

Daily Rhythms 2: travel purpose, activity spaces and the spatio-temporal patterning of crime

Manchester Metropolitan University Crime & Well-Being Big Data Centre

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Contents

- Motivation: An investigation of how the daily rhythms of the city, the travel purposes of its citizenry (#1) and the characteristics of their destinations (#2), impact upon the spatio-temporal patterning of crime.
- Data: DR1 + additional datasets
 - Travel purpose: NTEM datasets (2017) from DfT, released by MSOA level.
 - Physical environments: POIs (2017) from crowded resources and Ordinance Survey, aggregated by LSOA level.
- Research questions:
 - 1) Does travel purpose hold an association with crime patterning?
 - 2) Are crime attractors / generators time-dependent?
 - 3) Do crime attractors / generators hold an influence on the spatio-temporal patterning of (violent) crime?

1. Personal exposure to the risk of violent crime

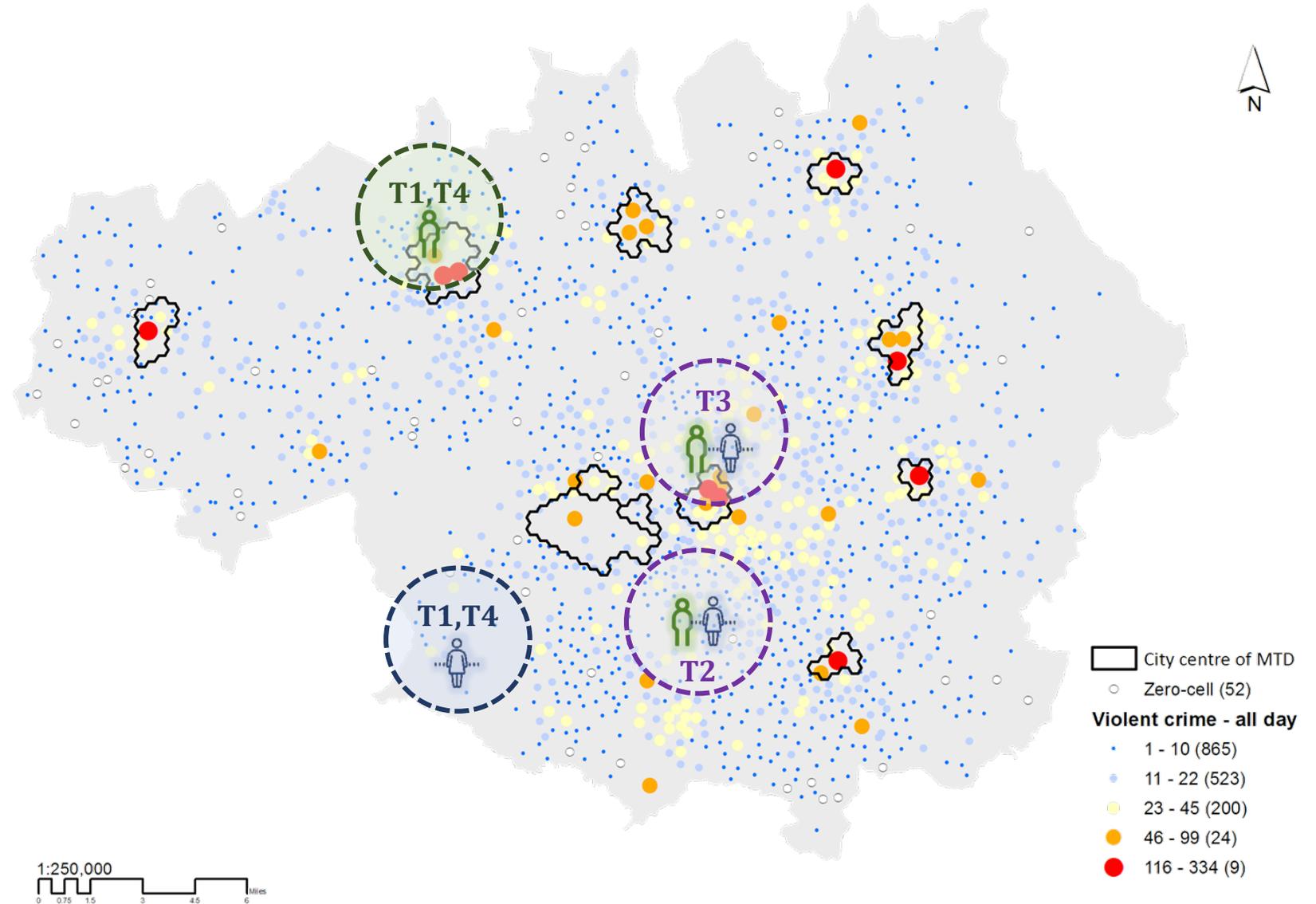
Individual agent



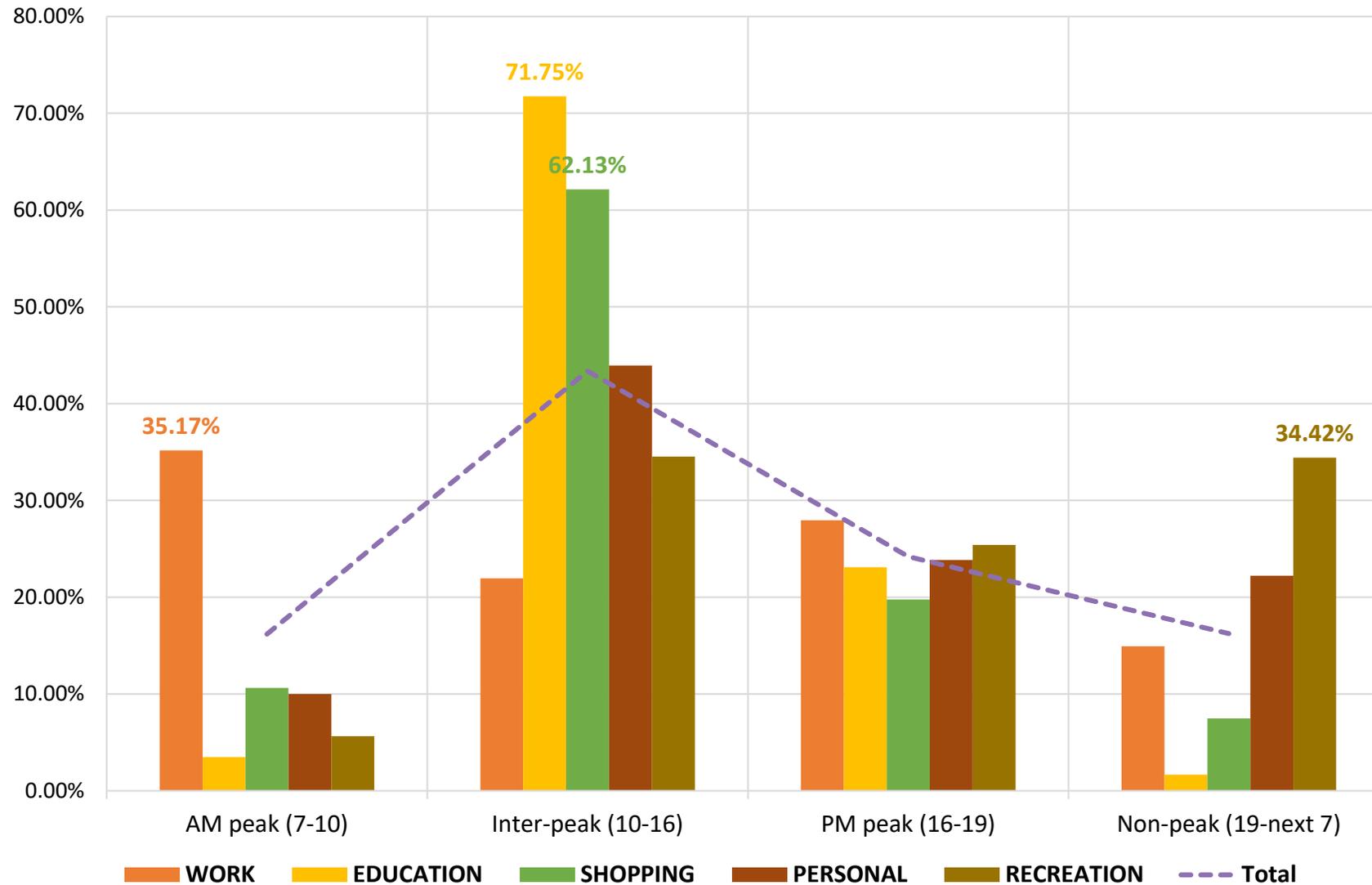
$$\beta_0 + \beta_A T_1 A_{home} + \beta_B T_2 A_{work} + \beta_C T_3 A_{leisure} + \beta_A T_4 A_{home}$$



$$\beta_0 + \beta_D T_1 A_{home} + \beta_B T_2 A_{work} + \beta_C T_3 A_{business} + \beta_D T_4 A_{home}$$

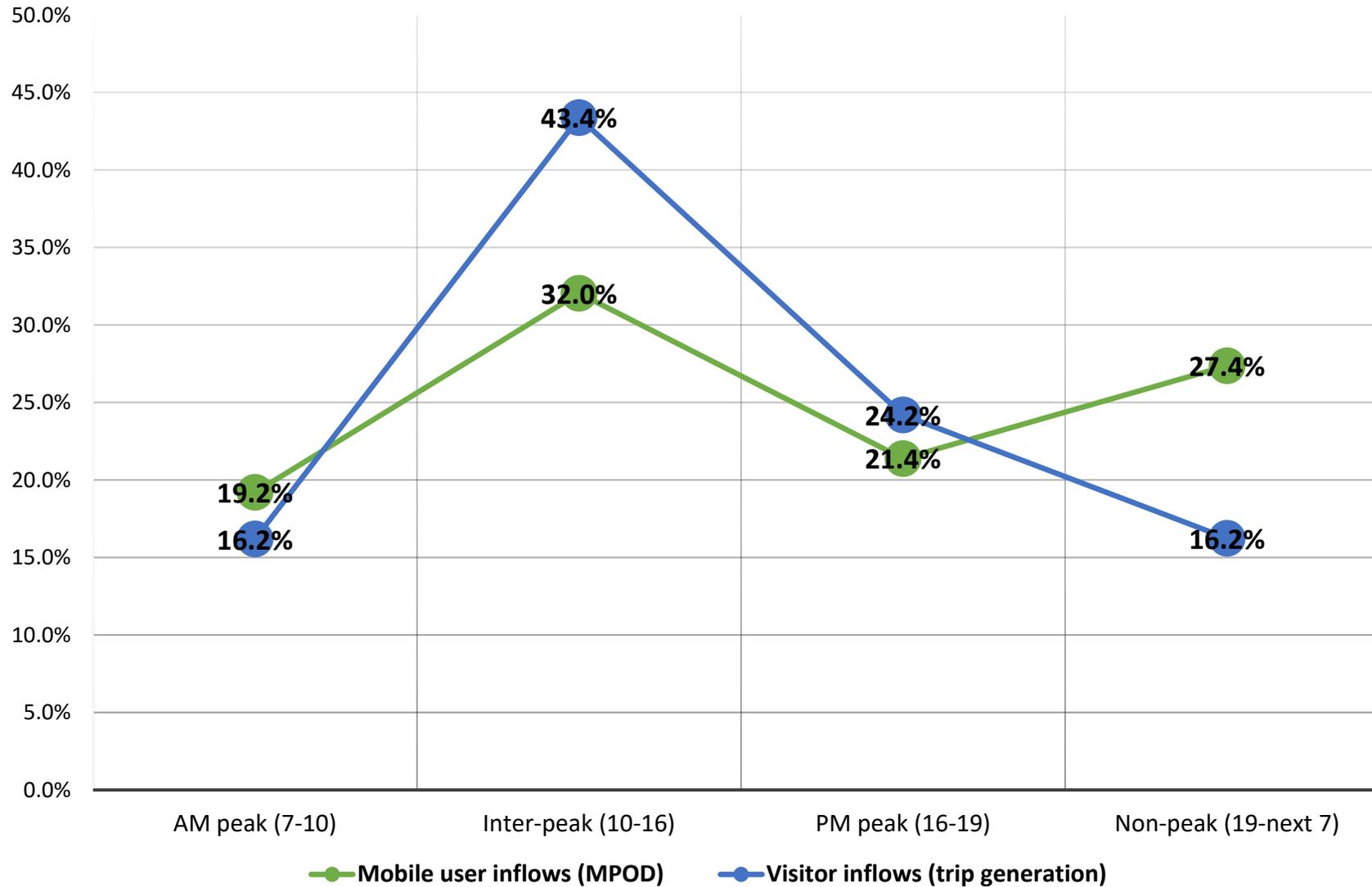


The distribution of trip purpose



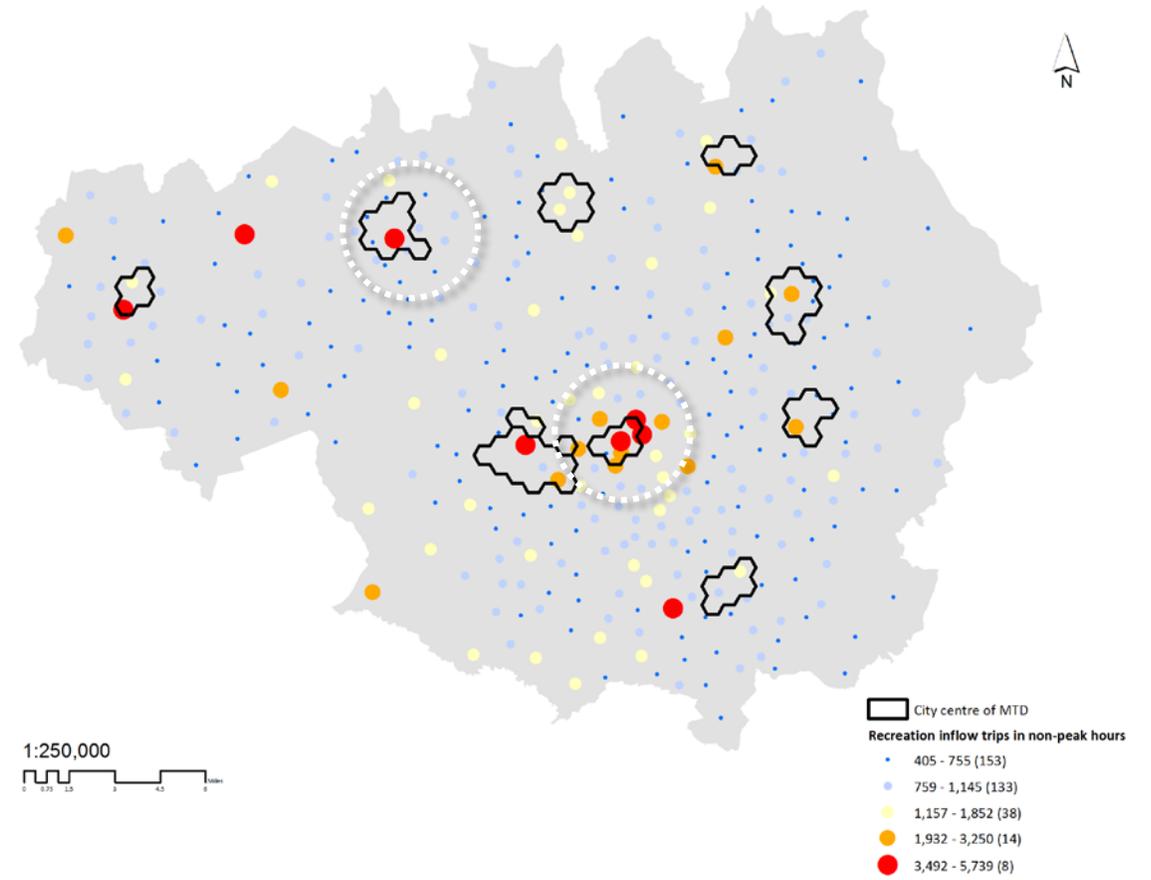
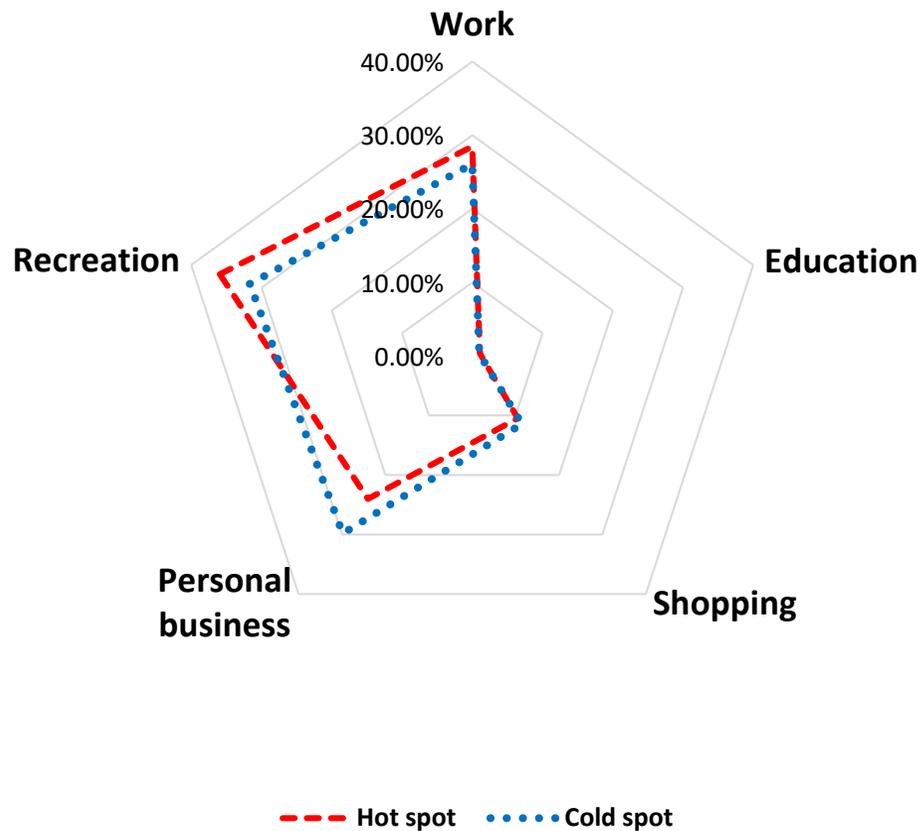
Data source: MPOD (Mobile Phone Origin-Destination) data from TfGM (Transport for Greater Manchester); NTEM (National Trip End Model) datasets from TEMPro (The Trip End Model Presentation Program) v. 7.2 from Department for Transport Survey

Population flow data



Data source: MPOD (Mobile Phone Origin-Destination) data from TfGM (Transport for Greater Manchester), NTEM (National Trip End Model) datasets from TEMPro (The Trip End Model Presentation Program) v. 7.2 from Department for Transport Survey

Trip distribution of (recreation) visitor inflows / violent crime patterning at night time



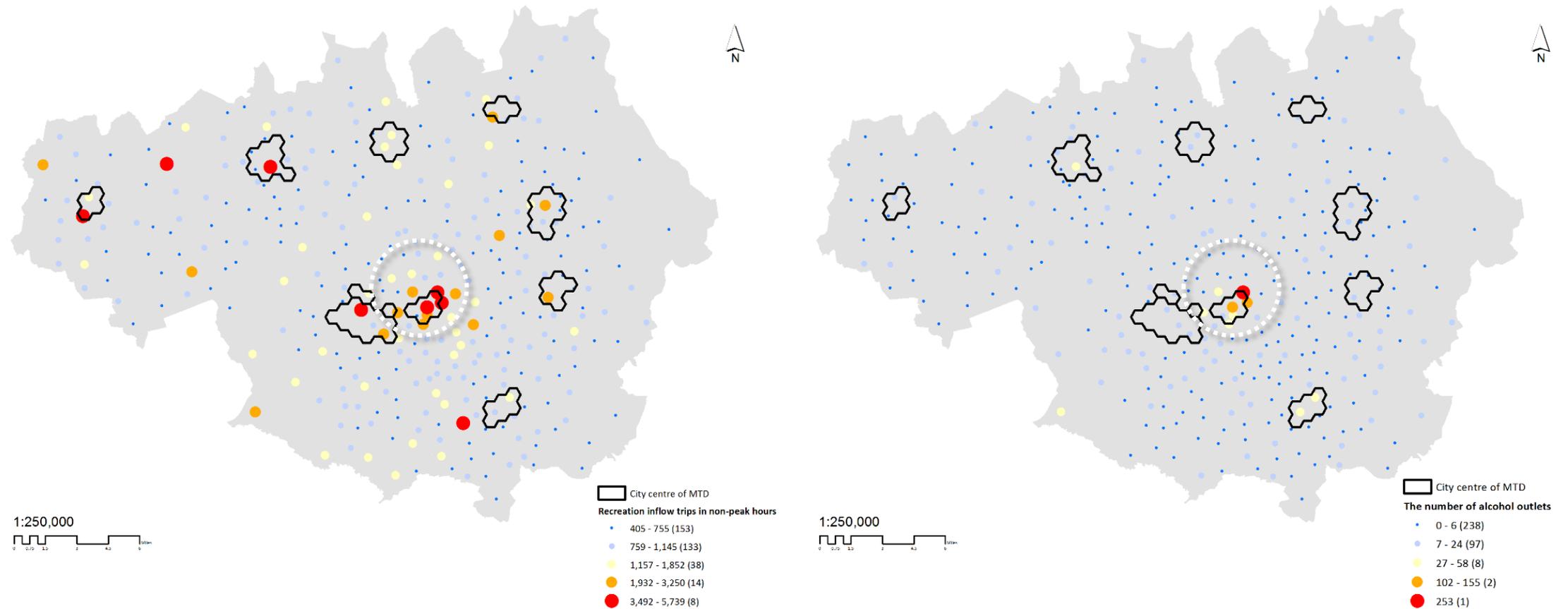
Data source: NTEM (National Trip End Model) datasets from TEMPro (The Trip End Model Presentation Program) v. 7.2 from Department for Transport

2. Time-dependent crime attractors / generators?

- Crime and the night-time economy in the UK.
- Are crime attractors / generators related to spatio-temporal crime hotspots?

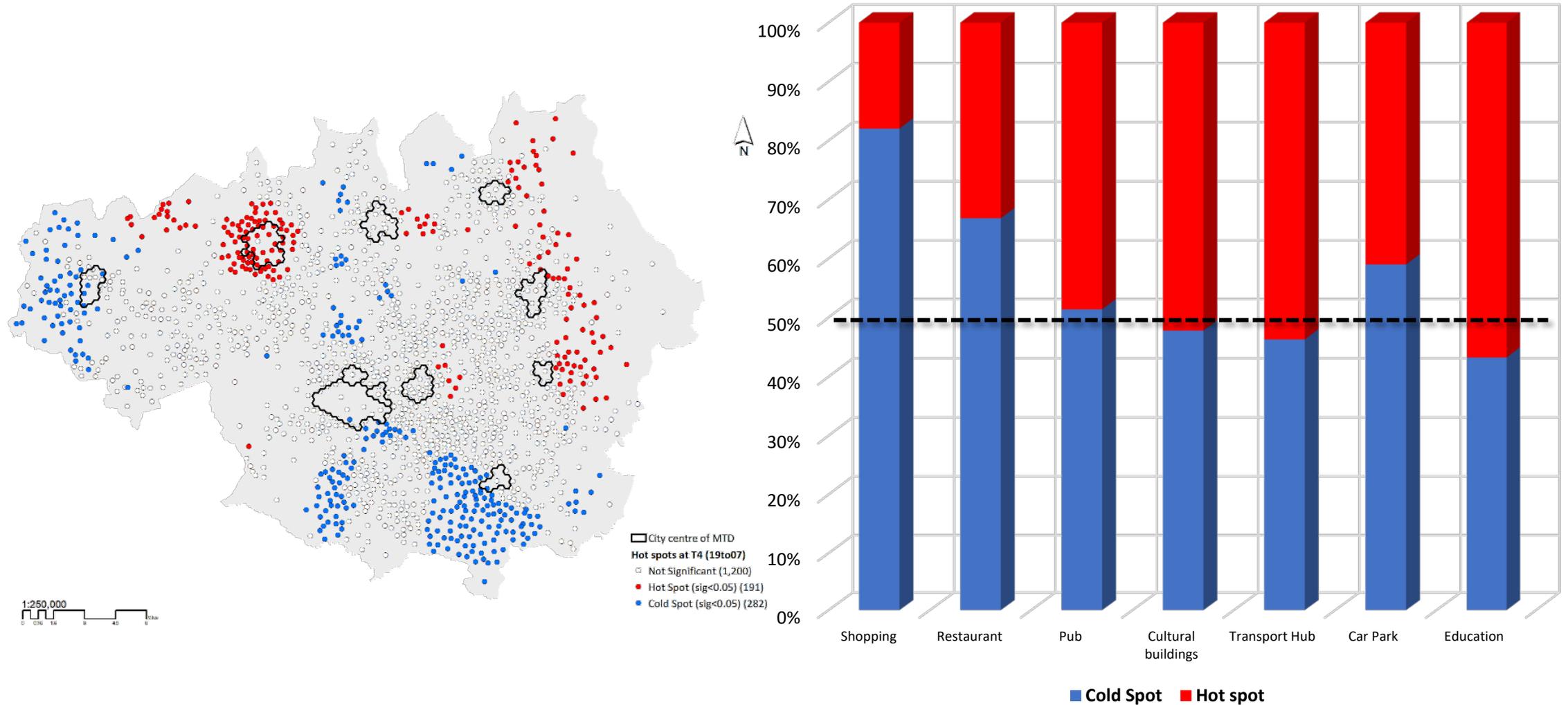


The spatial distribution of recreational visitor flows (at night time, L) and alcohol outlets (R)



Data source: (L) NTEM (National Trip End Model) datasets from TEMPro (The Trip End Model Presentation Program) v. 7.2 from Department for Transport, (R) POIs (Point of Interests) product from Ordnance Survey.

POI area composition (night time) by exposed population hotspot type



□ no significant associations with crime generators / attractors, WHY?

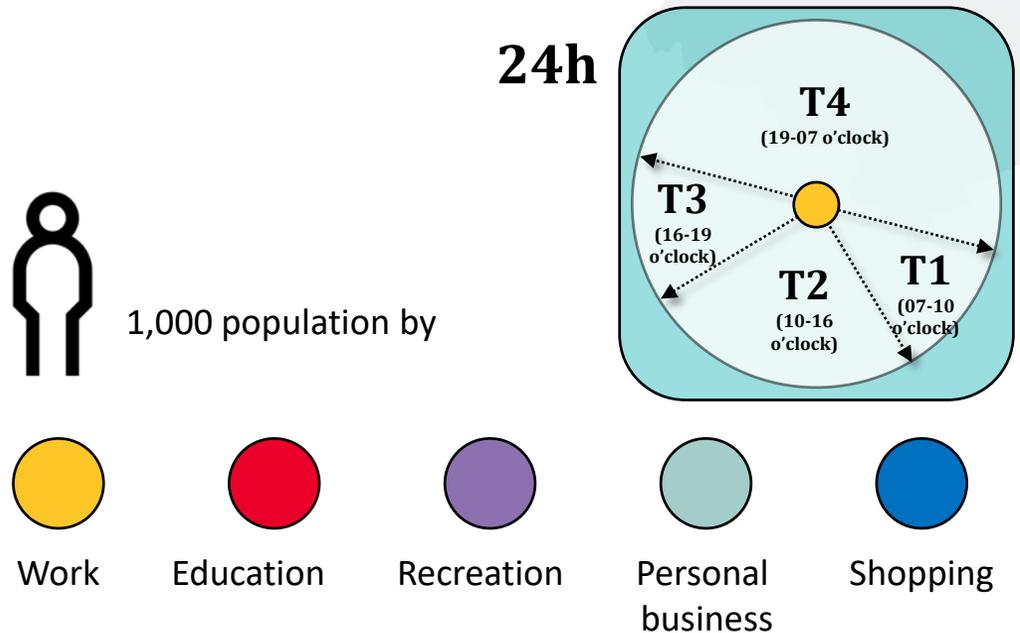
3. Investigating the crime and time dependent features link

- Boivin & Felson (2017) examined the crime counts related to visitor count / travel purpose.
- Malleson & Andresen (2016) indicated the physical characteristics of hotspots are distinct.
- Exploring the time-dependent influence of population flows, purpose and crime generators / attractors on the number of (violent) crimes in each time-bins using count-based modelling (negative binomial regression model).



The time-dependent exposed pop. with travel purpose

- H_0 : The number of crime counts in a given area will have **no influence** on the time-dependent features.
- H_A : The number of crime counts in a given area **will have a (positive or negative) influence** on the time-dependent features



Estimation results by each time-bins using NBM

Crime counts (DEP)		7-10 o'clock (T1)	10-16 o'clock (T2)	16-19 o'clock (T3)	19-07 o'clock (T4)
Constant		-0.618 ^{***}	0.705 ^{***}	0.402 ^{***}	1.927 ^{***}
Expose pop.	Work	0.001 ^{***}	-0.004 ^{***}	-0.006 ^{***}	0.002 ^{***}
	Education	0.002	-0.0004	0.008 ^{***}	0.124 ^{***}
	Shopping	-0.001	0.002 ^{***}	0.002 ^{***}	0.008 ^{***}
	Personal business	0.002 ^{**}	0.003 ^{***}	0.005 ^{***}	-0.008 ^{***}
	Recreation	-0.001	0.001 ^{**}	0.001 ^{***}	-0.0004
POIs	Shopping centre	-0.01	-0.007	0.01	0.001
	Restaurant	0.007	0.004	-0.012	-0.01
	Pub	-0.018	-0.002	0.027	-0.007
	Transport hub	0.002	-0.003	-0.0004	-0.006
	Car park	0.015	0.008	-0.005	-0.002
	Education	-0.013	-0.034 ^{**}	-0.015	-0.019
	Cultural building	0.029	0.009	0.007	0.035
Model criteria	Theta	2.098 ^{***} (0.307)	1.500 ^{***} (0.089)	1.516 ^{***} (0.101)	1.434 ^{***} (0.060)
	AIC	3648.509	6921.801	6175.904	10057.08

Note: ***p<0.01, **p<0.05.

Conclusion and discussion

- Findings
 - Routines activities: i) The travel purposes of the transient population vary throughout the day, ii) The volume of adjusted (recreational) population is temporally distinctive.
 - Physical environments: i) The concentration of crime generators / attractors hold limited to influence on crime events, ii) The functionality of POIs may not hold a linear relationship with crime across space.
- Response to research questions:
 - 1) Individual activity-travel patterns create dynamic exposure to crime risks.
 - 2) Physical environments 'may' influence (violent) crime patterning at night.
 - 3) Time-dependent features (positively or negatively) influence crime incidence.

Limitations and future research items

- We need more details of socio-demographic info. and finer granularity of visitors' travel purpose.
 - 1) This study indicated the interruptions from skewed distribution both of POIs and populations; to develop the separate model in terms of 'urbanity' level?
 - 2) The measurement of POIs are may reserve to investigate; %POI types are not an appropriate measure to distinguish the difference between spaces; concerning the saturation effects (on spatial scale) and seasonal effects (on temporal time frames)
 - 3) Measuring the (excess) risk, and implementation of microscopic location variables.



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