Urban Policy and Research

ISSN: 0811-1146 (Print) 1476-7244 (Online) Journal homepage: https://www.tandfonline.com/loi/cupr20

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To cite this article: Anthony Kimpton, Rebecca Wickes & Jonathan Corcoran (2014) Greenspace and Place Attachment: Do Greener Suburbs Lead to Greater Residential Place Attachment?, Urban Policy and Research, 32:4, 477-497, DOI: 10.1080/08111146.2014.908769

To link to this article: https://doi.org/10.1080/08111146.2014.908769

Urban Policy and Research, 2014
Vol. 32, No. 4, 477–497, http://dx.doi.org/10.1080/08111146.2014.908769

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Greenspace and Place Attachment: Do Greener Suburbs Lead to Greater Residential Place Attachment?

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(*Received 20 June 2013; accepted 13 March 2014*)

ABSTRACT *While contemporary urban theories suggest that individuals have transcended their geographical community, evidence suggests that urban residents still feel 'attached' to place. In the literature, several socio-demographic characteristics are associated with place attachment. Scholars suggest physical features, such as community 'greenspace', may also influence place attachment. Yet research does not consider the relationship between one's objective proximity to greenspace or the objective availability of community greenspace on residents' place attachment. This study employs multi-level models and draws on police incident data, census data, two spatial data sets and survey data from over 4000 residents living across 148 state suburbs in Australia to assess the relationship between greenspace proximity and greenspace availability on place attachment. Our findings indicate that greater proportions and more accessible greenspace may not improve residents' attachment to their local community.*

当代城市理论指出，个体已超越了其地理共同体，但有证据表明城市居民仍然感到"归属于"某地。在相关文献中，几个社会-人口学特征与地域归属感相关。有学者指出，物理特征，如社区的"绿化空间"，也会影响地域归属感。然而研究并未考虑人与绿化空间客观距离，或者社区绿化空间的客观获得性，与居民地域归属感之间的关系。本研究运用多层模型，利用警察局记录、人口调查数据、 两个空间数据库和澳大利亚 148 个郊区四千多位居民的调查数据，评估绿化空间 距离和绿化空间获得性与地域归属感的关系。我们的研究成果显示，更多和更可 获得的绿化空间并不能提高居民对本地社区的归属感

KEY WORDS: Place attachment, public greenspace

Introduction

Australia has one of the lowest population densities in the world. As much of this land area is uninhabitable, the majority of Australians live in capital cities or urban, higher

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density areas in regional centres and townships (Australian Bureau of Statistics, 2011). Australians also prefer separated housing with private backyards and amenity-rich urban locations (Australian Bureau of Statistics, 2011). This spatial clustering and demand for private lots cause a dilemma for urban planners and policymakers who need to maximise the space allocated for private dwellings and public amenities, like parks or greenspaces.

Parks, or 'public greenspaces', represent an important public amenity in urban areas as they provide residents with access to spaces conducive to health-related activities and encourage community sociability (Coley *et al.*, 1997; Takano *et al.*, 2002; Kaplan & Kim, 2004; Giles-Corti *et al.*, 2005; Cohen *et al.*, 2007; Pretty *et al.*, 2007; Barton & Pretty, 2010; Bowler *et al.*, 2010);. In the literature, having accessible[1] greenspace has many associated benefits.[2] For example, living proximate to greenspace is associated with greater longevity (Takano *et al.*, 2002); heightened physical activity (Giles-Corti *et al.*, 2005; Cohen *et al.*, 2007); improved mental health (Pretty *et al.*, 2007; Barton & Pretty, 2010; Bowler *et al.*, 2010) and more social ties (Coley *et al.*, 1997; Kaplan & Kim, 2004). Further, greenspace reduces the presence of airborne and waterborne contaminants (Yang *et al.*, 2005) and has a positive influence on ambient temperatures, also known as the 'urban heat island effect' (Li *et al.*, 2012). Indeed, an increasing list of benefits associated with having accessible greenspace may explain why environmental justice research has more recently expanded in scope to also examine the positive environmental features which disadvantaged communities can lack as well as the negative environmental features they already feature, such as pollutants (Heynen *et al.*, 2006; Walker, 2009).

Beyond providing spaces for recreational activities or improving air quality, public greenspaces may also influence residents' affective attachment to their local geographical community. Studies show that *perceptions* of community greenspace are linked to higher levels of place attachment (Fried, 1982; Bonaiuto *et al.*, 1999; Kaplan & Kim, 2004; Kearney, 2006; Hur *et al.*, 2010; Arnberger & Eder, 2012). Yet, to date, few studies have examined the relationships between *objective* greenspace and place attachment across different types of urban communities.

In this article, we redressed this gap by employing a novel approach to investigate the relationship between greenspace and place attachment. We achieved this by using objective spatial predictors, including the proximity of greenspace to the household and the proportion of greenspace at the suburb scale of analysis. By controlling for already established contextual effects associated with place attachment, such as economic disadvantage and ethno-racial heterogeneity, we considered whether living in a 'greener' suburb increased place attachment. Further, we assessed whether residents' proximity to greenspaces also influenced place attachment. To do this we brought together four formerly disparate data sets: Wave 3 of the Australian Community Capacity Study (ACCS); the Australian Bureau of Statistics (ABS) census data; the Queensland Valuation and Sales (QVAS) data set and the Digital Cadastral Database (DCDB). These collective data sources allowed us to examine whether a resident's place attachment is, at least in part, derived from spatial features such as public greenspace.

The Relevance of Geographical Communities and Place Attachment

In the social sciences, interest in place attachment has increased considerably over the last 20 years (Lewicka, 2011), however, the salience of place in generating a sense of belonging and constancy in an otherwise changing society has captured the imagination of

scholars since the 1970s (Relph, 1976; Tuan, 1977; Norberg-Schulz, 1980). Kasarda and Janowitz coined the term 'place attachment' in 1974 and although there is no agreed definition of place attachment, many scholars view it as a pro-social good that represents the bond between individuals and their affectively important locations (Altman & Low, 1992; Scannell & Gifford, 2010b; Lewicka, 2011).

Increasing evidence suggests that people who report higher levels of place attachment to their geographic communities have greater access to social capital (Kasarda & Janowitz, 1974; Fried, 1982; Mesch & Manor, 1998) and positive mental health outcomes (Ross *et al.*, 2000). Further, communities with higher levels of place attachment have greater levels of civic engagement (Sampson, 1988; Comstock *et al.*, 2010), are more effective at collective lobbying and crime control (Vorkinn & Riese, 2001; Manzo & Perkins, 2006), and are more environmentally responsible (Vorkinn & Riese, 2001; Scannell & Gifford, 2010a). Private properties and community spaces are also well maintained in areas with higher place attachment (Carrus *et al.*, 2005; Brehm *et al.*, 2006; Scannell & Gifford, 2010a). These findings have led scholars to more rigorously consider the key individual and community factors that lead to greater (or lesser) place attachment.

Research indicates that several individual socio-demographic factors are strongly associated with place attachment. For example, some studies indicate that belonging to an ethno-racial minority or having a different language background is associated with lower place attachment (Austin & Baba, 1990; Theodori, 2004; Bailey *et al.*, 2012). Poverty, renting and residential mobility are also linked to reduced place attachment (Fried, 1982; Austin & Baba, 1990; Ringel & Finkelstein, 1991; Mesch & Manor, 1998; Bonaiuto *et al.*, 1999; Parkes *et al.*, 2002; Brown *et al.*, 2003; Comstock *et al.*, 2010). Lastly, local social ties mediate the relationship between these socio-demographic characteristics and place attachment (Kasarda & Janowitz, 1974; Lewicka, 2010). Indeed, one of the strongest predictors of place attachment is the availability of local social ties (Kasarda & Janowitz, 1974; Fried, 1982; Austin & Baba, 1990; Ringel & Finkelstein, 1991; Mesch & Manor, 1998; Lewicka, 2010).

Social ties require time to develop, which explains why older residents tend to report higher place attachment (Kasarda & Janowitz, 1974; Hidalgo & Hernández, 2001; Pretty *et al.*, 2003; Lewicka, 2010). In contrast, younger residents are more likely to be socially mobile, have fewer local social ties and in turn report lower place attachment (Woolever, 1992; Hidalgo & Hernandez, 2001; Pretty *et al.*, 2003; Bailey *et al.*, 2012). Residential duration is also associated with the availability of social ties and consequently higher levels of place attachment (Kasarda & Janowitz, 1974; Bonaiuto *et al.*, 1999; Brown *et al.*, 2003; Comstock *et al.*, 2010; Lewicka, 2010).

For the most part, studies of place attachment consider the individual level characteristics associated with place attachment. Yet as individuals live in different communities, it is important to consider the contextual influences of the community that might also influence residents' reports of place attachment. Two of the strongest contextual features associated with place attachment are ethno-racial heterogenity (Taylor *et al.*, 1985; Arthurson *et al.*, 2010; Bailey *et al.*, 2012) and economic disadvantage (Sampson, 1988; Parkes *et al.*, 2002; Twigg & Mohan, 2007; Bailey *et al.*, 2012). Putnam (2007) argues that residents of ethno-racially heterogeneous communities are more likely to 'hunker' within their homes rather than form social ties, which may explain why people in these types of communities report lower place attachment. Home ownership, an indicator of advantage, is also associated with place attachment, which may explain why more place-attached residents are located

in areas with higher proportions of homeowners (Woolever, 1992; Parkes *et al.*, 2002; Brown *et al.*, 2003; Bailey *et al.*, 2012).

The ethno-racial and economic context may only explain part of the variation in place attachment across geographical communities. The physical features of the community may also influence place attachment. However, this relationship is not as clear in the literature. To date the majority of research considering this relationship relies on residents' subjective evaluations of their communities (Fried, 1982; St. John *et al.*, 1986; Bonaiuto *et al.*, 1999; Kaplan & Kim, 2004; Kearney, 2006; Brown & Raymond, 2007; Hur *et al.*, 2010; Arnberger & Eder, 2012). From this, the most influential physical feature associated with residents' reports of place attachment is greenspace (Fried, 1982; Bonaiuto *et al.*, 1999; Kaplan & Kim, 2004; Kearney, 2006; Brown & Raymond, 2007; Arnberger & Eder, 2012). Moreover, when residents order their local features by importance, greenspace often tops these lists (Kaltenborn & Bjerke, 2002; Brown & Raymond, 2007; Korpela *et al.*, 2009).

What Makes Greenspace so Important?

Contemporary scholarship provides substantial evidence of the benefits of greenspace through active interaction with greenspace (exercising or dog walking) and passive environmental influences (improved air quality). Accessibility theories suggest that by lowering the associated travel time to features, such as greenspace, residents are more likely to interact with the feature (Batty, 2009). Consistent with this theory, studies show that residents who report living close to greenspace are more likely to exercise more regularly (Giles-Corti *et al.*, 2005; Cohen *et al.*, 2007); exhibit greater longevity (Takano *et al.*, 2002); report better subjective well-being (Barton & Pretty, 2010); and form more local social ties (Coley *et al.*, 1997; Kaplan & Kim, 2004). Likewise, residents living in objectively greener contexts benefit from fewer airborne and waterborne contaminants (Yang *et al.*, 2005); lower temperatures attributable to the 'urban heat island effect' (Li *et al.*, 2012); lower local crime rates (Kuo & Sullivan, 2001); and if they appreciate nature, a higher abbundance of local wildlife (Yencken & Wilkinson, 2001).

Given the associated benefits of greenspace for residents, it is possible that greenspace also improves the strength of place attachment. Several studies highlight that residents reporting greater place attachment are more likely to perceive that they live in greener contexts (Fried, 1982; Hur *et al.*, 2010; Rioux & Werner, 2011; Arnberger & Eder, 2012). As perceptions are likely to vary from person to person within the same context, their inherit subjectivity limits the range of interpretations available to place attachment researchers. For example, does stronger place attachment result in less critical perceptions of the greenspace accessibility or does greenspace accessibility influence subjective place attachment? The study by Hur *et al.* (2010)attempts to distiguish the subjectivity of greenspace perceptions, which they refer to as 'naturalness and openness', and place attachment by employing remote sensing techniques and drawing upon satellite imagery to objectively define measures of objective 'vegetation rates and building density'. They find that residents living in objectively greener contexts are more satisfied with their neighbourhood and thus more likely to report higher place attachment. However, this study does not control for other known contextual influences associated with place attachment (for example, neighbourhood disadvantage) and which may better explain this relationship.[3] As others note, there is significant inequality in access to greenspace with

poorer residents or more disadvantaged neighbourhoods unable to access the necessary resources to develop and sustain greenspaces (Heynen *et al.*, 2006; Walker, 2009).

The Present Study

In this article, we argue that subjective orientations to greenspace have limited application for effective planning. In order to maximise the limited space in densely populated urban environments, research must focus on the objective levels of greenspace needed to promote the aforementioned benefits for urban residents. The growing demands on 'space' in urban environments requires us to disentangle the subjective experiences of greenspace from contextual influences of greenspace to determine if the objective features of the environment influence active benefits like place attachment. To this end, the aim of our research is to examine the relationship between place attachment and public greenspace through both measures of accessibility and contextual greenness, while also controlling for previously established predictors of place attachment. Drawing on the literature discussed herewith, we suggest that the association between individual/household factors and place attachment will be partially mediated by residents' social ties (Kasarda & Janowitz, 1974; Austin & Baba, 1990; Ringel & Finkelstein, 1991; Mesch & Manor, 1998; Lewicka, 2010). We also contend that the neighborhood context (e.g. ethno-racial heterogeneity and economic disadvantage) will have a direct effect on place attachment (Taylor *et al.*, 1985; Sampson, 1988; Parkes *et al.*, 2002; Twigg & Twigg, 2007; Arthurson *et al.*, 2010; Bailey *et al.*, 2012). Further, in line with the environmental justice literature (Heynen *et al.*, 2006; Walker, 2009), accessibility to greenspace and the proportion of greenspace in the neighbourhood may directly affect residents' reports of place attachment. We illustrate these proposed relationships in Figure 1.

Methods

The Australian Community Capacity Study Survey

This article draws on survey data from the Australian Community Capacity Study (ACCS). The ACCS is a longitudinal panel study of urban communities in Australia supported by Australia Research Council funding (Mazerolle *et al.*, 2007, 2012; Wickes *et al.*, 2011).[4] The overarching goal of the ACCS is to understand and analyse the key social processes associated with the spatial variation of crime and disorder across urban communities over time. This current study employs data collected in 2010 representing the

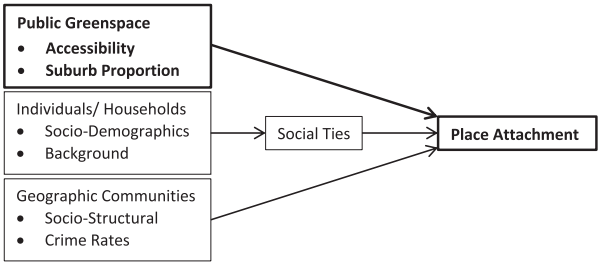

Figure 1. Public Greenspace Influencing Place Attachment Conceptual Model

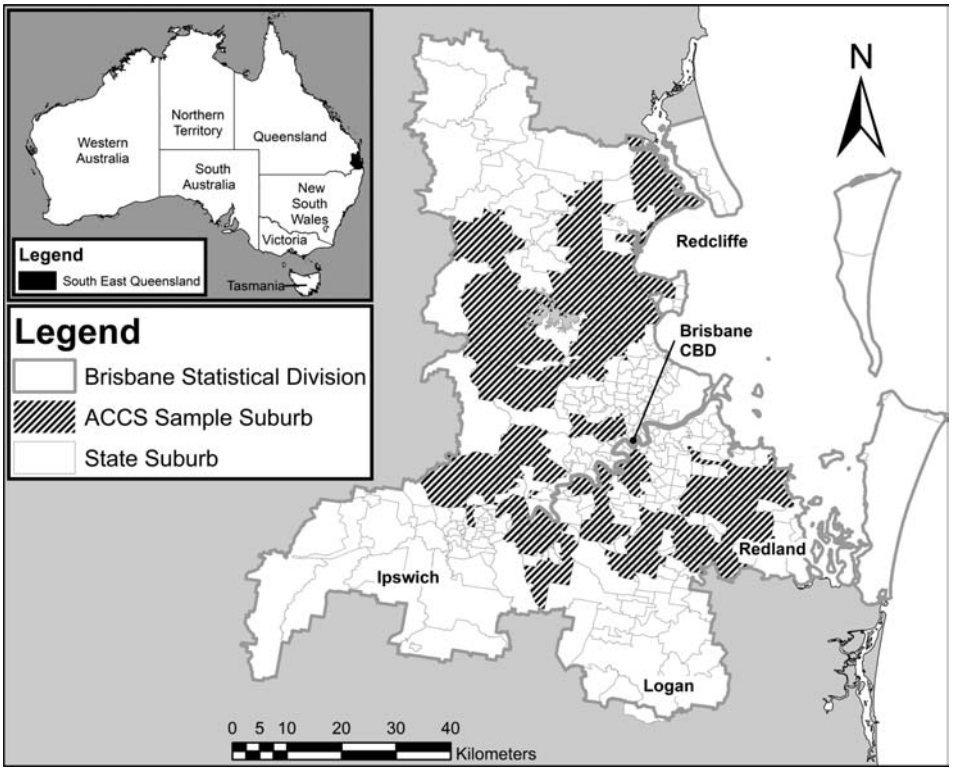

Figure 2. ACCS Sample Suburbs and BSD extent

third wave of the ACCS in the Brisbane Statistical Division (BSD) located in Queensland. The Brisbane ACCS sample comprises 148 randomly drawn state suburbs with a residential population ranging from 245 to 20 999 (total suburbs in the BSD = 429 with a residential population ranging from 15 to 21 001) (see Figure 2). Unique features of this data set are its inclusion of a three-item place attachment index, consistent with the majority of the literature (see Giuliani, 2003), along with the x and y spatial coordinates that capture the home address of participants.[5]

Additional Data Sets

The spatial coordinates (capturing respondents' home locations) contained in the ACCS data provide a unique opportunity to merge several formerly disparate data sets to examine objective community and household characteristics on place attachment. For our analyses, we draw upon the Queensland Police Service's (QPS) violent crime incident data from 2006 to 2010 to control for negative effects that crime may have on residents' reports of place attachment. Additionally, we use ABS census data (2006) to provide suburb-level socio-demographic characteristics associated with place attachment[6] (Taylor *et al.*, 1985; Sampson, 1988; Parkes *et al.*, 2002; Twigg & Twigg, 2007; Arthurson *et al.*, 2010; Bailey *et al.*, 2012). This was the most recent census collection to occur prior to the collection of

the ACCS survey data and these data allow us to test the temporal relationship between our predictors and our dependent variable. Moreover, these census data align with the spatial boundaries used to capture violent crime incidents. This approach ensures that the spatial definitions of community remain consistent. Finally, we use the Department of Environmental Resource Management's Queensland Valuation and Sales (QVAS) data set in combination with the Digital Cadastral Database (DCDB) to identify locations of public greenspace. Integrating these formerly disparate data sets allows for the first study of place attachment that simultaneously considers the association between personal, household, socio-structural and greenspace on residents' reports of place attachment.

The ACCS Survey Participants

The Brisbane sample comprises 4404 participants. In Brisbane, the ACCS survey collects across four waves in 2005, 2008, 2010 and 2014. The current study draws on the survey data from Wave 3. The Wave 3 participant sample comprises a longitudinal sample and a top-up sample. As there is attrition in the longitudinal sample, each Brisbane wave contains a top-up sample to maintain ecometrically valid indicators of social processes (Raudenbush & Sampson, 1999). In addition, power analyses from Optimal Design Software determine number of residents needed to maintain ecometric reliability for multi-level samples. The Wave 3 participant sample comprised respondents from the two previous waves ($n = 2248$) and a randomly selected top-up sample ($n = 2156$). The Brisbane top-up sample participants are randomly selected using random digit dialling and the overall consent and completion rate for the total Brisbane sample was 68.52 per cent. This rate represents the number of interviews completed proportional to the number of in-scope contacts.

The ACCS Wave 3 survey was conducted from 25 August to 15 December 2010 by the Institute for Social Science Research at the University of Queensland. Trained interviewers used computer-assisted telephone interviewing to administer the survey, which lasted approximately 24 minutes. The in-scope survey population comprised all people aged 18 years or over who were usually resident in private dwellings with telephones in the selected neighbourhoods.

Measures

Dependent measure. The ACCS-derived dependent variable *Place Attachment* is a three-item, unweighted index measure of affective attachment to the community ($\alpha = 0.82$). We combined the following three questions to construct the index: (1) "I feel that I belong to this community"; (2) "I would like to be living in this community in three years"; and (3) "I am proud to live in this local community." These three items were consistent with the measures found in the majority of place attachment publications (see Kasarda & Janowitz, 1974; Brown *et al.*, 2003; Giuliani, 2003; Comstock *et al.*, 2010; Lewicka, 2010) and the index average varied significantly between suburbs (see Figure 3).

Independent measures. There is no consistent contextual greenspace measure in the literature (Kearney, 2006; Hur *et al.*, 2010; Rioux & Werner, 2011), therefore, in this article, we adopted approaches detailed by other scholars (Mitchell & Popham, 2007; Batty, 2009) and employ two conceptually distinct measures of greenspace. The g*reenspace proportion* measure provided the overall public greenspace density within

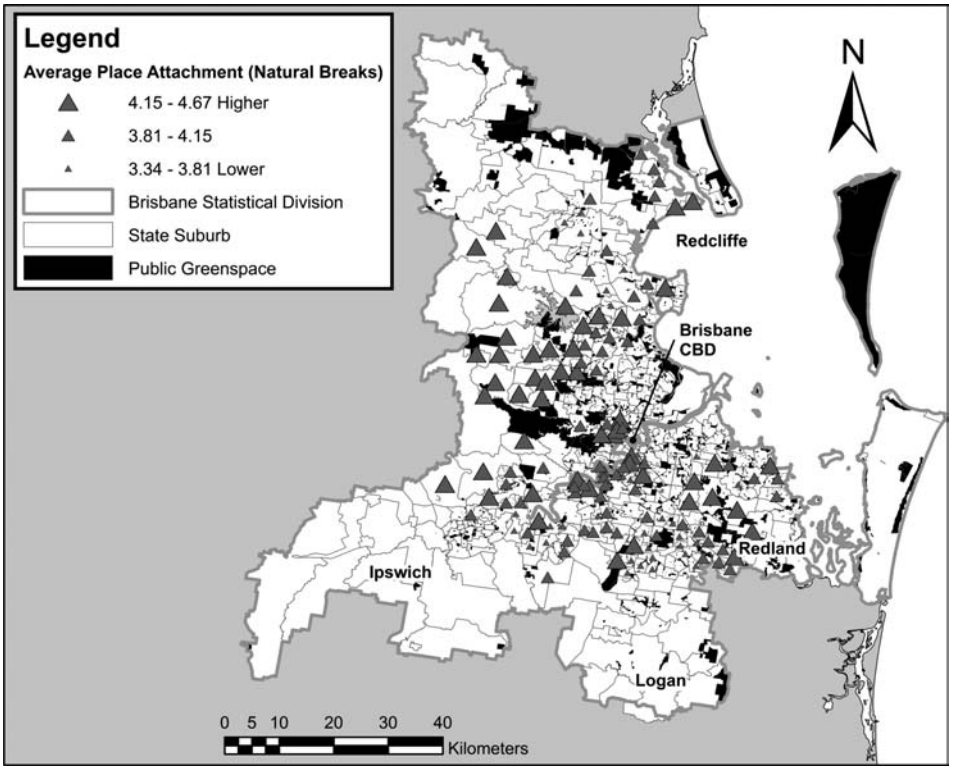

Figure 3. Place Attachment Spatial Variation by Suburb and Public Greenspace

suburbs, excluding industrial zoned land. The *greenspace proximity* measure captured each household's proximity to their nearest public greenspace based on Euclidean distance. Batty (2009) refers to this accessibility as 'type 1' which was the most appropriate measure for our study since we could not determine each resident's preferred mode of transport to their nearest greenspace. Other accessibility types would have introduced new assumptions into the analysis such as whether a walker cuts across vacant lots, or if there is a threshold where a resident decides that the walk is too far so they instead drive. Conceptually, the *greenspace proportion* measure captured each suburb's relative *greenness*, while a *greenspace proximity* measure captured each household's relative *greenspace accessibility*.

Neighbourhood-Level Control Measures. We included several ABS census-derived suburb control measures and violent victimisation incident rates from the QPS. Several studies suggest population density reduces place attachment (Wasserman, 1982; Sampson, 1988; Woolever, 1992); therefore, we constructed a measure of *population density* using ABS-derived suburb populations divided by the suburb area without public greenspace or industrial areas. As ethno-racial heterogeneity also influences place attachment (Taylor *et al.*, 1985; Arthurson *et al.*, 2010; Bailey *et al.*, 2012), we constructed a *country of birth diversity* index (see Blau, 1977) from the ABS's census

data. Economic disadvantage also influences place attachment (Sampson, 1988; Parkes *et al.*, 2002; Twigg & Twigg, 2007; Bailey *et al.*, 2012). In our models, we used three ABS suburb-level socio-economic status measures: *median income*; *Indigenous* proportion; and *unemployed* proportion. Additionally, the residency status of community members influences place attachment (Woolever, 1992; Parkes *et al.*, 2002; Brown *et al.*, 2003; Bailey *et al.*, 2012). To capture residency status we used the ABS's census to derive the proportion of people renting (*renters*) and the proportion of residents that have lived in the suburb for less than one year (*less than 1 year residents*). Lastly, objective crime influences place attachment (Skogan, 1990; Brown *et al.*, 2004); therefore, we employed a log of the QPS violent crime rate per 100 000 as the *violent crime rate*.

Individual/Household-Level Measures. We also controlled for individual and household-level socio-demographics previously found to influence place attachment. As the life stages of residents can influence their place attachment (Kasarda & Janowitz, 1974; Woolever, 1992; Hidalgo & Hernández, 2001; Pretty *et al.*, 2003; Lewicka, 2010; Bailey *et al.*, 2012), we employed *age* and squared *age* (*age* ^{2}) to control this curvilinear effect. In addition, gender (Mesch & Manor, 1998; Hidalgo & Hernández, 2001), marital status (Brown *et al.*, 2004), and having dependent children (Logan & Spitze, 1994; Hay, 1998) each influence place attachment; thus, we included three binary measures: *female*, *married* and *dependent children*. Lastly, as household affluence also influences place attachment (Mesch & Manor, 1998; Bonaiuto *et al.*, 1999), we included four approximately equal income group binaries in our analyses: *undisclosed*, *lower*, *middle* and *upper* (middle income was the reference category).

The cultural background of a resident can influence their place attachment (Austin & Baba, 1990; Theodori, 2004; Bailey *et al.*, 2012). We controlled for this by employing three binary measures: *born in Australia*; *non-English speaking background*; and *Indigenous*. Additionally, as residential status influences place attachment (Fried, 1982; Austin & Baba, 1990; Ringel & Finkelstein, 1991; Mesch & Manor, 1998; Bonaiuto *et al.*, 1999; Parkes *et al.*, 2002; Brown *et al.*, 2003), we included a binary measure for *renters* and an ordinal measure of duration at present address: *less than 5 years*; *5 to less than 10 years*; *10 to less than 20 years*; and *more than 20 years* (reference category is less than 5 years). Finally, as studies show that community social ties strongly influence place attachment (Kasarda & Janowitz, 1974; Fried, 1982; Austin & Baba, 1990; Ringel & Finkelstein, 1991; Mesch & Manor, 1998; Lewicka, 2010), we employed an ordinal measure of acquaintances in the community: *none*, *few*, *many* and *most* (see Table 1 for dependent, independent and control variable summary statistics).

Statistical Analysis

As the survey data represents individuals nested in suburbs, we used a multi-level mixed-effects linear regression model to examine the simultaneous individual and contextual influences on place attachment. We used STATA v.12.1's 'xtmixed' command (StataCorp, 2011):

$$y_{ij} = X\beta + Zb_{ij} + Wb_j + \varepsilon_{ij} \quad (1)$$

Where y_{ij} is the place attachment response vector, subscript i represents individuals (1–4392) and subscript j is their respective suburbs (1–148). On the explanatory side of

Table 1. Variable Summary Statistics

Variables	n.	Proportion/mean(sd)
Individual/household		
Place attachment (agreement index)	**4392**	**3.99 (0.75)**
Greenspace accessibility (m)	**3032**[a]	**563.94 (837.69)**
Age (years)	4340[b]	51.31 (15.20)
Female	4392	59.18%
Married	4368[b]	67.26%
Have dependent children	4360[b]	37.82%
Household income groups (undisclosed/lower/middle/upper)	4392	21.65/30.69/ 21.97/25.68%
Australian born	4379[b]	72.14%
Non-English Speaking Background	4386[b]	10.76%
Indigenous	4159[b]	0.91%
Renter	4315[b]	13.12%
Duration at present address (<5, <10, <20, <20 years)	4361[b]	23.07/24.35/ 28.94/23.64%
You know x people in your community (ordinal: none, few, many, most)	4378[b]	2.45 (0.74)
Suburb		
Suburb greenspace (%)	**4392**	**0.09 (0.08)**
Population density (population/ha)	4392	5.13 (4.36)
Ethno-racial Heterogenity Index (Country of Birth)	4392	0.46 (0.11)
Median income ($)	4392	1208 (319)
Indigenous (%)	4392	0.02 (0.02)
Unemployment (%)	4392	0.02 (0.01)
Renters (%)	4392	0.24 (0.13)
Less than 1 year residents (%)	4392	0.18 (0.05)
Violent crime rate (log(rate/n * 100 000))	4257[b]	5.67 (0.95)

[a] Observations include only ACCS participants willing to disclose their home address which is necessary for an accessibility measure.
[b] Observations with all three place attachment items and a response for this indicator.

the equation: $X\beta$ are the independent and control variables with their vector; Zb_{ij} is the fixed effects covariate matrix – similar to a standard OLS (ordinary least squares); Wb_j is the random effects covariate matrix; and ε_{ij} is the error term.

As only 73 per cent of the ACCS residents provided full address details, we conducted two sets of analyses. Our first analysis employed all residents of the ACCS survey ($n = 4392$) and examined whether or not living in a green suburb influenced residents' place attachment. Our models built from a null model, to one that included the individual demographic characteristics, then social ties. The fourth model then followed, which included all suburb socio-structural characteristics. In the last model, we included our independent variable: suburb greenspace proportion.

In the second analysis, we used a partial data set that comprised only those residents that provided an exact home address ($n = 3032$). These analyses allowed us to consider if living proximate to greenspace improved residents' place attachment. Our analyses again proceeded with a null model, followed by a model that included all individual level variables, followed by the social ties. We then examined the independent effects of the

suburb-level characteristics with our final model examining the effect of living close to greenspace on place attachment.

Results

The first step in our analysis was to calculate an intra-class correlation coefficient (ICC). We found that nearly 10 per cent of the variation in place attachment was attributable to the suburb. This was true for both the complete data set and the partial data set. Model 1 for each analysis contains the relevant ICC.

The Effect of Living in a Green Environment on Place Attachment. The first series of analyses employed the complete data set and examined if objective greenspace at the level of the suburb could explain the contextual variation in place attachment. In Model 2, we entered the individual level control variables. We found that being older ($\beta = 0.016$, $p < 0.001$), female ($\beta = 0.076$, $p < 0.001$), married ($\beta = 0.103$, $p < 0.001$), a long-term resident (*5 and up to 10 years* $\beta = 0.111$, $p < 0.001$; *10 and up to 20 years* $\beta = 0.159$, $p < 0.001$; *more than 20 years* $\beta = 0.146$, $p < 0.001$), having dependent children ($\beta = 0.088$, $p < 0.01$) or an annual income greater than \$100 000 ($\beta = 0.070$, $p < 0.05$) was associated with higher place attachment. Unsurprisingly, renting negatively influenced place attachment ($\beta = -0.134$, $p < 0.001$). By including these individual level control variables, the ICC (8.82 per cent) reduced by 7 per cent from the null model (9.50 per cent). In Model 3, we included our measure of social ties which were significantly and positively associated with place attachment ($\beta = 0.278$, $p < 0.001$). The inclusion of social ties partially mediated residential duration, being female and being a parent. Yet when our measure of social ties was entered in the model, the relationship between rental status and place attachment increased.

We then entered the suburb-level control variables in Model 4. In line with previous research, residents reported lower place attachment when they lived in ethno-racially heterogeneous communities ($\beta = -0.344$, $p < 0.05$). In addition, residents who lived in suburbs with high concentrations of Indigenous Australians ($\beta = -3.240$, $p < 0.01$) and high levels of unemployment ($\beta = -9.017$, $p < 0.01$) were associated with lower place attachment. Contrary to prior studies, residential turnover was associated with improved place attachment ($\beta = 0.842$, $p < 0.05$).With the inclusion of these suburb control variables, the length of time individuals have resided in their community becomes statistically significant ($\beta = 0.091$, $p < 0.05$). Including the suburb variables in Model 4 reduced the ICC by 67 per cent (ICC = 2.52 per cent). Finally, Model 5 included the proportion of greenspace in the suburb. We found that living in greener suburbs did not influence residents' place attachment. The ICC remained unchanged in this final model (Table 2).

The Effect of Greenspace Proximity on Place Attachment. Using the partial data set ($n = 3032$), we then examined if living close to greenspace influenced place attachment. In Model 2, we included the individual level control variables. Similar to our first analyses, older ($\beta = 0.019$, $p < 0.001$), female ($\beta = 0.081$, $p < 0.01$), married residents ($\beta = 0.080$, $p < 0.05$) having a \$100 000 or greater household income ($\beta = 0.075$, $p < 0.05$), or residential duration greater than 20 years ($\beta = 0.105$, $p < 0.05$) led to higher place attachment, while rental status reduced place attachment ($\beta = -0.134$, $p < 0.01$). Including these individual level control variables reduced the ICC (8.44 per cent) by 12 per

Table 2. Suburb Public Greenspace Proportion Predicting Place Attachment

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variables	β	*se*	β	*se*	β	*se*	β	*se*	β	*se*
Constant	4.011	0.022	3.194	0.116	2.631	0.115	2.787	0.218	2.773	0.218
Greenspace	–		–		–		–		0.189	0.176
Individual/household										
Age	–		0.016	0.004***	0.016	0.004***	0.015	0.004***	0.015	0.004***
Age^2	–		0.000	0.000*	0.000	0.000**	0.000	0.000*	0.000	0.000*
Female	–		0.076	0.023***	0.056	0.022*	0.058	0.022**	0.058	0.022**
Married	–		0.103	0.027***	0.099	0.026***	0.095	0.026***	0.096	0.026***
Dependent children	–		0.088	0.028**	0.056	0.027*	0.055	0.027*	0.055	0.027*
Income: Undisclosed	–		−0.038	0.035	−0.032	0.034	−0.014	0.034	−0.015	0.034
Lower	–		0.007	0.033	0.002	0.032	0.020	0.032	0.019	0.032
Middle	–		–		–		–		–	
Upper	–		0.070	0.031*	0.069	0.030*	0.065	0.031*	0.065	0.031*
Australian born	–		0.019	0.027	0.014	0.026	0.016	0.026	0.015	0.026
NESB	–		0.073	0.048	0.051	0.046	0.053	0.047	0.053	0.047
Indigenous	–		0.113	0.115	0.046	0.111	0.066	0.111	0.067	0.111
Renter	–		−0.134	0.038***	−0.155	0.037***	−0.122	0.037**	−0.121	0.037**
Residence: <5 years	–		–		–		–		–	
5 to <10 years	–		0.111	0.033***	0.068	0.032*	0.075	0.033*	0.075	0.033*
10 to <20 years	–		0.159	0.033***	0.093	0.032**	0.098	0.033**	0.098	0.033**
>20 years	–		0.146	0.037***	0.068	0.036	0.091	0.037*	0.090	0.037*
Community ties	–		–		0.278	0.015***	0.274	0.015***	0.273	0.015***
Suburb										
Population	–		–		–		0.006	0.005	0.006	0.005
Median income	–		–		–		0.000	0.000	0.000	0.000
Ethno-racial heterogenity	–		–		–		−0.340	0.163*	−0.352	0.163*
Indigenous	–		–		–		−3.240	1.439*	−2.797	1.494
Unemployment	–		–		–		−9.017	3.242**	−9.532	3.269**
Renters	–		–		–		−0.494	0.279	−0.529	0.281
<1 year residents	–		–		–		0.842	0.375*	0.945	0.386*

Table 2. *Continued*

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variables	β	*se*	β	*se*	β	*se*	β	*se*	β	*se*
Violent crime rate	–		–		–		0.014	0.020	0.015	0.020
ICC		9.50%		8.82%		7.73%		2.52%		2.49%
n_1		4392		4046		4038		3906		3906
n_2		148		148		148		141		141
Log likelihood		−4826		−4305.94		−4177.69		−4022.44		−4022.69
X^2 (*d.f*)		(0)		196.27(15)		574.56 (16)		756.00 (24)		758.27 (25)

Significance: *0.05, **0.01, ***0.001.
NESB, non-English speaking background.

Table 3. Household Public Greenspace Proximity Predicting Place Attachment

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
Variables	β	*se*	β	*se*	β	*se*	β	*se*	β	*se*	β	*se*
Constant	4.027	0.023	3.159	0.136***	2.630	0.134***	2.755	0.250***	2.721	0.253***	2.706	0.253***
Greenspace proximity	–		–		–		–		0.000	0.000	0.000	0.000
Greenspace	–		–		–		–		–		0.187	0.201
Individual/household												
Age	–		0.019	0.005***	0.017	0.005**	0.017	0.005**	0.018	0.005***	0.018	0.005***
Age^2	–		0.000	0.000*	0.000	0.000*	0.000	0.000*	0.000	0.000*	0.000	0.000*
Female	–		0.081	0.026**	0.057	0.025*	0.061	0.026*	0.059	0.026*	0.059	0.026*
Married	–		0.080	0.031*	0.081	0.030**	0.075	0.031*	0.075	0.031*	0.075	0.031*
Dependent children	–		0.067	0.033*	0.046	0.032	0.046	0.032	0.041	0.033	0.040	0.033
Income: Undisclosed	–		−0.013	0.041	−0.016	0.040	0.008	0.040	0.010	0.041	0.009	0.041
Lower	–		0.003	0.038	−0.006	0.037	0.017	0.037	0.015	0.038	0.014	0.038
Middle	–		–	–	–		–		–		–	
Upper	–		0.086	0.037*	0.075	0.036*	0.067	0.036	0.065	0.037	0.065	0.037
Australian born	–		0.018	0.032	0.013	0.030	0.020	0.031	0.018	0.031	0.018	0.031
NESB	–		0.071	0.057	0.048	0.055	0.055	0.056	0.063	0.057	0.064	0.057
Indigenous	–		0.117	0.133	0.022	0.128	0.039	0.127	0.031	0.130	0.034	0.130
Renter	–		−0.134	0.044**	−0.146	0.043**	−0.107	0.043*	−0.107	0.044*	−0.107	0.044*
Residence: <5 years	–				–		–		–		–	
5 to <10 years	–		0.078	0.040	0.036	0.038	0.039	0.039	0.038	0.039	0.037	0.039
10 to <20 years	–		0.140	0.039	0.075	0.038	0.076	0.039*	0.076	0.039	0.075	0.039
>20 years	–		0.105	0.044*	0.033	0.042	0.049	0.043	0.050	0.044	0.050	0.044
Community ties	–		–		0.282	0.017***	0.276	0.018***	0.276	0.018***	0.276	0.018***
Suburb												
Population density	–		–		–		0.003	0.006	0.002	0.006	0.002	0.006
Median income	–		–		–		0.000	0.000	0.000	0.000	0.000	0.000
Ethno-racial heterogenity	–		–		–		−0.272	0.183	−0.292	0.185	−0.304	0.185
Indigenous	–		–		–		−3.946	1.603*	−3.837	1.615*	−3.399	1.683*
Unemployment	–		–		–		−7.844	3.701*	−7.778	3.720*	−8.209	3.752*
Renters	–		–		–		−0.126	0.314	−0.128	0.319	−0.164	0.322

Table 3. *Continued*

Variables	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	β	*se*	β	*se*	β	*se*	β	*se*	β	*se*	β	*se*
< 1 year residents	–		–		–		0.507	0.424	0.545	0.427	0.644	0.440
Violent crime rate	–		–		–		− 7.844	3.701*	− 7.778	3.720*	− 8.209	3.752*
ICC		9.63%		8.44%		7.91%		2.66%		2.78%		2.79%
n_1		3032		2948		2940		2940		2797		2797
n_2		148		148		148		148		141		141
Log likelihood		− 3297.2		− 3130.58		− 3042.50		− 2924.28		− 2900.46		− 2,900.72
X^2 (*d.f*)		0		135.05 (15)		416.98 (16)		545.6 (24)		539.38 (25)		539.93 (26)

Significance: *0.05, **0.01, ***0.001.
NESB, non-English speaking background.

cent from the null model (9.63 per cent). In Model 3, we included social ties. As with our previous analyses, social ties was significantly and positively associated with place attachment. The inclusion of this variable fully mediated the relationship between long-term residential duration and having dependent children and partially mediated being female. Again, similar to our earlier analyses, including social ties strengthened the negative relationship between rental status and place attachment. By including the individual level control variables and social ties, the ICC (7.91 per cent) reduced by 18 per cent from the null model (9.63 per cent%).

Next, we included the suburb-level control variables in Model 4. In this model, the concentration of Indigenous Australians ($\beta = -3.946$, $p < 0.05$) and levels of unemployment ($\beta = -7.884$, $p < 0.05$) were associated with lower place attachment. Including these suburb-level control variables reduced the ICC (2.66 per cent) by 72 per cent from the null model (9.63 per cent), once more revealing that these contextual effects explained the majority of variation in residents' reports of place attachment. We then included the individual greenspace proximity variable in Model 5. Greenspace proximity did not have a statistically significant influence upon place attachment. Last, we included the suburb proportional greenspace variable for Model 6. For this last model, suburb proportional greenspace, while controlling for individual contextual variation, did not influence place attachment. In sum, neither the proximity to greenspace nor the contextual greenspace significantly influenced an individual resident's place attachment (Table 3).

Discussion

This study's primary aim was to determine if contextual greenspace influences place attachment. By controlling for the established characteristics associated with place attachment, we examined the relationship between: (a) the proportion of greenspace in the community; and (b) the proximity of residents to greenspace and reports of place attachment. Contrary to what we expected from previous research on the relationship between *perceived* greenspace and place attachment (Fried, 1982; Kaplan & Kim, 2004; Hur *et al.*, 2010; Arnberger & Eder, 2012), our study did not find that living next to greenspaces or living in a green community influenced how attached residents felt towards their community.

In line with other research, we found that the community characteristics that have the greatest effect on residents' place attachment are social ties, ethno-racial heterogeneity and economic disadvantage. Indeed, social ties were very strong predictors of place attachment across all models. This supports Kasarda and Janowitz's (1974) early suggestion that community social ties explained the majority of individual place attachment variations (see also Kasarda & Janowitz, 1974; Fried, 1982; Austin & Baba, 1990; Ringel & Finkelstein, 1991; Mesch & Manor, 1998; Lewicka, 2010). Further, community socio-structural characteristics such as ethno-racial diversity and affluence explained the majority of contextual place attachment variation consistent with the literature (Taylor *et al.*, 1985; Sampson, 1988; Parkes *et al.*, 2002; Twigg & Twigg, 2007; Arthurson *et al.*, 2010; Bailey *et al.*, 2012). In sum by observing context, there was little evidence supporting Fried (1982) and St John *et al.*'s (1986)suggestions that physical features such as greenspace are more influential than social ties.

Our findings have important implications for research examining the relationship between greenspace and place attachment. First, studies that focus on the relationship between *perceived* greenspace and place attachment (see Fried, 1982; Bonaiuto *et al.*,

1999; Kaplan & Kim, 2004; Kearney, 2006; Brown & Raymond, 2007; Hur *et al.*, 2010; Rioux & Werner, 2011; Arnberger & Eder, 2012) could be *affirming the consequent* by measuring perceptions influenced by place attachment to explain place attachment. Second, place attachment studies that have not controlled for socio-structural characteristics should be treated with caution as the association between objective greenspace and place attachment may be spurious. For example, Hur *et al.* (2010, p. 57) suggest objective "vegetation rate and building density" are associated with place attachment. Yet this study does not control for neighbourhood disadvantage, household disadvantage or other socio-structural, socio-demographic characteristics that may better explain this relationship (see Fried, 1982; Wasserman, 1982; Sampson, 1988; Woolever, 1992; Bonaiuto *et al.*, 1999; Parkes *et al.*, 2002).

While our results extend the understood association between objective measures of greenspace and place attachment, there are two caveats to be considered. First, our findings did not directly imply a null relationship between contextual greenspace and place attachment since other objective greenspace measures could influence place attachment. For example, our cadastral data set did not include the characteristics of the public greenspaces, so comparing specific greenspace types to place attachment may result in different findings. For example, accessible public playgrounds, barbeque or sporting areas could be particularly important in predicting place attachment. Future researchers should consider including ground observations or satellite imagery to address this limitation.

A second limitation was our use of census-defined boundaries. Aggregating communities to the suburb raised the question of the modifiable areal unit problem (MAUP). This is a well-known problem of spatial analyses where both spatial scale and level of aggregation can influence the results of modelling exercises (Openshaw & Taylor, 1979). For this study, suburb boundaries classified residents into geographic communities for two reasons. First, suburbs are a readily identifiable unit for Australian residents (Davison, 1994; Ferber *et al.*, 1994) and, therefore, represent a unit likely that conceptually aligns with their perceptions of a geographic community. Second, they are the finest grain of QPS crime incident data available that is spatially relatable to ABS socio-structural data. If subsequent researchers can modify their geographic community areal unit in to smaller ABS geographic classification units, they may detect a different relationship between greenspace and place attachment.

Despite these limitations, our approach provides a robust template for subsequent research that compares communities' physical environments for affective influence. Studies employing a similar approach could expect to contribute towards better evidence-based policy. Including objective features of the physical environment would permit a comparison between the communities that are affectively important to residents to those communities that fail to produce the same feelings of belonging, pride and long-term commitment. Further, this contextual approach would allow for potential cost savings since it would identify the communities that require further development, rather than generalising development goals across a diverse urban geography. In line with prior studies (see Hoehner *et al.*, 2005; Ball *et al.*, 2008; Brownson *et al.*, 2009), we argue the poor agreement between objective and perceived greenspace confounds the affective relationship between residents and their environments. Policymakers should be wary of advice such as 'more greenspace is better greenspace' if the findings are drawn from perception-based research. These studies have not accounted for contextual greenspace variation, but rather reported that residents consistently desire a greener context than the

status quo. A more efficient and informed approach would be to adopt a community-level 'needs-based approach' rather than employing objective minimum standards which can result in uninspiring and bland public greenspaces (Byrne *et al.*, 2010). Two examples in the USA are particularly helpful here: a case study in Louisiana's post-Hurricane Katrina New Orleans and another in Atlanta, Georgia (Dolesh, 2010). In New Orleans, 25 000 community residents volunteered their labour and greenspace requirements to rebuild City Park. This approach improved residents' affective attachment to their public greenspace and confirmed the importance of involving community at the planning stage. In Atlanta, one of the USA's most heavily traffic-congested cities, the city's mayor and council reallocated 22 miles of a disused train track loop for a public greenspace that provided thoroughfares for city residents. This Belt Line project featured smart planning principles such as proximate housing and commercial sites to increase the foot traffic, which acted as a crime deterrent by community presence (Dolesh, 2010). Both examples reduced the user–designer gap between designers' intentions and users' experiences since they incorporated community stakeholders into the greenspace design process. This, we argue, offers a step forward from policy that outlines minimum policy standards universally across communities without first evidencing that these greenspaces are affectively important to residents living in socially varied communities.

Acknowledgments

This research was funded by the Australian Research Council (ARC RO700002, DP1093960, and DP1094589). The ARC did not have a role in study design, data collection, manuscript preparations, or decisions to publish.

Notes

1. While we note that accessibility measures differ throughout the literature, each measure is conceptually consistent with Batty's (2009) accessibility definition, which is the associated travel cost weighed against the benefits of arrival.
2. We also note that access to 'stocks' of greenspace is unequally distributed, with poorer residents unable to develop and cultivate expansive greenspaces (Heynen *et al.*, 2006; Walker, 2009). This unequal access may have deleterious consequences for the health and well-being of more disadvantaged individuals.
3. We note that Hur *et al* (2010) employ satellite imagery to objectively define a combined public and private contextual greenspace within a 'walkable' buffer zone from the home. By including private greenspace, they are subsequently unable to describe accessibility given that these spaces are not accessible to the general public.
4. For the full Wave 3 ACCS instrument and technical report, see http://www.uq.edu.au/accs
5. A total of 73 per cent of participants (n=3032) were mapped to the address level of geocoding precision and 16 per cent (n = 645) were located to their nearest crossroad.
6. This study enumerates communities to the suburb for three reasons. First, suburb level is the highest resolution available for the crime incident data. Second, suburbs have administrative significance to councils. Third, by virtue of suburbs having a name, it is often the level that residents can most readily identify as their community (Davison, 1994; Ferber *et al.*, 1994).

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