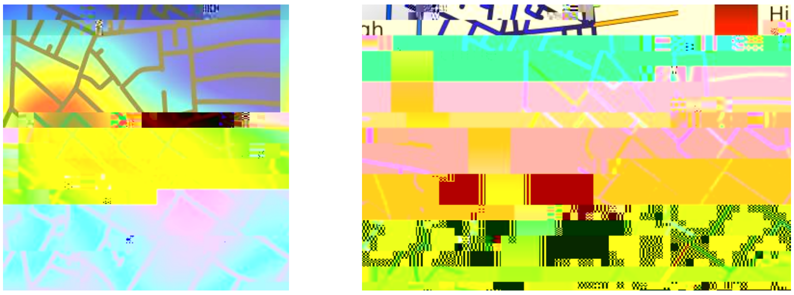
PURPOSE: Research shows that crime is more likely to occur at some places than others. One common aim of crime mapping is, therefore, hotspots occur. This may be achieved by identifying which areas (*e.g.* police beats) have the highest crime, or by using Kernel Density Estimation (KDE). A problem with these approaches, however, is that they ignore one of the main factors that influences where many types of crime can occur: the street network. In doing so, they do not allow the analyst to see if particular features of the street network affect crime risk, or to deploy resources to the precise locations at greatest risk (see Figure 1).

Figure 1 Comparison of KDE and street segment analysis: risk varies considerably from street to street (right panel), but this is lost in a KDE



risky streets can be identified analytically. In this Brief, we discuss one reason why risk may vary between streets, and how such effects can be tested. We also describe further analyses that may inform crime prevention and operational policing.

THEORY: *Crime pattern theory* (including those of offenders) influence crime risk. People develop routine activity spaces, and an awareness of them, as a result of travelling to and from the places they commonly frequent (*e.g.* home, work, and so on). For criminals, it is where their awareness spaces overlap with opportunities for crime that - according to the theory - they are most likely to offend. Consequently, in places where the awareness spaces of many offenders intersect with crime opportunities, crime hotspots will form.

The street network determines the routes that people can take between locations, and hence the places of which they become aware. Some routes (*e.g.* the shortest ones) will be more popular than others. Similarly, some street segments (sections of road between junctions) feature in routes more often than others: cul-de-sacs, for instance, are unlikely to feature in many. Since the level of use of a street reflects how often it features in offender awareness spaces, CPT suggests that more popular streets will experience more crime. Existing research supports this: the risk of burglary is highest on those streets most likely to feature in travel routes, and lowest on cul-de-sacs or private roads. Segment characteristics thus appear to provide a useful indication of the potential for crime.

Since neighbouring streets can be of significantly different character, patterns at this scale cannot be identified using traditional hotspot analysis approaches (*e.g.* KDE). Because of this, attempts at explanation and intervention may fail when these methods are used, and it is therefore necessary to consider approaches which account for street network effects. Put simply: since many crimes occur rime analysis focus on streets?

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APPLICATION: Analyses for one policing area on Merseyside (UK) examined how the risk of residential burglary varied for cul-de-sacs and other types of road.

GENERAL RESOURCES

SANET: http://sanet.csis.u-tokyo.ac.jp

GeoDaNet: https://geodacenter.asu.edu/software

ArcGIS network analyst

Urban Network Analysis: http://cityform.mit.edu/projects/urban-network-analysis.html

NetworkX package for Python: http://networkx.github.io/

DATA SOURCES

Ordnance Survey: http://www.ordnancesurvey.co.uk

OpenStreetMap: http://www.openstreetmap.org

A SELECTION OF ACADEMIC PAPERS AND BOOK CHAPTERS

Andresen, M. A., & Malleson, N. (2011). Testing the stability of crime patterns: Implications for theory and policy. *Journal of Research in Crime and Delinquency*, 48(1), 58-82.

Davies, T, & Johnson, S.D. (2014). Examining the Relationship Between Road Structure and Burglary Risk Via Quantitative Network Analysis. *Journal of Quantitative Criminology*, Advance online access.

Johnson, S. D., & Bowers, K. J. (2010). Permeability and burglary risk: are cul-de-sacs safer?. *Journal of Quantitative Criminology*, 26(1), 89-111.

Johnson, S.D., and Bowers, K.J. (2013). How guardianship dynamics may vary across the street network: A case study of Residential Burglary. In S. Ruiter, W. Bernasco, W Huisman and G. Bruinsma (Eds.)