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Spatial Association Between Dog Ownership and Crime Rate in New York City

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Findings

This paper identifies the spatial relationship between dog ownership and the property crime rate in New York City. This zip-code level study reveals that the dog ownership rate in 2019 positively correlates with the crime rate in past three years (2016-2018). It also finds that areas with high poverty rates, high proportions of Asian and Black people, and larger households (more than two) have lower dog-ownership rates than their counterparts. Areas with denser sidewalks also correlate with high dog-ownership rates. The finding underscores the role of dogs in increasing the feeling of safety in high crime rate areas.

1. Questions

Owning a dog comes with several benefits. Physical health and social benefits, in addition to the other benefits (e.g., psychological, emotional, and therapeutic), have been pronounced by past studies, primarily for the positive relationship between dog walking and physical activity (Christian et al. 2013; Westgarth et al. 2019). This relationship can be influenced by the neighborhood characteristics and safety perceptions. It's clear from the previous studies that dogs provide a feeling of safety at home and while walking (Cutt et al. 2007; Knight and Edwards 2008; Wood, Giles-Corti, and Bulsara 2005). The available studies mostly present personal interviews and survey-based findings, primarily grounded in people's safety perceptions. On the other hand, an aggregated study can offer a more general and city-wide overview linked to the actual crime rate. We are not aware of any such study with an exclusive focus on the dog-crime relationship in US cities. In response, the research objective of this study is to find the association between dog ownership and crime rate after controlling the sociodemographic and environmental factors and spatial autocorrelation.

2. Methods

This study uses a dog licensing dataset for 2019 from the open data portal of New York City. The final dataset used in this study contains only the dog breeds that can be used as watch dogs or guard dogs (see Table A in Appendix for the list of breeds). Dog ownership is expressed by the number of dogs per 100 families in zip codes. The geo-coded crime complaint dataset from the open data portal is used to compute the three-year average (2016-2018) crime rate (i.e., number of incidents per 1000 people in zip codes). Only the property crimes (i.e., larceny, burglary, robbery, trespass, theft, arson) are included in this study. The model investigates if the past crime rate (2016-2018) (i.e., independent variable) is associated with the dog ownership rate in 2019 (i.e.,

Table 1. Descriptive statistics

variables	Unit	Min	Mean	SD	Median	Max
Dependent variable						
Dog ownership rate in 2019	Number of dogs per 100 families	0.07	1.28	0.90	1.07	5.38
Independent variables						
Annual crime rate in 2016-2018	Annual average number of crimes per 1000 population	0.8	31.0	27.5	24.0	187.3
Population density	Person/square mile	1622	46232	52756	37590	631265
HH size (above 2)	Proportion of total households with 3 or more members	0.00	0.39	0.14	0.41	0.70
Asian & Black	Percentage of total population with Asian or Black race	1.3	36.4	21.2	33.0	93.5
Poverty rate	Percentage of total families living below poverty level	0.0	11.9	8.9	9.2	40.4
Sidewalk density	Proportion of zip area covered with sidewalk.	0.00	0.08	0.03	0.08	0.14

dependent variable). With these two main variables of interest, five variables are used to control dog ownership. We have used population density, percentage of Asian or Black people, the proportion of households with 3 or more members, and the percentage of families living below the poverty level. Since environmental features like sidewalks encourage dog walking (Cutt et al. 2007), we used sidewalk density as another control. The zip code level sociodemographic data is collected from the American Community Survey 5-year estimate for 2019. The summary statistics of the dependent and independent variables are provided in Table 1.

The spatial distribution of dog ownership in Figure 1 reveals that the number of dogs per 100 families is highest in Manhattan and surrounding areas. Staten Island also has a moderate number of dogs. The peripheral zip codes in Bronx, Brooklyn, and Queens have a relatively lower number of dogs per family. The property crime rate map shows high rates in Manhattan, Bronx, and Brooklyn. Queens and Staten Island have a low rate of crime.

We used Geographically Weighted Regression (GWR) to model the relationship between dog ownership and property crime. This model allows the regression coefficients to vary over space (Brunsdon, Fotheringham, and Charlton 2010).

3. Findings

The descriptive statistics of the local parameters of the GWR model are provided in Table 2. The crime rate in the past three years (2016-2018) has a significant positive association (in 95.7% zip codes) with the dog ownership rate in 2019 in New York. The effects of other control variables on dog ownership do not vary by the sign (+/-) over the space. Sidewalk density positively correlates with dog ownership in 47% of zip areas. The effect of population density is not significant in any zip area after including other

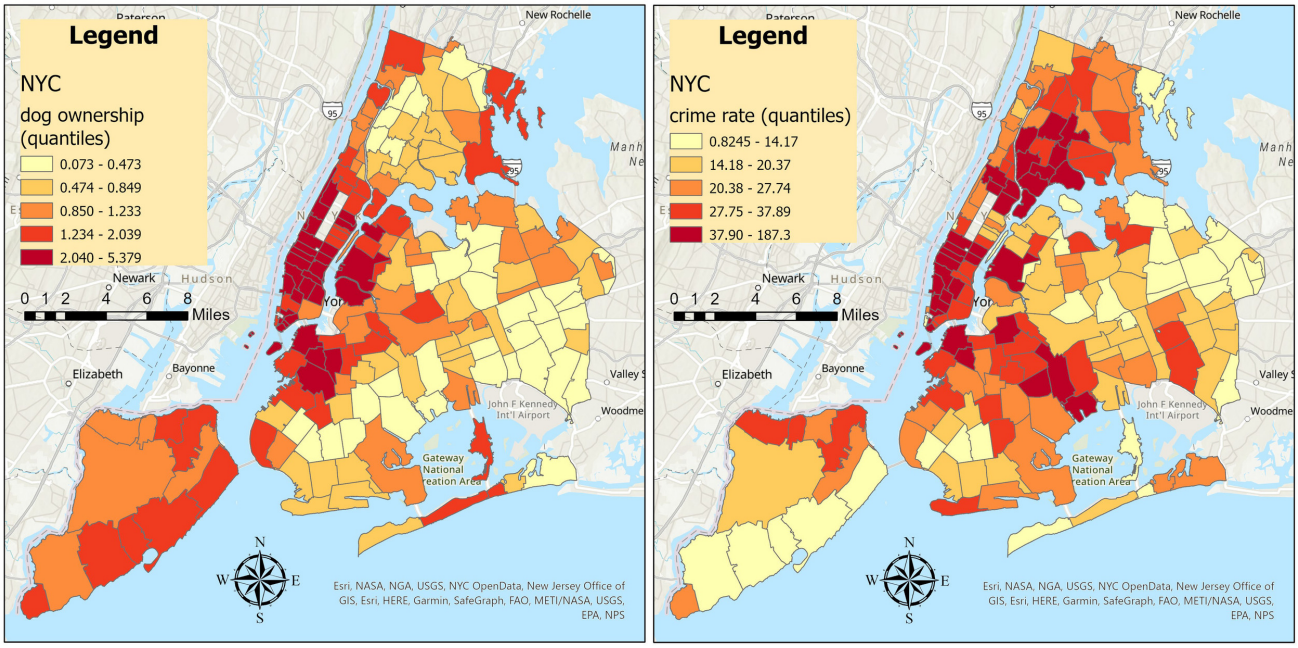

Figure 1. Spatial distribution of dog ownership per 100 families in 2019 (left) and annual property crime rate in 2016-2018 (right) in zip areas of New York city

demographic densities in the model. The areas with a high percentage of households with 3 or more members have a lower rate of dog ownership. Although this is contrary to expectation, the loneliness of people in smaller households could be one reason behind the high dog-ownership rate (Antonacopoulos 2017; Oliva and Johnston 2021). Further, our exploratory correlation (not reported here) confirms that some areas (i.e., mostly Manhattan and Brooklyn) with a high percentage of larger households (more than 2) are correlated with high poverty rates. Also, the smaller households are separately correlated with high crime rate and high dog-ownership rate in bivariate correlation. Therefore, it is intuitive that areas with smaller households in New York own dogs more than in areas high in bigger households. Zip codes with more Asian or Black people and families below the poverty level have a lower rate of dog ownership. This model explains a good amount of variance (i.e., 69%) in dog ownership. The residual of the model is randomly distributed and not spatially autocorrelated, which is indicated by insignificant Moran's index.

We mapped the local parameters of the crime rate to see how its association varies in space. Figure 2 shows that the association is strongest in Queens and some parts of the Bronx. It is strong in Brooklyn as well. In these areas, the rate how dog ownership increases with the crime rate is higher than in the other parts of New York. The association gets weaker in Manhattan and Staten Island. The map of t statistics indicates that the local estimates for crime rate are significant at a 95% confidence level (i.e., t statistics > 1.96) in most of the zip code areas except a few zip codes in Staten Island.

Table 2. GWR model result (Dependent variable: dog ownership rate in 2019)

variable	Min	Mean	SD	Median	Max	% sig
Intercept	1.619	2.662	0.428	2.745	3.582	98.9
Crime rate (2016-2018)	0.003	0.007	0.001	0.006	0.010	95.7
Population density	-0.000029	0.000000	0.000002	0.000000	0.000003	0.0
HH size (above 2)	-3.783	-2.901	0.590	-3.012	-0.851	98.4
Asian & Black	-0.020	-0.014	0.002	-0.014	-0.011	98.9
Below poverty	-0.031	-0.020	0.003	-0.020	-0.012	96.8
Sidewalk density	0.681	3.794	1.731	3.713	17.415	47.1
N	190					
Adj R^2	0.69					
Moran's *I*	0.005458 (p = 0.937)					

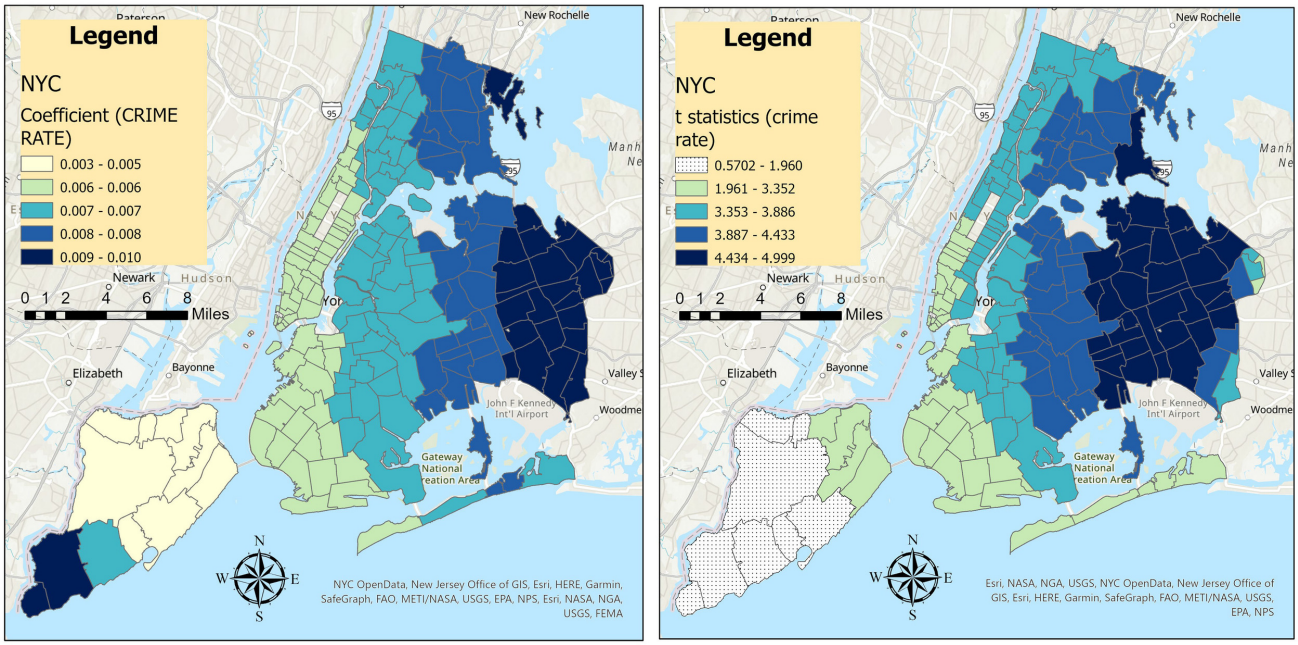

Figure 2. The local coefficient estimates of crime rate (left) and t-statistics (right)

The findings of this article offer unique insights and directions for future research. We argue that owning more dogs in high crime rate areas is an indication that New Yorkers, beyond other benefits, might own dogs to be or keep their property secure. The revealed association offers a preliminary understanding and can be helpful for designing future surveys for dog owners. The information can expand the perception of safety analysts and urban planners for preventing crime through environmental design.

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Appendix

Table A. Dog breeds considered in this study

Breed name	Count	%	Breed name	Count	%
Labrador Retriever	2219	12.95	Bull Terrier	99	0.58
Labrador Retriever Crossbreed	2110	12.31	Collie, Border	98	0.57
American Pit Bull Mix / Pit Bull Mix	1733	10.11	Great Dane	90	0.53
American Pit Bull Terrier/Pit Bull	1194	6.97	Basenji	89	0.52
Jack Russell Terrier	790	4.61	Cane Corso	85	0.50
German Shepherd Crossbreed	744	4.34	Schnauzer, Standard	83	0.48
Terrier Crossbreed	575	3.36	Basset Hound	80	0.47
Dachshund	507	2.96	Wire Fox Terrier	79	0.46
Boxer	424	2.47	Weimaraner	71	0.41
American Staffordshire Terrier	359	2.10	Coonhound, Black and Tan	70	0.41
Dachshund Smooth Coat	328	1.91	Portuguese Water Dog	70	0.41
Shepard Crossbreed	310	1.81	Akita	69	0.40
Dachshund Smooth Coat Miniature	279	1.63	Samoyed	69	0.40
Rottweiler	257	1.50	Coonhound, Treeing Walker	57	0.33
Dachshund Crossbreed	243	1.42	Bull Dog, American	56	0.33
Australian Cattle dog	222	1.30	Rottweiler Crossbreed	53	0.31
Jack Russell Terrier Crossbreed	203	1.18	Alaskan Malamute	50	0.29
Border Collie	197	1.15	American Foxhound	45	0.26
Staffordshire Bull Terrier	163	0.95	Mastiff	44	0.26
American Bully	160	0.93	Basset Hound Crossbreed	39	0.23
Bernese Mountain Dog	159	0.93	Dachshund, Wirehaired	26	0.15
Rat Terrier	159	0.93	Coonhound, Blue Tick	25	0.15
Dachshund, Long Haired Miniature	158	0.92	Pointer, German Shorthaired	23	0.13
Siberian Husky Crossbreed	155	0.90	Bloodhound Crossbreed	20	0.12
Boxer Crossbreed	151	0.88	Bloodhound	17	0.10
American Eskimo dog	147	0.86	Afghan Hound	16	0.09
Border Collie Crossbreed	146	0.85	Pharaoh Hound	16	0.09
Doberman Pinscher	137	0.80	Russell Terrier	14	0.08
Shetland Sheepdog	134	0.78	English Foxhound	13	0.08
Australian Cattle Dog	132	0.77	Mastiff, Bull	12	0.07
Pointer	131	0.76	Saint Bernard	11	0.06
Italian Greyhound	126	0.74	Greater Swiss Mountain Dog	8	0.05
Collie Crossbreed	123	0.72	Ibizan Hound	8	0.05
Rhodesian Ridgeback	114	0.67	Irish Wolfhound	8	0.05
Greyhound	113	0.66	American Leopard Hound	3	0.02
Dachshund, Long Haired	108	0.63	Polish Hound	3	0.02
Border Terrier	101	0.59	Afghan Hound Crossbreed	2	0.01
Great Pyrenees	101	0.59	Coonhound, Redbone	1	0.01
Tibetan Terrier	100	0.58	Scottish Deerhound	1	0.01