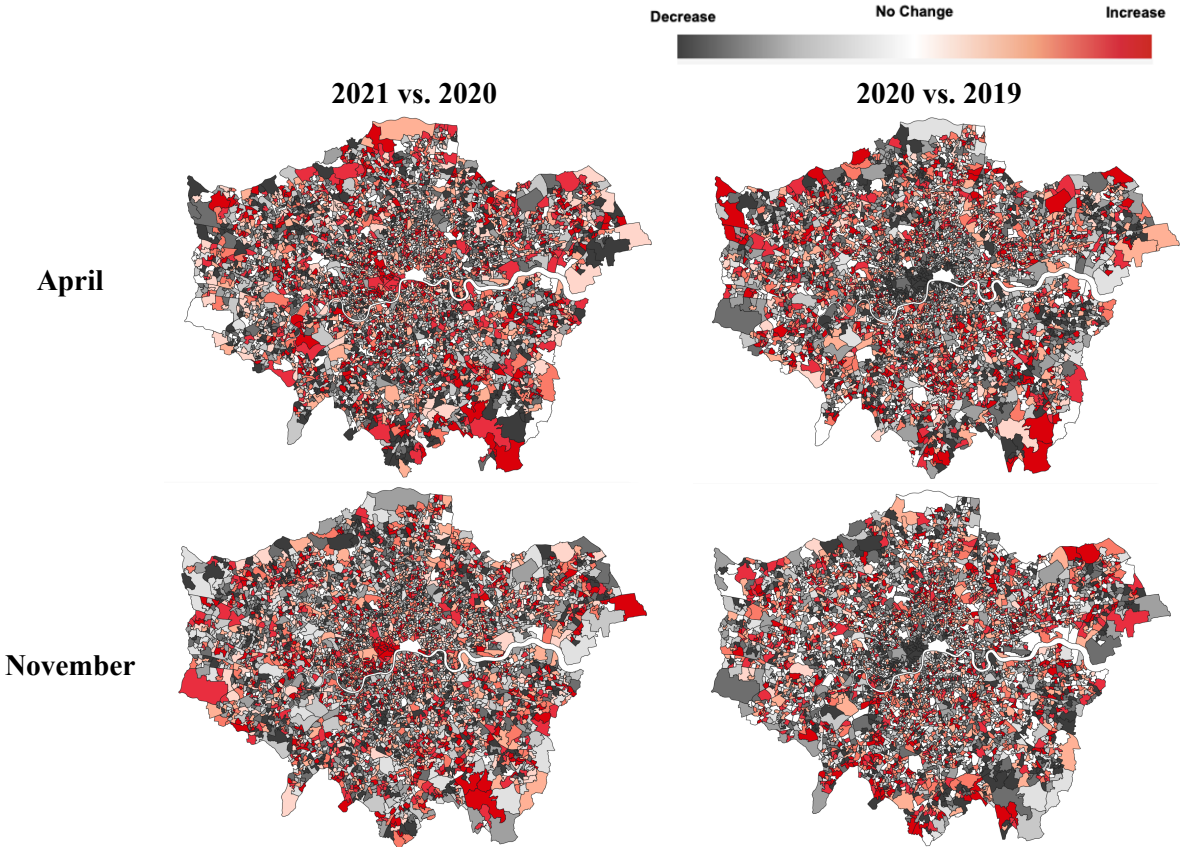


Figure 5 London Crime Change (%) Pre- and Post- Lockdowns in April and November by LSOAs

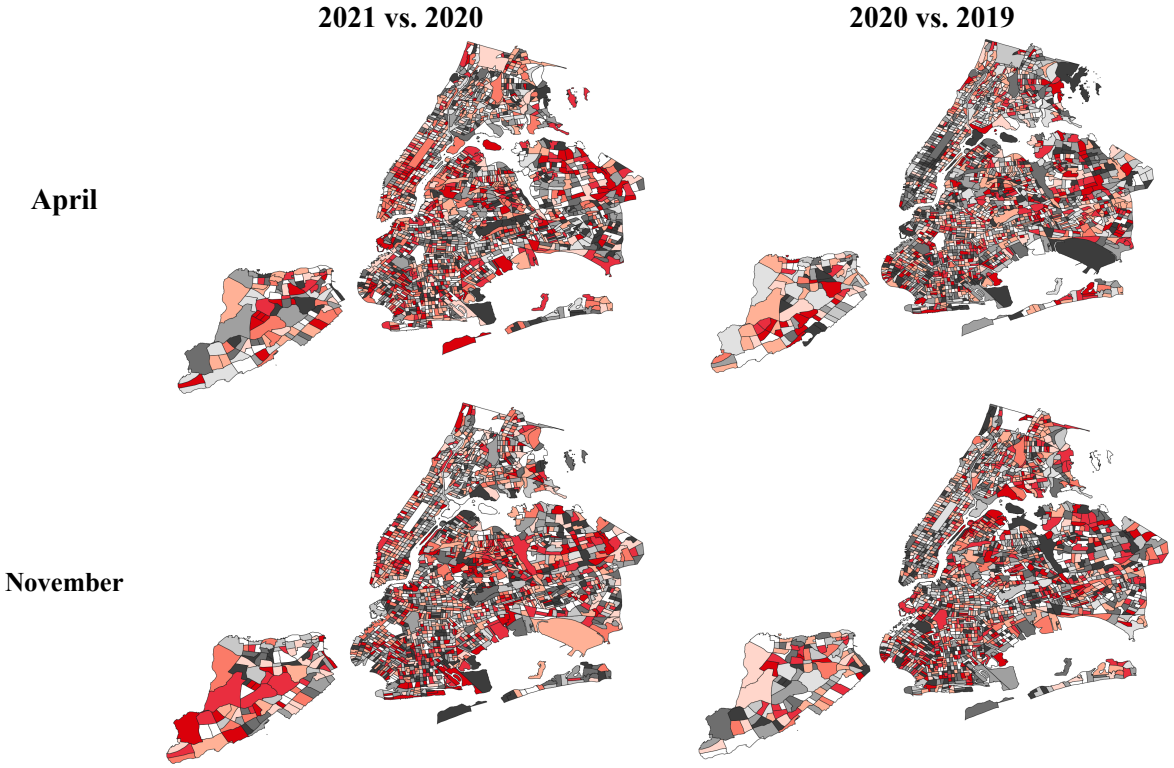


Figure 6 New York Crime Change (%) Pre- and Post- Lockdowns by Tracts

3.3 Spatial Regression Models

Upon applying K-Means clustering technique on selected demographical, social, and economic status (SES) variables at the finest geographical scale, it was found in both target cities an optimal 6 (or 5 in New York City) SES clusters. In reflection of the PROP-C model, neighbouring regions' influences on crime change, i.e., regional SES profiling, and impacts from mobility changes had been taken as the indicators for preparedness (P) and Recovery (R), while the crime changes indicated for the regional vulnerability (V) against pandemic-incurred crimes. Spatial lag model (SLM) and spatial error model (SEM) had been utilised to identify the most influential factors in **.**

Table 1.

Table 1 Spatial Regressions among London, Sydney, and New York City (2021 vs.2020 & 2020 vs. 2019)

		London (2020 vs. 2019)		**Recovery (2021 vs 2020)**		**New York City (2020 vs. 2019)**		**Recovery (2021 vs 2020)**	
		SLM	*SEM*	*SLM*	*SEM*	*SLM*	*SEM*	*SLM*	*SEM*
April	R-squared	0.028	0.017	0.044	0.036	*0.005*	*0.005*	*0.024*	*0.022*
	Mobility Change	1.339***	1.482 ***	1.784***	1.94***	*-0.071*	*-0.079*	*1.042*	*1.043*
	SES Cluster	-1.165	-1.13	-2.358**	-1.789	*-0.209*	*-0.235*	*10.6****	*11.01****
	Neighbours' Crime Change	0.023***	0.026***	0.020***	0.025***	*0.071****	*0.095****	*0.105****	*0.088**
November	R-squared	0.021	0.001	0.028	0.028	*0.006*	*0.006*	*0.008*	*0.008*
	Mobility Change	0.265***	0.352***	0.649***	0.649***	*0.353*	*0.34*	*0.847*	*0.909*
	SES Cluster	-0.349	-0.388	-3.221***	-3.171***	*1.986*	*2.09*	*5.546****	*5.659****
	Neighbours' Crime Change	0.029***	0.031***	0.000	0.002	*0.096****	*0.095****	*0.039*	*0.036*

***p<0.01, **p<0.05, *p<0.1

4. Conclusions and Discussion

In London, mobility change and neighbouring regions' crime change had exhibited significant positive influences on crime change; in exception with the insignificant relation between crime change and local SES features. However, Sydney's crime change had been identified as only affected by its neighbouring areas' crime changes, rather than the mobility change throughout lockdowns. New York City had been found to be influenced significantly by not only the neighbouring crime rates over the lockdowns, but also in the SEM model to have positive associations with mobility change and negative relation with contextual profiling during the 2nd lockdown.

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