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# A socio-spatial analysis of neighbour complaints using large-scale administrative data: The case in Brisbane, Australia

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ABSTRACT

Large-scale administrative data collected by municipal government are increasingly being used by researchers to better understand a host of urban phenomena and the way they are patterned over space and time. In this paper, council data are used to explore the incidence of complaints about neighbours across urban neighbourhoods using a GIS-based spatial approach. Through an exploratory and a confirmatory factor analysis of the spatially extracted neighbour complaints data, we identify four types of neighbour complaints – animal related; building construction; property management issues; and health and visual amenity issues – that categorise neighbour problems. GIS technologies are applied to map the spatial distribution of each complaint type across the 218 suburbs, resulting in distinct patterns of neighbour complaints in Brisbane suburbs. Our research demonstrates the utility of naturally occurring administrative data as a means of learning more about the social life of urban areas.

## 1. Introduction

The use of large-scale municipal government datasets to understand contemporary urban patterns and phenomena has been growing in recent years, with new insights emerging from these naturally-occurring records of everyday life in local neighbourhoods. In the field of urban governance, much of the pioneering work has emanated from the United States and Canada where researchers have taken advantage of open-access municipal government data in the form of 311 non-emergency calls for government services and information (see, for example, O'Brien, Gordon, & Baldwin, 2014; O'Brien, 2015; Minkoff, 2016). Through an analysis of the spatial and temporal patterning of these calls, political scientists, criminologists and urban scholars have generated new knowledge about the ecology of neighbourhood disorder in urban areas (O'Brien, Sampson, & Winship, 2015); neighbourhood conflict (Legewie & Schaeffer, 2016); the spatial distribution of government enforcement activities (Brazil, 2018) and everyday forms of political engagement in the form of citizen requests for city services (Lerman & Weaver, 2013; Levine & Gershenson, 2014). Beyond the United States, research opportunities afforded by city government datasets have progressed much more slowly due to access restrictions, although Solymosi, Bowers, and Fujiyama (2018) use similar data in the UK to explore subjective perceptions of neighbourhood disorder while Greenberg (2016) advocates Freedom of Information Requests as a means of securing such data when it is not publicly available.

To date, then, the types of urban phenomena that are opened up to scrutiny through these new methods remain limited. One such gap relates to the nature of social relationships in urban neighbourhoods and the way people live and interact as neighbours, including ways that neighbours function as a source of annoyance and conflict for one another. While existing research has used municipal government data to explore the *behaviours* of individual urban dwellers in perceiving and reporting problems identified in their neighbourhoods (Kontokosta, Hong, & Korsberg, 2017; O'Brien, 2016a; Solymosi et al., 2018) and/or the distribution of those problems as *social facts* of the city (O'Brien et al., 2015), the interactional dynamics of social life within and around the private sphere of home has not attracted much attention. Instead, researchers have resorted to the use of traditional survey instruments for eliciting patterns in neighbourly interactions (see for example, Farrell, Aubry, & Coulombe, 2004; Nieuwenhuis, Völker, & Flap, 2013) despite such methods being limited in capturing only general patterns of behaviour rather than actual everyday neighbour experiences and encounters (Solymosi et al., 2018). Part of the reason for this absence is that the data themselves are often limited to the provision of one address only – that of the reported problem. Until now, the only way researchers have been able to assess the presence of problematic

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neighbour relations is through the selection of calls that *indicate* conflict (such as noise, blocked driveways and the illegal use of buildings (Legewie & Schaeffer, 2016) and not via complaints made to local government by one neighbour explicitly about another.

This paper uses local government administrative data from the Compliance and Regulatory Services (CARS) division of the Brisbane City Council in Queensland, Australia to interrogate neighbour complaints as a previously unexplored but important aspect of urban social life, which, if unresolved, have the potential to undermine one's sense of home and community in ways that are not yet fully known. In doing so, we also demonstrate the utility of a GIS-based spatial data mining approach to extract neighbour complaints from the broad range of urban and compliance issues that urban governments deal with on a daily basis. Rather than relying on researcher conceptions of which types of problems *appear* to be neighbour related, the inclusion of addresses for both the offending neighbour and the complainant within the dataset has enabled the application of spatial procedures for isolating our core theoretical concept of neighbour complaint, which then allows us to further classify and analyse the spatial and temporal patterning of neighbour complaints across the city. With these goals in mind, the remainder of the paper is oriented around three questions pertaining to the social life of cities as understood through the phenomenon of neighbour complaints. These are as follows:

1) How can spatial technologies be employed to examine the problematic features of urban residential life as manifest through the naturally occurring incidence of neighbour complaints to a city council?
2) What kinds of issues elicit complaints from neighbours and to what extent are particular formations of neighbour complaint types experienced together, and why?
3) How are neighbour complaints spatially distributed across the city and over time, and how might we make sense of these patterns?

The following section provides an overview of current scholarship around the study of neighbour problems, and an exposition of the virtues, challenges and precedents of using administrative city government data to analyse the spatial and temporal patterns of urban phenomena. Data and the spatial analytical methods adopted are presented in Section 2, followed by the presentation of results. The results show that the kinds of neighbour annoyances that incite complaints tend to cluster into particular constellations of problems around animals; building construction; property management; and health and visual amenity and that these clustering effects can be explained through urban processes such as gentrification, urban consolidation (or densification), the suburbanization of disadvantage and residential instability. These same processes are clearly at work in the spatial distribution of these complaint types across the city over time, whereby certain neighbourhoods experiencing specific kinds of urban change process are exhibiting a distinct prevalence of one type of neighbour problem over another. These findings have clear relevance for local and State government planning activities in that they demonstrate the social consequences of deliberate or unintended policies that change the socio-economic and physical composition of residential neighbourhoods. While local government, in particular, is keen to find ways to better manage the large, and apparently increasing, volume of neighbour complaints that are generated in Brisbane and to encourage residents to manage problems informally rather than seeking the intervention of third party actors, the results suggest that managing the externalities of urban change and development policies, such as the provision of adequate parking, or appropriate noise attenuation in high-density dwellings, would be an equally useful strategy.

## 2. From surveys of self-reported neighbour annoyances to administrative records of neighbour complaints

Prior research suggests that problems between neighbours, ranging from low-level annoyances to anti-social or criminal activity, are a key feature of contemporary urban living and that their prevalence is influenced by neighbourhood conditions such as concentrated disadvantage and residential instability (Cheshire & Fitzgerald, 2015; Nieuwenhuis et al., 2013), as well as processes of urban change such as gentrification and rising residential density (Cheshire, Fitzgerald, & Liu, 2018). While much is known about the positive outcomes of good relations with neighbours (Farrell et al., 2004; Prezza, Amici, Roberti, & Tedeschi, 2001; Ross & Jang, 2000), the negative side of neighbouring has been overlooked in urban studies except in more specific instances of problem neighbours as 'anti-social' public housing tenants (Flint, 2004) or signs of physical and social disorder (Ross & Mirowsky, 1999; Taylor & Hale, 1986). In these latter studies, links have been established between the presence of troublesome or disorderly neighbours and a range of concerning outcomes, such as teenage delinquency (Sampson & Groves, 1989), decreased quality of life for residents (Chappell, Monk-Turner, & Payne, 2011), reduced levels of health and wellbeing (Fisher, Li, Michael, & Cleveland, 2004; Ross & Jang, 2000; Steptoe & Feldman, 2001) and reduced levels of neighbourhood cohesion (Ellaway, Macintyre, & Kearns, 2001).

However, embedding neighbour problems within the realm of anti-social or disorderly behaviour overlooks the fact that most neighbour problems are low-level, occur within the confines of domestic settings rather than public city spaces, and are a normal and everyday feature of otherwise harmonious neighbourly interactions. More recent scholarship acknowledges this and has sought to capture the prevalence of all types of neighbour problems through survey research that invites respondents to self-report on how annoyed or bothered they have been by some aspect of a neighbour's conduct. Such studies have shown that the nature and extent of neighbour problems are wide-ranging, with 18% (Nieuwenhuis et al., 2013) to 64% (Cheshire & Fitzgerald, 2015) of respondents reporting some kind of annoyance from a neighbour depending on how narrowly or broadly the term 'neighbour' is defined.[1] Aside from varying definitions, the difficulty of effectively measuring neighbour problems through self-report surveys is further compounded by the subjective nature of neighbour nuisances themselves and the range of factors that influence when an otherwise tolerable aspect of neighbourly life becomes a nuisance. For example, negative assessments of neighbour behaviour can be influenced by who the neighbour is (with young renters typically viewed as a problematic social category) (Baker, 2013) and what form the annoying behaviour takes (with noise caused by a baby crying regarded as less problematic than, say, noise from loud music or raised voices) (MORI, 2003; Stokoe, 2006).

Survey data has broader limitations too (see Connelly, Playford, Gayle, & Dibben, 2016). To begin with, there is the substantially poor reuse potential of data that has been designed with one particular study in mind and the lack of comparability across datasets as researchers measure slightly different phenomena and concepts. Further, there is the probability of sampling errors and bias, as well as the often small sample size, rendering attempts to make well-supported general inferences from the data difficult (Dale, 2006; Morgan & Wincop, 2007; Spielman, Folch, & Nagle, 2014). Even in studies that aim to address issues of sample size with greater data collection, there is often inadequate data to enable sound statistical analysis of potential subclasses of interest (Connelly et al., 2016), particularly with populations that are hard to reach and vulnerable. There are also the issues of high cost, low spatial resolution, and the potential of reporting bias due to

[1] The problem of subjectivity in what constitutes a neighbour echoes the modifiable areal unit problem (MAUP) that besets research of this kind. As Openshaw (1984) described, 'the areal units (zonal objects) used in many geographical studies are arbitrary, modifiable, and subject to the whims and fancies of whoever is doing, or did, the aggregating' (p3). When the geographical unit used in a spatial analysis changes, the statistical inferences and interpretations derived from the different geographical units are also different.

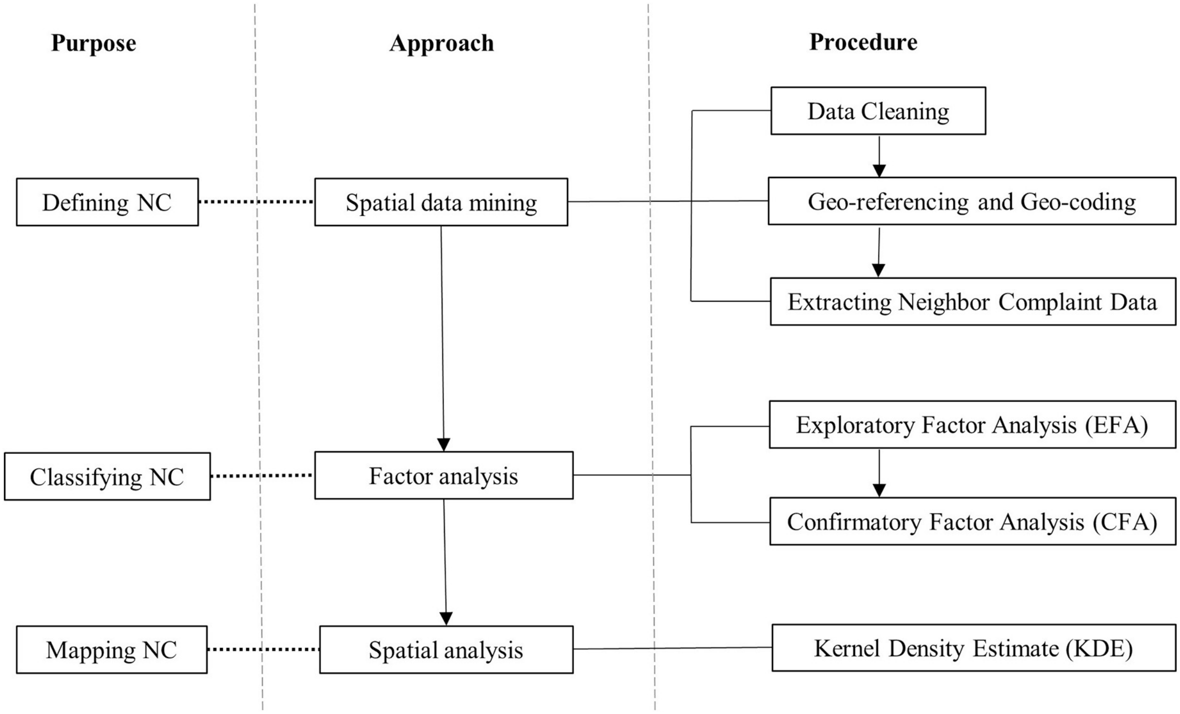



**Fig. 1.** Workflow and methods used to define, classify and map neighbour complaints.

participants' unwillingness to be forthcoming with researchers around sensitive matters (Goerge & Lee, 2002; Zhang, 2012).

To offset these limitations, so-called 'big data' from administrative sources has emerged as a new source of potential research data. Administrative data are acquired from the agency of administrative departments such as regional/national crime reports, rates of suicide and road assistance records (Duşa, Nelle, Stock, & Wagner, 2014) and are collected in the course of programmatic activities for the purposes of program operation, service provision, client-level tracking, or decision-making; all essentially non-research activities (Connelly et al., 2016). One of the benefits of assessing administrative rather than survey data is the distinct decrease in bias resulting from the unwillingness of participants to be candid about sensitive issues, which enables a far more reliable analysis of those issues (Goerge & Lee, 2002). Furthermore, with such a large data size, there is often significant support for the analysis of a range of minor subgroups within the data, especially considering the potential to capture the entire population of interest (Card, Chetty, Feldstein, & Saez, 2010; Lazer et al., 2009). Other supporting arguments for the use of large administrative data are their significant cost efficiency, very few issues with measurement error, and their high reusability among researchers in a variety of fields (Cukier & Mayer-Schoenberger, 2013; Legewie & Schaeffer, 2016; Zhang, 2012).

Nevertheless, certain intricacies come to light when these data are taken up for research purposes. From the outset, gaining access to such data is difficult – except in cases such as many of the 311 datasets where the data have been made publicly available – and there are considerable legal and ethical issues associated with accessing the personal information of individuals (Boyd & Crawford, 2012; Morozov, 2013). This is usually dealt with through the prior removal of identifying data or the establishment of strict confidentiality agreements imposed by the data owners. Further, administrative data are often generated primarily for reasons other than research, which means they are less well-curated than researcher-generated datasets (Connelly et al., 2016). As a result, the raw data can be noisy; the dataset may contain biased incidents; and it is not always immediately clear how the constructs and variables deployed in the dataset link to the social science theories and concepts of interest to the researcher (O'Brien et al., 2015). Hence, having data prepared for further analysis becomes a primary and major activity in the use of administrative data (Goerge & Lee, 2002). Through appropriate cleaning and pre-processing of the raw data, the benefits of using administrative data regularly outweigh the limitations, and it is clearly seen that they can address many of the issues with survey research discussed above.

By way of demonstration, the interrogation of city government administrative datasets has become a more frequent practice for urban researchers, particularly since the establishment of telephone or web-based customer relationship manager (CRM) hotlines for residents seeking municipal government information (such as technical or tax advice), or when requesting non-emergency government services (such as street light repairs, bulk refuse collection and street clearing). Various studies have examined the spatial patterning of these calls to uncover various novel aspects of city life. These include the propensity of different neighbourhoods to engage with governments through requests for city services (White & Trump, 2016) and the incidence of objective neighbourhood disorder (O'Brien, 2015; O'Brien et al., 2015) or neighbourhood conflict (Legewie & Schaeffer, 2016) net of 'contacting propensity' (Legewie & Schaeffer, 2016, 138) or 'civic response rates' (O'Brien et al., 2015, 113). Researchers remain aware of the limitations of CRM datasets, however, noting the absence of individual level demographic detail about the callers and the need to establish neighbourhood-level rather than individual-level correlations about the patterns observed (Levine & Gershenson, 2014; White & Trump, 2016). Additionally, high call volumes are not necessarily indicative of widespread problems or levels of civic engagement since it is not possible to determine the frequency with which any single resident makes contact, or whether the total volume of calls is inflated by the activities of a few frequent callers (Minkoff, 2016; White & Trump, 2016).

This paper adds to this growing body of research by demonstrating some of the additional affordances of city government administrative datasets for a new domain of urban social life not previously examined. It does this by moving away from survey data and its reliance upon post-hoc recollections of neighbours as subjectively bothersome towards the naturally-occurring phenomenon of neighbour *complaints* as reported to, and recorded by, a local government authority. Analysing complaints rather than perceived problems extends our understanding of conflict between neighbours in several ways. First, as Levine and Gershenson, (2014:615) have noted, administrative data captures 'the full census of actual behaviours' that surveys do not. Second, the concept of neighbour complaint is less slippery than neighbour problem in that it represents the incidence of one neighbour being sufficiently annoyed by another to initiate complaint to local government. Recording neighbour problems or disputes is more problematic since not all neighbour nuisances are brought to anyone's attention, often because they are a low-level or an acceptable, if bothersome, aspect of living in close proximity to others; because they do not breach any formal code; because complaining may disrupt otherwise harmonious neighbour relations; or because residents have little expectation that the problem will be rectified (Cheshire & Fitzgerald, 2015). Further, unreported neighbour nuisances or annoyances may do little to disrupt neighbourly life, whereas complaints have a tendency to escalate neighbour tensions and create disharmony. In effect, not only are complaints a clearly identifiable and measurable phenomenon for researchers to interrogate, but they are also indicative of the potential for rising neighbour tensions across the city.

## 3. Data and method

We developed an integrated approach using GIS technology to defining neighbour complaints from Brisbane City Council's CARS dataset; classifying them into problem types; and mapping them to discern their spatio-temporal distribution and patterns across the city. Fig. 1 illustrates the methodological approaches deployed in each stage of the process, which we outline in more detail below.

### 3.1. The Brisbane City Council CARS dataset

The CARS dataset of BCC contains records of complaints that residents lodge through the council's 24 h call centre; in writing; through an online portal; in person; or via social media, with all relevant complaints about potential breaches of local laws or requests for information about those laws being channelled to the CARS branch. All complainants are required to provide their name, address and telephone number (which are kept confidential), along with the date, time and source address of the nuisance issue. The advantage of the CARS dataset over existing publicly available datasets (such as 311) is that the provision of two sets of residential addresses (that of the complainant and of the problem) is compulsory for all callers and not limited to those who are registered users of the system (O'Brien, 2016a found around 55% of callers in Boston had provided a home address). Since 2007, CARS has maintained its own administrative record keeping system for responding to and tracking cases. A total of 427,215 records of request for information, along with reported problems and complaints, were received by CARS between 2007 and 2014 on a range of regulatory and compliance issues relating to animals, commercial premises, public spaces, residential dwellings and local neighbourhood nuisances. Only some of these issues are generated by neighbours, and not all occur in the neighbourhood in which the caller resides. Many are simply calls for service that are unrelated to neighbour issues or are reports of public issues such as health hazards or disputed parking fines that arise outside the immediate vicinity of one's local neighbourhood.

The CARS dataset was made available to the research team under a signed confidentiality agreement following extensive negotiations given the sensitive nature of the dataset in identifying who had lodged a complaint about who. While names and telephone numbers were removed from the dataset, addresses were essential for the extraction and analysis of specifically *neighbour* complaints, as we discuss below. Each record thus contains information such as the date of complaint; the nature and type of complaint; a detailed description of the case; the street address and suburb of the complainant; the street address and suburb of the nuisance issue; and reason for closing the case.

### 3.2. A spatial data mining approach to identify neighbour complaints

As briefly outlined earlier, our immediate challenge with the CARS dataset is that our theoretical construct of interest – neighbour complaints – did not match the organizational categories used by CARS for record keeping. While a considerable volume of CARS cases were neighbour complaints, they were not immediately discernible within the dataset, and a first step was to establish a means of identifying and extracting neighbour complaints from the other complaint types. Instead of viewing neighbours as co-residents of a local neighbourhood, only some of whom are known to each other, we adopt the long established and straightforward definition of neighbours based on close physical proximity: those who live next door, up the street, across the road or over the fence (Bulmer, 1986). To extract data on neighbour complaints, we began by removing records where the address of the complaint was missing or where the two addresses were identical (that is, requests for services that did not involve other parties, or complaints about issues occurring outside the caller's home but not perpetrated by a neighbour). These excluded records comprised 31.8% of the original dataset. A further 9208 records (2.2%) were also removed because they were clearly not neighbour issues, such as complaints about commercial establishments or public spaces.

Three other datasets were used to geo-reference the CARS data. The first is the Geocoded National Address File (G-NAF), a trusted index of Australian address information which contains the street addresses and geographical coordinates of all properties in Australia. Publicly available under the Australian government open data policy, the dataset contains nearly 14 million addresses, updated on a quarterly basis. The second is the Digital Cadastral Database (DCDB) from the Queensland Department of Natural Resources, Mines and Energy, which contains property boundaries of all private and public owned land parcels in Queensland. We also used the Australian Census of Population and Housing for the 2006, 2011 and 2016 census points from which the number of household data were used as a control factor for analysing the distribution of neighbour complaints. Using the G-NAF database we were able to match and geocode the addresses of the complainant and the object of complaint for 211,000 records (or 49.4% of the original dataset). The remaining 16.6% of records which could not be geocoded due to a typing or other error in the addresses were excluded from further analysis.

We generated a set of line data by collecting each pair of complaint and complainant addresses in GIS, and selected records where the distance between the two addresses is within 100 m. We used 100 m as benchmark to define neighbouring properties as those that are adjacent, as well as those located across the street, around the corner or down the road. To account for the presence of properties on larger blocks > 100 m apart, we overlaid the geocoded point data of the complainant and the complaint addresses to the DCDB and selected properties where the complainant and the complaint addresses were adjacent and shared a common property boundary. This process resulted in a total of 111,228 valid neighbour complaint records for the eight-year duration. The average physical distance between the complaint and complainant addresses is 38 m, with a maximum of 554 m and a standard deviation of 29 m. This dataset was then referred to as the final neighbour complaint (NC) records and used for further analysis (Fig. 2).

Having isolated neighbour complaints from all other issues that residents bring to council for attention, our next step was to examine broad patterns in the incidence of complaints over time. This is an important question since anecdotal and media accounts suggests a breakdown of neighbour relations in late modern society, as reflected in rising neighbour disputes and an increased volume of complaints to councils and other third party agencies. Academic literature provides compelling reasons for why this might be, suggesting that macro-level social forces of mobility and globalization are eroding the significance

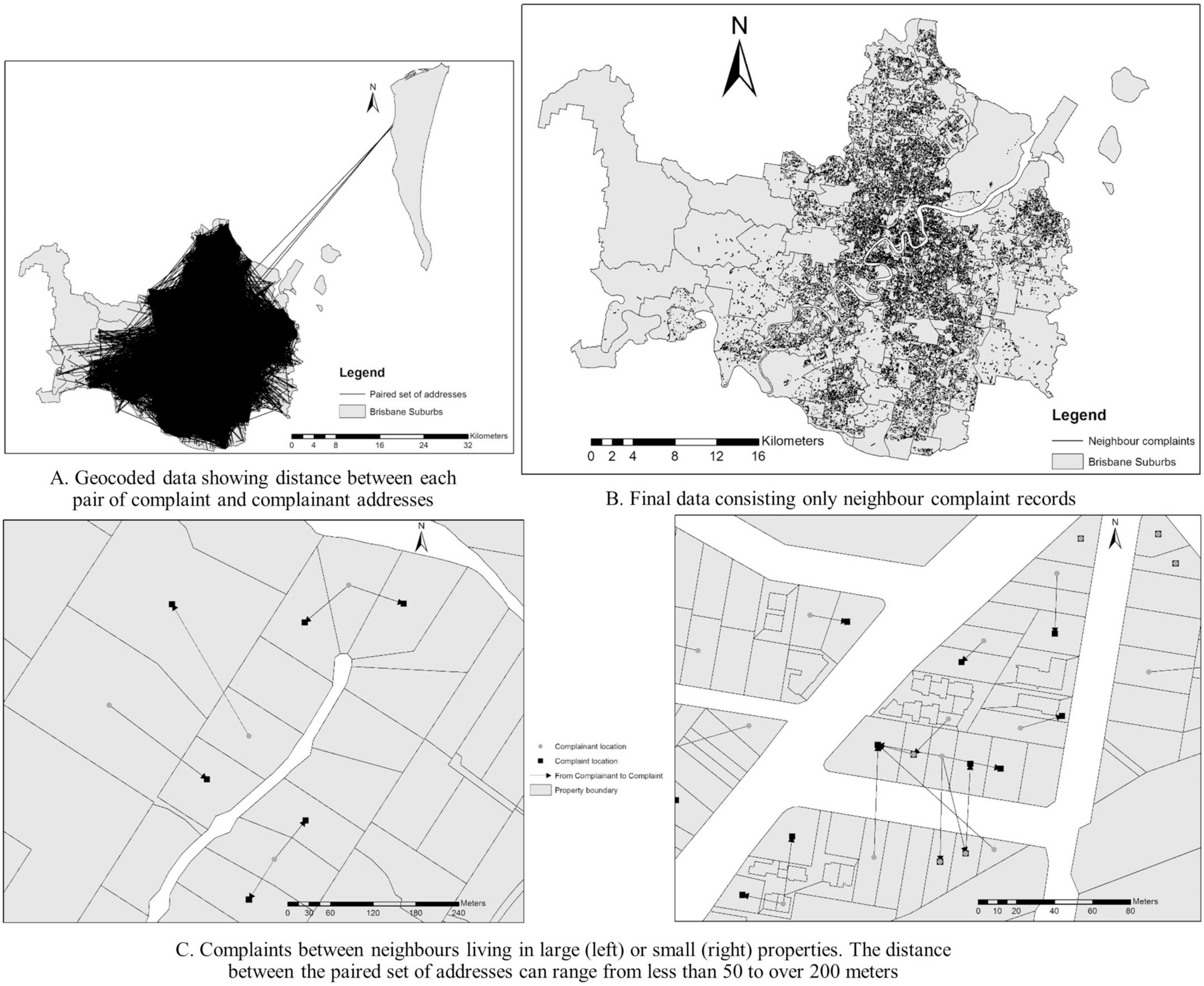



**Fig. 2.** Identification of neighbour complaints using both Euclidian distance and 'Polygon Neighbours' tool in ArcGIS.

**Table 1**
Number of neighbour complaints by year and by estimated number of households.

| | Number of households[a] | Number of NC | NC normalized by per 1000 households |
|---|---|---|---|
| 2007 | 358,547 | 13,305 | 37 |
| 2008 | 364,105 | 13,846 | 38 |
| 2009 | 369,662 | 13,556 | 37 |
| 2010 | 375,220 | 13,566 | 36 |
| 2011 | 380,777 | 12,156 | 32 |
| 2012 | 385,453 | 10,737 | 28 |
| 2013 | 390,129 | 11,172 | 29 |
| 2014 | 394,805 | 22,887 | 58 |

[a] The number of households for each year (except for 2011) were estimated through a linear interpolation from the nearest two censuses (2006 and 2016); data in 2011 was extracted from the census.

of local social ties, turning neighbours into mere strangers who lack the social bases to resolve problems informally (Cockayne, 2012; Dunkelman, 2014; Putnam, 2000). Yet, to date, there have been limited data available to test these propositions empirically. As a first step, the CARS data enables us to do this while controlling for population change.

We did this by collecting ABS housing and population data in 2006, 2011 and 2016 and interpolated the number of households for other years (see Table 1). The number of households in these three census years were 352,990, 380,777 and 404,157, respectively, representing an increase of 7.87% from 2006 to 2011 and 6.14% from 2011 to 2016. Based on the sheer count of neighbour complaints and the count normalized by the number of households, we were able to observe the change of neighbour complaints over time.

### *3.3. Using factor analysis to identify the types of issues that elicit neighbour complaints*

The resulting set of records of neighbour complaints extracted through the spatial data mining approach were originally coded by CARS into 17 broad categories in the 'Nature' field (such as air/odor pollution), and 108 sub-categories in the 'Type' field (which, under air/odor pollution would include asbestos, backyard burning, chemical smell, dust, odor, overspray/particulates, and smoke). While the scheme used to categorize complaints held meaning for CARS by directing complaint types to the relevant work unit, it was unsuited for our purposes. For example, some problem types relating to animals were classified by CARS into a range of Nature categories (e.g. animal noise was classified under the noise category whereas animal attacks

**Table 2**
Counts of complaint case types that reflect latent factors, including the factor loadings from the Exploratory Factor Analysis.

| Case type | Count | Factor Loading | Case type | Count | Factor loading |
|---|---|---|---|---|---|
| Factor 1: animal related issues | | | Factor 3: property management related issues | | |
| Dog | 8745 | 1.00 | Parking | 13,659 | 0.80 |
| Other animal | 2439 | 0.90 | Waste management/water conservation | 4287 | 0.76 |
| Animal attack | 1293 | 0.88 | Road/footpath hazard | 4257 | 0.55 |
| Animal noise | 22,937 | 0.82 | Light glare at residential premises | 231 | 0.49 |
| Backyard burning and smoke | 1074 | 0.59 | Plumbing complaint | 1395 | 0.47 |
| Animal lost and found | 2505 | 0.56 | Vegetation other[b] | 3706 | 0.42 |
| Permit advice | 3545 | 0.51 | Airborne pollution[d] | 1232 | – |
| Factor 2: building construction related issues | | | Factor 4: health and visual amenity related issues | | |
| Soil and water pollution | 1114 | 0.75 | Visual amenity | 3981 | 0.83 |
| General development compliance[a] | 3032 | 0.73 | Overcrowding[c] | 267 | 0.72 |
| Builder's noise[a] | 2773 | 0.70 | Unsightly vegetation | 8753 | 0.67 |
| Unlawful and unsafe structure | 3746 | 0.69 | Home business | 1302 | 0.47 |
| Storm/water drainage[a] | 4988 | 0.64 | Insect, vermin, fire safety | 2898 | 0.38 |
| Fences/walls[a] | 828 | 0.64 | dangerous/hazardous materials[c] | | |
| Technical advice[b] | 2734 | 0.56 | | | |
| Other noise | 2124 | 0.55 | | | |
| Swimming pool[b] | 968 | 0.40 | | | |
| Asbestos[d] | 415 | – | | | |

Note: For factor analysis, n = 182 suburbs. A Maximum Likelihood Estimation was used with a Promax rotation.
[a] Items loaded on both Factor 2 and Factor 3. It was maintained on the factor with highest loading at > 0.2 gap.
[b] Items loaded on both Factor 2 and Factor 3. It was maintained on the factor with highest loading at < 0.2 gap.
[c] Items loaded on both Factor 3 and Factor 4. It was maintained on the factor with highest loading at > 0.2 gap.
[d] Items did not load on initial factor analysis but were added on the basis of content similar to factor or one or more of its constituent items.

were characterized as animal problems). This required some re-coding so that similar complaints were brought together into a single category, which resulted in 29 broad categories (see Table 2). This manual process was then followed with a factor analysis of the 29 types of complaints in order to discern any interrelationships between different complaint types that were not immediately discernible, and to identify a few latent constructs that these complaint types reflect.

Factor analysis is a method used to provide a relatively small number of latent factors as satisfactory substitutes for a much larger number of variables. We first conducted an exploratory factor analysis (EFA) using principle axis factoring and Promax rotation methods to determine the main factors involved in neighbour complaints (Costello & Osborne, 2005). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was used to assess the proportion of variance in the types that might be caused by the underlying factor construct. All complaint types were kept to preserve the integrity of the data in the model. We determined the number of factors based on the eigenvalue and scree plot. A best fit factor structure was obtained when all factor loadings are larger than 0.3 and fewer cross loadings exist on the pattern matrix. Cross-loading items with a gap value larger than 0.2 were assigned to a factor with the highest factor loading. This is in line with the fact that one complaint type may be associated with more than one factor due to different casual mechanisms.

Second, we verified the factor structure of neighbour complaints extracted from the EFA using structure equation modelling (SEM). We evaluated the Root Mean Squared Error of Approximation (RMSEA), the Standardized Root Mean Squared Residual (SRMSR), and the Comparative Fit Index (CFI) as indicators of model fit. In the case of CFI, any value larger than 0.85 indicates an acceptable model fit while for RMSEA and SRMSR, the desirable values are 0.06 and 0.09 or less, respectively (Marsh, Balla, & McDonald, 1988). All analyses were conducted using SPSS and AMOS version 24.

### 3.4. Measuring the spatial distribution of neighbour complaints across city areas

In order to measure the density of complaint events across neighbourhoods, we used a kernel density estimate (KDE) for each of the latent factors derived from the factor analysis. A kernel density is the density of features within a given radius (or bandwidth) based on a kernel function (Gray & Moore, 2003). In this study, we adopted the kernel density function tool in ArcGIS 10.6 which is built using the quartic kernel function described in Silverman (1986:76).

A focal point for KDE is the selection of the bandwidth (Raykar & Duraiswami, 2006). We started with the default bandwidth set by the tool's default calculation using a spatial variant of *Silverman's Rule of Thumb* (Silverman, 1986). This method has the advantage in handling spatial data outliers (that is, points that are far away from the rest of the points) (Silverman, 1986), and is commonly used in spatial econometrics to identify optimal search radius at the scale of neighbourhood, block and street (Porta et al., 2009).

We also tested the robustness of the KDE to bandwidth by increasing or decreasing the default bandwidth by 10% each time until the value reaches up to 30% higher or lower than the default bandwidth, resulting in seven different bandwidths. We then used ArcGIS to generate a KDE for all complaint data points to check the sensitivity of the KDE to bandwidth and identify the most suitable bandwidth for use to produce density estimate of neighbour complaint cases by factors and by year. A gradient colour scheme using Jenks natural breaks classification method was applied thereafter to produce each map to enhance the discrimination between relative high and low density values, with blue coloured areas representing a lower number of neighbour complaints per square kilometre, yellow to orange coloured areas indicating a moderate density of neighbour complaints, and the red coloured areas indicating neighbourhoods with the highest density of complaints, or complaint 'hot spots'.

## 4. Results: the prevalence of neighbour complaints and their spatio-temporal patterning across the city

In our first stage of analysis, we examined the prevalence of neighbour complaints in Brisbane from 2007 to 2014. The results show that while the number of households in Brisbane as a whole has increased, the number of neighbour complaints per 1000 households actually decreased between 2007 and 2013. An exception was in 2014 when a substantially higher number of neighbour complaints was observed (i.e., 58 complaints per 1000 households in 2014 compared to 28 to 38 complaints in the earlier years). The rise in reported neighbour complaints was not something the CARS team was aware of prior to the data being extracted through the spatial data mining approach. When asked about this unexpected increase, they indicated that it was both feasible and in line with their perceptions that neighbour complaints were beginning to occur more frequently, and that no change in their reporting or recording practices had occurred in that year which might otherwise account for the exponential rise. What it does indicate, however, is the need for ongoing analysis of subsequent years of data as they become available.

### *4.1. Latent factors eliciting complaints from neighbours and their change over time*

We turn now to the results of the second research question which explores the kinds of issues that elicit complaints from neighbours and the way complaints appear to cluster together in a particular constellation of problems. With the exploratory factor analysis on the 29 complaint types, the KMO measure of sampling adequacy is 0.92, which is higher than the recommended index of 0.60, indicating that the sample size is sufficient for further analysis. The exploratory factor analysis resulted in a four-factor solution, which accounts for 67% of the variance. The first factor (*animal related complaints*) brings together all kinds of complaints related to domestic pets. It is mainly driven by complaints about noisy animals, but dogs are a particular source of complaint, followed by other animal complaints, animal attacks and animal lost/found. It also includes permit advice and backyard burning/smoke, which, while evidently not animal related, nevertheless fit better with Factor 1 complaints than with those in the other three. The animal related complaints factor has an eigenvalue greater than five and explains 37% of the variance.

The second factor includes soil/water pollution, general development compliance, builder's noise, unlawful/unsafe structures, storm/water drainage, fences/walls, technical advice, other noise, swimming pool and asbestos. These items typically relate to the construction, maintenance and safety of residential structures, such as noise and other concerns about new building developments, but also complaints and disputes around fences and retaining walls where damage can be caused by water run-off or poor drainage, or where there is disagreement over responsibility for, or cost of, repairs. These items are collectively labelled *building construction* related complaints, which demonstrates an eigenvalue of 2.8 and explains 11% of the variance.

The third factor is best described as *property management* related issues and includes parking, waste management/water conservation, road/footpath hazard, light glare at residential premises, plumbing, other vegetation related complaints and airborne pollution. Where Factor 2 complaints are induced by buildings and other structures, we saw Factor 3 complaints as being generated by the *use* of residential spaces, such that where a neighbour parks a car (in the street rather than a driveway or garage); or whether the neighbour adheres to rules about the use of domestic water for garden sprinklers; or fails to remedy hazardous vegetation, becomes a matter of complaint by another. This factor has an eigenvalue of 3.1 and explain 12% of the variance.

The last factor is *health and visual amenity* related complaints and contains five observed items (visual amenity, overcrowding, unsightly vegetation, home business, insect/vermin/fire safety issues and dangerous/hazardous materials). Almost three quarters of these complaints are triggered by visual amenity issues which relate to the unsightly nature of vegetation or a view that has been spoilt or blocked (such as by a new building, the planting or removal of trees, unkempt gardens, or some other form of unsightly feature), rather than by concerns about health hazards. This set of complaints has an eigenvalue of 1.5 accounting for 7% of the variance. Table 2 lists the number of counts for each complaint item and their factor loading from EFA. The correlation between factors varies from 0.393 to 0.652.

Table 2 also shows that some complaint items, such as general development complaints, builder's noise, and storm/water drainage are cross loaded on both factors of property maintenance related complaints and building construction-related complaints. This resulted in a relatively strong correlation (r = 0.652) between the two factors. We chose to introduce a second-order factoring structure between building construction and property maintenance related complaint factors, and applied a second-order CFA via structure equation modelling to test the hypothesized model (Fig. 3).

A further step in assessing the model fit is to assess its reliability and validity, estimated using Cronbach's alpha, which was calculated globally for all items and for each of the latent factors. Animal related and health/visual amenities related factors were the most homogeneous with alpha values of 0.83 and 0.84, respectively. The factors of building construction and property maintenance related complaints were less homogeneous, with alpha values of 0.79 and 0.78, respectively, and an alpha value of 0.66 for the two factors combined. As such, we choose to remain the four-factor construct of neighbour complaints. For the global score, the alpha was 0.86.

While the overall count of neighbour complaints across the seven years from 2007 to 2014 gave an indication of very broad trends in the prevalence of neighbour complaints over time, it is more fruitful to examine specific trends in the nature and type of neighbour problems reported. Following the four-factor construct of neighbour complaints from the EFA and CFA, we thus summarized the number of neighbour complaints by factor for each year from 2007 to 2014 (Table 3), together with the highest number of complaints by suburb across all Brisbane suburbs. Data shown in brackets on Table 3 are normalized by per 1000 households of the city or suburb. Apart from the substantially higher number of complaints under all factors in 2014, the number of complaints in other years appears to be relatively stable. Animal-related complaints (Factor 1) are the most common source of complaint across the city, and have remained consistently so, followed by property management related complaints (Factor 3) and then building construction-type complaints (Factor 2). Health and visual amenity related neighbour complaints (Factor 4) are the smallest in scale across all years.

### *4.2. The spatial clustering of neighbour complaints*

One of the key features of the CARS dataset is the ability to spatially map the incidence of problem types, and track them over time, using the address of the complainant and object of complaint. The resulting outcomes are presented in Fig. 4 which reflects the spatial distribution and density of each of the four categories of neighbour complaint types and illustrates city areas where the density of neighbour complaints is high (red); moderately high (yellow/orange) and low (blue). All factors demonstrate a clear set of spatial trends in Brisbane City, with complaints occurring most frequently in the inner city areas, apart from animal-related complaints and health and visual amenity complaints, which also extend away from the city centre towards the outer-suburbs in the north and south, respectively. On account of the strong correlation between construction-related complaints and property management complaints identified in the factor analysis, these two factors exhibit similar density distribution patterns by clustering mainly around the inner and middle suburbs of the city.

Using the kernel density estimate, the optimal bandwidth generated from the default setting of the KDE tool in ArcGIS was 248.2 m, which we approximated to 250 m. Thereafter, we tested seven different bandwidths at 175 m, 200 m, 225 m, 250 m, 275 m, 300 m and 325 m, which are within the range of ± 10 − 30% from the default bandwidth. Table 4 list some key statistical measures generated from the KDE using different bandwidth for all complaint point data.

Table 4 shows that larger bandwidth tends to produce more smoothed KDE with lower extreme value (i.e., maximum number of complaints per $km^2$) and standard deviation (SD), while smaller bandwidth tends to produce larger variation in KDE with higher extreme and SD. Considering that the standard land lot in Australian neighbourhood is about 600–650 $m^2$(or about 25 by 25 $m^2$), the default bandwidth of 250 m closely resembles a neighbourhood block with

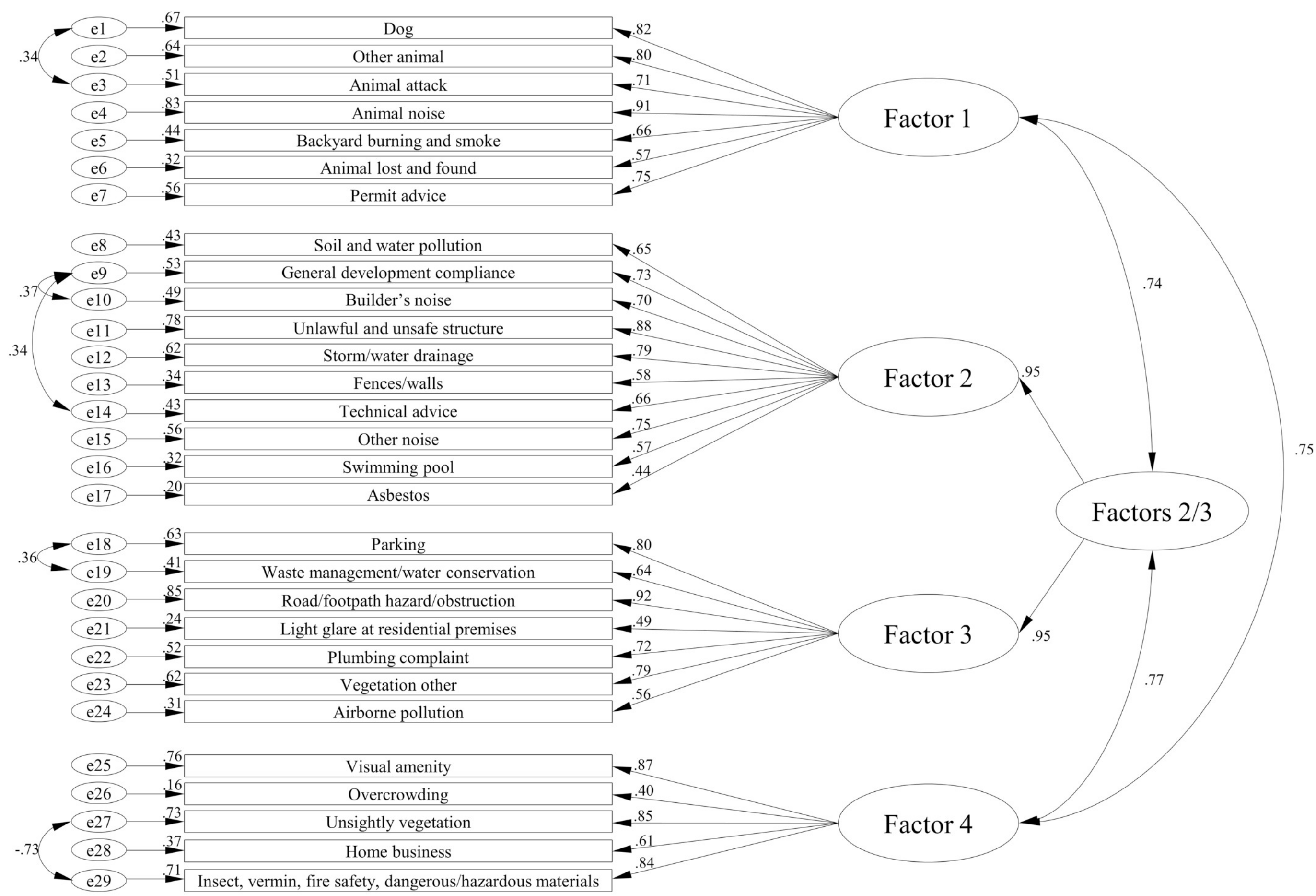



**Fig. 3.** Estimated relationships between neighbour complaint factors with standardized parameters from best-fitting second-order confirmatory factor analysis, with RMSEA = 0.078; CFI = 0.883, SRMS = 0.082, n = 182 suburbs. All parameters significant at $p < 0.001$.

**Table 3**
Summary of neighbour complaints by factors and by year.

| | Factor 1 | | Factor 2 | | Factor 3 | | Factor 4 | | Overall | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Highest | Total | Highest | Total | Highest | Total | Highest | Total | Highest |
| 2007 | 5788 | 191 | 1993 | 45 | 3929 | 94 | 1595 | 38 | 13,305 | 294 |
| | (14) | (85) | (5) | (20) | (10) | (42) | (4) | (17) | (32) | (130) |
| 2008 | 5523 | 154 | 2444 | 59 | 3385 | 65 | 2494 | 58 | 13,846 | 240 |
| | (13) | (67) | (6) | (26) | (8) | (28) | (6) | (25) | (33) | (105) |
| 2009 | 5405 | 160 | 2585 | 72 | 3220 | 59 | 2346 | 51 | 13,556 | 258 |
| | (13) | (69) | (6) | (31) | (8) | (26) | (6) | (22) | (32) | (112) |
| 2010 | 4797 | 126 | 2703 | 53 | 3345 | 86 | 2721 | 66 | 13,566 | 228 |
| | (11) | (54) | (6) | (23) | (8) | (37) | (6) | (28) | (32) | (98) |
| 2011 | 4264 | 122 | 2696 | 63 | 2997 | 79 | 2199 | 54 | 12,156 | 209 |
| | (10) | (52) | (6) | (27) | (7) | (34) | (5) | (23) | (28) | (89) |
| 2012 | 4198 | 94 | 2091 | 42 | 2535 | 62 | 1913 | 63 | 10,737 | 186 |
| | (10) | (42) | (5) | (19) | (6) | (28) | (5) | (28) | (26) | (83) |
| 2013 | 4417 | 135 | 2208 | 49 | 2913 | 79 | 1634 | 45 | 11,172 | 221 |
| | (11) | (64) | (6) | (23) | (8) | (37) | (4) | (21) | (29) | (104) |
| 2014 | 10,268 | 735 | 3878 | 88 | 6442 | 130 | 2299 | 54 | 22,887 | 889 |
| | (28) | (366) | (11) | (44) | (18) | (65) | (6) | (27) | (62) | (443) |

Notes
The number normalized by per 1000 households is shown in the bracket underneath.
Total: the total number of NC for a certain factor type in Brisbane.
Highest: the highest number of NC for a certain factor type in a particular suburb in Brisbane.
Factor 1: Animal related complaints.
Factor 2: Building construction related complaints.
Factor 3: Property management related complaints.
Factor 4: Health and visual amenity related complaints.
Overall: All types of neighbour complaints.

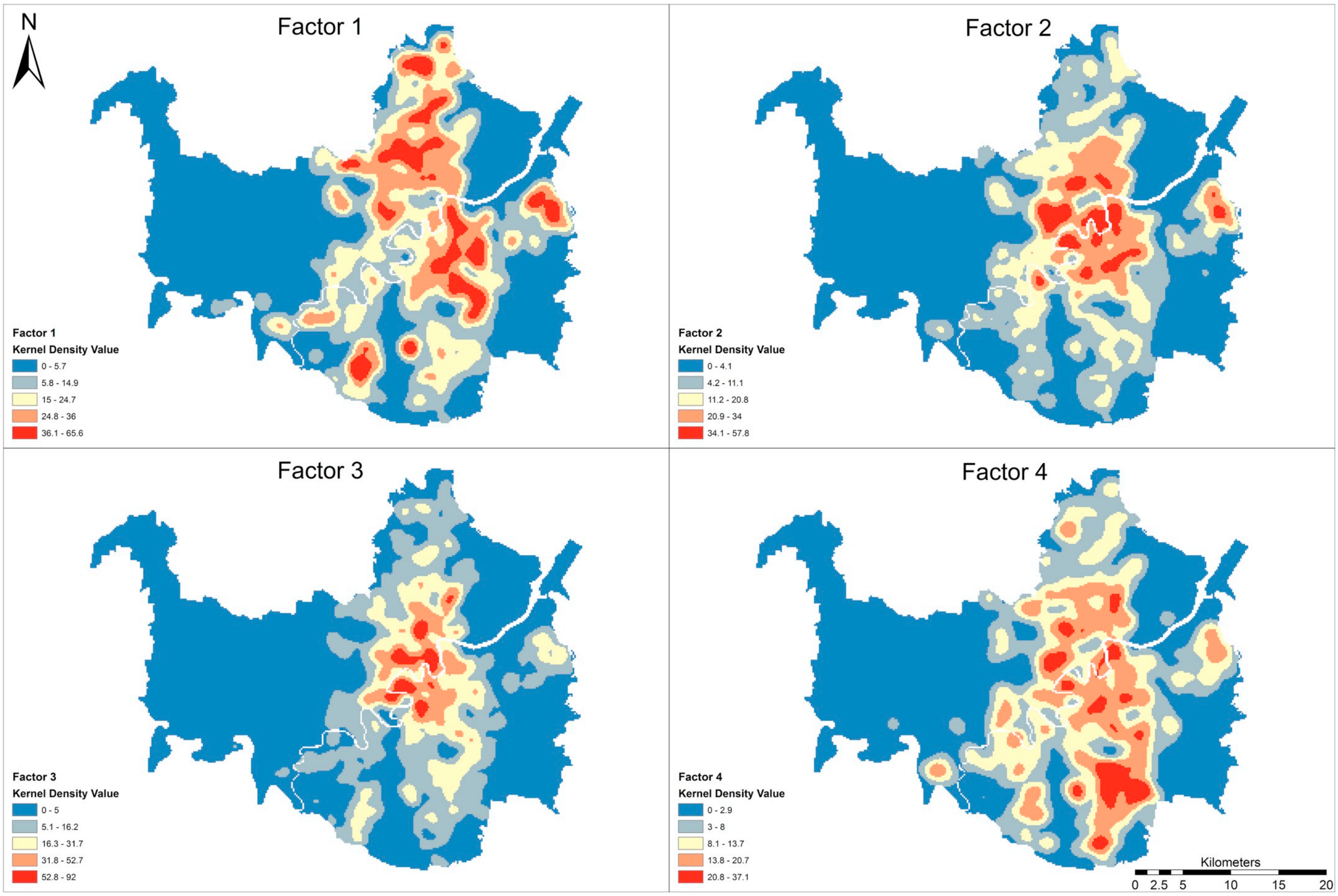



**Fig. 4.** Kernel density estimation of neighbour complaints in Brisbane City from 2007 to 2014 by factors.

around 100 households, which is considered suitable in the context of our study on neighbouring relationship.

To examine the change of spatial distributions of each type of neighbour complaints, we created a series of KDE maps (Fig. 5) and compared them with the eight-year overall neighbour complaint patterns (Fig. 4). Except for some potential data variation in 2014 (reflecting the anomaly of the 2014 data that we identified earlier), the spatial patterns in the remaining years remain largely consistent. The spatial distribution of animal-related complaints, for example, does not change substantially over time, although the maps indicate an increase in the density or frequency of complaints, which appears to culminate in a high volume of animal complaints in suburbs around the city in 2012 (Fig. 5A). In contrast, building construction-related complaints (Fig. 5B) are contracting towards the inner city areas over time, but they are also reducing in density. Similar to Factor 2 complaints (with which they are highly correlated), the spatial distribution of property management complaints (Fig. 5C) is also highly concentrated around the inner city areas. However, unlike Factor 2 complaints, Factor 3 complaints have more variation in density over time, commencing with relatively high density in those areas in 2007 followed by a relatively stable period of reduced density from 2008 to 2013. In 2014, the distribution and density of property management complaints contracts further, such that the only hot spot of intense complaints to arise is a small pocket of the central city area.

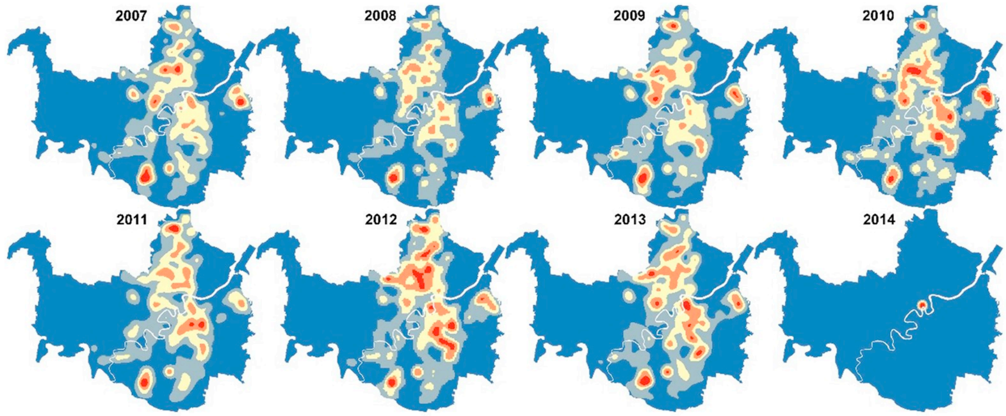
Finally, the spatial pattern of the health and visual amenity complaints is similar to that of Factor 1 complaints in that they are distributed more widely across the city than the other two types of complaints. As Fig. 5D illustrates, this spatial pattern of dispersion is relatively consistent over time, although its density appears to be increasing in all parts of the city, but especially those suburbs located in the middle and outer suburban ring.

## 5. Discussion: understanding the dynamics of neighbour complaints

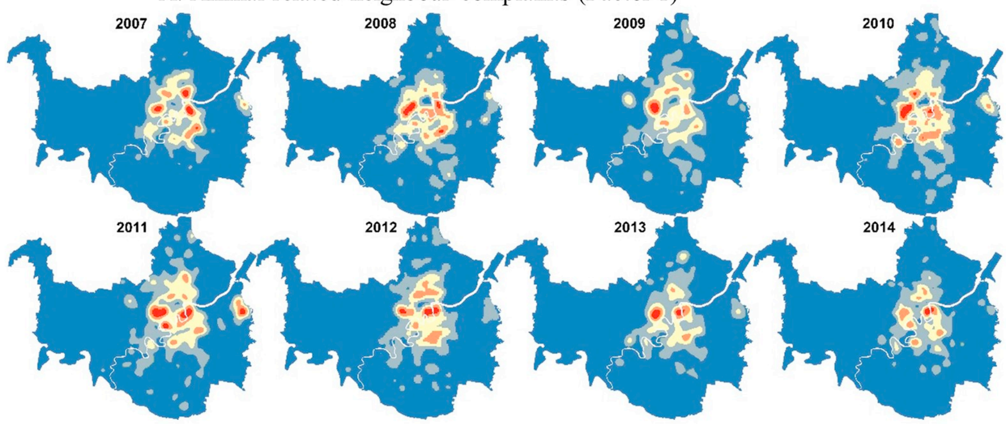
Drawing on a large-scale administrative dataset in the city of Brisbane, Australia, this paper examines a new kind of urban issue not previously considered in the literature: the dynamics of residential

**Table 4**
Statistics from KDE using different bandwidth for all complaint points.

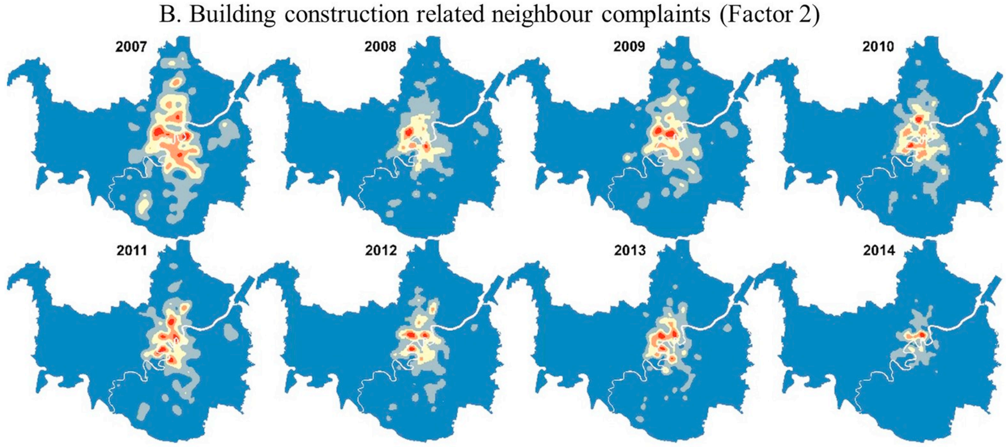
| Number of complaints per km$^2$ | Bandwidth (in metres) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 175 | 200 | 225 | 250 | 275 | 300 | 325 |
| Minimum | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Maximum | 6244.34 | 7030.29 | 6987.92 | 6584.53 | 6054.10 | 5509.48 | 4999.84 |
| Mean | 27.58 | 27.67 | 27.71 | 27.71 | 27.71 | 27.71 | 27.71 |
| SD | 108.70 | 107.42 | 105.36 | 102.92 | 100.49 | 98.27 | 96.36 |



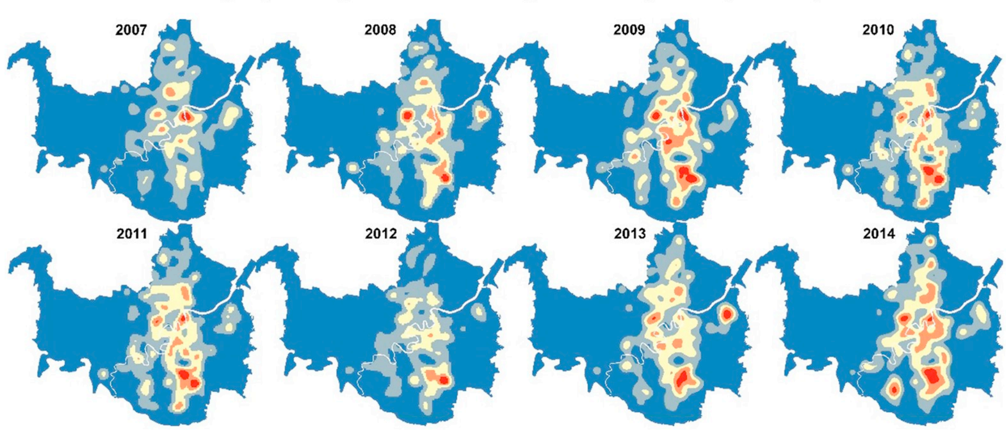

A. Animal-related neighbour complaints (Factor 1)




B. Building construction related neighbour complaints (Factor 2)




C. Property management related neighbour complaints (Factor 3)




D. Health and visual amenity related neighbour complaints (Factor 4)

(caption on next page)

**Fig. 5.** The spatio-temporal change of kernel density estimation of neighbour complaints by factors in Brisbane City, 2007–2014.

neighbour relations and the way perceptions of problematic neighbour conduct manifest in complaint to municipal councils. Through an analysis of the spatial and temporal patterns of neighbour complaints, the paper illustrates the utility of naturally-occurring administrative data as a means of learning more about the social life of urban areas.

The paper identifies the kinds of neighbour-problems that residents generally complain about and the way these cluster into a package of problems that are typically encountered together: (domestic) animal-related complaints; building construction; property management; and health and visual amenity nature. In seeking to account for these patterns, there are various possible explanations, but the nature of the dataset and the absence of any knowledge about the complainants (or objects of complaint) requires us to seek neighbourhood level, rather than individual level, explanations for the trends observed (Levine & Gershenson, 2014; White & Trump, 2016). With animal complaints, it is no surprise that complaints over nuisance dogs might occur in concert with complaints about excessive animal noise, particularly in neighbourhoods where domestic pets are prevalent (such as those containing suburban blocks) or where pet-keeping may be viewed as problematic (such as apartment blocks). Nevertheless, it is presently unclear whether a single nuisance pet is a frequent nuisance, thus prompting multiple complaints from one or more neighbours; whether there are neighbourhoods where pets are generally intolerable and neighbours are willing to complain about them; or whether an initial pet complaint triggers retaliatory complaints in a street of pet owners. Controlling for propensity to call council in future analyses for this, and other complaints, will provide some direction (O'Brien, 2015; O'Brien et al., 2015). Additionally, the clustering of complaints around buildings and other residential structures might point to a neighbourhood where significant new building or residential upgrade is taking place, such as high-amenity gentrifying neighbourhoods in inner city areas (Wyly & Hammel, 2001), or areas of urban infill driven by policies of urban consolidation or third wave (developer-led, apartment driven) gentrification (Davidson & Lees, 2005; Murphy, 2008).

The high correlation between Factor 2 and Factor 3 complaints might suggest similar processes at work in the clustering of complaints around property management related issues, whereby conflicts and complaints over the use of residential space might occur more frequently in relatively dense or densifying neighbourhoods. In these contexts, use and access to public spaces outside the home is fiercely competitive, prompting complaints about car parking and other obstructions, while limited distance between dwellings may cause domestic practices to spill out into other people's space and cause annoyance (even to the point where turning on one's lights attracts complaints from a neighbour).

Finally, there may be multiple factors at work in the clustering together of health and visual amenity type complaints. To begin with, the visual amenity and aesthetic appeal of a neighbouring property might be undermined by construction works next door, suggesting neighbourhoods where (re)development is taking place. Yet, complaints about overgrown or unkempt gardens, or overcrowded or unsightly properties might also suggest the presence of class or tenure dynamics at work in neighbourhoods where these types of complaints are most prevalent. On the one hand, the failure to care for one's property is a common criticism charged at those living in the private or social rented sector (Cheshire, Walters, & Rosenblatt, 2010), suggesting that these types of complaints are likely to occur in neighbourhoods with some degree of residential instability, such as low income neighbourhoods or high turnover inner city areas. On the other hand, the preoccupation among the middle classes with the home as a symbol of status and identity, and a low tolerance for neighbouring properties that fail to meet established standards of care and aesthetics (Cheshire, Rosenblatt, Lawrence, & Walters, 2009), may also be a factor.

The spatial patterning of complaint types, revealed by our spatial analysis, provides some indication of which these processes are at work. As with all cities, economic and labour market restructuring, immigration, housing market logics and processes of gentrification and urban redevelopment have induced a process of spatial sorting across Brisbane and a polarization of social advantage and disadvantage into distinct parts of the city. The effect is that the high-amenity, well-networked inner-urban areas have been colonized by affluent populations, while the older middle and outer-suburban or fringe locations have become sites of concentrated disadvantage (Randolph & Holloway, 2005). These same processes have dramatically altered the urban landscape, with entrepreneurial city governments repackaging inner-city spaces for high-value housing and consumption activities (Porter & Barber, 2006), while policies of urban consolidation have prompted a more compact urban form through in-fill and apartment development, particularly in suburbs close to the city.

The spatial distribution of the four types of neighbour complaints maps onto these urban processes in interesting ways, creating a complex ecology of neighbour complaints that requires more in-depth analysis than can be offered here. At a broad level, though, there is a logic to the spatial distribution of animal related complaints across the city, particularly in the middle and outer-ring suburbs where pet ownership coincides with single dwellings and gardens. Over time, the increasing density of pet problems in inner city areas correlates with the growth and consolidation of residential living in city areas, including in apartment and townhouse blocks where pet ownership is permitted, subject to approval from body corporate committees. As Power (2015) notes, pets are a key source of complaint in multi-unit dwellings, largely induced by the materialities of apartment buildings in which the comings and goings of other residents cause dogs to bark and the sounds of pet noise are readily transmitted through stairwells, lift shafts and wall cavities.

Similarly, if complaints around building and other residential structures (Factor 2), or the use of residential space (Factor 3), are more likely to arise in areas where new building or the upgrade of existing dwellings is taking place, or where space around the dwelling is in short supply and high demand, the trends towards urban consolidation would explain the concentration of these types of complaints in areas close to the city. That there are signs of reduced density in the volume of these complaints might be indicative of one of three trends. First, that the construction phase of urban development in Brisbane is now settling down and there is less reason for residents to complaint. Second, that urban residents are becoming more tolerant of building and property-related problems, or find their complaints go unaddressed, and are hence less likely to complain to council than they once were. And, third, that the growth of apartment living has been accompanied by the rise of new governance structures such as residents' associations or body corporates, which have come to replace local council as a vehicle for complaint (Easthope & Randolph, 2009).

The multiple factors that might underpin health and visual amenity related complaints (Factor 4) – residential development, the incidence of low-income renter households, or the desire to preserve aesthetic standards among the middle classes – would imply a spatial distribution of these complaints that is more dispersed across the city, as is indeed the case. In all instances, though, the density of health and visual amenity complaints appears to be rising over time, especially in suburbs located in the middle and outer-suburban ring. This pattern coincides with the growing concentration of disadvantage in Australian cities towards the middle and outer suburbs, which would suggest that rising disadvantage and low-income private renting might be linked to these spatial trends. Since social housing is a relatively stable, if declining, housing sector in Australia, it is unlikely to contribute much towards the increased intensity of health and visual amenity type of problems except insofar as its targeting of highly disadvantage populations (Morris, 2013) might mean a growing population of social housing tenants in hot-spot neighbourhoods who lack the capacity to care for their homes in the way their neighbours might expect.

## 6. Conclusion

This paper offers a comprehensive spatial procedure to manipulate large scale administrative datasets to define, classify and map neighbour complaints. At the same time, it also enhances our understanding on the nature of neighbour complaints in Australia's dynamically evolving urban spaces and the main sources of contention between neighbours. Our focus on objective neighbour *complaints* (to council) rather than self-reported perceptions of neighbour nuisances (Cheshire & Fitzgerald, 2015; Nieuwenhuis et al., 2013) or 'conflict' between neighbours (Legewie & Schaeffer, 2016, 138) enables us to make clear inferences from the data without the need to account for any compounding factors, such as contacting propensity or objective neighbour nuisance that otherwise account for the patterns discerned. Nevertheless, incorporating contacting propensity into future analyses will enable clearer identification of the processes at work in generating neighbour complaints to council. Do complaints indicate a breakdown of neighbour relations in our cities and a propensity for neighbours to become a source of annoyance and complaint, for example, or is it more that when citizens are annoyed by their neighbours, they are more likely to demand 'public' control (O'Brien, 2016b, 85) of those neighbours by the state than to resolve matters informally through neighbourly, over the fence conversations?

There are some additional limitations to this study that propose future work. In terms of data quality, and following Goerge and Lee (2002), one direction would be to draw on other data sets (survey or administrative) through record-linkage in order to improve data efficiency and make the aggregation of process-generated data more accurate. Second, the current analyses clearly need to be complemented by additional research that better explains the forces behind the spatial distribution of neighbour complaints that we have uncovered. A third avenue would be to examine the relationship between the concentration of neighbour complaints in specific neighbourhoods and the socio-economic characteristics and environmental features of those neighbourhoods. Finally, as outlined above, we have no information about complainants' underlying motives for complaining and whether any increase in neighbour complaints occurs because of an objective rise in neighbour-based problems or a growing tendency to draw on third party actors for resolution. We conclude by encouraging scholars to continue advancing knowledge on these, and related, questions, and to embrace the use of administrative datasets in helping to answer these questions.

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