Understanding Sense of community in Subiaco, Western Australia

A Study of Human Behaviour and Movement Patterns

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Abstract

Despite being an important physical environment capable of promoting social sustainability, sense of community and contributing to a better quality of life, residential streets and neighbourhoods have not attracted significant research interest until now. The integrated physical interconnected network of houses, front yards, walkways, alleyways and streets offers a high potential for community building through social interactions at a neighbourhood level. Understanding people's movements, activities and perceptions about their streets can inform design practices and local planning policy in creating better communities. This study presents an investigation of a residential neighbourhood in Subiaco, Western Australia through the use of a mixed-method methodology based on observation and a perception survey. A total of 61 households were observed and interviewed during the spring and summer of 2016–2017 to develop useful typological models centred on activities, movements and resident perceptions. The findings endorse the importance of the residential street as a focus place for behaviour setting but argues that in the case of the Subiaco neighbourhood, which is part of a larger car-dependent metropolitain area, movement patterns– including vehicular, cycling, pedestrian modes and jaywalking, have no significant impact on social interactions. According to the perception survey, 82% of the Subiaco neighbourhood residents see activities across the street as generating the highest level of sense of community. The study expands both, the existing theory and approaches to urban planning, by emphasising the need for making neighbourhood streets the centre of liveability through better physical design which encourages and facilitates pedestrian movement.

Keywords: activity, built form type, community building, pedestrian, quality of life, sense of community, social sustainability, vehicular

1. Introduction

Social interaction between neighbours in a residential street is very important for good quality of life and community building. With neighbours knowing each other and with people's visual presence in the neighbourhood, a sense of security and comfort is created which contributes to making the city more liveable. The main places for neighbourhood interactions are the residential streets, driveways, pedestrian paths, alleyways and sidewalks as well as the houses' fronts and their front yards. This study examines human movements around places of residence and respective residential streets using a case study in Subiaco, Western Australia, in order to understand casual social interactions and how they relate to the built urban form. The mixed-method methodology combines observation with perceptions and helps describe the sense of community whilst the new knowledge can inform planners, architects, urban designers, decision makers and interest groups to contribute to local policy and improve life in the cities where the majority of the world's population now resides. People's wellbeing is at the core of vibrant and attractive cities (Liu, 2010).

In their quest for understanding people's interactions in the city, social scientists have long ignored its physical dimensions (Mehta, 2006). Urban planners and designers however strongly suggest that the physical and social environment are inseparable in contributing to lived experiences (Jacobs, 1993). Among the limited amount of studies on people's movements and behaviour in urban open public spaces (Mehta, 2009), plazas and commercial areas have attracted attention the most (Banerjee & Loukaito-Sederis, 1992; Cooper Marcus & Francis, 1998; Gehl & Svarre, 2013; Whyte, 1980). There are only a few studies on residential areas (Appleyard,

1980; Eubank-Ahrens, 1987; Skjoeveland, 2001; Sullivan, Kuo, & Depooter, 2004). Given their importance for community building and the establishment of sense of place, residential streets are part of any integrated sustainability agenda (McKenzie, 2004). Such streets are now considered essential in creating liveable and vibrant urban social public space where daily life activities can take place (Mehta, 2013). It is important to understand the nature, patterns and frequencies of human movements, be it pedestrian, by car or bicycle, within residential areas and this study addresses this gap as research related to measuring sense of place, and people's perceptions about it, is a relatively new field of interest. It can also make practical contribution by informing any work related to the design of the urban form.

Building sense of community is an area that has gained attention in the last two decades (Meyer, Hyde, & Jenkins, 2005) theoretically but also as an applied concept with different models and measuring indices put forward. Despite this progress, people's specific activities in residential areas have not yet been thoroughly analysed. In previous work, Swapan, Bay, & Marinova (2018a; 2018b) investigated the importance of the residential front yard for community building and sustainability as a place for social bonding. They examined several new dimensions of this semi-private-public space, including visual permeability and physical distance and were able to identify that the front yard plays a distinctive role in residential neighbourhoods (Swapan, Marinova, & Bay, 2018). This body of work however does not analyse activities within residential neighbourhoods which can potentially better describe and measure movement patterns and their contribution to community building.

Using a case study in Perth, Western Australia, the main research question addressed in this research is: "Are activities and movements in residential streets affecting the quality of social relationships between neighbours in Subiaco?" In order to answer this question, the aim is to first examine the level of the existing social activities in Subiaco and then analyse the elements which contribute to the sense of community. Social interactions are represented through movement (vehicular, pedestrian, cyclist) patterns and the focus is on casual activities which take place in the houses' front spaces, such as front-yards, as well as sidewalks, verges, parking areas and in the streets. A socio-spatial activity-based typology is compared with a movement typology and the outcomes are tested against a resident perceptions survey to explore the sense of community for the Subiaco neighbourhood.

1.1 Research Background

The purpose of the built form is to provide shelter and place for human activities and movement patterns, but also for social interactions and coexistence (Knight & Ruddock, 2009). Lower density, automobile dependent, suburb style built environment characteristic for the wealthier industrialised societies of the 20th century started to be criticised for social isolation (Jacobs, 1961; Bernick & Cervero, 1997; Newman & Kenworthy, 1999). The new urban planning of 1990s called for higher density (Newman & Kenworthy, 1999; Davies, 2000) and more compact cities (Raman, 2010). Walkable streets (Gehl, 1996; Goldsteen & Elliot, 1994; Lund, 2002) with limited thoroughfare were seen as essential to better neighbourhoods (Kim & Kaplan, 2004; Perkins & Long, 2002) which could allow for more social interactions and enhance the sense of community among neighbours.

Although the importance of residential areas became to be recognised, there is a limited number of theoretical frameworks that support this (see Table 1). According to McMillan and Chavis (1986), the design of the built form in urban neighbourhoods allows for a collective identity to emerge. Residents share similar value systems and are attached to each other and their living environment. The common routes of movement bring people closer (Chua & Edwards, 1992; Chua, 1995) and residential streets become the behaviour settings for community activities and movements (Lockwood, 1997).

Table 1. Theoretical frameworks related to residential areas

Theorist	Theory	Research approach
McMillan and Chavis (1986)	Residents share common values, feel attached to each other and thus establish a collective identity with the living environment.	Literature review
Chua and Edwards (1992); Chua (1995)	Residential common circulation spaces are known as routes that bring people closer.	Literature review
Lockwood (1997)	The street is a residential 'behaviour setting' accommodating various activities and movements and enabling the enhancement of sense of community.	Literature review Practice

While psychologists prefer to keep urban design and sense of community separate (Farrell, Aubry, & Coulombe, 2004; Long & Perkins, 2003), they are often intertwined (Pendola & Gen, 2008). Sense of community is in fact a complex theoretical concept. McMillan and Chavis (1986, further elaborated in McMillan, 2011) define sense of community using four elements: (1) membership –belonging to a particular group; (2) influence – making a difference through actions and activities; (3) reinforcement – fulfilment of needs through social interactions; and (4) shared emotional connections – through familiarity and similar experiences. Primary measuring systems or tools to describe these aspects are limited. They include the Sense of Community Index (Chavis, Hogge, McMillan, & Wandersman, 1986) which is based on judges' estimates of variables related to the above four elements. Different scales for measuring the sense of community were put forward with Hill (1996) concluding that it is an aggregate variable which goes beyond individual behaviours and perceptions. Kingston, Mitchell, Florin, and Stevenson (1999) introduced the importance of neighbourhood characteristics rather than city blocks in measuring sense of community which leads to the emergence of distinct neighbourhood profiles.

The study of Puddifoot (2003) combines personal and shared dimensions as part of a Sense of Community Identity index. A Brief Sense of Community Index was put forward by Peterson, Speer, & McMillan (2008) whilst Proescholdbell, Rosa, & Nemeroff (2006) suggested needs fulfilment and membership to be combined into one component of sense of community. The community-based Brief Sense of Community Scale is a comparatively different approach which considers community perception, empowerment, mental health and depression (Peterson et al., 2008). None of these measures includes individual perceptions by community residents and this is the gap that the current study aims to address.

Sense of community is also strongly associated with the notion of social capital (Granovetter, 1973; Pooley, Cohen, & Pike, 2005; Putnam, 2000; Rose, 2000; Putnam, Feldstein, & Cohen, 2003) and social sustainability (McKenzie, 2004; Dempsey, Bramley, Power, & Brown, 2011). Using social capital as a measuring tool for sense of community has some limitations. First, it is not clear how community members are being integrated in the development process and what their individual contributions are. Second, the use of survey methods can be time- and resource-consuming requiring specialist involvement in the analysis and smaller communities or neighbourhoods can rarely afford this (Rapley & Pretty, 1999). Meyer et al. (2005) considered a community-driven resident perceptions study to measure sense of community rejecting the need for individual opinions. By comparison, this study uses individual resident perceptions in its applied methodology to inform the urban built form design process.

Sense of community has strong association with objective indicators, such as age, income and length of residence (Brodsky, O'Campo, & Aronson, 1999; Davidson, Cotter, & Stovall, 1991) but also with subjective assessment of wellbeing (Davidson & Cotter, 1991). Neighbourhood initiatives (Bolland & McCallum, 2002; Prezza, Amici, Roverti, & Tedeschi, 2001), charity and civic engagement (Davidson & Cotter, 1986), participation in local (Obst, Smith, & Zinkiewicz, 2002) and religious (Brodsky et al., 1999) organisations and political associations (Davidson & Cotter, 1989) have also been correlated with sense of community. All these studies do not incorporate individual personal opinions in framing the perception of community building. Contrastingly, this study investigates the individual residents' perceptions into measuring the sense of community at a neighbourhood level. It links this with casual acquaintances and movements in the residential streets by using a particular case study of a relatively small neighbourhood.

1.2 Research Design

The research design is based around people's daily life activities and movements within a spatially defined residential neighbourhood area. Human activity is an important factor in spatial design and social science theories explain relationships, such as homophily – people's tendency to express preferences for those who resemble them (McPherson, Smith-Lovin, & Cook, 2001), or reciprocity (Smith, McPherson, & Smith-Lovin, 2014). This allows for people to reinforce their collective identity and sense of belonging to a particular place (McMillan & Chavis, 1986). Even in the age of technological advancement, physical distance has significant influence in the formation of social relationships (Mok, Wellman, & Carrasco, 2010) and residential neighbourhoods provide a fertile ground.

A neighbourhood study of activities and movements can shed light on sense of community and social capital. Unlike natural capital which in the best-case scenario remains preserved or gradually exhausted when exploited, social capital is depleted if not used (Weston & Bollier, 2013) and augmented when certain practices and behaviours expand. Measuring activities and movements provides a good basis for understanding the status quo and shape expectations for the future.

This study is descriptive (Shields & Rangarajan 2013) in nature based on one particular detailed case study. A

mixed-method methodology is applied to describe, classify and analyse people's activities and movements within the selected residential neighbourhood in Subiaco, Western Australia. It combines insights from architecture, urban design and social science to generate new conceptualisation of sense of community.

2. Method

The following methods are applied in this research:

1) Case study method (Yin, 2013);

2) Observation (taking photographs, counting, taking notes, drawing sketches etc.) through small exploratory surveys (using behaviour mapping);

3) Interviews (gathering information about residents' perceptions).

They are outlined in more detail below.

2.1 Case Study

The case study method is based on a detailed, thick description of a distinctive unit of analysis which allows to produce new understanding about a complex multi-layered phenomenon. Selecting the actual case study depends as much as on convenience of access for the researchers as on its ability to inform theoretical development and generalisation (Yin, 2013). The chosen Subiaco residential neighbourhood satisfies these requirements. It comprises seven streets which are easily accessible and offer opportunities for rich observation and engagement with local residents to produce in-depth depiction of activities and movements.

2.2 Observation

The observation methods applied in this study are non-intrusive without the researcher participating in any of the activities. They look at the use of the area and are based on walking (Mehta, 2006) in order to map behaviour patterns (Matan, 2017). As distinct from watching casually, the direct observational methods adopted here are based on observing systematically with predetermined criteria (Matan, 2017). Activities and movements were observed separately.

Test walks (Gehl & Svarre, 2013, p. 24) or walk-by observations (Mehta, 2006; 2009) were conducted from 6 am to 6 pm during weekdays and weekends excluding school hours (7.30 am to 9.00 am and 2.30 pm to 4.00 pm). All streets from the case neighbourhood were segmented based on blocks with residential houses and activities were recorded from selected observation points for 10-minute periods throughout the day (peak and non-peak hours; morning, noon, afternoon and late afternoon). Streets are divided into six segments, namely: a) Axon Street – Barker Road cross-section to Barker Road – Bedford Avenue cross-section; b) Barker Road – Bedford Avenue cross-section to Bagot Road – Bedford Avenue cross-section; c) Axon Street – Bagot Road cross-section to Bagot Road – Bedford Avenue cross-section; d) Axon Street – Bagot Road cross-section to Axon Street – Barker Road cross-section; e) Barker Road – Townshend Road cross-section to Bagot Road – Townshend Road cross-section; and f) Barker Road – Olive Street cross-section to Bagot Road – Olive Street cross-section. In every one hour, each street segment was observed for 10 minutes and the same procedure repeated all day long. This way all six street segments were covered within an hour. Observation of activities took two months and observation of movements – two weeks to complete except some unexpected weather conditions. Weather condition during October to December 2016 and Jannuary 2017 were considered suitable for maximum outdoor social activities and movements.

Social interaction between immediate neighbours on the same street (side-by-side or across the street) is a good indicator for routine daily-life encounters. A detailed nomenclature of 40 activities was used (see Table 2) which includes playing, walking, resting, gardening, eating, drinking etc. The activities were further categorised (see Table 3) according to observed street, purpose (casual in workdays or recreational during weekends), people's posture (laying, sitting, standing or non-stationary) and location in relation to the street (front yard, parking/driveway, sidewalk/pathways, verge and street).

Using observation, movements were also recorded based on the following categories: vehicular, pedestrian, cycling, jaywalking (crossing in a matter which is not permitted or without regard of the traffic), and crossing the street to meet neighbours. There are no explicit jaywalking laws in Australia and in the state of Western Australia where the case study is based, except for pedestrians crossing at a red signal at traffic lights or within 20 m of a pedestrian crossing. A distinction between jaywalking and crossing the street to meet neighbours was carefully made to avoid bias in the observation process. A large number of jaywalkers might give an indication about faults in street design or existing pedestrian facilities.

Counting – a universal tool for studying daily life (Gehl & Svarre, 2013) was used to record activities and

movements. The total counts of activities then represent a good measure for the intensity of socialising between neighbours. According to Gehl and Svarre (2013), observing 10 minutes per hour gives a reasonable picture of the whole day's regular activities and allows a simultaneously comparative outcome to be achieved for several streets in an hour. The movement counts allow behaviours to be understood (Powell, 2010).

Looking for traces (Gehl & Svarre, 2013; p.30) or tracing (Matan, 2017) is also a very useful indirect observational method for identifying activities in a residential neighbourhood. For instance, tracing footprints on grass can help understand public movement; abandoned toys on verges, pathways or streets show children playing beyond their front-yards; full rubbish bins indicate group sitting; chairs, tables or pot plants left in public spaces show interaction among neighbours and many more similar traces can signal community activities. However, tracing was not applied in this study as we were able to observe directly the actual activities and movements. Global Positioning Systems (GPSs) and devices with GPS tools, such as mobile phones and watches can also be used, but this method of tracking (Matan, 2017) requires negotiating agreements with residents to share and disclose such information which we did not pursue. Again, the direct observation from the selected viewpoints gave us a good picture of behaviour patterns and we were able to closely monitor the residential streets.

Table 2. Nomenclature of activities

#	Description	#	Description	#	Description	#	Description
1	Chatting, talking	11	Greeting neighbours and passing-by people	21	Playing a collective game (e.g. football, volleyball)	31	Taking bins out/in
2	Checking mail	12	Having coffee/tea	22	Playing (e.g. games, chest, cards, trampoline, swings, sandpit)	32	Taking pictures/videos
3	Cleaning house, yard, objects	13	Inviting people, door knocking	23	Reading	33	Using mobile phone, e-gadgets
4	Collecting mail	14	Jaywalking	24	Resting, sleeping	34	Walking the dog
5	Eating/drinking	15	Joining gathering of people, meeting	25	Riding bicycle	35	Walking, strolling, jogging, pushing a stroller
6	Enjoying, meditating	16	Listening to radio, music/playing music	26	Skateboarding, rollerblading	36	Walking to neighbours
7	Exercising, playing individual sport, practising yoga	17	Maintaining house, roof, fence, yard, driveway and parking area	27	Smoking	37	Walking to shops, park, public transport stop
8	Feeding birds, animals	18	Maintaining verge, pathways, sideways	28	Swimming in pool	38	Washing/ drying
9	Fixing something	19	Moving objects	29	Supervising children	39	Watching
10	Gardening/watering	20	Mowing the grass	30	Supervising work	40	Working, studying, practising art

Table 3. Taxonomy of activities

Setting	Axon Street	Townshend Road	Olive Street	Bedford Avenue	Barker Road	Park Street	Bagot Road
Location	Front yard	Street parking, driveway		Verge	Sidewalk, pathway		Street
Posture	Laying		Sitting	Standing		Non-stationary	
Purpose	Casual			Recreational			

2.3 Interviews

Interviews with structured and semi-structures questions were used to collect residents' perceptions, including household members and passers-by, about sense of community in the residential area. Several of the questions related to the impact of vehicular traffic on socialising; others solicited opinion about the role of locations, such as verge, sidewalk, pathway, parking space or front yard, about joint activities with neighbours; another set referred explicitly to road design, speed levels, traffic calming and pedestrian crossing; and the final suite asked whether residents knew their neighbours by first name as informed by previous research (Glynn, 1986; Campbell & Lee, 1992; Pendola & Gen, 2008). The interviews were conducted with a total of 61 people at their house front or nearby places during the summer and spring time of 2016 and 2017 in different daytimes of weekdays and weekends. Each interview took 15 to 25 minutes on average to complete (see Table 9 and 10).

2.4 Research Steps

The mixed-methods approach required detailed information to be collected in a sequence of research steps (see Figure 1). A detailed observation of the selected Subiaco residential neighbourhood area was conducted first, followed by questionnaire-based survey interviews. Finally, the analysis of the data allowed for insights to be drawn from this case study.
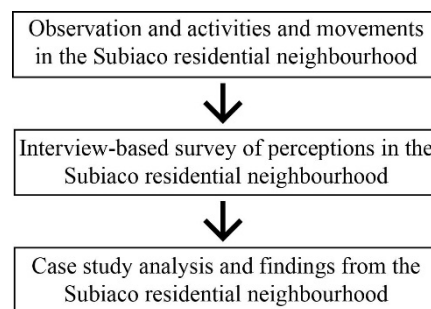

Figure 1. Research steps

3. Results

After introducing the case study for this research, the sections to follow present the data from the detailed observation, namely counts of activities and movements, and from the perceptions interview-based survey. The analysis is presented for each individual street as well as for the total of seven streets in the selected residential neighbourhood.

3.1 Case Study Description

The residential neighbourhood selected for the case study in this research is part of the suburb of Subiaco located in Perth, Western Australia – at the west of the state capital's central business district (CBD), five km east from the Indian Ocean, 12 km north-east of the port of Fremantle and north of the Swan river (see Figure 2). It is one of the oldest inner-city suburbs of Perth, subdivided in 1880 as part of the development process of the new British colony (Howe, Glass, & Curtis, 2009). Since the 1990s, Subiaco has been a vibrant and culturally attractive place. Its resident population has a relatively higher educational and income levels than the rest of Perth, Western Australia and Australia (ABS, 2016).

A neighbourhood defined by seven residential streets (see Figures 3 and 4), namely Axon Street, Townshend Road, Olive Street, Bedford Avenue, Baker Road, Park Street and Bagot Road, was chosen for the detailed analysis. The case neighbourhood is rectangular in shape with three of the streets, namely Bagot Road, Park

Street and Baker Road, running east-west (horizontally on the map in Figure 4) and the remaining four, Axon Street, Townshend Road, Olive Street and Bedford Avenue, – north-south (vertically on the map in Figure 4). There are differences in length between the streets included in the neighbourhood with the east-west being approximately double the stretch of the north-west streets. The photos shown in Figure 5 give some visual representation of selected neighbourhood segments. Although we did not explicitly use tracing, it is interesting to see some of the available house and yard features, fences, gardens, outdoor furniture and outlooks to the streets as well as free pick-up objects made available to passing-by people.
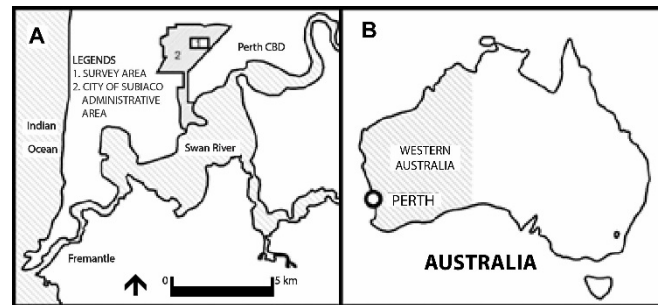

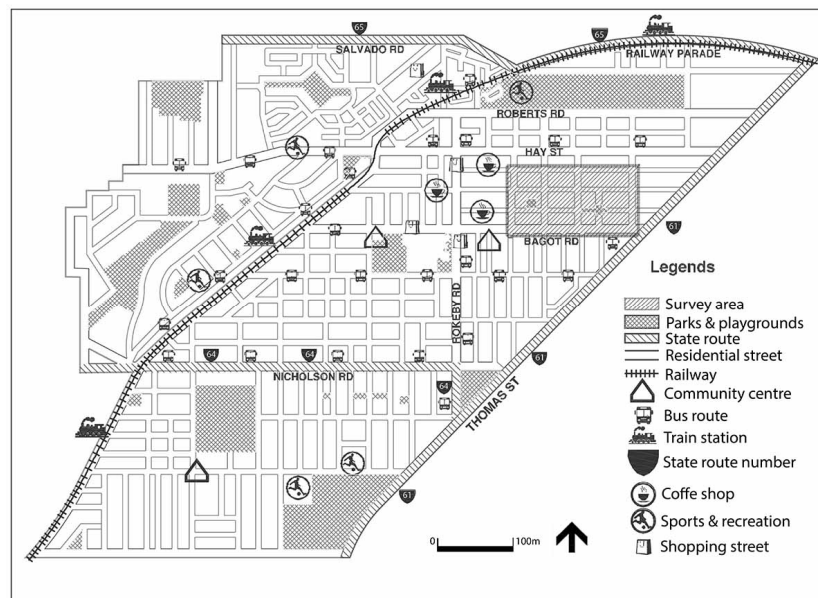Figure 2. Subiaco and the residential neighbourhood area within Australia (A) and Perth (B)

Figure 3. The case neighbourhood within the Suburb of Subiaco in Perth, Western Australia
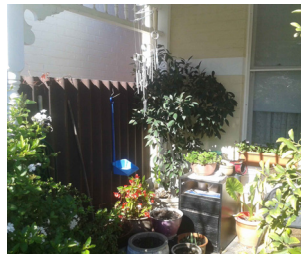
3.2 Activities

Table 4 shows the recorded activities in the case neighbourhood separately for weekdays and weekends. The distributions of the counts are according to location and by street. During weekdays, Park Street had the highest number of activities with the majority of them occurring in the front yards of the houses. Park Street is similarly the busiest during weekends when the number of activities increases and the front yard continues to be their main location.

Figure 4. The Subiaco Case Neighbourhood

Park Street – view across front yard, sidewalk, verge and street
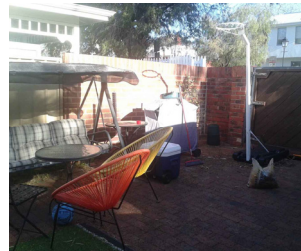
Park Street – looking for traces

Park Street – overlooking across the street

Olive Street – overlooking from the front yard

Barker Road – traces of front yard activities

Tracing sense of community – free pick-up objects

Figure 5. Snapshots from the Subiaco Case Neighbourhood

As a rule, for all streets in this case neighbourhood, the maximum activities counted take place in the front yard during weekdays as well as during weekends, with the exception of Bedford Avenue where there are more street than front yard activities during weekends. Traffic calming keeps this street almost vehicle-free during weekends and residents take the opportunity to utilise the space as an extended front yard.

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Table 4. Average number of activities per day for the Subiaco Case Neighbourhood

		Axon Street			Townshend Road			Olive Street			Bedford Avenue			Barker Road			Park Street			Bagot Road		
		w/d	w/e	total	w/d	w/e	total	w/d	w/e	total	w/d	w/e	total	w/d	w/e	total	w/d	w/e	total	w/d	w/e	total
Front yard activities		37	103	140	280	488	768	112	271	383	162	82	244	198	378	576	411	640	1051	343	442	785
Sidewalk activities		14	5	19	166	76	242	24	45	69	56	37	93	94	82	176	97	136	233	113	94	207
Verge activities		0	0	0	41	61	102	17	23	40	24	31	55	36	26	62	44	76	120	38	42	80
Parking/driveway activities		0	0	0	57	35	92	22	21	43	19	25	44	24	34	58	54	62	116	42	46	88
Street activities		0	0	0	8	4	12	4	6	10	87	146	233	4	7	11	107	97	204	8	3	11
Total		51	108	159	552	664	1216	179	366	545	348	321	669	356	527	883	713	1011	1724	544	627	1171

Note: w/d – weekdays, w/e – weekend

Table 5. Average Number of Movements per Day for the Subiaco Case Neighbourhood

	Axon Street			Townshend Road			Olive Street			Bedford Avenue			Barker Road			Park Street			Bagot Road		
	w/d	w/e	total	w/d	w/e	total	w/d	w/e	total	w/d	w/e	total	w/d	w/e	total	w/d	w/e	total	w/d	w/e	total
Vehicle	738	360	1098	6014	3692	9706	289	276	565	349	372	721	1849	1448	3297	255	382	637	4077	5542	9619
Pedestrian	210	188	398	217	268	485	180	168	348	80	196	276	276	264	540	436	494	930	136	680	816
Cyclist	11	80	91	16	24	40	17	8	26	11	12	23	54	48	102	39	24	63	46	110	156
Jaywalking	6	7	13	48	64	112	12	9	21	2	8	10	17	8	25	32	36	68	15	24	39
Crossing the street to meet others	0	3	3	26	44	70	18	26	44	21	32	53	34	39	73	78	97	175	31	52	83
Total	965	638	1603	6321	4092	10413	516	487	1003	463	620	1083	2230	1807	4037	840	1033	1873	4305	6408	10713

Notes: Note: w/d – weekdays, w/e – weekend; vehicle includes motorised means of transport, such as car, sport utility vehicle (SUV), utility vehicle (ute), van, mini-van, delivery van, bus, school bus or truck.

Park Street, part of which also has traffic calming, is the street with the maximum overall activities during all days of the week with the majority happening in the front yards. Axon Street has no verges and parking areas which results also in no street activities. These are the two extremes in the neighbourhood – Park Street with a very high level of sense of community and Axon Street with least public presence. Olive Street also appears with a low sense of community compared to the other streets.

In all streets, with the exception of Bedford Avenue, the number of activities increases during weekends compared to weekdays. This increase is more than twofold for the two streets with the lowest sense of community, namely Axon Street and Olive Street. Bedford Avenue has traffic calming and children playground areas and the street activities increase during weekends; however, there is much less happening in the front yards.

Park Street and Bedford Avenue have by far more street activities. In the other parts of the case neighbourhood, the amounts of street activities are almost negligible whilst sidewalks and pathways seem to be more attractive and come second after front yards.

3.3 Movements

The various movements during weekdays, weekends and in total are presented in Table 5. Vehicle movements dominate the residential neighbourhood with the exception of Park Street where pedestrians prevail throughout all days of the week. Cycling is very low by comparison and was observed mainly on Bagot Road, Barker Road and Park Street.

Bagot Road and Townshend Road are by far the busiest streets in this residential neighbourhood whilst low level of movement was observed in Bedford Avenue, Olive Street and Axon Street. During the weekends, vehicle movement diminishes in all streets except Bagot Road which seems to be taking the pressure from the neighbourhood. Jaywalking is the highest in Townshend Road. Residents are observed to frequently cross Park Street to interact with their neighbours which indicates significant amount of socialising.

During weekends, there is a major fivefold increase in pedestrian movement in Bagot Street. Total movements increases in weekends for three of the streets, namely Bedford Avenue, Park Street and Bagot Road whilst they decrease in the other four streets, namely Axon Street, Townshend Road, Olive Street and Barker Road.

3.4 Perceptions

Table 6 displays the results from the perception survey. All questions relate to the factors encouraging neighbourhood activities and movements within the context of their location and setting, such as vehicular traffic, existing activities and movements, the role of the front yard, speed level, road design to facilitate pedestrian movement and traffic calming. They allow to compare the real behaviour with people's attitudes. There are major significant differences which indicates that people now are well aware of their surroundings.

The street with the highest level of agreement is Park Street which also had the highest level of activities and movements. Townshend Road's results are also very consistent with the street being the second highest in terms of activities, movements and level of agreement. At the other end of the spectrum, the residents of Axon Street reported the lowest level of agreement that the current conditions in the street facilitate socialising which resonates with their activities (lowest) and movements (third lowest) in this neighbourhood. The results from Olive Street are similarly consistent with second lowest levels for activities, lowest for movements and average level of agreement as well as for Barker Road – forth in activities, third in movements but second lowest in perceptions. The remaining two streets (Bedford Avenue and Bagot Road) sit in the middle in terms of perceptions and again there are some discrepancies in the case of both Bagot Road (which has the fifth lowest level of agreement but is first in movements and third in activities) and Bedford Avenue (which has the third highest level of agreement but is fifth in activities and second last in movements).

Looking across all questions, it appears that activities across the street generate the highest level of sense of community, with 82% of the residents agreeing with this statement. This is followed by the front yard (78% agreement). Not surprisingly, vehicular traffic is seen as the biggest impediment – only 53% of residents reporting being encouraged to socialise with neighbours across the street, 45% satisfied with the specific provisions for pedestrians and 47% with the current traffic.

Several streets have 100% agreement with the assumptions in the questions, namely Axon Street in relation to vehicular traffic impeding socialising, Bedford Avenue in relation to activities across the street encouraging socialising and satisfaction with the speed limit, Park Street – with verge activities and activities across the street encouraging socialising, and Bagot Street – with movements on sidewalks encouraging socialising.

Table 6. Subicao case neighbourhood perception survey results

Question	Axon Street	Townshend Road	Olive Street	Bedford Avenue	Barker Road	Park Street	Bagot Road	Average
	% yes	% yes	% yes	% yes	% yes	% yes	% yes	% yes
1. Does existing vehicular traffic in the street encourage socialising with your neighbours across the street?	0	63	60	51	38	86	70	53
2. Is vehicular traffic in your street encourage you to watch/ engage activities/movements taking place across the street?	0	89	71	86	64	93	80	69
3. Do existing activities or movements on the sidewalks encourage socialising with your neighbours across the street?	0	89	86	43	86	93	100	71
4. Do existing activities or movements on the verges encourage socialising with your neighbours across the street?	0	78	72	72	74	100	80	68
5. Do existing activities or movements in the street parking spaces encourage socialising with your neighbours across the street?	0	89	100	57	75	86	90	71
6. Is your front yard helping you socialise with your neighbours across the street?	66	78	57	86	87	93	80	78
7. Do the activities across the street generate attachment with your neighbours enhancing the sense of community?	34	100	71	100	87	100	80	82
8. Does the speed level in this street allow social interaction with your neighbours across the street?	16	33	66	100	74	86	60	62
9. Are you satisfied with the existing road design for pedestrians (crossings, islands, road width, traffic sign etc.) in relation to your interaction with neighbours across the street?	33	78	57	57	50	72	30	54
10. Is traffic calming beneficial for interaction with your neighbours across the street?	33	89	62	72	50	57	90	65
11. Are you satisfied with the pedestrian crossing across the street to socialise with your neighbours?	0	78	28	100	25	57	30	45
Average level of agreement	17	79	66	75	65	84	72	65

The answers reported in Table 7 relate to knowing neighbours by their first name considered a good indicator about familiarity. Townshend Road, which has the second highest level of activities and movements, is also the street whose residents have the highest familiarity with their neighbours. They know on average 16 neighbours by first name (see Table 7). Park Street residents' familiarity is knowing 14 neighbours by first name which is also relatively high and in line with the street having the highest level of activities.

Table 7. Knowing Your Neighbours by Name in the Subicao Case Neighbourhood

Street	Number of residents interviewed	12. How many neighbours do you know by first name at the same side of your street?	13. How many neighbours do you know by first name across the street?	14. How many neighbours do you know by first name in your neighbourhood?	Average for the neighbourhood
Axon Street	6	8	12	29	4.8
Townshend Road	8	105	54	126	15.8
Olive Street	7	12	12	32	4.6
Bedford Avenue	7	27	38	43	6.1
Barker Road	8	47	37	91	11.3
Park Street	15	170	109	205	13.7
Bagot Road	10	92	41	100	10.0

4. Discussion

In order to understand sense of community, we need to have some indication as to what are reasonable levels of happenings and going-ons which involve social interactions and create the conditions for people to feel attached and belonging to a community (McMillan & Chavis, 1986; McMillan, 2011). This case study of one particular residential neighbourhood offers a suite of examples of different levels of activities and movements, which allow us to develop a taxonomy. The categories put forward are high, medium and low representing standard classification groups and the easiest way to categorise data. There are different ways to define the category thresholds and the one used here is based on the quantile method (Slocum, 1999) which requires equal distribution of values based on the number of classes – three in this case. For convenience, the thresholds are rounded up to the nearest one hundred for activities and one thousand for movements. A similar approach is used for the perception typology but the rounding is only to percentage.

Table 8 shows a comparison between the streets in the residential neighbourhood based on the so-developed typologies. There seems to be a close alignment between categories of activities and movements for Axon Street (low), Townshend Road (high) and Bagot Road (high). Barker Road falls within high activities, but medium movements while Olive Street and Bedford Avenue have medium activities but low movements. The most interesting case is Park Street where there appears to be a discrepancy between high activities and low movement; this however is the result from relatively low vehicular movement. If the typology is based only on movements other than vehicular, both activities and movements fall within the high category.

Table 8. Typology of activities and movement

	Activities typology			Movement typology			Perceptions typology		
	High	Medium	Low	High	Medium	Low	High	Medium	Low
	Number of activities			*Number of vehicles/persons*			*Percentage*		
Range	*900+*	*400-899*	*0-399*	*8000+*	*5000-7999*	*0-4999*	*≥63*	*40 to 62*	*≤39*
Axon Street			x			x			x
Townshend Road	x			x			x		
Olive Street		x				x	x		
Bedford Avenue		x				x	x		
Barker Road	x				x		x		
Park Street	x					x	x		
Bagot Road	x			x			x		

Residents in the majority of the streets in the neighbourhood have adequate perception levels about sense of community – high in Park Street, Barker Road, Bagot Road and Townshend Road and low in Axon Street. However, residents in Olive Street and Bedford Avenue had higher opinion about the socialising in their neighbourhood while activities were at a medium level and movements at a low level.

Townshend Road displays an overall good sense of community; however, it has the highest number of jaywalkers (see Table 5) which indicates that pedestrian provisions need some improvement. This is despite the high level of approval (78%) of existing pedestrian crossings, islands, traffic signals and road width.

The residents are crossing Park Street as part of social encounters without using any designed pedestrian crossings which seems to be a safe way to move given the low vehicular presence and high number of pedestrian movements. Park Street residents similarly have a high perception of their street encouraging socialising.

Traffic calming is not an explicit factor in promoting sense of community. Although Park Street and Bedford Avenue which have traffic calming and playgrounds rank high in people's perceptions, Park Street is good in activities and pedestrian movements while Bedford Avenue is below average for both which may indicate that it is being deliberately avoided. Townshend Road on the other hand has no traffic calming and playgrounds but is second best for activates, movements and people's perceptions.

It is interesting to note that the busiest streets in terms of movements, namely Bagot Road and Townshend Road have some of the highest levels of activities and people also perceive them as encouraging socialising. This confirms Lockwood's (1977) theory about the role of the street as a central focus. Axon Street which has no verges or street parking similarly aligns with this theory as it exhibits the least activities and movements and people also perceive it as not encouraging socialising.

Finally, out of all spaces which bring people closer (Chua & Edwards, 1992; Chua, 1995), the residential front yard seems to be the second most attractive location competing only with activities across the street which are also likely to be in the neighbours' front yards too. This confirms previous research about the important role of the front yard for social sustainability (Swapan et al., 2018a; 2018b).

The results from the analysis of the Subiaco case neighbourhood show an overall high level of sense of community. Movement patterns on the streets are integral part of the physical communication network connecting each house with the neighbourhood through streets. Each house is connected to the street network and establishes a compulsory and unavoidable relationship web to communicate in a socio-spatial manner. This research proves that movement patterns do not have any significant effect on social interaction in the case of Subiaco as we see large discrepancies between movements, activities and perceptions. A possible explanation for this may be the fact that Perth continues to be a car-dependent city and despite some recent transformations (Newman & Kenworthy, 2015), the efforts to drastically change this have a long way to go. Motor vehicle-based practice is still prevailing and often weakening the process of sustainable design (Curtis, 2005). In the meantime, people are working solidly on engaging with their neighbours and creating communities which make our cities liveable and desirable.

Acknowledgments

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