

Curtin University Sustainability Policy Institute

**Sense of Community: an Investigation of the Semi-Private-Public
Interface in a Residential Community**

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Doctor of Philosophy
at
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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made. This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

The research presented and reported in this thesis was conducted in accordance with the Ethic approval obtained from the Curtin University Human Research Ethics Committee Approval Number RDHU-42-16.

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A handwritten signature in black ink, appearing to read 'Abu Yousuf Swapan', with a stylized flourish at the end.

Date: 14 October 2018

Statement of Contribution of Others

All of the written materials submitted as part of this PhD by Publication were conceived and coordinated by Abu Yousuf Swapan. Swapan also undertook the majority of the empirical data collection, analysis and writing for each publication.

Signed detailed statements from all co-authors relating to each publication are provided as appendices at the back of this volume (Appendix A).



Signed
Abu Yousuf Swapan, PhD candidate



Signed
Professor Dora Marinova, Supervisor
Date: October 2018

ABSTRACT

This thesis by publication consists of four articles investigating the community building potential in inner-city residential suburbs by using as an example a neighbourhood in Subiaco – a suburb in Perth, Western Australia. In response to the need to understand the frequency of social interaction within a physical environment, the study develops taxonomic tools based on detailed observations and perception surveys of residents and residential properties. These tools can inform urban planning policy aimed at making cities more sustainable.

With the majority of the world population residing in cities, the integration of social issues into urban sustainability policy and planning is increasingly becoming more important. However, most empirical research separates the social from physical aspects and focusses predominantly on public plazas and commercial areas. Investigations of residential suburbs are scarce and this study fills this gap by exploring the community building potential of a neighbourhood. It does so by measuring socialisation, creating a residential built form typology and analysing street life. A particular attention is given to the fronts of residential houses or units, namely the front yards, and how they interact with the street.

In response to the recently developing trends which identify the special importance of semi-public residential spaces in creating a sense of community, the study develops a novel built form typology and introduces the new type of the semi-private-public space. To do so, it uses a mixed-methods approach based on observation and surveys of public perception, to examine the strength of the sense of community as means for building communal engagement and identity. This semi-private-public space is the front yard of the houses – an area often forgotten by planners and policy makers but essential for social interactions in residential neighbourhoods.

The four publications examine key factors influencing the intensity and quality of social contacts and life on the residential streets of the Subiaco neighbourhood. Compared with other outdoor open spaces, the first publication identifies the front yard as the most appropriate built form type for promoting social interaction. The second publication introduces visual permeability as a passive way of socialising in addition to physical accessibility in order to balance the private and public domains. Based on an original typology of physical distances and social closeness, the third publication allows a better conceptual development of the sense of community to inform integrated sustainability. The fourth publication examines the quality of social interaction by qualifying casual daily-life activities against various movement patterns in the residential streets of the studied Subiaco neighbourhood. Theoretically, this thesis informs a better understanding of social interactions through the notion of the semi-private-public space which has practical implications for planning better residential areas.

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PUBLICATIONS INCLUDED AS PART OF THIS THESIS

The following list includes the publications which form part of this thesis.

Publication 1:

Swapan, A. Y., Bay, J. H., & Marinova, D. (2019). Importance of the residential front yard for social sustainability: comparing sense of community levels in semi-private-public open spaces. *Journal of Green Building*, 14(2), 177-202. doi:10.3992/1943-4618.14.2.177

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LIST OF ADDITIONAL PUBLICATIONS

The following list includes other publications and a conference presentation relevant to this thesis but not forming part of it.

Other publications:

Swapan, A. Y. (2016). Holistic strategy for urban design: A microclimatic concern to sustainability. *Journal of Urban and Environmental Engineering*, 10(2), 221-232.

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CHAPTER 1: INTRODUCTION

The current global population represents mostly urban dwellers and their numbers are estimated to continue to increase. Designing a quality physical or built environment which takes into consideration people's social, economic and ecological needs is a concern of urban planners and policy makers. However, physical design together with economic and environmental issues tends to attract more attention in city planning than building resilient communities with strong bonding and commitment to their place of residence.

Social sustainability and planning the urban built form are often conducted as separate activities. They are seen to come together mainly in relation to the role of public spaces, and particularly public open spaces, which allow for social interaction (Jacobs 1961; Lynch 1981; Gehl 1986; Cooper-Marcus & Francis 1998). Nevertheless, the last few decades have witnessed shrinking of the outdoor urban open spaces in many countries, including Australia (Freestone, 2004) and the United States (Banerjee 2001). For example, in the 1970s common outdoor places in Australian suburbs, including parks, playgrounds and small pocket spaces, have been transformed for other public uses, such as fire stations and housing for pensioners (Freestone, 2004). Even the existing open public spaces are often under-utilised because of their anonymous character and lack of self-identity (Arendt, 2013; Lofland, 2017).

Another place fostering social interaction is the street. Nowadays streets are no longer seen only as a route of transport (Carmona, Heath, Oc, & Tiesdell, 2003) but also as a place which fulfils people's social needs and contributes to the sense of community (Langdon, 1997). Their commercial setup however has attracted more research attention as representing the public realm (Mehta, 2006) than the importance of residential streets which seem to have being neglected. Furthermore, limited interest has been given to the nexus between the house fronts and the residential street. The current PhD study is focused on the overlooked link between the house fronts and the residential street. It uses a case study from Perth, Western Australia to analyse the importance of the front yards within residential areas for creating a sense of community. Perth covers a large metropolitan area divided into 355 suburbs (Landgate, 2019), one of which is Subiaco – the particular case study covered in this PhD research.

Subiaco is an inner-city suburb in Perth is located west of the central business district of the Western Australian capital, five kilometres east of the Indian Ocean and 12 km north-east of the Fremantle port (Howe et al., 2009). It first appeared as a suburb in 1885 and until the 1950s was populated by working-class low-income residents (Spillman, 1985). Since the 1970s, its location close to the University of Western Australia and cheap rents attracted students and younger families, and by the 1990s it became a culturally vibrant neighbourhood (Spillman, 2006). The 2016 population of Subiaco was 16,234 with a density of 31 persons per hectare over a total land area of 562 hectares (City of Subiaco Community Profile, 2016). Nowadays, Subiaco is a suburb of educated people with a sound economic status. In 2016, the personal median yearly income of its residents was AUS\$59,592 compared to AUS\$37,648 for Western Australia and AUS\$34,424 for Australia (Australian Bureau of Statistics, 2016). A particular neighbourhood covering seven streets was selected within Subiaco for a detailed analysis.

There are several reasons for selecting Subiaco as a case study for this research. First, this is a relatively old suburb within the Perth metropolitan area which has experienced the influence of different urban development concepts. It was originally established in the 19th century based on the walking city model (Newman, 2018) but in the 1970s was highly impacted by the influence of the automobile and now is being shaped by residential infill and medium density developments. Second, the case neighbourhood area identified within Subiaco is completely residential without any commercial activities. The selected streets have house fronts which allow to investigate, observe and count any social interactions of the local residents in addition to conducting surveys about the importance and use of the interface between the public and private areas. Third, the central location of Subiaco allowed ease of access for the systematic and prolonged research observation and investigation required for this PhD research.

This case study-based research investigates human behaviour in such an existing inner-city residential context in Australia to further explore the level of social interaction. It analyses key links between the physical design and community responses in relation to the creating of sense of belonging and engagement at the local level. A number of taxonomical models related to the classification of the urban form are derived from a human behaviour-based theoretical framework, then confirmed through observation and cross-examined based on people's perceptions. These first-hand collected data are used to produce scaled typologies with the objective being to aid local planning policy in improving the existing physical design of residential areas.

In addition to the four refereed publications forming the body of the PhD thesis, this overview describes the background, states the research questions, objectives and clarifies the used methodology. The four published papers are then summarised. They all are based on the case study of the residential suburb of Subiaco in Perth – the capital of Western Australia. Nevertheless, it is hoped that the insights, including the developed taxonomies, can be applicable to many similar urban planning situations. Finally, future research directions are put forward.

1.1 Background

It is vital to see sustainability through the lens of sense of community. The Western Australia Council of Social Service (WACOSS) defines 'social sustainability' as a process that fosters socially interactive and vibrant communities which promote improved quality of life for current and next generations (Barron, & Gauntlet, 2002; McKenzie, 2004; Sen, 2013; Anand, & Sen, 1996). Social sustainability aims at supporting public needs through a combined effort of creating a liveable, pleasant and enjoyable physical and social environment (Woodcraft, 2012). One major indicator for social sustainability is quality of life which relates mainly to housing and health, including mental wellbeing (Sen, 2013; Anand, & Sen, 1996) and healthy communities.

Urbanisation and community development are closely inter-related. According to UN DESA (2018), 4.2 billion people already lived in the cities in 2018 with some estimates putting the share of the current global urban population as high as 84% (Scruggs, 2018). Irrespective of the actual figure, the reality is that in the upcoming

years people will continue to live mainly in human-made urban environments described as the built form (Lewin, 2012). This urban development will also have to deliver the transition to more sustainable practices and become the catalyst for better relationships between people and the natural world (Wheeler, & Beatley, 2000; Lewin, 2012) as well as between people themselves.

In the last few decades, sustainability thinking is considered a serious framework for the built form as reflected in the disciplines of planning, architecture, and urban design (Williams, Burton, & Jenks, 2000). Various urban forms are being defined as “sustainable” (Giddings, Hopwood, & O'brien, 2002; Jenks, & Dempsey, 2005) and the concept of “sustainable community” aims to create resilient long-term social interactions (Dempsey, 2011). Furthermore, the “sense of community” and “sense of place” notions are explored as a condition for sustainability and ways to develop the quality of life and strengthen urban communities (Pretty, Chipuer, & Bramston, 2003; Stedman, 1999).

A major shift towards more sustainable cities has been the emergence of New Urbanism as a planning and development approach for a human-scale design of the urban fabric with walkable streets, proximity to shopping areas and easy accessibility to public spaces (CNU, n.d.). It offers an alternative to the sprawling, automobile-dependent and low-density urban developments which have “shown to inflict negative economic, health, and environmental impacts on communities” (CNU, n.d., n.p.). The transition to the new urbanism paradigm (The Charter of the New Urbanism, 2001) aims at making cities friendlier, more livable, environmentally better, cleaner and improve service delivery using digitalisation and other smart technologies. Perth, Western Australia is an example of such a transitioning from a low-density, car-dependent city in the 1970s to a more sustainable new urbanist approach.

In 1997, the State Government of Western Australia adopted the new urbanist approach as a dominant concept in its planning and community design for sustainable cities, namely the Liveable Neighbourhoods policy (WAPC, 2007). This Liveable Neighbourhoods agenda promotes building strong communities through features, such as closely interconnected neighbourhoods, walkability as a healthy travel behaviour, public-private relationships and site responsive identity for local places (Falconer et al., 2010). Despite some questioning whether there is a significant difference with the previous conventional model of the 1970s, 1980s and the early 1990s and doubting the contextual relevance between standards and practice, there has been consistent support for new urbanism in Perth, Western Australia (Falconer et al., 2010). The Liveable Neighbourhoods policy has been reviewed five times since its inception with the latest edition released in 2015 (WAPC, 2015). The case study adopted in this PhD research contributes to understanding the importance of the front yards within the new urbanism approach from a sense of community perspective. In order to understand the contributions made by the four published papers, it is important to shed light on the concept of sense of community and its various components.

1.2 Sense of Community

Sense of community is a vitally important element of quality of life but since the late 1990s it has been found to be significantly missing in the developments that have

taken place in western countries, including Australia (Baum, & Palmer, 2002; Raman, 2010). Even the new urbanism approach has left gaps when it comes to establishing vibrant communities. Sense of community means an emotional state (Davison, & Rowden, 2012) of belonging and of residents being respected reciprocally; it is a common belief that community members' necessities will be privileged (McMillan, & Chavis, 1986).

Despite its good intentions, new urbanism has been evaluated as being too ambitious and loosely integrated with mobility in the city and its transport network (Flint, 2006). This impacts on urban walkability and the ability to engage with the local community. New urbanist housing models, such as Vauban Freiburg and Solarcity Linz (Schroepfer and Hee, 2008), have been criticised for creating false hopes about community building in a built environment where streets are privatised (Sorkin, 2001), the right of speech in public spaces is snatched away (Kohn, 2004) and there is little exposure for interaction at the house fronts (Schroepfer and Hee, 2008). This creates residential built forms with limited variation and affects the owners' ability to express their individuality preventing the establishment of sense of community (McMillan and Chavis, 1986; McMillan, 2011). Considering these circumstances, the PhD case study tests and justifies the prime components of the new urbanist agenda within a Western Australian context by bringing together the physical design and the sense of community.

As the conceptual model and empirical foundation of sense of community (McMillan & Chavis, 1986) have avoided the physical aspects of a neighbourhood, these two aspects need to be brought together with further exploration (Talen, 1999). Even though the elements of sense of community, namely attachment, interaction, identity and walkability, have been identified (Nasar & Julian, 1995), the physical environments are widely absent in the existing literature (Kim 2001). Unless a strong connection is made between the urban form and the socio-psychological aspects of the way people feel and interact on a daily basis within a location (Rappaport, 1987, it is difficult to achieve sense of community. These four elements need to align within the socio-physical design of a neighbourhood for a sense of community to emerge.

Against this background, the Subiaco case study intertwines the socio-psychological aspects with the physical characteristics of residential neighbourhoods and establishes ways to capture the sense of community. The four elements which bind together the social and physical environment are explained first followed by a discussion of gaps in the research related to sense of community.

1.2.1 Socio-physical aspects of sense of community

According to Kim and Kaplan (2004), the four elements of sense of community are: attachment to community, socialising, community identity and walkability.

Community attachment relates to the residents' sense of emotional bonding with other people living in the same place. Socialising happens during regular and irregular encounters establishing relationships and connections between residents. Community identity concerns public and personal identification with geographically specific suburban dwellers of distinguished character. Walkability represents the extent of neighbourhood design for pedestrian movement, encouraging activities on streets which delineate a given physical setting (Kim, 2007).

Attachment

Attachment to community evolves when residents are emotionally connected to their own neighbourhood. A strong homely feeling can be developed from a high level of satisfaction with the home environment and thus create close emotional attachment with the immediate community (Mesch & Manor, 1998; Zaff & Devlin, 1998). The strong sense of connectedness promotes greater wellbeing (Jose, Ryan & Pryor, 2012). In addition, community attachment is enhanced when residents have a high sense of physical (Kelly & Hosking, 2008; Waxman, 2006) or psychological ownership (Liu, Wang, Hui & Lee, 2012; Hummon, 1992). Place attachment is strongly connected to community participation and contributes to developing sense of community (Manzo & Perkins, 2006).

Compared to rural environments, the attractiveness of cities lies in the wider range of opportunities, including better education, employment and services, they offer to their residents. Cities however are also under pressure to accommodate their growing populations with apartment housing. In developing countries, such as Brazil, India, Kenya, Pakistan or the Philippines, this has resulted in vast slum areas. In other parts of the world where the government has adopted a centrally planned approach, such as in China, new uniform residential suburbs are being created. Being a migrant country, Australia is similarly under pressure to provide housing for its burgeoning urban populations. Extending the physical limits of its automobile-dependent cities, also known as urban sprawl (Newman, & Kenworthy, 1999), has been the solution for many decades. The outcome from most urban development strategies across the globe was the creation of residential areas to which people cannot attach emotionally as they are not attractive and do not enrich their lives.

In Australia, and specifically in Western Australia, efforts have been made more recently to stop the urban sprawl and replace it with strategies which encourage urban infill, higher density and mixed use of the space (Newton, & Glackin, 2014; Foster, 2006; Llewelyn-Davies, 2000) in line with the theoretical position of urban planners such as Jane Jacobs (1961). This has made established inner-city residential areas more attractive with their green public open spaces, networks of services, facilities, communal events and activities, offering an appealing quality of life (Urban Task Force, 1999 in Raman, 2010, p. 64; Rudlin, & Falk, 1999). Residents feel attached to this alluring lifestyle and vibrancy. The Subiaco case study for this thesis is an example of such an inner-city neighbourhood and the presented analysis discusses the contributing factors for attachment to this physical environment and developing a sense of community.

Social interaction

Social interaction is closely associated to sense of community. It allows people to mix with each other in a formal or informal way and works as a catalyst in developing different types of relationships. Social interactions in public places are often anonymous (Swapan, Bay & Marinova, 2019) while ordinary casual encounters in a residential suburb are more important for identity building. They have however been widely overlooked in previous research (Gehl, 1986).

The physical characteristics of the suburban neighbourhoods impact on the movements and behaviour patterns of their residents (Burton, Jenks, & Williams, 1996). They influence the establishment of social relationships and networks

impacting on people's interactions (Raman, 2010). For example, physical barriers, such as walls, fences and security bars, can directly restrict criminals (Newman, 1972) but also residents. Symbolic barriers, such as low walls, railing and shrubs, on the other hand help define the identity of the private from public areas and also influence the level of social interaction (Perkins et al., 1990, p.85, 87). A design which restricts mingling and social mixing can lead towards degraded sense of community (Putnam, 2000; Frumkin, Frank, & Jackson, 2004). According to Huat (1995), community building develops during the process of familiarisation with neighbours and people in the locality through greeting, meeting and seeing each other in common areas.

Furthermore, Gehl (1987) emphasises the necessity of passive participation, and low-intensity contacts, such as acquaintances and chance encounters, which provide valuable opportunities for interactions. These occasions often happen in the residential streets, alleyways, lanes, walkways, right-of-ways and footpaths, as well as at the interface between the private house and the public street. The Subiaco case study explores the need for a nexus between the front of the house and the residential street as well as the importance of the streets themselves for the intensity and nature of social interactions. Natural surveillance (Jacobs, 1961; Bentley, Alcock, Murrain, McGlynn, & Smith, 2015; Dovey & Wood, 2015) is another factor in interaction which creates a feeling of safety, stabilises the sense of community and ensures familiarity and engagement amongst neighbours (Iveson, 2006). These aspects are also discussed in the case study.

Community identity

Community identity relates to the private and public recognition and identification with a particular physical and social environment (Kim & Kaplan, 2004). It can be triggered in various ways, including through displaying a distinct local character (Twigger-Ross & Uzzell, 1996), continuous property ownership or residence from generation to generation (Giuliani, 1991; Mumford, 1961) and feeling a sense of belonging to the local community (Puddifoot, 1994).

Identity is related firstly, to the visual appearance of the urban form with residential suburbs passing the test of character (Dovey, Woodcock, & Wood, 2009). Increasingly calls are made for direct involvement of residents in designing specific features (Jiven, & Larkham, 2003), including pathways, street art, markets, festivals and community events, or making decisions, such as shift to carbon neutrality or participatory budgeting by local government (Hartz-Karp, & Gorissen, 2018). Secondly, people exhibit a sense of belonging and identify with the residential area where they live. For example, a woman can describe herself as a "Fremantle girl" (another suburb in Perth) or a "Subiaco lady". People also use diminutive nicknames to portray the specific identity of a place, such as Freo (for Fremantle) or Subi (for Subiaco).

The case study suburb, which has long existed as an Aboriginal Noongar settlement, was given the Italian name Subiaco – the birthplace of the Benedictine Order, by a group of monks who settled in the area in 1851 (History of Subiaco, 2018). This history is long forgotten by present-day dwellers whilst the vibrant, attractive and culturally rich nature of the suburb is often expressed by the way people talk about Subi. A complete list of the origin of all street names, including the ones in the case

study neighbourhood, is available on the website of the City of Subiaco local council. (<https://www.subiaco.wa.gov.au/CityofSubiaco/media/City-of-Subiaco/Your-council/History-of-Subiaco/CITY-OF-SUBIACO-STREET-NAMES,-July-2016-updates-and-revisions.pdf>) which indicates not only engagement with history but also desire to establish a distinctive identity. Identifying with Subiaco helps local residents not only express their interest in the history and cultural vibes of the place but also to engage with the vision and planning for its future. The design of the physical environment further influences such an engagement.

Pedestrianism

Pedestrianism refers to the walkability of a place; in other words, how easy and enjoyable it is to experience the locality by walking. Studies on how *pedestrianism* can contribute to the social environment are scarce and positioned beneath the shadow of the transportation literature (Lund, 2002). Recently however pedestrianism has started to gain ground as a major concern in urban planning policy in Australia (Falconer et al., 2010) and other parts of the world (Wey & Hsu, 2014). Although the new urbanist desire for more social mixing, limited automobile dependence and enhanced sense of place are better matched in older neighbourhoods, such as Subiaco, local residents are also expecting those qualities in modern suburbs (Lund, 2002).

Walkability gives a different perspective about the design of the urban form and the resultant sense of community. Spatial typologies on the other hand can affect the movement and social interactions within a specific locality (Southworth, & Owens, 1993). Historically, the streets were used for everyday public needs (Rudofsky, 1969; Lofland, 1973, 1998), such as shopping, meeting with others and spending leisure time. Gradually in contemporary societies, such activities have moved to private, parochial or virtual public spaces (Brill, 1989a, 1989b; Banerjee, 2001; Chidister, 1989; Rybczynski, 1993). To encourage walkability, streets, alleys, sidewalks and pathways should remain prominent public spaces (Mehta, 2009; Jacobs, 1961) and vital as informal civic realm (Carmona, 2003).

Residential streets should encourage pedestrian mobility and connectivity between neighbours. By connecting the private spaces of the house fronts with the public space, streets provide opportunities for extended outdoor presence and increased communication between members of the community (Gehl, 1987). More often than not, social interactions extend from the street to the private realms of the houses, such as the front yard, entrance deck, plinth, porch, veranda, forecourt or front garden. This set of built form types leading the pedestrian from indoor to outdoor or vice versa, is defined as 'semi-private-public' because it represents the interface between the publicly and privately owned domains of the inner-city suburban living areas. These transitory semi-private-public places have a high community building potential and this was explored in the case neighbourhood of Subiaco.

Pedestrianism is also affected by people's perceptions about safety and the overall physical conditions in which they live (Raman, 2010). While there have been studies examining the correlation between the qualities of the urban built form, its social context and the satisfaction with residential conditions (Rohe, 1985; Taylor, 1982; Weidemann, & Anderson, 1985), the role of residential streets and the adjacent

semi-private-public spaces in creating a sense of community is explored for the first time with the Subiaco case study.

1.2.2 Research gaps in analysing sense of community

Based on the psychological perceptions as a central idea in community building, there was an urge for theoretical development during the 1980s with the aim to focus on social and environmental wellbeing. The new urbanism was a manifestation of this. Among other things, it put a strong emphasis on daily interactions within neighbourhoods. In following the new urbanism conceptual tradition, this PhD study bridges several gaps in existing research as they relate to the socio-physical aspects of sense of community. They are described as gaps in the analytical focus, measuring sense of community and redefining the private-public discourse and are discussed in turn below.

Analytical focus

Residential streets have not attracted a lot of research attention as a place for social interaction. Only a few studies have examined residential spaces and streets (e.g. Skjoeveland, 2001; Appleyard, 1981; Sullivan, Kuo, & DePooter, 2004; Eubank-Ahrens, 1991). According to Mehta (2009, p.31), even residential area related research “categorically separates the study of the physical features of the environment from the land uses”. It does not account for the management and operation of these streets (Joardar, & Neill, 1978; Hass-Klau, 1999) whilst social science investigations tend to ignore the physical environment (Mehta, 2006) or take it as a given factor that is hard to change. On the other hand, planners and urban designers realise that “it remains difficult to isolate physical features from social and economic activities that bring value to our experiences” (Jacobs 1993, p. 270).

There have been mixed-use studies in residential neighbourhood but most of them focus mainly on commercial activities, such as small scale industrial uses, cultural and retail enterprises (Mehta, 2009). Plazas have attracted significant interest as public places (e.g. Dornbush, & Gelb, 1977; Joardar, & Neill, 1978; Linday, 1978; Miles, Cook, & Roberts, 1978; Loukaitou-Sederis, & Banerjee, 1993; Share, 1978; Cooper-Marcus, & Francis, 1998; Liebermann, 1984; Banerjee, & Loukaitou-Sederis, 1992; Whyte, 1980). For example, the work of Whyte (1990) is the foundation for the place-making transformation of New York which successfully changed various outdoor spaces, including streets, plazas, parking lots into “people places” to boost commercial activities. Other examples to allow activities are traffic calming and street sharing. Although these are ways to control vehicle speed, in most cases the main design input comes from engineers rather than architects or planners (Ben-Joseph, 1995) with residents having very limited contribution.

In this PhD thesis, the analytical focus is entirely on the residential streets the way they are perceived and used by the local people. In addition to analysing the physical design, public perception is also used as a method of investigation. Related specifically to the role of residential streets, this new study enriches the academic literature by examining that particular gap in the analysis of sense of community.

Measuring sense of community

The Subiaco case study used in this thesis is an example of a traditional historical suburb which has experienced the impacts of the age of automobile and then new

urbanism. Being a reaction to modernism (Congress for the New Urbanism, 1996), not all intentions of new urbanism to create communities by planning materialised. Some of its problematic consequences include privatisation of public spaces due to inability to afford the maintenance cost (Freie, 1998) and shrinking of social mixing (Zukin, 1995). According to the study by Southworth and Parthasarathy (1997), residents in Seaside Florida in USA exhibit restricted friendliness to their next-door neighbours and often discourage free public movement around their premises. This creates tension in connecting neighbourhoods and community (Robbins, 1998).

New urbanism does not embrace the social, economic, cultural, spatial transformations related to contemporary daily life and Winstanley et al. (2003, p. 175) describe it more as a “rhetoric designed to sell houses profitably rather than a community development project”. Measuring sense of community can potentially help in understanding what we are doing better or worse with new urban concepts and practices. However, this is another research area with many gaps and differences of opinion.

Different scales and indices have been used in the sense of community literature to capture the impacts of the physical environment and the way people experience it (Chipuer & Pretty, 1999). However, there is too much variation in the models, scales or measures used for different contexts (Hill, 1996; Chipuer & Pretty, 1999, p.645). Furthermore, only a few studies address the association between socialising, interaction, collective identity and community satisfaction with sense of community (Chipuer & Pretty, 1999, p.645).

The roadmap to defining a sense of community is complex and largely unknown. An attempt at measuring it is the Sense of Community Scale (Doolittle & MacDonald, 1978; Tropman, 1969) which includes five factors, namely: likely informal socialising with neighbours, safety, pro-urbanism, frequent social mixing, and involvement in neighbourhood issues. Many other similar tools and measures have been put forward, including among others the Brief Sense of Community Scale (Peterson, Speer, & McMillan, 2008) and the Italian Sense of Community Scale (Tartaglia, 2006).

It is essential to acknowledge that the urban physical space, including the characteristics of the built form typology, is the behaviour setting (Barker, 1968) where the sense of community manifests. In this sense, the feeling of belonging and attachment is dependent on the built environment in which people live and where they exhibit particular behaviour patterns (Lang, 1987). The physical environment should not be analysed or designed without understanding its social importance and this is particularly relevant to residential streets (Mehta, 2009). Measuring the link between the physical space and social needs is essential for good quality of life and the building of resilient communities. This helps identify a research gap related to measuring the place of the street as a new frontier in building better neighbourhoods.

This PhD study is an attempt to address and measure the socio- physical attributes of the case-study neighbourhood in Subiaco. It does this by redefining the importance of the space which links the house fronts and the residential streets and putting forward the concept of the semi-private-public place.

Redefining the private–public discourse

The majority of urban design schemes since the 1990s have been based on mixed-use, optimal density, and better access to local amenities (Llewelyn-Davies, 2000). Being a prominent global promoter of public space, Jan Gehl has also drawn attention to the “soft edges” with the private realms (Gehl, 1986) as a significant factor influencing urban rhythms and the social interaction in the residential suburbs of Canada, Denmark and Australia. The interrelationship between private and public space, namely the soft edge of the streets, needs further understanding with regard to sense of community (Gehl, 1986). Avoiding potential bias in comparing suburbs within different socio-demographic context, this PhD study focusses only on Subiaco to critically address and extend the private-public discussion further. It introduces the new frontier of the ‘semi-private-public’ place which shapes the ability of residential streets and neighbourhoods to facilitate building sense of community.

Such a semi-private-public place is represented by the house fronts and their front yards. These small-scale residential built forms are almost absent in the previous literature and this PhD opens up new insights to address the issue using the physical context of Subiaco.

Understanding the regular activities within the residential streets has the potential to build resilient and sustainable community and this requires further improvement in theory and practical implementations. Linking the physical and the social environment presents a challenge despite its critical importance in creating liveable neighbourhoods. The question how the built form enables the sense of community to develop remains an unexplored area and the PhD research fills this gap using a case example from Western Australia.

1.3 Need for this research

Although Australian inner-city suburbs are rich in tradition, they are poor in design and street life is often overlooked as a driving force to boost community building (Australia, 1994). This PhD research aims to inform planning practices as there is a lot of conceptual and policy-based shifts towards making Australian suburbs more sustainable. For example, the Australian Neighbourhood Improvement Program (NIP) wants to integrate social elements in the planning scheme. Crime Prevention Through Environmental Design (CPTED) similarly targets creating better residential communities with safe pedestrian movement (Sohn, 2016). This cannot be achieved without recognising the significance of the residential streets (Lockwood 1997; Swapan, 2016) and the adjacent to them semi-private-public spaces. Hence, the need for research which can evaluate the connection between the physical environment and people’s perceptions about it within a residential context.

Planners and researchers acknowledge the value of advancing sense of community (Francis, Giles-Corti, Wood, & Knuiman, 2012). People’s perceptions about the built environment where they live further impacts on their sense of community (Foster, Giles-Corti, & Knuiman, 2010; Wood, Frank, & Giles-Corti, 2010). There is however very limited research on linking the built form and sense of community on residential streets. The PhD research contributes filling this existing gap through investigating the connection between physical milieu and people’s sense of community in residential areas. It uses social elements which are found to be more

appropriate to determine sense of community than environmental aspects (Moustafa, 2009).

The scarcity of research on physical factors in social science might be limiting the transfer of theoretical knowledge into application (McMillan, & Chavis, 1986). This research intends to contribute towards value-adding by exploring the existing pitfalls within the context of residential neighbourhoods. It can be informative and useful for developers, consumers, design consultants, and policy makers in creating more attractive urban living environments. The knowledge drawn from one specific detailed case study informs the development of built form typologies that can be used as building blocks within residential streets with the understanding of their implications for the local community and its engagement with the neighbourhood.

1.4 Research questions and objectives

This research investigates the issue of the physical environment influencing social relationships for enhancing the potential for community building in the inner-city residential context of Perth, Western Australia.

The overarching question which this thesis seeks to answer is:

- *How does the built form influence social interactions within a residential neighbourhood?*

This research question is answered using a case study neighbourhood in the centrally located suburb of Subiaco in Perth, Western Australia.

In order to answer the research question, the main objectives of this study are:

1. To identify and analyse the residential built form type which is the most important within a sense of community context;
2. To analyse the concept of accessibility as a requirement for the frequency of social interaction in an inner-city living environment;
3. To analyse the concept of distance and develop a typology which allows better conceptualisation of the sense of community within a residential neighbourhood;
4. To analyse people's movements, activities and perceptions about their residential street from the perspective of creating a sense of community.

In total four publications are presented as part of this thesis in response to the above four objectives:

- *Objective 1* is achieved in *Publication 1 "Importance of the residential front yard for social sustainability: Comparing sense of community levels in semi-private-public open spaces"*. It identifies and explores the front yard as the most desired outdoor place for social interaction for Subiaco residents. A two-tier survey method is applied under a mixed-method approach to elicit the result. The front yard is identified as an important semi-private-public interface for creating a sense of community.
- *Objective 2* is achieved in *Publication 2 "Understanding the importance of front yard accessibility for community building: A case study of Subiaco, Western Australia"*. It explores the concept of accessibility as an integration

between the built form – represented through physical accessibility and visibility, and social interaction – represented through the perceptions about accessibility. Visual permeability is a new dimension of passive accessibility equally important as a key driver promoting sense of community. The study further endorses the front yard’s role as an important interactive social outdoor place.

- *Objective 3* is achieved in *Publication 3 “Built form and community building in residential neighbourhoods: A case study of physical distance in Subiaco, Western Australia”*. It develops a physical distance typology based on social closeness as a tool to measure the conditions for social bonding between immediate neighbours. A comparison is then made between the physical and perceived social closeness which indicates some discrepancies showing that Subiaco residents are selective in choosing friends but are overall open-minded in maintaining basic relationships with their neighbours.
- *Objective 4* is achieved in *Publication 4 “Understanding sense of community in Subiaco, Western Australia: A study of human behaviour and movement patterns”*. It presents a detailed analysis of human movements (pedestrian, vehicular and by bicycle) and casual activities (based on a comprehensive nomenclature) within the Subiaco neighbourhood and compares them with the perceptions of the residents. Three typologies (of movements, activities and perceptions) are created which allow to test the quality of social interaction in residential neighbourhoods.

Positioned within the same theoretical framework of sense of community and social sustainability, all publications contain detailed description of the Subiaco neighbourhood including discussion of the urban design and policy implications from the research findings. They use a methodology which combines detailed observation of the physical set-up and perception surveys of the neighbourhood residents. This mixed-methods approach allows for physical and social dimensions to be caught up and analysed simultaneously in order to produce meaningful outcomes.

1.5 Thesis structure

Being a thesis by publication, this Chapter 1 introduced the main theoretical framework for the study and stated its research question and objectives. Further literature review and discussion of previous studies are presented in the published papers. Chapter 2 explains the overarching research methodology and techniques used given the fact that a detail description of the methods is contained in each individual publication. Chapter 3 summarises the four publications included in this research and outlines the overall contribution of the thesis. Finally, Chapter 4 draws conclusions from this work and directions for future research.

The four chapters are followed by the published articles which are reproduced word-for-word for Publications 2 to 4 and in the authors’ final version for Publication 1. Figure 1 represents the structure of the thesis.

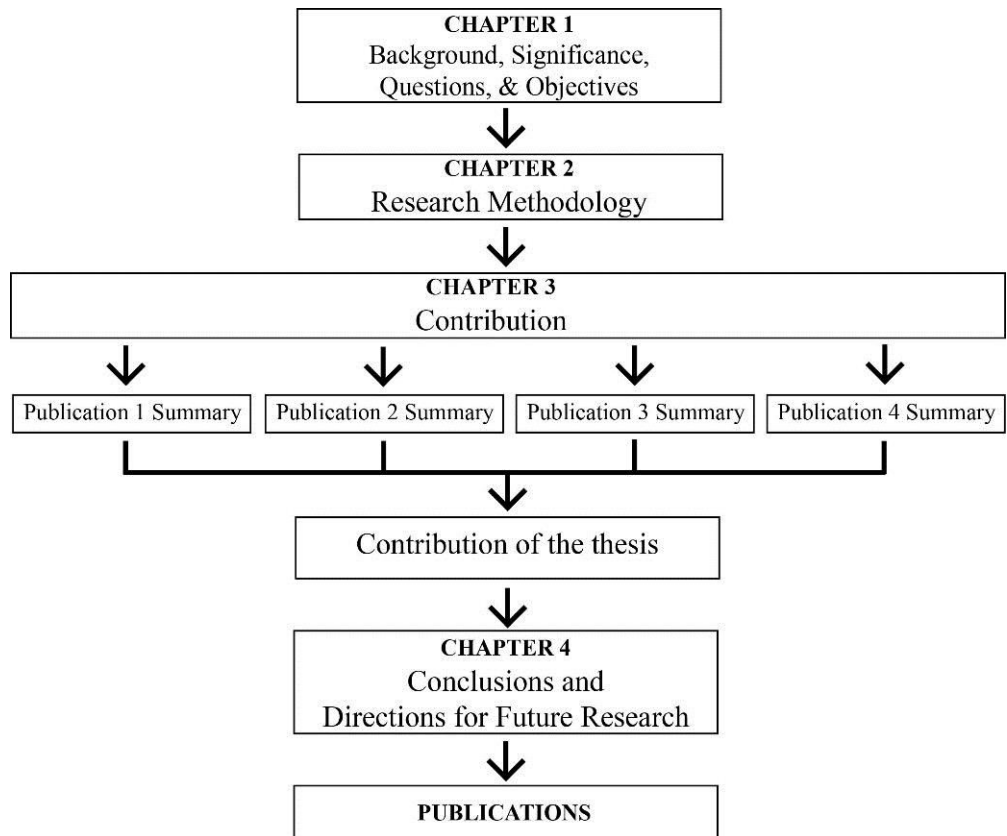


Figure 1. Structure of the PhD thesis

CHAPTER 2: RESEARCH METHODOLOGY

Researching the built environment is a complex task because of its links with information from various disciplines like urban design, architecture, policy studies and social science. Moreover, the socio-environmental inter-relationships between users, stakeholders, property owners and other interest groups make planning and decision making even more multi-faceted (Daddi, Testa, Frey, & Iraldo 2016; Clemen, & Reilly, 2014). Single-method (Rossman, & Wilson, 1985) research approaches are often proved as incompatible (Howe 1988), unsuitable and strongly opposed by mixed-method researchers who are looking for pragmatic outcomes (Leech, Dellinger, Brannagan, & Tanaka, 2010; Onwuegbuzie, & Leech, 2005). According to Ibn-Mohammed (2017), research related to the built environment often encompasses different opinions, viewpoints, emotions and behaviour patterns which are unable to be captured through a single-method approach. Furthermore, urban design is in many ways intertwined with people's behaviour and perceptions about the place where they live.

Against the background of investigating sustainability issues which promote an integration of environmental, social and economic priorities, exploratory research based on literature and secondary data is rarely enough to formulate new concepts (Creswell, 2008) and hybrid models are required in what could be perceived as quasi-experimental (Kong et al., 2018) or living laboratory (Keyson, Guerra-Santin, & Lockton, 2017) circumstances. Hence hybrid models, combined strategies (Groat & Wang, 2013) and mixed-methods methodologies are adopted as more appropriate (Youmans, 2011; Yeap, Yaacob, Rao, & Hashim, 2012).

The use of mixed-methods methodologies is not new. It is particularly attractive for areas which require conceptual development and practical application, including the development of nomenclatures to be used across different disciplines. According to Greene, Caracelli, and Graham (1989), the majority of the studies which employ mixed-methods approaches pursue complementary results (as distinct to triangulation of results) and expansion of the breath and range of inquiry. This is also the reason for adopting a mixed-methods methodology in the current PhD study.

Designing the specific type of mixed-methods methodology depends on three considerations, namely timing of the application of the specific methods (Greene et al., 1989), relative weight and combination or mixing of qualitative and quantitative methods (Creswell, & Plano-Clark, 2011). Timing refers to the sequence of the various methods used, which can be sequential or simultaneous, including bracketed and concurrent (Greene et al., 1989) but also iterative – for example, literature review might be required at different stages of the research process. Weighting depends on the appropriately proportionate mixture of quantitative and qualitative methods in addressing the research questions with distinction made between equal priority or more weight given to one (that is qualitative or quantitative) of the approaches (Creswell, & Plano-Clark, 2011). Mixing establishes a relationship between the qualitative and quantitative data and strands of research during design of study, collection of data, analysis and interpretation (Creswell, & Plano-Clark, 2011).

Most importantly, this study mixes quantitative and qualitative approached to achieve a transformative framework (Creswell, & Plano-Clark, 2011) in analysing the issues related to understanding how the built form influences social interactions

within a residential neighbourhood. It uses a case study approach (Yin, 2013) to illustrate how theory development can occur from formulation of the problem to establishing of different categories and typologies, to identifying of research outcomes and informing urban design practice. All four publications are based on the same case study which provides a rich foundation for eliciting understanding about the interrelated issues of building sense of community within a neighbourhood as they relate to the most important built form, accessibility and distance as well as movements, activities and perceptions linked to the residential street. Hence, the mixed-methods methodology adopted in this research is of a small-exploratory-descriptive type which is unable to produce generalised decisions for any urban environment (Schutt, 2012). It does however generate appropriate initial understanding of unexplored issues (Babbie, 2015) which is quite important for boosting up further comprehensive investigation. The applicability of the research findings depends on the ability of the future researcher, practitioner or policy maker to find appropriate similarities and common conceptual grounds when looking for solutions in a different set of circumstances (Yin, 2013).

Generally, this study primarily accumulates qualitative data to formulate theoretical frameworks (Bryman, 2006; Creswell, 2003) and create ground for observation. It then applies less prominently quantitative data for generalising, replicating, validating and supporting the qualitative data (Creswell, Shope, Plano-Clark, & Green, 2006). The qualitative and quantitative methods are applied in a connected and integrated manner. All four papers use three distinctive research stages, namely: establishing of a theoretical framework, observation and perception survey, and interpretation of results and research findings. They are explained in further detail below.

Establishing a theoretical framework

All four publications share a common theoretical framework which was developed based on thorough literature review. The key theories relate to the works of Whyte (1980) who established the link between physical space and social cohesion, Gehl (1986) who promotes the importance of outdoor stay for social interaction, Bay (2010) who introduced the notion of semi-open space, Carmona (2011) who advocates the importance of typologies and most importantly the writings of McMillan and Chavis (1986) who defined and described the concept of sense of community. They all link physical design with social interactions which is also the basis for this study.

Observation

As distinct from needs, human behaviour can be observed. In fact, behaviour is considered to be the empirical counterpart of human needs (Doyal, & Gough, 1991, p. 50), which also include needs for social interactions. Hence, observation is a useful way to understand human behaviour (Michelson, 1975; Craik, 1970; Studer, 1969) whose characteristics can be made empirically verifiable and operationally definable (Joardar, 1977). Conceptually 'behaviour circuits' (Sachs, 2018; Perin, 1970) connotes that people's behaviour can be tracked throughout the fulfilling of daily needs at the scale of the house, block, street or neighbourhood in order to understand how urban design works. Gehl (2011) used this to measure social interaction by counting daily life activities between buildings. When using

observation, meaningful results can be obtained without the need to specify the reasons for a particular behaviour (Groat, & Wang, 2013).

The four publications used direct systematic observation as a non-intrusive way to record human behaviour as follows:

- Publication 1 – observation was applied to develop an inventory of outdoor places in Subiaco. This inventory was used for surveying all residents in the selected neighbourhood soliciting responses related to the importance of the various open built forms for socialising;
- Publication 2 – all front yards in the selected Subiaco neighbourhood, which covers seven streets, were observed and the respective physical and visual accessibilities recorded. Based on these data, a front yard accessibility taxonomy (high, medium and low) was developed which informs built form design;
- Publication 3 – all houses in the selected Subiaco neighbourhood were observed with the distance from the edge of the veranda to the centre point of the sidewalk measured and then categorised according to the developed scale of social closeness. The data for individual houses were aggregated at a street level and analysed;
- Publication 4 – resident activities based on a detailed nomenclature comprising 40 items (ranging from greeting neighbours to cleaning the yard) and movements (pedestrian, vehicular and by bicycle) were observed and counted. This allowed for a typology (high, medium and low) to be developed and the resident streets in the Subiaco neighbourhood to be classified and analysed.

Perception survey

Community development, including sense of community, is a process rooted not only within the physical form but also how people feel about their neighbours and the social environment in which they live (Chavis, & Wandersman, 1990, pp. 56-57). Resident perceptions are used to predict the sense of community (French et al., 2014). They relate to perceptions about the environment, existing social relationships, professed control and empowerment in the community. What people think, which statements they support or reject, how they answer specific questions related to their neighbourhood, represent their attitudes and in many ways determine people's behaviour.

Perception surveys were used in all four publications based on direct interviews with representatives from all households in the Subiaco neighbourhood. The specific details are explained below:

- Publication 1 – representatives from all households were asked four questions related to the social use of the open outdoor places in Subiaco identified through the detailed observation. The front yard stood out as the most preferred place. A further set of 11 statements related to accessibility, activity and ownership of the front yard were read to the participants who were asked to agree or disagree with them. The front yard was seen as a socially connecting place which sits outside the juxtaposed notions of private and public spaces;
- Publication 2 – the same 11 statements as used in Publication 1 are analysed from the point of view of physical accessibility, visual permeability, sense of

safety, activity, sense of belonging and interactions and communication. The study found a good match between the physical design and people's perceptions of the front yard;

- Publication 3 – the Subiaco residents were asked to agree or disagree with statements which describe the degree of social interaction in relation to their front yards. The results were then compared with the observed physical distance to develop a typology of closeness;
- Publication 4 – the residents in the Subiaco neighbourhood were asked for a “yes” or “no” answer to 11 questions related to the physical design of their residential street. They were then requested to state the number of neighbours whom they know by first name. The data were aggregated at a street level and a perception typology of activities and movements (high, medium and low) was developed which allowed analysis and comparison with the information obtained through observation.

Interpretation of results and research findings

In all publications, the qualitative methods based on literature review established the overall research framework and formulate the areas of interest, were followed by quantitative analysis. To draw conclusions qualitative analysis is further used. Hence, the timing of the qualitative and quantitative methods is sequential bracketed (Greene, Kreider, & Mayer, 2005) and their weighting is equal. The mixing was essential to capture a concept which is that fluid and difficult to seize or get control over as in the case of sense of community. This allowed to maintain a flexible approach with room for adaptability. A range of typological scales for the sense of community were developed which facilitated the description and categorisation of the urban built form (Casadevall, & Fang, 2008).

The interpretation of the research results was based on description (Shields, & Rangarajan, 2013) in the case of Publications 1, 2, and 3 where the aim was to identify which is the urban form and what are the existing taxonomies. Publication 4 was exploratory as it provided answers related to patterns of activities and movements. The chapter to follow summarises all individual publications and explains their contribution to knowledge.

One limitation of the work was that the collection of data had to be manageable by a single person within the duration of a PhD project. No additional technical assistance was used. In addition to satisfying the criterion of being a well-established inner-city suburb, the particular Subiaco neighbourhood segment was selected based on convenience and easy access by public transport.

CHAPTER 3: SUMMARY OF PUBLICATIONS AND CONTRIBUTION

This chapter shows a summary of the four publications submitted as part of this thesis with full texts available in Appendix 1. All publications cohesively contribute to answering the research question of the thesis. They are summarised in Table 1 followed by descriptions of the individual papers and the overall contribution of the thesis.

Table 1. Summary of the publications included in this PhD thesis

Paper title	Journal and status	Contribution
Publication 1: Importance of the residential front yard for social sustainability: Comparing sense of community levels in semi-private-public open spaces	<i>Journal of Green Building</i> , 14(2) Published 2019	Significance of residential streets to sense of community and the importance of the semi-private-public front yards in comparison to other outdoors open space types
Publication 2: Understanding the importance of front yard accessibility for community building: A case study of Subiaco, Western Australia	<i>Urban Science</i> , 2(2), 41 Published 2018	Importance of keeping a balance between public and private inter-relationship in inner city residential neighbourhoods for creating and maintaining a sense of community
Publication 3: Built form and community building in residential neighbourhoods: A case study of physical distance in Subiaco, Western Australia	<i>Sustainability</i> , 10(6), 1703 Published 2018	A novel typology of physical distances and social closeness within a residential neighbourhood which allows better conceptualising of the sense of community for achieving integrated sustainability
Publication 4: Understanding sense of community in Subiaco, Western Australia: A study of human behaviour and movement patterns	<i>Journal of Sustainable Development</i> , 11(5), doi:10.5539/jsd.v11n5p1 Published 2018	Importance of activities within residential streets for social interactions with movement patterns having no significant impact in an automobile-dependent city

3.1. Publication 1 Importance of the residential front yard for social sustainability: Comparing sense of community levels in semi-private-public open spaces

Bibliographic reference:

Swapan, A. Y., Bay, J. H., & Marinova, D. (2019). Importance of the residential front yard for social sustainability: comparing sense of community levels in semi-private-public open spaces. *Journal of Green Building*, 14(2), 177-202.
doi:10.3992/1943-4618.14.2.177

Status: Published refereed journal article.

Publication abstract

Sustainable design is emerging as inevitable for the global urban population. Usually sustainable design is associated with economic, ecological and social aspects with the importance of the physical environment often ignored, particularly in social science. However, the physical and social dimensions should be inseparable in the sustainable development agenda. Increasingly urban designers are emphasising the link between physical design and sense of community in public open spaces, but there is limited research on the importance of residential streets and associated semi open public spaces, such as verges, and private spaces, such as the front yard. Using the case study method, including observation and a survey in the suburb of Subiaco in Perth, Western Australia, this article explores the significance of residential streets and the space typology of front yards in comparison to other outdoors open space types. The analysis of the front yard's contribution to the street and community can inform designers, developers, planners, policy makers and residents to achieve more attractive inner city living environment.

Approach

Cities will remain the main living place for the current and future global population – estimated to reach 68% by 2050 (UN DESA, 2018). They need to provide human habitat but also contribute towards making people's lives and development more sustainable. To make this happen, research related to the urban built environment has to adopt a further holistic viewpoint giving importance to integrate the social issues within a sustainable design framework. The way residential neighbourhoods are designed, including the combination of private, semi-public and public spaces, is directly related to people's quality of life as well as sense of community. Access to open spaces within the urban environment in particular is observed as a vital aspect of city life. In fact, it is a particular target of the United Nations Sustainable Development Goal 11 Sustainable Settlements and Communities (Sustainable Development Knowledge Platform 2017). This publication investigates the problem of building sense of community through the lens of residential outdoor spaces and their influence on establishing social relationships.

Based on the case study of a neighbourhood in the suburb of Subiaco in Perth, Western Australia, this research justifies the need to understand the importance of the houses' front yards for social interactions and maintaining a sense of place. Research on front yards in relation to enhancing the sense of community as well as contributing to sustainable community building is scarce and this publication introduces a new frontier in investigating the urban built form.

Methods and findings

The study first establishes the link between sustainability and sense of community by exploring the existing definitions and theoretical backgrounds. Second, an inventory of outdoor spaces is organised based on observation which is then used to shortlist the favoured places for socialising for the Subiaco residents. A quantitative survey asking 140 residents (8% confidence interval width at 95% confidence level) indicated the houses' front yard as the most favourite outdoor place within the neighbourhood. Third, a typological study of the outdoor spaces in relation to their influence on regular encounters for social interactions was conducted. The 61 semi-structured interviews with various questions (demographic, opinion-based and open-ended) confirmed people's perceptions about the front yard being the most important outdoor space for local residents. Finally, the significance of the front yard was discussed within a human-environment connection.

The two-stage survey produced convincing evidence that the front yard is the most commonly used outdoor urban form for Subiaco residents. Its importance as a significant sense of community place is also confirmed by the perception study. The front yard plays an essential role in constructing bonding relationships between residents.

Contribution

The front yard is termed in this study as a 'semi-private-public' place is the most active physical setting offering various social activities, defined built form and a development source for sense of community. This publication opened up a new frontier on a different aspect of sense of community by rejuvenating a widely neglected urban built type, namely the front yard which offers high potential and needs to be considered in local planning schemes. Ultimately this is a cutting-edge study of the urban built form in the field of social sustainability.

3.2. Publication 2 Understanding the importance of front yard accessibility for community building: A case study of Subiaco, Western Australia

Bibliographic reference:

Swapan, A. Y., Marinova, D., & Bay, J. H. (2018). Understanding the importance of front yard accessibility for community building: A case study of Subiaco, Western Australia. *Urban Science*, 2(2), 41.

Status: Published refereed journal article.

Publication abstract

The residential built form, including open space, provides the physical environment for social interaction. Understanding urban open space, including semi-public and public domains, through the lens of physical accessibility and visual permeability can potentially facilitate the building of a sense of community contributing to a better quality of life. Using an inner-city suburb in Perth, Western Australia as a case study, this research explores the importance of physical accessibility patterns and visual permeability for socialising in semi-public and public domains, such as the front yard and the residential streets. It argues that maintaining a balance between public and private inter-relationship in inner city residential neighbourhoods is important for creating and maintaining a sense of community.

Approach

Ultimately social sustainability promotes resilient communities through a better sense of community and close social interactions. The design of the physical environment can influence social interactions by bringing people closer. Public places are an important physical environment where people congregate and researchers have previously analysed them from the perspective of commercial settings. However, social mixing in commercial public places often lacks a sense of identity (Mehta, 2006) compared to small spaces which shape the residential streetscape and foster social interactions. Studies on inner-city residential suburbs however are rare despite the potential offered by spatial elements available at the house fronts and nexus to the street to promote intense social interaction. They include front yard, walkways, verges, parking lots and actual streets.

The front yard is a popular common space all over the globe with various social, economic and climatic usability (Groth, 1990). Though being private, the front yard is able to perform as a public space showcasing the personal identity and defined as semi-private-public for its omnipotent quality. Thus the front yard is able to afford mixed social experience with both active physical and passive visual involvement. This human-environment relationship is strongly related to creating sense of community. This paper explores the front yard's contribution in community building as well as towards sense of community by analysing its specific qualities of being physically accessible and visually seen.

Methods and findings

Methodologically, this study firstly explored the physical environment based on the level of socializing and then compared to the residents' opinion to justify it. The majority of the front yards in Subiaco are found to offer potential for social interaction based on their physical accessibility. Based on the perception survey, the residents' opinion about the physical design in contextualising social interaction, relationship development and community building is also quite affirmative of the importance of the front yard.

Contribution

In this research, public-private visual connections between neighbours are investigated. This is a new field in community building research. The developed physical and visual connection-based typology of the semi-private-public front yard is able to inform local planning policy. Although the socialising potential of the physical settings of the front yard is obvious, the opportunities remain vague without considering residents' perceptions. By extending the understanding of the importance of the front yard accessibility, this piece of work contributes towards community building.

3.3. Publication 3 Built form and community building in residential neighbourhoods: A case study of physical distance in Subiaco, Western Australia

Bibliographic reference:

Swapan, A. Y., Bay, J. H., & Marinova, D. (2018). Built form and community building in residential neighbourhoods: A case study of physical distance in Subiaco, Western Australia. *Sustainability*, 10(6), 1703.

Status: Published refereed journal article.

Publication abstract

With physical and social aspects being inseparable within urban environments, design for sustainability needs to include the link between the distance and sense of community. However, only a few studies examine residential suburbs and specifically focus on the physical and social interactions occurring within the streets and adjacent to them spaces, such as verges, sidewalks and front yards. Using a case study method, including observation and a perception-based survey in the inner-city suburb of Subiaco in Perth, Western Australia, this investigation opens up a new understanding of physical distance and social interaction. It develops a novel typology of physical distances and social closeness within a residential neighbourhood which allows better conceptualising the sense of community for achieving integrated sustainability.

Approach

The current global population residing in urban areas (54% in 2014) needs to place further attention on integrated sustainable living environments (Peterson, 2016; Cuthill, 2010) to combat future demands – urban population size is predicted to increase to 66% by 2050 (UN, 2014). Urban living environments in this century emphasise quality of life in respect of health and habitat (Lessmann, & Rauschmayer, 2013; Anand, & Sen, 1994), including more cohesive social relationships and stronger sense of community. Safe access to open green public spaces is important for human wellbeing (Roseland, & Spiliotopoulou, 2017), particularly in residential suburbs. Conventionally, residential streets are prototypical public spaces able to promote sense of community (Francis, 2016). However, given the traffic in an automobile-dependent city, the semi-private-public house fronts with their connections to the street become crucial for enhancing urban quality of life (Swapan et al., 2019). A properly designed physical environment can facilitate a socially responsive and resilient local community. Considering Subiaco as the case study, this publication aims at exploring the combined effect of physical distance and social relationships within a residential context.

Methods and findings

This latest research is a rare case of addressing physical and social issues, and their impacts on human behaviour. First, the theoretical background is conceptualised in relation to built form, sense of community and human behaviour. Second, the case study method is elaborated and presented with research outcomes. Third, a cutting-edge typology named ‘social closeness’ is developed informed by the work of Latané and colleagues (Latané, & Liu, 1996; Latané, & Wolf, 1981; Latané et al., 1995; Latané, & Liu, 1994), to link directly physical distance and social interaction. The neighbourhood size taxonomical findings help to better perceive the relation between residential built form and sense of community.

The publication shows that design decisions based on theoretical knowledge are not only inadequate but also subject to cross-evaluation prior to application. This study explored the front yard as crucial in partaking cultural practices and developing empirical knowledge. Subiaco residents’ conservative mentality about socializing with their next-door neighbours is an important outcome which can help policy makers in understanding the local community sentiments and social conditions. The Subiaco residents’ moderate open-mindedness is a unique social-psychological entity

through which they maintain a balance between closer and necessary relationships. Thus, physical distance cannot be considered the only means of understanding social closeness.

Contribution

For the first time this study explored the unique nature of the socialising capacity of Subiaco residents which is a strong indicator for urban planning policy. Moreover, the developed closeness typology is a useful tool for measuring the socialising capacity of local residents. This new knowledge is beneficial for urban planners, architects, urban designers, policy makers and various interest groups contributing in the community building process.

3.4. Publication 4 Understanding sense of community in Subiaco, Western Australia: a study of human behaviour and movement patterns

Bibliographic reference:

Swapan, A. Y., & Marinova, D. (2018). Understanding sense of community in Subiaco, Western Australia: a study of human behaviour and movement patterns. *The Journal of Sustainable Development*, 11(5), doi:10.5539/jsd.v11n5p1

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Publication 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 metropolitan 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.

Approach

Quality of life is a primary condition for achieving socially interactive and desired lifestyle in an urban context (Liu, 2010). Casual encounters in the inner-city residential suburbs are crucial for social wellbeing and improving the sense of community. This study represents a combined investigation (Jacobs, 1993) of physical and social issues embraced by urban designers and planners which was previously an area neglected by social scientists (Mehta, 2006). Within the few studies which link human behaviour and movement to the urban context (Mehta, 2009), research on commercial plazas dominate (Gehl & Svarre, 2013; Cooper Marcus, & Francis, 1998; Banerjee, & Loukaito-Sederis, 1992; Whyte, 1980) while interest in residential areas (Sullivan, et al., 2004; Skjoeveland, 2001; Eubank-Ahrens, 1987; Appleyard, 1980) is rare. This study is focused on the importance of understanding the characteristics, types and frequencies of human movements (i.e. vehicular, pedestrian and cyclists) and correlates them to public perception. Previous attempts of measuring the sense of community through frequency of movement do not include people's perception. This is the first study aimed to fill in this gap in measuring the sense of community. Additionally, this can inform the application of practical design for improving the urban built form.

During the last two decades the theoretical development in creating sense of community is receiving increased importance (Meyer, Hyde, & Jenkins, 2005), including various applications and measuring methods (Hill, 1996; Mitchell, Florin, & Stevenson, 1999; Puddifort, 2003; Peterson, Speer, & McMillan, 2008; Proescholdbell, Rosa, & Nemeroff, 2006; Peterson, Speer, & McMillan, 2008). Nevertheless, none of these methods considers individual perceptions in the investigation process. Activity-based studies of human behaviour in residential area are also scarce. This study is in the vein of the recent cutting-edge research (Swapan, Bay, & Marinova, 2019) on the significance of the residential front yard as community building device and a common place for bringing neighbours closer to each other. These investigations on the semi-private-public front yards developed new knowledge about visual permeability as a passive socialising process, and physical distance as measuring social closeness (Swapan, Marinova, & Bay, 2018). This study, however, analyses observed behaviour.

Realising the urge for better understanding and measuring the qualities of social interactions in terms of various activities and movement patterns, this study applies a case study method to further expand the existing knowledge. This publication develops a taxonomy of activities, movement patterns and perceptions with three different scales (high, medium and low) which help analyse and categorise the residential streets.

Methods and findings

Using a mixed-methods approach this study closely observed various activities and movement patterns around the house fronts to examine regular social interactions which were then confirmed by the perceptions of residents. The outcomes from this publication show that Subiaco residents have a highly positive level of sense of community. Although high frequencies of activities are important for social interactions, traffic calming has very little influence on encouraging safe movements and enhancing the sense of community. Traffic calming use is often misleading in planning decisions about neighbourhood street design. The perception study confirms the front yard as the most useful semi-private-public space engaging neighbours in various casual activities within and across the streets.

Contribution

Busy streets in the neighbourhood case study area, such as Bagot Road and Townshend Road demonstrate higher sense of community despite their heavy vehicular traffic which endorses Lockwood's (1977) explanation about the central role of the main street in neighbourhood design. This publication shows that movement patterns have no impact on social interaction. It exposes the dominance of motorist-oriented planning practice which often hinders progress towards a more sustainable design development (Curtis, 2005).

This study endorses the previous three publications (Swapan et al., 2018, 2019) and creates a strong ground for the front yard as the most significant physical environment for social interaction in inner-city residential suburbs, such as Subiaco. Hence, the case of Subiaco can be a role model for future research, architects, urban planners, policy makers and other interest groups.

3.5 Contribution of the thesis

This PhD thesis is designed to investigate the following research question:

- *How does the built form influence social interactions within a residential neighbourhood?*

All four publications help in providing insights how to answer this question and the contribution to knowledge development of the thesis is multi-dimensional. The overall provided answer is that in suburban neighbourhoods, the main way in which the built form influences social interactions is through the semi-private-public places that connect to residential streets. Below is an explanation of the main contributions this PhD thesis makes.

An overlooked issue re-introduced

The issue about the built form influencing social interactions within residential settings has been long overlooked. Residential streets have been neglected by urban design researchers for decades. This thesis re-introduces this issue on the research agenda. It establishes a logical ground for recognising the link between social interactions and the built form by starting with a study of the most desired physical space encouraging socialisation, namely the front yard, then widening its scope by exploring functional capability through passive connectivity between the streets and their front yards, furthering the importance of distance oriented typologies at the nexus between the public and private spaces and finally testing the actual capability of the physical design to encourage activities and movements within the residential streets.

New terminology and a new built form type introduced

This PhD research delivers a deeper understanding of the public-private interrelationship within a residential context through a thorough exploration of the inter-mingling capacity of the front yards in Subiaco and its capacity for building sense of community. The study is innovative in introducing a new terminology, named 'semi-private-public', to describe a very important built form type – the front yard.

A new multi-disciplinary research methodology

This research is rejecting the conventional social science approach of splitting physical and social studies. It is an example of multi-disciplinary research combining theoretical knowledge and practical applicability from the domains of built environment, urban design, architecture and social science. The overarching innovative research approach using mixed-methods methodology in combining observation with perception surveys is consistently applied across all publications. Mixed-methods studies are increasingly important in comparatively new and underdeveloped research areas.

Public views about sense of community

This thesis touches the ambiguous task of incorporating public involvement in local planning and policy making. The majority of existing studies excludes residents' personal opinions about sense of community. On the contrary, this research takes an opposite stand to this approach and comprehensively integrates public perception as playing a central role in community building.

Importance of ordinary socialising

Every iconic place for a sense of community has an ordinary beginning. People need repeated ordinary encounters to establish a close relationship and this thesis is specifically focused on these routine interactions. It showcases these casual relationships as being central to our daily life and significantly impacting on building of sense of community.

Common symbol system

A wide nomenclature of activities during social interactions is catalytic to forming relationships within the community. A number of typological (both physical and social) models were developed in this thesis which help understand our practiced common symbol system representing collective social attitudes. It could be concluded from this research that social interactions (activities) are capable of contributing to the physical environment (street scape) of our neighbourhoods as well as to our city. This means that the process of community building is directly informing the physical formation of the built environment.

Missing link between architecture and urbanism in modernism

Being the language of urbanism, typology forms the streets, neighbourhoods and community (Kelbaugh, 1996). Nevertheless, typological explorations are still scarce from a social viewpoint. While modernism requires architecture and urban design to deliver better living environments, typological confusion is evident in American cities (Kelbaugh, 1996) which might be also influencing Australian cities (Troy, 2000; Falconer, Newman, & Giles-Corti, 2010, p. 287). This thesis categorically shows that socially informed typological models are significantly able to contribute towards forming the physical coherence of the built environment and facilitate the community building process.

In summary, this thesis makes a very strong argument that the role of the semi-private-public spaces should no longer be overlooked in sustainable urban design. They create a fertile ground for the development of sense of community and strengthening civil society through social cohesion. In this detailed study of the front yard, insights and methods are used from architecture, urban design and social

sciences to provide empirical evidence and conceptually frame the semi-private-public space in residential neighbourhoods.

CHAPTER 4: CONCLUSIONS AND FUTURE RESEARCH

The concept of sense of community being enhanced by the physical environments so far has been ambiguous. Although there is some evidence about human-environment interactions affecting the levels of socialisation (Rapoport, 2016), investigations exploring dimensions of sense of community are scarce. The conventional approaches of community building are limited in various aspects and thus unable to address both theory and practice except for some partial gains. There is a clear need for broader research specifically addressing the direct links between physical and social issues for understanding sense of community and its elements. It is evident that the interrelations between residential built forms and social engagement in various activities can create a vital impact on the sense of community through public-private interaction. However, researchers so far have been more concerned about strong relationships during socialising rather than weaker casual interactions. Contrary to this, the PhD study brings the weaker and ordinary encounters into the limelight as a starter and supporter of the socialising process by linking the physical and social aspects within residential neighbourhoods. The developed systematic process to better understand the issue through a series of published investigations was able to enrich the existing knowledge about the residential street and the spaces adjacent to it, including the importance of the front yard.

4.1 Conclusion

This thesis brought together knowledge from architecture, urban design and social science to widen the concept of sense of community. The ‘mixed-methods’ methodology used in this thesis informed a new approach in academic research. Reflected separately in all four publications, the perception study was used as the core overarching method which synergistically complimented observation to deliver better informed understanding of the role of urban form in building sense of community. Combining a qualitative and quantitative set up allowed to pursue investigation relating to social interaction within particular physical settings.

The PhD study developed new cutting-edge knowledge that clarifies which built form is most suited for promoting sense of community, what are the primary aspects of sense of community and how to measure the quality of sense of community. This research found that the front yard is the best apposite built form for fostering regular mixed-use activities and encouraging strong bonding between neighbours. In doing so, the thesis developed a number of new taxonomic tools useful in future urban design for making more sustainable living environments.

This thesis also redefined the sense of community by including individual perceptions of the residents. This approach can offer insights to decision making related to urban design. Hence, the research has practical implications.

Recently, in Australia there have been anti-sprawl strategies which target infill developments and contribute towards increased suburban density. If not done properly, such infill developments may compromise the importance of the semi-private-public spaces for community life. Although not every new unit or apartment might be in a position to have a front yard, this research shows the importance of the nexus or interface between the residential street and the living quarters. The findings indicate that this area is likely to remain the main space for building and energising

the sense of community. There is already evidence that certain built forms, such as verandas, backyards, and gardens (Hall, 2010) have started to disappear. They however have tremendous community building importance and this needs to be acknowledged in future prospective developments. If such forms are to disappear, they require to be replaced with other spaces which link residents to the street and support the feeling of belonging to a community.

4.2 Directions for future research

This study opens up a new frontier in research related to sustainable built form, social wellbeing, health, safety, visual permeability, social bonding and neighbourhood design. There are many issues requiring further attention in relation to this piece of work.

First, the mixed-methods approach needs to be developed more to provide capability for meeting complex targets. The technical combination of observation and perception studies employed in this research is seldom used by architects, planners and designers so far. A better understanding in the inter-dependence of data collection techniques is still scarce which is crucial and case sensitive.

Second, several publications included in this research indirectly address safety issues which are closely related to mental and physical health. Built environment research requires more integrated study of human health which is also dependent in many ways on the built form design.

Third, this study developed several taxonomical datasets useful for urban planning policy, including accessibility typology (considering visual permeability which allows resident participation in activities without being involved), closeness typology (measuring neighbouring intensity), activity typology, movement typology and behaviour typology. It is time to introduce a brand-new doctrine of semi-private-public built form typology combining public and private domains. Hopefully, a new tradition of research will be able to expand the scope of 'sense of community' in both theory and practice.

Fourth, combined studies of physical environment generating social enterprises are scarce and this area needs comprehensive development. The dominant social science tradition needs to be challenged in order to produce better informed solutions for urban form design and more liveable environments.

Finally, this research was based on a case study in a city which is heavily reliant on the private car. Motor-vehicle dominated planning practices and automobile-dependent cities are misleading the sustainable design process. Ground breaking research needs to find its way to offer effective solutions for a more interactive vibrant society.

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IMPORTANCE OF THE RESIDENTIAL FRONT YARD FOR SOCIAL SUSTAINABILITY: COMPARING SENSE OF COMMUNITY LEVELS IN SEMI-PRIVATE-PUBLIC OPEN SPACES

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ABSTRACT

Sustainable design is emerging as an increasingly important concern for the global urban population. Usually sustainable design is associated with economic, ecological and social aspects with the importance of the physical environment often ignored, particularly in the social sciences. However, the physical and social dimensions should be inseparable in the sustainable development agenda. Increasingly, urban designers are emphasizing the link between physical design and sense of community in public open spaces, but there is limited research on the importance of residential streets and associated semi-open public spaces, such as verges, and private spaces, like the front yard. Using the case study method, including observation and a survey in the suburb of Subiaco in Perth, Western Australia, this article explores the significance of residential streets and the space typology of front yards in comparison to other outdoor open space types. The analysis of the front yard's contribution to the street and community can inform designers, developers, planners, policy makers and residents to achieve a more attractive inner city living environment.

KEYWORDS

outdoor open space, front yard, community building, quality of life, built form typology, sustainability, physical accessibility, visual accessibility, interaction, communication

INTRODUCTION

With the majority of the global population now living in urban environments, neighbourhood designs, including streets and adjacent open public, semi-open and private spaces are increasingly defining the quality of life in the city. They are contributing to establishing a sense of community, encouraging social interactions and improving people's experiences in urban environments. It is not surprising that the UN Sustainable Development Goal 11 which aims

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at making urban spaces more inclusive, safe, resilient and sustainable (Sustainable Development Knowledge Platform 2017), specifically focusses on providing safe quality access to public open spaces. Whilst there is increasing understanding about the importance of parks, gardens and green reserves for the health and well-being of urban populations, there is limited research about the role of the front yard in residential streets for establishing a sense of community and contributing to social interactions and sustainability. This study addresses this issue using a case study from Western Australia.

The paper is structured as follows. First, the link between sustainability and sense of community is discussed, including definitions and related theories. Then the classification of urban outdoor spaces is examined in relation to their links to street life and community well-being. The Subiaco case study is presented which allows for a typology and inventory of outdoor spaces to be developed. Finally, the importance of the front yard in human-urban environment interactions is investigated. The study concludes that the front yard acts as a semi-private-public space where people enjoy important activities and its physical design should accommodate for the need of social interactions, identity creation and the development of a sense of community.

SUSTAINABILITY AND URBAN DESIGN

Sustainable design (McLennan 2004) refers to designing the built environment to comply with the principles of integrating social, economic and ecological sustainability. The Hannover Principles (McDonough and Braungart 1992) consider the spiritual and material relationships between different human settlement aspects, such as community and dwelling, and the liability of design decisions on human well-being. In 1993, the American Institute of Architects and the International Union of Architects embraced these principles by signing a declaration that included social sustainability as one of the main concerns which could improve the existing environment to sustainable design standards—a commitment endorsed later on as “sustainable by design” (IUA 2009).

Furthermore, the Interprofessional Council on Environmental Design (ICED) was established to reaffirm the allegiance by many professionals, including architects, landscape architects and engineers, to a common vision for achieving a sustainable future. As these professions contribute towards improving people’s living standards in urban settings, they link design to sustainability in a very practical way with a high focus on delivering social improvements. Social sustainability is defined as a process that fosters socially interactive vibrant communities for present and future generations to enjoy a good quality of life (Anand and Sen 1996; McKenzie 2004; Sen 2013). It aims at supporting public needs through a combined effort of creating physical and social environments (Woodcraft et al. 2011) where design plays a major role. Quality of life is an important characteristic of social sustainability which includes many aspects of housing in urban settings (Anand and Sen 1996; Sen 2013) as well as community-driven social interactions by local residents (Holtzman 2014).

The link between sustainability and design is felt particularly strongly when it comes to life in the city. According to the UN (2014), 54% of the world population was urban in 2014 and this is estimated to inflate to 66% by 2050. This means the primary living space for human beings is the human-made built environment rather than the natural ecosystems (Lewin 2012) with sustainability becoming a significant framework in architecture, planning and urban design during the last decades (Williams and Dair 2007). Sustainable design is expected to contribute

to a sense of community, including its major element of sense of place, in urban environments and counteract against negative aspects of city life (Pretty et al. 2003).

Before exploring how design facilitates the sense of community using an Australian case study, some definitions and theoretical interpretation need to be clarified. This allows a focus on urban public spaces and the ability to explore their classification and importance for sustainability.

Sense of community: definitions and domains

Sense of community, which has attracted research attention since the 1950s, is a crucial element of the quality of life concept and experience. According to Gusfield (1975), community refers to a territorially determined group of people, such as a neighbourhood, town or city, as well as a relational experience which may or may not be linked to a locality, such as a virtual community or community of practice. The sense of community, however, is a relational experience as it is by definition a feeling (Davison and Rowden 2012) of belonging and of individuals being important to each other. It is also described as a shared faith that the needs of the people forming the community will be valued and “met through their commitment to being together” (McMillan and Chavis 1986, p.9). Although many of the aspects of sense of community apply equally to territorially defined and territorially unrestricted communities, this study focusses on geographically determined neighbourhoods and explores the role of physical design and its contribution to the feeling of belonging. This is particularly relevant as many claims have been made that urban developments that have taken place since the late 1990s are missing a sense of community.

There are no universally accepted ways to define the elements of a sense of community or instruments to measure its manifestation. Many disciplines, ranging from psychology and sociology to urban planning and sustainability policy are offering insights into understanding this complex phenomenon. McMillan and Chavis (1986, see also McMillan 2011), for example, defined sense of community with four elements, namely: (1) membership—a feeling of belonging, (2) influence—a reciprocal sense of mattering or making a difference, (3) reinforcement—integration and fulfilment of needs, and (4) shared emotional connection—mainly through similar experiences. They claimed that these elements provide the basis for planners and urban designers to preserve and strengthen communities. Although all elements relate to a particular defined neighbourhood, the various components of the physical design—streets, open public spaces, verges, houses and yards, make a different contribution to how people feel about a place. The Sense of Community Scale (Doolittle and MacDonald 1978; Tropman 1969) has been used to measure people’s relationships, sentiments and reactions based on five interconnected factors: (1) informal interaction with neighbours, (2) safety, (3) pro-urbanism, (4) preference for frequent neighbour interaction, and (5) localism (desire to participate in neighbourhood affairs). Many other similar instruments have been devised and the analysis by Kim (2007, p.20), covering “233 questions exhibiting considerable similarity and overlap,” groups them into four domains, namely: (1) community attachment, (2) social interaction, (3) community identity and (4) pedestrianism.

It is impossible to establish a consensus as to what is the best way to describe or measure a sense of community given the fact that ultimately this is a very subjective feeling. On the other hand, urban planners need to be aware of the importance put by people on the different elements and aspects of the city landscape when designing the physical environment that represents the foundations for a community life.

The neighbourhood is the smallest geographically identified component or spatial unit of an urban environment where people dwell. In fact, Mumford (1954) described neighbourhoods as a natural phenomenon rather than a subjective judgement as socially people tend to congregate. Hence, neighbourhoods are simply based on proximity of dwelling. They generally include some level of pedestrianism, although in automobile-dependent cities this could be very limited. In line with Kim (2007), four aspects play a major role in identifying the sense of community from a neighbourhood perspective:

- boundaries, including membership
- interactions, including socialising
- emotional connections, including safety
- walkability.

They are discussed in more detail below.

Boundaries determine spatially the neighbourhood and implicitly define its membership, that is the people who belong to this particular geographical area. Associated with membership are desires to identify and present yourself as belonging to the neighbourhood as well as contributing to its identity and endorsing its common symbol system. Examples of common symbol system manifestation are maintaining lawns, keeping front yards and sidewalks tidy (Kearns and Forrest 2000). Also, when people endeavour to make their front yard distinctive, they similarly gravitate towards displaying their membership of a group (Gregory 1986; McMillan and Chavis 1986).

When people take part in common events (rituals, festivals or doing something together), the sense of community increases. *Interactions*—planned or unplanned, formal or informal (Kim 2007), describe the contact and engagement between people in a neighbourhood. The more the interaction, the closer the relationships within a community (Festinger 1950, 1953; Sherif et al. 1955; Wilson and Miller 1961; Allan and Allan 1971). Furthermore, the more the successful, positive contact, the higher the social cohesion (Cook 1969), whilst ambiguous interactions keep residents isolated from the community (Hamblin 1958; Mann 1959). One of the answers sought in the case to follow is to appropriate residential outdoor spaces (Holtzman 2014) that promote better socialising at a neighbourhood scale.

The *emotional connection* to a neighbourhood creates the sense of belonging, safety, familiarity, comfort and willingness to make personal investment—be it time, effort, creativity, materials or other resources. According to Doolittle & MacDonald (1978), there is a reverse connection between the sense of safety and privacy. In other words, quality public open spaces play a very important role in creating the feeling of safety and stimulate people's emotional attachment to a neighbourhood. An untidy front yard can affect the sense of attachment (Kasarda and Janowitz 1974; Nash and Christie 2003). This might also bring negative impact on the sense of safety and on social interaction (Dempsey et al. 2011).

Walkability, a term similar to pedestrianism, reflects the extent to which a neighbourhood is designed for walking and fostering street-side activities that characterise a given physical environment (Kim 2007). Matan (2017, p.32) describes walkability as “encouraging physical activity by minimising the need and distances required to travel” and depicts the outcome of neighbourhoods designed for pedestrians as being pleasant, interesting, with access to nature and providing necessary services.

Open spaces: theoretical background

A lot of work has been done on the importance of open spaces in the urban environment. Jane Jacobs (1961) acknowledged the importance of the relationship between urban design and human behaviour. Advocates of user-focused urban design like Whyte (1980) and Gehl (1987) have highlighted the place of open space, physical design and their direct relationship to sense of community. There are implicit suppositions that improved urban form would lead to a better quality of life (Rudlin and Falk 1999; Raman 2010).

Mark Francis (2003) identified two types of urban open space, namely traditional and innovative. Traditional open spaces are public parks, neighbourhood public parks, playgrounds, pedestrian malls and plazas. Innovative open spaces are community based and often encroached by housing, such as neighbourhood open spaces, schoolyards, streets (most freely accessible spaces in cities), transit malls, farmers' markets using existing parks, streets or parking spaces, town trails (integrating streets and open spaces), vacant/undeveloped open spaces, waterfronts and found spaces, such as street corners, sidewalks, passages/paths connecting buildings, bus stands, steps at public building entrances and so on.

The majority of the urban open spaces are either public or with easy public access whilst residential open spaces, such as yards, driveways, patios, verandas and balconies, are predominantly private. Increasingly, though, the distinction between public and private for creating a sense of community is becoming blurred with ease of access and outdoor exposure being the main characteristics that identify open space. In addition to the traditional public open spaces, some privately owned areas are in reality becoming semi-public places because of the ease of access and activities occurring there. In many neighbourhoods people are opening their premises, particularly the yards, for holding community events, festivals, art shows, celebrations, establishing community gardens or native flora conservation areas. For example, the annual Kitchener's Festival of Neighbourhoods in Ontario, Canada (Creative City Network of Canada 2005) contributes to the building of community identity and pride facilitating social cohesion. Furthermore, semi-open spaces, such as courtyards provide transition between indoor and outdoor in different contexts (Guimaraes 2012) and are increasingly becoming central socialising spaces in a neighbourhood (Scott 2006). According to Bay (2010), the interactions in the semi-open space contribute strongly to strengthening social sustainability.

Within a neighbourhood, the streets identify its boundaries and fabrics while the urban and residential open spaces, including streets, allow for social interactions to occur. Together they contribute to the development of emotional connections and physical experiences through their walkability.

Streets are now being considered as an innovative open space but historically their use was basically for regular public access (Rudofsky 1969; Lofland 1973) and everyday needs, such as shopping and meeting with others. Although some of these needs have moved to the residential, virtual or parochial public spaces in contemporary societies (Brill 1989a, 1989b; Chidister 1989; Rybczynski 1993; Banerjee 2001), there is recent evidence that leisure activities are returning to the public realm. Streets, sidewalks and bordering paths are common open spaces (Mehta 2009) and areas significant as informal public realm (Carmona et al. 2010) accommodating various public-private interaction.

Traditional urban open spaces are present in most neighbourhoods, and they contribute significantly to the environmental, economic and social quality of life there (Monday 2006; Pacione 2012a). In general, natural open spaces are environmentally, socially and psychologically

beneficial for the well-being of residents by purifying air and water, filtering noise and air pollution and mitigating microclimate. The use of urban green space helps relieve stress (Ulrich 1981), increases the sense of peacefulness, thoughtfulness and refreshes citizens (Kaplan 1985). Natural spaces improve mental and physical health (Schroeder 1991; Godbey et al. 1992; Conway 2000). Green common spaces, such as grassed lawns, can promote social interaction, enhance relaxation and reduce impatience among neighbours (Kuo et al. 1998; Bambrick et al. 2011). Moreover, these natural commons might be used for privacy, intimacy, visual impression and historic consistency (Chiesura and de Groot 2003). Some empirical studies also claim that encircling greener spaces mitigates sense of fear, aggressiveness, violence and antisocial behaviours (Kuo and Sullivan 2001).

Providing recreation for people is a major important function of open spaces (Chiesura 2004). Socialising with family and friends within the community is considered a regular source for attachment to place (Mesch and Manor 1998; Warde et al. 2005) which contributes to the feeling of belonging. Accessibility to outdoor green spaces enhances residents' sense of community (Nasar and Julian 1995).

Residential open spaces, including front yards, backyards, side yards, swimming pool areas and even driveways, also allow for social interactions and contribute to building a sense of community (Bay and Lehmann 2017). They are often a place of encounter, conversation, partying and other ways of socialising within the neighbourhood but have received very little research attention. The front yard in particular provides the transition and connection to the street and the rest of the neighbourhood. Although technically part of the residential open space, in reality because of its relatively high ease of access, the front yard sits on the cusp between the private and public domain. Nevertheless, very little is known as to what its role and contribution to the sense of community are. Therefore, the case study to follow explicitly examines the importance of the front yard.

Designing sustainable neighbourhoods: intentions and challenges

When planning or redeveloping neighbourhoods, making them more sustainable and creating a sense of community is now a widely accepted aim. This is seen at the core of the new urbanism (Kim and Kaplan 2004). Though community building is considered in planning policies, it often fails to meet this aim. For instance, the suburban models of Vauban and solarCity Linz emerged as new sustainable housing developments embodying complex design goals, including creating community in space (Schroepfer and Hee 2008). Although incorporating many sustainability features, these neighbourhood developments are criticised as representing “showcases” rather than being truly interactive and having “the glue to the tenable sustainable communities” (Schroepfer and Hee 2008, p.75).

It is evident that people have benefitted in various ways from open spaces that continue to be important for the social formation of neighbourhood housing development (Binti Omar et al. 2015). False hope of community building is echoed in developments where public spaces, such as streets, are privatised (Sorkin 2001). Public space has become a consumer product to be purchased from the property market, where streets are owned by a property management company and the former public town centre becomes private property (Kohn 2004). Such attempts put even the right of speech in public spaces into question and are criticised as producing imaginary rather than real communities. Urban forms have been decried for not promoting social interaction on the residential streets due to little exposure at house fronts (Schroepfer and Hee 2008). This is limiting the residents' freedom of choice to alter their precinct and thus

affect the sense of ownership, which is an important element of sense of community (McMillan and Chavis 1986; McMillan 2011).

Several programs and tools have been developed to measure the evidence for sustainable development, including Building Environmental Assessment (BEA), Environmental Impact Assessment (EIA), Environmental Footprinting (EF) and Ecologically Sustainable Design (ESD). They all have limitations, particularly in relation to sense of community—BEA is too elaborate and building-focussed; EIA and EF are mainly ecology oriented and do not address social and economic issues (Schroepfer and Hee 2008); ESD is an engineering-oriented system which is limited and needs further development (Bay 2010). Others like Life Cycle Cost Analysis (LCCA), Life Cycle Assessment (LCA) and Leadership in Energy and Environmental Design (LEED) (Holzer and Lockrem 2011; Lewin 2013) are also limited in assessing social and economic sustainability (Lewin 2012; Valentin and Bogus 2015).

New simulation models have also emerged and are being tested, such as Integrated Land Use Transportation Environment (ILUTE) (Salvini and Miller 2005; Beykai and Miller 2017), Integrated Urban Metabolism Analysis Tool (IUMAT) (Mostafavi et al. 2014) and CitySim (Miller et al. 2018). These are important first steps to include social and economic parameters in an integrated sustainability analysis of the built environment, however more work is required.

In fact, social sustainability, which is the framework for endorsing the importance of sense of community, is the least developed aspect of sustainability. According to Allen and Shonnard (2011), social sustainability addresses the physical environment to meet human needs. The first principle of social sustainability is about improving the quality of human life (Hill and Bowen 1997). The Green Urbanism principles also advocate for social sustainability and include the importance of liveability, healthy community and diversity (Lehmann 2011). Public perception and opinion are similarly extremely important in formulating social sustainability principles (Valentin and Bogus 2015) and in impacting people's attitudes and lived realities in a neighbourhood.

Typology and sense of community: emergence, importance and criticism

With the lack of any distinctive tools for measuring social sustainability in neighbourhood design, one possible way to analyse the sense of community is through creating a typology of the places which people perceive as contributing. Typologies—classifications of places and buildings in reference to various criteria, such as location (e.g. rural or urban), age (e.g. old or new) or use (e.g. agricultural, commercial, residential, medical, educational, government, industrial, non-building etc.) are commonly used in urban planning and architecture. For example, a building typology can refer to the learning which has occurred around the building form (e.g. physical dimensions and orientation), specific formal expression (bungalow, row house, homestead, residential premises etc.) or differences in materials used, longevity, building practice and technology (Kelbaugh 1996; Firley and Stahl 2009). Normally, building types are identified by their basic form, surroundings or scale but not by their architectural style or use (Caniggia and Maffei 2001). The assembly of indoor and outdoor space types helps form a physical language of architecture by organising public-private zoning to achieve the desired architectural experience (Scott 2006).

In general, architects and urban planners develop a common typology for their work guided by standard considerations, such as dimensions, bulks, sites or circulations. This enables them to point out particular design aspects related to orientation, structure, size or materials (Scheer 2010). An Italian school of thought founded by Saverio Muratori identified that

typology is able to maintain continuity in the cityscape (Caniggia and Maffei 2001). They acknowledged the role of types in modern architecture about how to incorporate upcoming developments without mimicking the historic expressions and styles emerged in the course of time (Moudon 1989). A Form-Based Code (FBC) is currently used to preserve historical type developments and urban artefacts (Parolek et al. 2008). New urbanists recognise typology as a vital means to further define user-friendly places (Conzen 1960; Caniggia and Maffei 2001).

Moudon (1989) identified blocks, lots and street patterns as essential for typological consistency and this is particularly relevant to neighbourhood design. Normally, neighbourhood streets and lots are readymade infrastructures to accommodate common types and are like the 'building blocks' for the city. In the pre-design phase, the common urban tissue patterns—a combination of types, streets, lots or public open spaces, is identified to inter-relate and form the neighbourhood. This urban fabric is the one which provides the physical environment and surroundings for the sense of community to emerge and make neighbourhood areas socially sustainable.

Front yards and sense of community

Front yards are an often-neglected aspect of residential neighbourhoods. They are generally privately-owned but have the high potential to act as a public space. Though the front yard is physically private, if visible from the street, it is considered as public (Carmona 2010a; Holtzman 2014). That means, the front yard has high potential to accommodate mixed activities (Capon and Blakely 2007). Moreover, residents' perception (Carmona 2010a) about the front yard's usability can influence the activity pattern criteria. Such socialising activities involve the users with the space and are able to contribute for enhanced sense of community. Thus, the front yard promotes community building and social sustainability.

The front yard is also a transition to the residential street which is an innovative outdoor space and a new frontier in sustainability research. Most mixed-use studies in a residential neighbourhood context examine the street for its commercial functions, such as retail, work, cultural and light industrial uses (Mehta 2009). Not much attention has been given to residential streets. By linking the front yard to the street, this research is able to fill some of this gap.

Social science studies commonly ignore the physical environment and only a few empirical investigations address the stationary and social behaviour of people in urban open public spaces (Mehta 2009). Most of research examining social interactions has been on plazas (Joardar and Neill 1978; Miles et al. 1978; Share 1978; Whyte 1980; Loukaitou-Sederis and Banerjee 1993; Marcus and Francis 1997) with only a few studies focused on residential streets and spaces (Appleyard 1980; Eubank-Ahrens 1987; Skjøveland 2001; Sullivan et al. 2004). Australia's National Strategy on Ecologically Sustainable Development originally excluded the social dimensions, research however shows that the physical and social aspects are an integral part of any sustainability agenda (McKenzie 2004).

According to Mehta (2009), research generally separates the study of the physical features of the environment from the land uses and does not care about the operations and management of the street spaces (Joardar and Neill 1978; Hass-Klau et al. 1999). Urban designers and planners however realise that "it remains difficult to isolate physical features from social and economic activities that bring value to our experiences" (Jacobs 1993, p. 270). According to Chua (1995), community building tends to develop where familiarisation through seeing, meeting and greeting takes place in common spaces, such as corridors or walkways (Capon and Blakely 2007). The residents' routine lifestyle is an opportunity for planners to facilitate

social familiarity, with the physical route becoming also the route to each other (Chua 1995). Social interactions in the front yard break the barriers not only between the private and the public space but also between the house and the street contributing towards local engagement, familiarity and creating a sense of belonging.

Using one particular case study—a neighbourhood in the Subiaco suburb of Perth, Western Australia, what the remainder of this paper does is create and explore a typology of the places for social interactions. Given that the boundaries are well-defined as they spatially position the studied neighbourhood, social interactions become a crucial aspect for creating a sense of community allowing for emotional connections to develop and encouraging walkability. As a preferred place for social interaction, the front yard is then analysed.

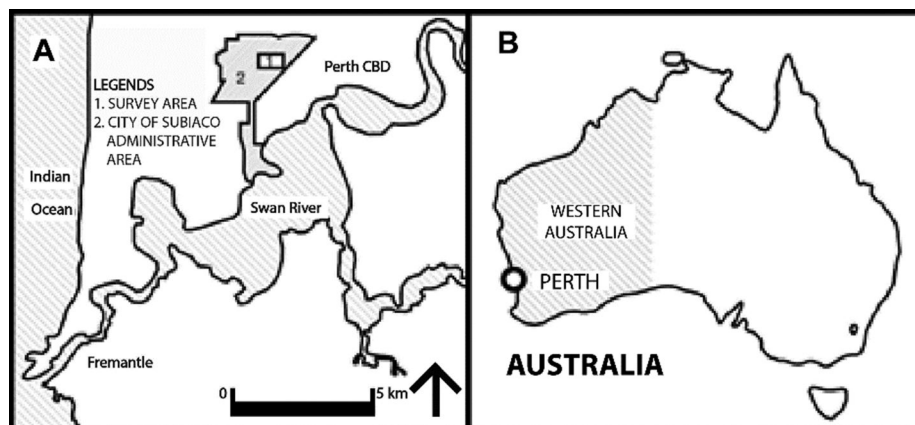
CASE STUDY AND METHODOLOGY

The case study for this analysis is a neighbourhood in Subiaco—a suburb situated at the immediate west of the central business district of Western Australia’s capital city of Perth. Geographically, it is five kilometres east of the Indian Ocean, 12 km north-east of the port of Fremantle, and is situated north of the Swan River (see Figure 1). According to the Australian Bureau of Statistics, the 2016 resident population of Subiaco is 16,234 (City of Subiaco 2016), with a density of 31 persons per hectare over a total land area of 562 hectares (6 square kilometres). The number of people above 15 years of age who have an income earning capacity is 13,762. It is a relatively wealthy suburb with a 2016 median annual personal income of A\$59,592 compared to A\$37,648 for Western Australia and AUS\$34,424 for Australia (ABS 2016).

Established in the 1880s as part of the Swan Colony (Howe and Strauss 2009), Subiaco was a working-class suburb in the early 20th century (Spillman 1985 in Davison and Rowden 2012). However, in the 1990s it emerged as a culturally vibrant centre attracting a student and academic population because of the proximity to the University of Western Australia. Close to half (i.e. 49.8%) of its residents aged above 15 have a university education compared to only 20.5% for Western Australia and 22% for Australia (ABS 2016).

The aim of the study is to analyse the contribution of the various neighbourhood physical building blocks to creating a sense of community. A mixed method approach (Lynch 1960; Groat and Wang 2013) is applied which combines:

FIGURE 1. Map of Australia (A) and Perth (B).



1. Detailed observation (Whyte 1980; Gehl 1986, Mehta 2009; Gehl and Svarre 2013), particularly of streets and front yards;
2. Survey (Drever 1995; Harrel and Bradley 2009);
3. Case neighbourhood selection (Yin 2013);
4. Interviews (Drever 1995; Harrel and Bradley 2009).

Before the approach is presented in further detail (see Figure 2), Table 1 summarises the theoretical frameworks that link social interactions with sense of community and describes the methods used for theory testing. They all point to the importance of open and outdoor places, with Bay (2010) also emphasising the role of semi-open space. This justifies the need to first explore a typology of outdoor places for Subiaco.

Detailed observation

People prefer various outdoor spaces for meeting others within or outside their neighbourhood, particularly in the Australian cites that enjoy a mild Mediterranean climate. Outdoor spaces in a suburb fall under private or public ownership and are represented by a long list of categories: local park, shopping mall, coffee shop, stadium, swimming pool, community club, street, footpath, walkway, parking area, front yard, backyard, veranda, balcony, terrace, stoop, stair, steps etc. In order to develop a typology of places which people visit for outing, meeting and gathering for socialising in Subiaco, detailed observation was used for the suburb. It provided the categories to be included in the survey of Subiaco residents. Detailed observation was later used also for analysing the selected neighbourhood within Subiaco.

Survey

Informed by the detailed observation of Subiaco's outdoor spaces, a quantitative survey was conducted of 140 residents. With the lack of previous research in this area, the original intention

TABLE 1. Key Theories.

Theorist	Theory	Method used
William Hollingsworth Whyte (1980)	Improved physical space can promote better social cohesion to achieve economic gain.	Observation Interview Filming
Jan Gehl (1986)	Prolonged outdoor stay can promote enhanced social interaction. Various social dimensions affect human perceptions during socialisation.	Observation Survey
Joo Hwa Bay (2010)	Semi-open space promotes social interactions.	Observation Survey
Matthew Carmona (2011)	Public space typology is an important planning measure for better management of urban outdoor spaces.	Literature review
David W. McMillan and David W. Chavis (1986); David W. McMillan (2011)	Sense of community is a feeling of belonging that individuals feel for each other and for the group or community; this helps to live in coherence by fulfilling each other's need.	Literature review

for the survey was to be exploratory (Shields and Rangarajan 2013) and search for insights. Notwithstanding this, the high response rate and willingness of the residents to engage with the topic of the survey allowed a good statistical representation of Subiaco—a confidence interval width of 8% at 95% confidence level.

The survey questions asked the respondents to assign importance to the various outdoor spaces for socialising and creating a sense of community. Out of all options, the analysis of the survey results showed the front yard being identified as the most important and commonly used place. It was then appropriate to focus the attention to the front yard which also appears to be an under-researched field in relation to social sustainability. To do so, the lens of analysis needed to shift to a neighbourhood area.

Case neighbourhood area

The selected neighbourhood for the case study is a traditional inner-city part of Subiaco. It is representative of the original area which has stood up and adapted to the challenges of time. On Figure 3, it is marked as “survey area.” Figure 3 also shows the main outdoor spaces and socialising places in Subiaco which include several parks and playgrounds, community centres, coffee shops and sports and recreation venues. The residents of the case neighbourhood have access to all of these places. Convenience was the main reason for selecting this particular neighbourhood. It also seemed relatively well-defined and unobstructed or divided by public open spaces making it distinctively local.

FIGURE 2. Research approach.

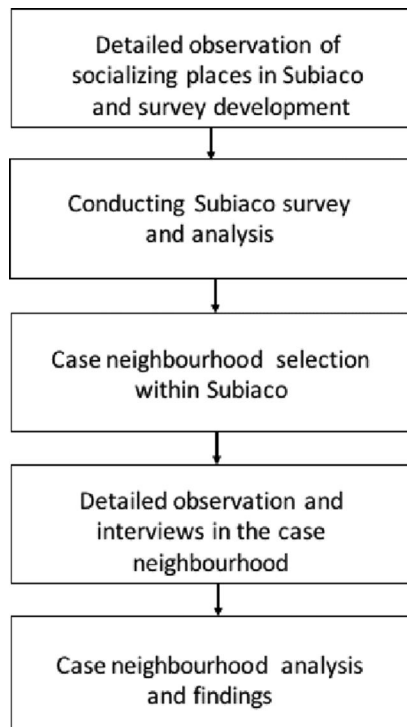
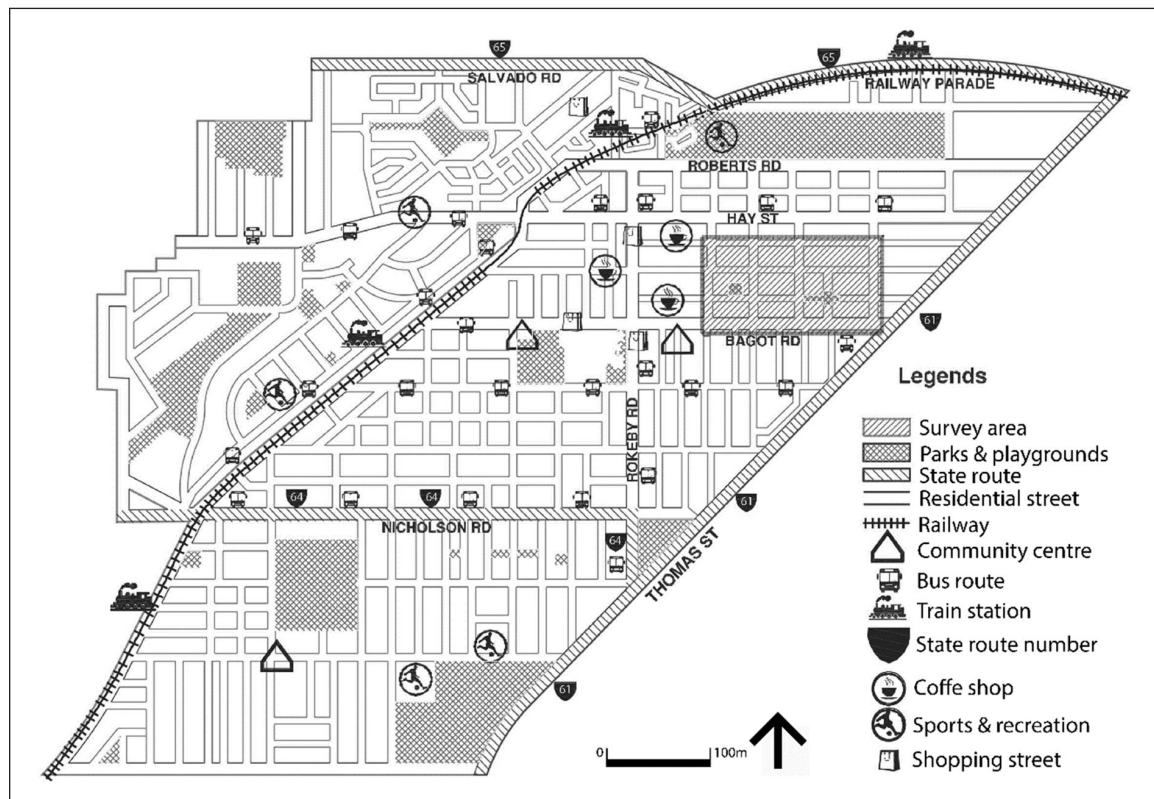


FIGURE 3. Outdoor spaces for local residents and visitors in Subiaco.



Interviews

Using a semi-structured questionnaire, 61 interviews were conducted with residents in the selected neighbourhood. The questionnaire canvassed demographic information (such as age and profession), opinions (on a Likert scale) and contained open-ended questions (comments, suggestions, recommendations etc.) for local residents. This allowed for the front yard—the most significant residential outdoor space, to be analysed from various viewpoints.

To find a new typology that enhances socialising in the front yard, three concepts are categorised to build a set of matrix. These are: (a) Accessibility pattern (Kohn 2004) based on physical condition (e.g. level of physical accessibility and visual connectivity); (b) Activity pattern based on interaction and communication (Kohn 2004); and (c) Ownership pattern (Kohn 2004; Carmona 2010a).

Case neighbourhood analysis and findings

Quantitative, graphic and qualitative analysis was carried out in order to describe the findings from the neighbourhood analysis. The results are presented below based on the four sense of community neighbourhood aspects identified above.

SUBIACO CASE STUDY: FINDINGS AND DISCUSSION

William W. Whyte (1980) and Jan Gehl (1987, see also Gehl and Svarre, 2013) observed the behaviour of ordinary people on the streets mainly based on chance encounter. It is however

clear that the chance of meeting a familiar face in a public place is rare. On the other hand, residential public places like streets, sidewalks and passages are common meeting places for residents to build up long-term familiarity. People are meeting each other while participating in daily life activities, such as bringing children to school, going to and coming back from work, regular trips to the grocery shop/mall, walking dogs, taking children to the park/playground, cleaning the front yard/sidewalk, rolling the rubbish and recycling bins out to the verge and so on. Regular daily life activities are predictable and thus have higher organising potentiality to be considered by urban designers, planners and policy makers (Chua 1995). It is possible to regulate these known routes based on residents' behaviour patterns to reflect the planning codes. Predictable residential public streets and semi-public sidewalks (Chua 1995) are an integral part of residential areas and are intensely interactive with semi-private front yards. Residential front parts are a fruitful ground to promote successful interaction. Streets, sidewalks, alleys and parks are able to acquire a sense of "collective-symbolic ownership" (Hester 1984; Skjøveland 2001).

Subiaco pattern of interaction in outdoor spaces

Subiaco residents were asked questions related to their favourable outdoor spaces where they prefer to meet people—neighbours, friends, relatives and other familiar persons. The detailed observation was organised to explore the available open outdoor spaces in the Subiaco area. Residents use outdoor open spaces mainly for regular and recreational activities. The type of activities they do include outings for coffee, breakfast, lunch, afternoon tea, baked goods, dinner, fancy trips, live music and late-night dancing, street front alfresco eating (with private courtyards), garden bars, cinemas, art and craft, shopping, buying accessories, gifts, homewares, visiting bookshops, second-hand shops, antique shops, boutiques, music shops and many more.

People use the same outdoor space for different purposes. Though Rokeby Road is the favourite shopping street for residents and visitors, people love to have an evening stroll while enjoying the crowd, or just choosing a path on the way to the supermarket. Various outdoor destinations on the streets of Subiaco are cafés (with outdoor sitting), kebab and pizza places (also with outdoor sitting), bars (outdoor sitting on footpaths often shaded and with safety railings), bookshops (outdoor books/cards display as street exhibition), ice-cream shops (front stall open for take-away without any sitting arrangement), bakery (linear sitting with benches along the front stall), fish and chips shop (sitting on footpath for at least 25 customers) and so on. Other prime outdoor destinations are the Subi Farmers' Market on Bagot Road, Earthwise Community Club (with outdoor sitting) on Bagot Road, Subiaco Arts Centre on Hamersley Road, dog walking areas, parks and open green areas.

A list of the open spaces available in the Subiaco case neighbourhood is presented in Table 2. It shows that irrespective of the ownership, many have public character because of their visibility and exposure.

In total, an inventory of 13 outdoor open spaces classified as mostly of interest was identified following the detailed observation (see Figure 4). The survey based on this inventory included four questions (see Table 3) and took on average 5 minutes to complete. It was easy to address people on the streets (even in rush hours), sidewalks and parks. A total of 140 residents willingly responded. In the first question respondents were asked about their favourite place for socialising, where they meet people in general. The second question was about planned (for meeting or get-together) locations. Question 3 explored the preferred place for activities or meetings for which residents do not need prior preparation based on Gehl's (1987) concept of chance encounters. Finally, the fourth question explored the relationship between outdoor

TABLE 2. Urban Open Spaces in Subiaco Case Neighbourhood.

Open space type	Description	Character
Back lane	Often provided with carport/s, suitable for informal encounters between neighbours during maintenance of car, motorcycle or bicycle	semi-public/public
Balcony	Projected outdoor platform usually above the ground floor	private
Children playground	Outdoor area included in the neighbourhood park designed for children to play, allows natural surveillance	public
Front garden	A space at the immediate front of the house, articulated mainly for aesthetic or ornamental purposes, or non-commercial food production, or flora and fauna	semi-public
Front yard	Space between the front facade of the house and a sidewalk or street	semi-private/ semi-public
Hedge	A boundary-forming bushes or shrubs grown along streets or paths, can be interrupted or uninterrupted	public
Neighbourhood green space	Small green space (grass-covered, trees and shrubs) used by local residents	semi-public/public
Neighbourhood park	Piece of land maintained by local council with trees, shrubs and lawns, incorporated with seating and children play equipment	public
Pocket park/green	Very small park area around and between buildings, planted with ornamental trees and shrubs, full public access, in close proximity to houses, streets and sidewalks	public
Tree alley	A narrow passage or lane along streets, sidewalks or edges of front yards planted with trees or bushes often in rows or solitary	private/ semi-public/public
Verge	Ground by the side of the street, often with or without trees, mainly grassy or shrubby	public

space and frequency of socialisation within Subiaco. The respondents were asked to rank the 13 types of outdoor spaces from the most to the least preferred (allocating a rank of 1, 2, 3, ... ,13). Their responses were accumulated in accordance with the stated importance to obtain the averages for all four questions. Table 3 and Figure 4 present the survey results.

The outdoor space with the highest potential for socialising identified in the Subiaco survey is the front yard (with 29% overall importance for socialising). All outdoor spaces were categorised in three levels, namely with high potential—front yard, footpath/walkway/verge, street and park/public space, medium potential—coffee shop, parking area and shopping street/mall, and low potential—back lane and balcony. Swimming pools and backyards are not considered as they provide limited links to public open spaces. The stadium was also excluded as it does not provide free public access. Following the front yard (at 29%), sidewalks (15%) and

TABLE 3. Comparison between Outdoor Spaces in Subiaco.

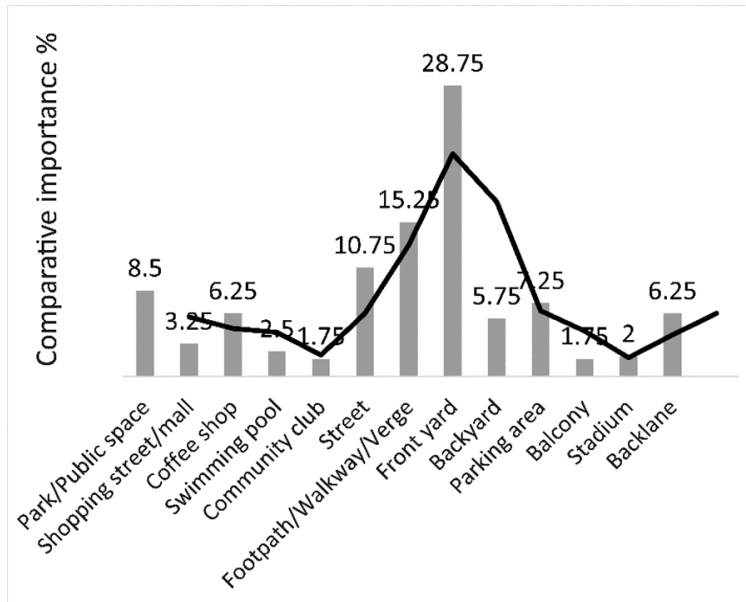
	Question 1. In a comfortable weather condition, in which outdoor spaces do you most get to know other people within your neighborhood?	Question 2. In a comfortable weather condition, in which neighbourhood outdoor spaces do you meet people most in a pre-planned manner?	Question 3. In a comfortable weather condition, in which neighbourhood outdoor spaces do you meet people most in an unplanned manner?	Question 4. Which outdoor space helps you most involve in socialising and thus enhancing the sense of community within your neighborhood?	Average importance of the space for social interaction
	%	%	%	%	%
1. Front yard	40	19	29	27	28.75
2. Footpath/ Walkway/ Verge	19	7	20	15	15.25
3. Street	12	5	14	12	10.75
4. Park/Public space	11	6	9	8	8.5
5. Parking area	5	4	11	9	7.25
6. Coffee shop	2	19	3	1	6.25
7. Back lane	4	4	5	12	6.25
8. Backyard	2	13	3	5	5.75
9. Shopping street/mall	2	7	2	2	3.25
10. Swimming pool	2	5	1	2	2.5
11. Stadium	0	6	0	2	2
12. Balcony	1	1	1	4	1.75
13. Community club	0	4	2	1	1.75
TOTAL	100	100	100	100	100

streets (11%) were identified as the most significant outdoor open spaces of interest to Subiaco residents with high potential to contribute for community building.

Neighbourhood study of the front yard

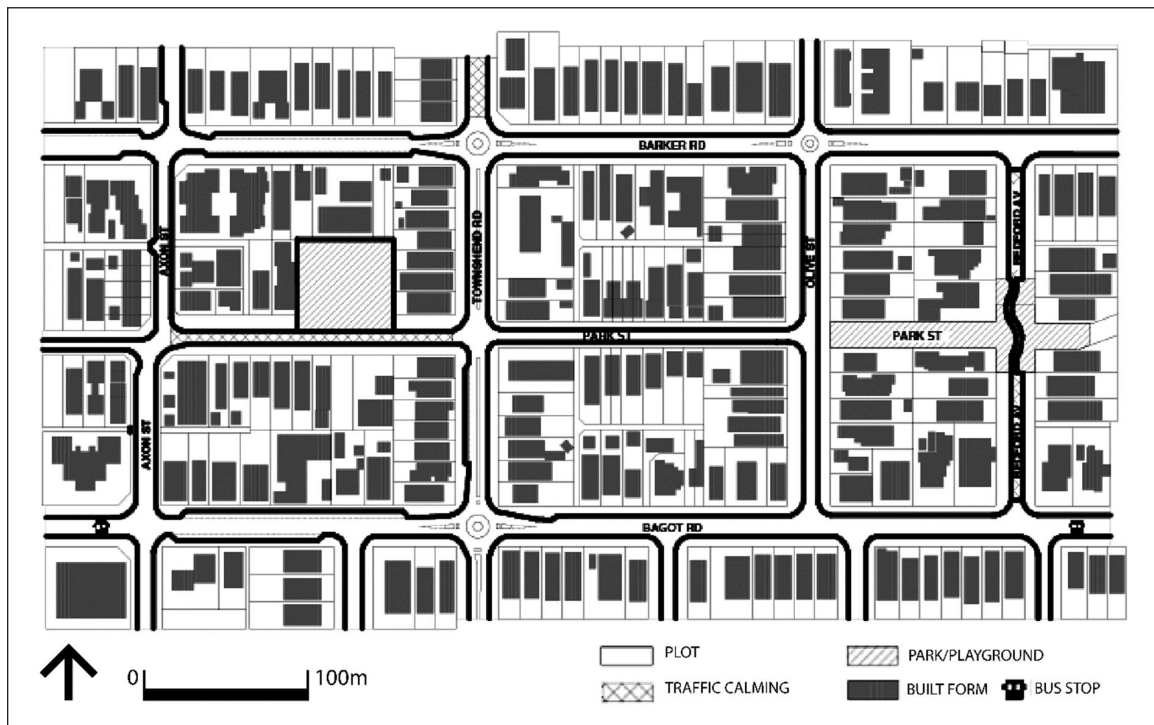
Given the high importance assigned to the front yard, a detailed observation survey was conducted in the selected neighbourhood area to explore the accessibility (physical and visual) and activity (interaction and communication) patterns in the front yards of its streets. The

FIGURE 4. Social interaction and community connection.



boundaries defining the selected surveyed area include seven streets of Subiaco, namely Axon Street, Townshend Road, Olive Street, Bedford Avenue, Barker Road, Park Street and Bagot Road (see Figure 5). In the selected surveyed area, each street has house front yards in a face-to-face and side-by-side manner. The survey area is outside any commercial or industrial enterprises.

FIGURE 5. Surveyed area in Subiaco.



Each house has a front yard and is surrounded by other houses on the same street and across the street. This ensures probabilities for social interaction between neighbours within their intimate vicinity.

In the neighbourhood area, 61 interviews were conducted with residents on a door-to-door basis and in residential streets during the spring and summer seasons of 2016 in different daytimes of weekdays and weekends. The questionnaire took 15 minutes on average to complete and not more than 25 minutes. Most of the respondents found it easy to visualise the answers to the questions while standing in their front yard, front deck or stoop. A few residents were comfortable to respond in the nearby sidewalks, parks and street corners. Their responses are summarised in Table 4.

TABLE 4. Survey Results on Accessibility, Activity and Ownership.

Question	Agree	Description	Characteristic
1. Overall the physical condition of my front yard helps me socialising.	67%	Physical	Accessibility
2. My front yard as an extended living area for socialising with neighbours or guests.	60%	Physical	
3. My front yard is visible enough from the street to communicate with neighbours in the adjacent walkways or streets which helps me engage with neighbours for socialising.	67%	Visual	
4. I am consciousness about the visibility of my front yard from the street.	80%	Visual	
5. My front yard has its own distinct 'personal expression' which contributes to the physical or visual characteristics of the street.	64%	Visual	
6. My front yard works as a part of the street helping me maintain a good relationship between the public and private domains.	64%	Interaction communication	Activity
7. During weekdays, I like to spend at least 1 hour in my front yard.	48%	Interaction	
8. During weekends, I like to spend 2 to 5 hours in my front yard.	52%	Interaction	
9. I feel a strong sense of ownership and sense of belonging in the front yard of my house which help me engage with my neighbourhood community.	77%	Sense of belonging	Ownership
10. I feel safe using my front yard while participating in daytime activities.	97%	Sense of safety	
11. I feel safe using my front yard while participating in activities after dark.	74%	Sense of safety	

The perception study of the Subiaco neighbourhood residents referred to various characteristics of their front yards and how they impact on socialising activities and *interactions*. As shown in Table 4, the majority of respondents—67%, think that the physical condition of their front yard helps them socialise. About 60% are of the opinion that the front yard works as an extension of the living area for socialising with their neighbours. The respondents were overwhelmingly conscious about the visual accessibility of their front yards with 80% being aware of this. Many—67%, expressed an opinion that the front yards are visible enough from the streets to help them communicate and socialise with neighbours in the adjacent walkways, sidewalks or streets and 64% saw the front yard as a distinct personal expression. These visual and physical characteristics of the front yards help create a sense of community. Most respondents—64%, are actively maintaining an interactive public-private relationship during communication with their neighbours. About 48% of the participants are spending at least 1 hour a day during weekdays and 52%—2 to 5 hours a day during weekends in the front yard. This means that the front yard is a frequently used immediate semi-public space that maintains a balance between public-private interactions. A significant share of residents—77%, feel a strong sense of ownership and belonging in their front yard; almost all—97%, feel safe during daytime and two quarters (74%) after dark.

The Subiaco neighbourhood analysis supports most theoretical concepts related to sense of community. To make a city liveable, urban public place is essential and quality urban spaces foster sense of safety, sense of belonging, increased consciousness, diverse activity, self-esteem and interest in the living environment (Crowhurst-Lennard and Lennard 1995). Collective representations like symbols, myths, customs, faiths, conventions, ceremonies, vacations (McMillan and Chavis 1986), stories, music and other symbolic expressions (McMillan 2011) foster a sense of community and trigger stronger integration. A heterogeneous modern community, such as the one of Subiaco, needs to have a common symbol system to function properly (McMillan and Chavis 1986). For instance, collectively practicing rules related to usage of common paths, dress codes, street etiquette or noise restrictions is common in neighbourhood groups of society. On a neighbourhood scale, the front yard also becomes such a symbol.

On Subiaco residential streets, the boundary design (high wall, low wall), fencing style (material, design and transparency), front yard orientation, veranda design are clear symbols attributed to various activities and behaviours of the local residents (see Figure 6). The majority (64%) of Subiaco residents (see Table 4) think that the personal expression of their front yard is able to contribute to the physical and visual characteristics of the streetscape and thus to the sense of community. Architecturally, front yards—a small-scale built form type with distinct characteristics, help shape the overall streetscape (city scale built form typology) and thus assist maintain the entire street typology through a process of continuous evolution (Moudon 1989; Caniggia and Maffei 2001; Scheer 2010).

Shared emotional connections are concerned with history, common place, time together and similar experience. There are important characteristics of shared emotional connections, such as: (1) the contact hypothesis—enhanced social interaction brings people closer (Festinger 1950; Sherif et al. 1955; Wilson and Miller 1961; Allan and Allan 1971); (2) quality of interaction—enhanced positive interaction and relationships make the bonding stronger (Cook 1969); (3) closure to events—anonymous interactions leave community issues unattended and thus hinder group cohesion; (4) investment increases the importance of members' position and status in the group—for instance, homeowners who invest time and energy will experience more intense emotional involvement; and intimacy is a kind of investment (Aronson and Mills

FIGURE 6. Snapshots of Subiaco case neighbourhood.

(A) Barker Road view shows an easily accessible front yard, low height boundary wall, veranda and parking; (B) Bedford Avenue view shows front yard with play equipment, veranda with sitting arrangements, vegetation, gardening and a fence-less boundary wall facilitating easy access to the streets; (C) Olive Street view shows variation in style, orientation and material but an unchanged scale and proportion—a clear representation of common symbol system; (D) Park Street view shows a tiny front yard full of activities like sitting, flowers and plant pots.



(A)



(B)



(C)



(D)

1959; Peterson and Martens 1972); and (5) spiritual bond is common in each community. All of these characteristics of emotional connection were present in the analysed Subiaco neighbourhood area.

The entire neighbourhood area encourages *walkability*, including its links to the rest of the Subiaco suburb and its open public places, facilities and transportation opportunities. Starting from the front yard, residents are encouraged to walk to their neighbours and meet others in the streets, walkways and sidewalks. An important aspect of walkability are the street features which make the pedestrian slow down or stop (Matan 2017). With their visibility, individuality, attractive presentation and being a place for socialising, the front yards strongly encourage walkability.

CONCLUSION

Social sustainability remains the most challenging aspect of any integrated holistic research of the urban built environment. This study approached this task through the lens of outdoor spaces and their importance in community building using one particular case. Methodologically, this study shows coherent positive outcomes in two tiers of analysis. First, the selected case study identified the significance of outdoor spaces of interest in the suburb of Subiaco. Second, the perception study of the front yard in the neighbourhood area validated the importance of sense of community.

With social elements being more suitable than environmental features to measure a sense of community (Moustafa 2009), this study endorses the quality of the front yard as an interactive outdoor space type with high social potential to promote community building, resilience and sustainability. Among all residential outdoor spaces, the front yard has significant potential to become a key space for socialising, bringing people together, and creating a sense of belonging. Such resilient communities are able to add value to the quality of life of their residents (Pacione 2012b) and thus ensure a sustainable future.

Front yard: A neglected issue in academic research and practice

Researchers and planners acknowledged the importance of fostering a sense of community (Putnam 2001; Florida 2012; Grodach and Loukaitou-Sideris 2007; Soja 2010). In contrast, anti-suburban critique (Gilbert 1988) condemned Australian suburbs for being isolated from real life, lack of community and being a one-dimensional consumer culture.

Most of the available studies looking at the relationship between the built form and sense of community focus on public spaces and plazas in commercial areas. There is very limited research on the relationships in residential streets. This study helped bridge this gap by examining the relationship between physical settings and people's sense of community in residential areas. Perceptions of built environment on the sense of community need further development (Foster et al. 2010). The study added some insights about the relationships between physical form and sense of community within the context of a specific residential environment. This knowledge can help guide designers, developers, consumers, residents and policy makers in creating more attractive city living environments.

Front yard: Blurring the boundaries between public and private spaces

Advocates of public places (Gehl 1987, 2011, 2013; Madanipour 2003; Carmona 2010a, 2010b) have realised that the front yard is a highly potential private space which could perform publicly. Even being physically private, the front yard performs as a public place if watched from the street (Carmona 2010b) and also when used for social interactions. This allows the front yard to be identified as a semi-public open space. In most cases it is privately owned, but publicly visible, offering easy access. This semi-public nature of the front yard facilitates the development of a sense of community. In architecture, buffer space is required to ensure gradual and smooth transformation between the private and the public, termed as semi-public. The front yard is thus defined as such semi-private-public space that is capable to equally satisfy both private and public uses. Thus, this magnificent space has tremendous potential to enhance the quality of sense of community and promote community building in the neighbourhood.

This study is in line with research on semi-public open spaces in the residential context that encourages enhanced socialising between neighbours (Kim and Kaplan 2004; Talen 1999). It

opens up further exploration of accessibility (Swapan et al. 2018a), visual permeability (Swapan et al 2018a) and distance-based social interaction (Swapan et al. 2018b).

The importance of the front yard is neglected in local laws except for some setback rules. Further research is required to understand the front yard types to maintain the homogeneity reflected in the local planning policy objectives (City of Subiaco, Planning Policy No. 4.8). There seems to be a desire for creating residential privacy as reflected in the local building regulations (see clause 7.1 Visual Privacy, in R-Codes, Residential Design Codes of Western Australia, p.59) which could be fulfilled in back yards and outdoor private domains. Based on the observation results and expressed people's preferences, this study indicates that the front yard should be a focused device to maintain interactive relationships between the private and public domain. Hence, the role and place of the front yard should be considered in any new or revised planning policies and regulations.

Despite a lot of attention to improve public open spaces, many maintain their characteristics of being impersonal and anonymous (Arendt 2013; Lofland 2017). By contrast, the front yard works as a public space (Carmona 2010a) where people do not lose their personal identity. Moreover, activities in and around the semi-private-public front yard can be enjoyable even without taking part in them. This is the beauty of this amazing intermediate space where people can enjoy their full freedom of choice to participate in activities and create emotional connections. The semi-private-public front yard thus accommodates various social activities without losing its distinct physical identity.

By highlighting the importance of the front yard as a connecting space within a residential neighbourhood, this study emphasised the fact that the sense of community sits outside the formal frameworks which juxtapose private to public places. The front yard acts as a semi-private-public territory which welcomes social interactions and offers personal identity. Its significance in creating social sustainability should not be underestimated. It allows residents to engage with each other and establish unique bonds, relationships and feelings of care that define a sense of community and make places sustainable. It is hoped that the findings from this study can help guide designers, developers, planners, residents and policy makers in creating more attractive and resilient city living environments that contribute to social sustainability.

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Article

Understanding the Importance of Front Yard Accessibility for Community Building: A Case Study of Subiaco, Western Australia

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Abstract: The residential built form, including open space, provides the physical environment for social interaction. Understanding urban open space, including semi-public and public domains, through the lens of physical accessibility and visual permeability can potentially facilitate the building of a sense of community contributing to a better quality of life. Using an inner-city suburb in Perth, Western Australia as a case study, this research explores the importance of physical accessibility patterns and visual permeability for socialising in semi-public and public domains, such as the front yard and the residential streets. It argues that maintaining a balance between public and private inter-relationship in inner city residential neighbourhoods is important for creating and maintaining a sense of community.

Keywords: community building; quality of life; built form typology; front-yard; physical accessibility; visual permeability; human behaviour

1. Introduction

A major aspect of social sustainability is the ability to foster resilient communities through the development of a sense of community and encouragement of social interactions. The role of public places as a prime component of the physical living environment in contributing towards community building has been the subject of many studies. Public places within a commercial setup, such as shopping areas, markets, arts districts, entertainment areas, café and restaurant precincts, have been of a particular interest. The main assumption is that a well-designed physical environment can stimulate social mixing as well as easy contact between people. Studies of such social interactions, however, are rare. As the sense of identity is often lost in a commercial public space, measuring interaction can also be difficult [1].

Social interactions within inner-city residential areas and neighbourhoods have been particularly unexplored. A lot of potential for community building lies beneath the soft edges of residential streets, including the house fronts [2]. In fact, house fronts are the ground which accommodates various activities promoting socializing between neighbours. Their physical characteristics shape the streetscape and the social interactions define the entire community.

As an integral part of a dwelling, the front yard is considered a common land between the street and the house front and is often found in residential suburbs in Australia [3], United States [4], Canada [5–7], and Europe [8–12]. Front yards vary in size, shape, and style according to geographical position, local planning regulations and design [13,14]. Generally, the front yard is used for different

social, economic or climatic [15] purposes, such as vegetable growing, household works, beautification, gardening and recreation [16].

The front yard is privately-owned but has high potential to act as a public space. Although the front yard is legally private, if visible from the street, it is considered as part of the public realm [17,18]. Thus, it is termed as “semi-private-public” for its omnipotence ownership character. This means front yards can accommodate mixed activities which involve users with the space and are able to contribute towards enhanced socialising. Moreover, residents’ perception [17,18] about the front yard’s usability has a keen influence on social activity patterns. The physical condition—physical accessibility and visual permeability—of the front yard is directly related to creating sense of community.

Despite the relative importance of house fronts, there is limited knowledge about the front yards in residential streets of inner-city suburbs. This potential built form and its typology require better understanding in terms of social interaction and physical articulation. Hence, a focus of this paper is the contribution of the front yard towards community building and sense of community through its characteristics of physical accessibility and visual permeability. It analyses one specific residential neighbourhood in the inner-city suburb of Subiaco in Perth, Western Australia.

2. Background

Advocates of mixed-use, high-density development, such as Jane Jacobs [19] assert the necessity of mixed urban layout and design for vibrant urban communities while acknowledging the importance of the relationship between design and human behaviour. There are also implicit suppositions that this urban form will lead to improved quality of life [20–22].

The visual appearance of the urban form has been overlooked by planning processes, activities and intentions [23] with “physical characteristics” seen as individual preferences rather than a “theory” that informs design [24]. In reality, the physical characteristics of cities have a significant impact on travel behaviour and patterns of movement, along with economic viability, real estate market dynamics, social equity, energy use and overall sustainability [25]. Many urban planning guidelines for urban design since the 1990s have aimed at optimal density, mix of use and better access to local facilities [26], but have not focused on the importance of how the built environment is perceived [22]. Whilst differences in residential density influence the establishment of social networks and relationships, physical factors such as public space location, urban form types and physical forms are important design elements which shape neighbourhoods, the way people relate to them [22] and the presence of a sense of community [27,28]. The house fronts contribute to the physical appearance of residential streets and are the interface between the public and private spaces providing distinctive neighbourhood identities.

2.1. Semi-Private-Public Space

If the house front includes a front yard, front garden, entrance deck, plinth, veranda, porch or forecourt, this space becomes the main area of public–private interface. The front portion of the house in all its different forms is something in between indoor and outdoor, leading from inward to outward to pedestrian walkways, such as sidewalks or footpaths, and ending in the street (or vice versa). This range of built form typologies describing the house front is termed as “semi-private-public” in this research as they represent the interface that interacts between the private and public domain of the inner city residential living environment. The potential the semi-private-public interface has to enhance social interaction between neighbours is evident in older traditional suburbs and is also important for any community building.

In the field of planning, urban design and architectural theory, the urban interface between public and private has become an important concern. Interface types, such as access, setback, transparency or mode of access, are evident in Australian inner-city contexts [29]. The transitory or interstitial spaces between private and public welcome friends and business; create identity at the foyer, front door and front garden; encourage socializing at the front porch and al fresco dining; establish boundary and

natural surveillance ensuring the feeling of safety [19,29]; offer transparency through gardens and front setbacks facilitating social activities [30]. This interface balances power relations at access where privacy acts as a stabilizer between private and public [31]. Simmel [32] equivocated interface as separating and connecting device where strangers are greeted or excluded [33], where exposure and confidentiality coexist. It provides opportunities for prolonged outdoor stays therefore increasing social interaction among community members and providing important opportunities for participating in public life [2]. The semi-public-private spaces shape commercial as well as residential streets, contributing to a sense of place.

2.2. Residential Streets

The street nowadays is perceived as an essential sociable and livable public space, able to accommodate various activities in the urban environment [34]. While there have been studies of mix-used streets in residential neighbourhoods, the emphasis has been mainly on the commercial functions, such as retail, work, cultural and light industrial uses [35]. Plazas and squares have also attracted a lot of research attention [36–45]. There is, however, limited research on purely residential streets and spaces [46–50] and very little is known about people's behaviour in the semi-private-public areas of the house fronts. While urban designers and planners found that physical environment and social activities are inseparable in contributing to life experiences [51], not much effort exists in bringing the two together within the residential street. Understanding the daily life activities within the physical settings does have the potential to facilitate community building but so far remains largely unexplored.

2.3. Studying Residential Semi-Private-Public Spaces

The relationship between the built form typology characteristics of residential streets and the behaviours and activities that take place can provide insights as to what extent the physical settings are able to support building sense of community [52]. In 1968, Barker [53] referred to this relationship as "behaviour settings" and the better they are, the more positive feelings, needs and interactions are likely to develop [35]. The house fronts, and the front yards in particular, offer unique surroundings for people to establish contact, share activities and spend time interacting with others. Observation can be used to register and analyse human behaviour in these semi-private-public spaces [54–57], including measuring of social interactions.

Although so far the front yard has attracted very limited attention, there have been other neighbourhood-based studies. For example, in 1972, Appleyard and Lintell [58] measured the frequency of social interaction by analysing familiarity, home territory and environmental awareness in different streets of the same neighbourhood. In his 2011 analysis, Gehl [59] measured social interaction by counting daily life activities in the "soft edges" between buildings. Raman's [22] 2010 study emphasised that the physical environment can mediate social behaviour and neighbourhood membership while in 2013, Groat and Wang [60] argued that there is no need to show causal relationships between such variables as they are mutually reinforced. Hence, observation is a good method to track human behaviour in a city, neighbourhood [61] and in the semi-private-public spaces of the front yards.

Furthermore, people's perceptions also play an important role in shaping human behaviour. Residents' perceptions can influence how the built environment is used [62] and the development of sense of community. In general, the physical qualities, social environment and residential satisfaction are interrelated [63–65]. Hence, in addition to observation, surveying people and collecting information based on their perceptions can be a useful tool to study semi-private-public spaces, such as the front yards.

There is one main characteristic of the semi-private-public places in residential neighbourhoods which is crucial for social interactions, impacts on behaviour patterns and needs to be analysed. It is their accessibility described as physical accessibility or ease of access—that is, how easy it is to

enter and use the semi-private-public space—and visual accessibility or permeability—that is, ability of human sight to pass through and observe the material features located there. Easy accessibility to a physical space can ensure smooth social interaction. A frequently accessible space generates familiarity, intimacy, attachment and thus encourages residents to get involved in community related activities [31,66,67]. Visual permeability of the semi-private-public spaces ensures psychological connection to the street and other public areas.

The social connectivity between the front yard and the street can be seen as directly proportionate to the degree of physical accessibility and visual permeability. Observation and perception studies can potentially measure and evaluate these two accessibility aspects of the semi-private-public spaces as well as contribute towards understanding their role in building sense of community.

2.4. The Front Yard

The aspects of physical accessibility and visual permeability have been considered seriously in the local planning scheme of Australia [68,69], United States [4,16], Canada [5,7], and all over Europe [9,10,70]. Back in 1829, the front yard was regularised in Australia by a mandate as a buffer space between the house and the street [13]. Front yard is also a widely accepted suburban built form type in North America [71]. Influenced by the trend in USA [72,73], many Australian houses adopted the fenceless open front yard to increase social interaction between neighbours and decrease anti-social activities [68].

Identity or personalisation makes a place unique, attractive and recognisable, determines what it is and how it differs from others. Personalisation of the physical environment can fulfil needs to participate in desired activities [52]. It creates sense of occupancy and control over the space which encourages people to maintain the physical environment in a distinctive manner, often involving design professionals [74]. For visitors, personalisation creates interest [2], generates comfort [35] and promotes casual leisure behaviour [75,76].

Front yard ornamentation (including gardening and planting) is a common practice that engages neighbours in social interaction [77] and thus helps to build a strong visual language for visitors. Neighbours not only apprehend through compliments, but also actively socializing during gardening in the front yard [78]. Active participation in the front yard promotes strong social interaction without the need to be a member of local clubs [79]. This “simultaneous visual diversity” [77,80] is a “common symbol system” [81,82], which is a prime component of sense of community.

Front yards vary in relation to physical accessibility, be it pedestrian or vehicular [83], and visual connectivity—that is, the ability to be seen [17,18]—from the public domain and this controls the level of social interaction between household residents, neighbours and pedestrian users. Use of fence, boundary wall, gate, vegetation, hedges and screening are common practice in the front yard to provide identity, privacy and control access. These devices serve both physical and visual purposes in terms of the public–private relationship between indoor and outdoor spaces.

In the early 1970s, Newman’s [84,85] work showed that the physical design of a space can promote better social phenomena and thus is able to enhance the sense of security which is an element of sense of community. Newman’s “socio-physical” [84,85] space is based only on a sense of security which is not enough to understand the sense of community. Thus, further exploration of social interaction, attachment and identity [82,86,87] is required to enhance community building. During the 2000s, Pollan [72] and Jurkow [79] identified the front yard as a “vehicle of consensus”, that is collective identity, rather than an “area of self-expression” and privacy, which indicates its semi-private-public nature. Physical accessibility, visual permeability and personalisation are important features of the front yard which this research intends to investigate as they determine the intensity of socialisation between neighbours. A case study example from a residential neighbourhood in Perth, Western Australia is used for this purpose.

The remainder of the paper first examines the connection between accessibility and sense of community from a theoretical point of view. It then presents the methodological framework for the

case study based around accessibility of front yards. Subiaco—a residential area in Perth and the case study for this analysis—is described in terms of physical accessibility and visual permeability using observation and survey of people’s perceptions. The concluding section emphasises the importance of the front yard as a vehicle for social interaction and community building.

3. Accessibility and Sense of Community

This research explores the scope of user-oriented physical environment to facilitate social interaction and promote community building within a residential neighbourhood context. Neighbourhood streets represent a behaviour setting which shapes potential behaviour patterns, physical articulation and design. Physical accessibility to a space, such as a front yard or veranda, varies and depends on the actual design. For instance, a fence, wall or vegetation can work to a different degree as a physical barrier [85]. Maximum physical access is ensured when there is no boundary wall between a front yard and sidewalk or pedestrian pathway. Similarly, maximum visual permeability is established when the semi-private-public spaces, e.g., the front yard, are seen from the public area, e.g., the sidewalk or street [79]. According to Chua [86], community building tends to develop where familiarisation through seeing, meeting and greeting takes place in common areas, such as walkways [87] or the front yard.

Hence, the physical design regulates the degree of accessibility, physical and visual, into semi-private-public domains which in turn influences social interaction [38,51,52]. The relationship between the built form as represented by the front yard and social interaction directly influencing the sense of community, is mediated through accessibility (in its physical and visual form), which is the prime concern of this study (see Figure 1).

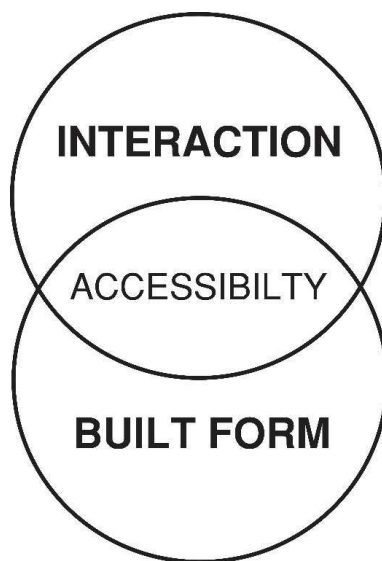


Figure 1. Relationship between built form and social interaction.

Social interaction is ultimately aimed at establishing sense of community. David McMillan and David Chavis [82] and David McMillan [88,89] define sense of community through four elements, namely: (1) membership or later described as spirit; (2) influence or trust; (3) reinforcement or trade; and (4) shared emotional connection or art. The factors which influence the sense of community include: interaction with neighbours, feeling of safety and desire to participate in neighbourhood affairs or localism [90,91].

Membership means the feeling of belonging or being part [92] as a member [93,94] of a body, group or organization. Elements defining membership are boundaries, emotional safety, sense of belonging and identification, personal investment and a common symbol system [89]. They help develop a

particular spirit of friendship or emotional feeling which allows people to connect to others and express their personality [88,95]. Examples of the common symbol system may include maintaining lawns, keeping front yards and sidewalks tidy [96]. In contrast, an untidy front yard affects the sense of attachment and discourages people to associate with this particular place [97]. There might also be negative impacts on the sense of safety as well as social interaction [98].

Influence is described as the ability of a community to influence its members and vice versa which is based on the trust they have in each other [88]. Related to the urban built form and semi-private-public spaces, influence is expressed by the adopted designs, norms and expectations about appearance and social behaviour. *Reinforcement* or trade represents the bargaining process through which community needs are fulfilled and resources are met based on shared values, fairness and ultimately through giving [88,89]. The front yard offers a space where such reinforcement can occur. When people compete to make their front yard distinct, they “gravitate” towards a group [82] and this is termed as “person–environment” fit [99]. *Shared emotional connection* is expressed by spending time together and these interactions have to be high quality making the collective experience become art [88]. When people take part in common events (e.g., rituals, festivals or simply doing something together), the sense of community increases. The more the interaction (contact), the closer the relationship [100–103]; the more the successful positive interaction, the more the social cohesion [66].

Sense of community is a crucial element of quality of life which has been missing in developments taking place since the late 1990s. The current trend of extended building footprint is creating architectural, social and cultural problems [75] which results in disappearing of space types such as front yard, sidewalk, verge, parking and even street. By encouraging privacy, recent planning policy does not promote socialising and sustainable community building [75,104]. By definition, sense of community is a “feeling” [105] of belonging and of individuals being important to each other; a shared faith that community members’ needs will be valued with commitment [82]. Access to appropriate residential outdoor spaces [106] is required to develop such a feeling and promote better socialising at a neighbourhood scale. Table 1 summarises key theories which link physical space with sense of community. This study investigates the front yard as such a space through its accessibility.

Table 1. Key theories.

Theorist	Theory	Method Used
William Hollingsworth Whyte [42,107]	Improved physical space can promote better social cohesion to achieve economic gain.	Observation Interview Filming
Jan Gehl [108]	Prolonged outdoor stay can promote enhanced social interaction. Various social dimensions affect human perceptions during socialisation.	Observation Survey
Joo Hwa Bay [109]	Social interaction in residential semi-open spaces promotes community building.	Observation Survey
Matthew Carmona [18,110]	Space typology is an important planning measure for better management of urban outdoor spaces.	Literature review
David W. McMillan and David M. Chavis [82]; David W. McMillan [88,89]	Sense of community is defined through social interaction, community attachment, community identity and sense of ownership/belonging.	Literature review

During the 1980s, urban designers, such as Gehl [2] and Whyte [42] worked on access to public open spaces in commercial areas. More recent studies segregate the physical environment without considering the relationship between interaction and the built form [1,51,111]. Local laws are similarly focused on commercial public place to promote social mixing [112]. Bay’s [109,113] work on residential semi-open spaces is rare and in this vein, the current study focuses on the front yard as a built form type in inner-city neighbourhoods which fosters mixed activities and acts as an interactive zone for private and public interactions.

The front yard and its functions as a semi-private-public space is a new frontier in studies about sense of community. It is an intermediate buffer space that helps maintaining public–private inter-relationship between indoor and outdoor. However, there are no proper guidelines on understanding the typological categorisation of this semi-private-public space in the planning scheme. On the other hand, this built form type has tremendous quality to foster social interaction and the current study aims at filling in the gap in knowledge around the front yard. Understanding daily life activities in this physical setting potentially contributes to community building and needs further development in academic knowledge and application to practice.

4. Methodology

This study uses a mixed method approach [60,114] which includes:

- Case study [115];
- Resident survey through interviews [116,117]; and
- Detailed observation [1,2,25].

4.1. Case Study

The case study method is appropriate for complex social investigations [115] and is used to understand what is happening within the residential streets of one particular inner-city area. Once the area of study is defined, different approaches to data collection can be used to describe social behaviour. Whyte [42] and Gehl [2] observed behaviour of ordinary people on the streets mainly as a result of chance encounters. Meeting a familiar face in a public place through chance encounter is rare; on the other hand, residential public places such as streets, sidewalks and passages are common meeting places for the residents. People are meeting each other while participating in daily life activities involving taking children to school, going and coming back to work, regular trips to the grocery shop/mall, walking dogs, bringing children to the park/playground, cleaning the front yard/sidewalk, rolling the rubbish and recycling bins out to the verge and so on. Regular daily life activities are predictable and thus have higher organising potentiality to be considered by urban designers, planners and policy makers [86]. It is possible to regulate these known routes based on resident behaviour patterns to reflect the planning codes. However, it is quite difficult to do it in public places with commercial enterprises. Predictable residential public streets and semi-public sidewalks [86] are integral part of residential areas and intensely interact with semi-private-public front yards.

The chosen case study for analysing social interaction in residential streets and adjacent front yards is Subiaco. Available built form types in Subiaco are veranda, front yard, sidewalk, verge, parking, back-lane and street. These are common shared spaces where various activities take place. Neighbours are meeting each other in those spaces to fulfil their daily life routines or for recreational purposes. We use the case study to assess all key theories listed in Table 1 recognising that the built form condition of these space types in terms of physical accessibility (pedestrian or vehicular) and visual permeability is required to achieve a set of typology. This typological setup can become a useful tool to identify the intensity of social interaction in the Subiaco neighbourhood.

4.2. Subiaco as a Case Study

Subiaco is situated at the immediate west of the Perth central business district (CBD), five kilometres east of 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 traditional inner-city suburbs of Perth, which was subdivided in 1880 as part of the development process [118]. In the early 20th century, Subiaco emerged as a working-class neighbourhood and by 1950s ranked as the most declined suburb [119,120]. In 1970s, dilapidated dwellings attracted families and students from the University of Western Australia and high schools to live in the cheaper rental properties, and thus by 1990s, Subiaco became a culturally vibrant community [120]. It hosts the landmark Regal Theatre, an arts centre, several hospitals, parks,

shops, cafés and restaurants, community centres and community markets. This leafy green suburb has good connectivity through public transport, including train and bus services, and is considered a stylish and attractive place. Subiaco has numerous outdoor and commercial places for local residents and visitors (see Figure 3).

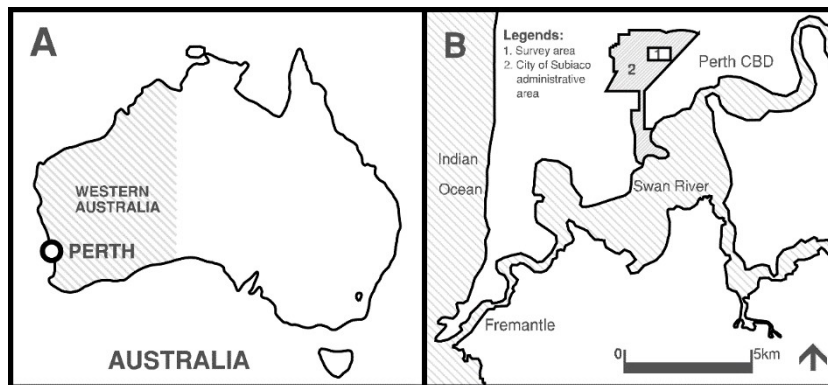


Figure 2. Maps of Australia and Perth: (A) Australia (B) Subiaco.

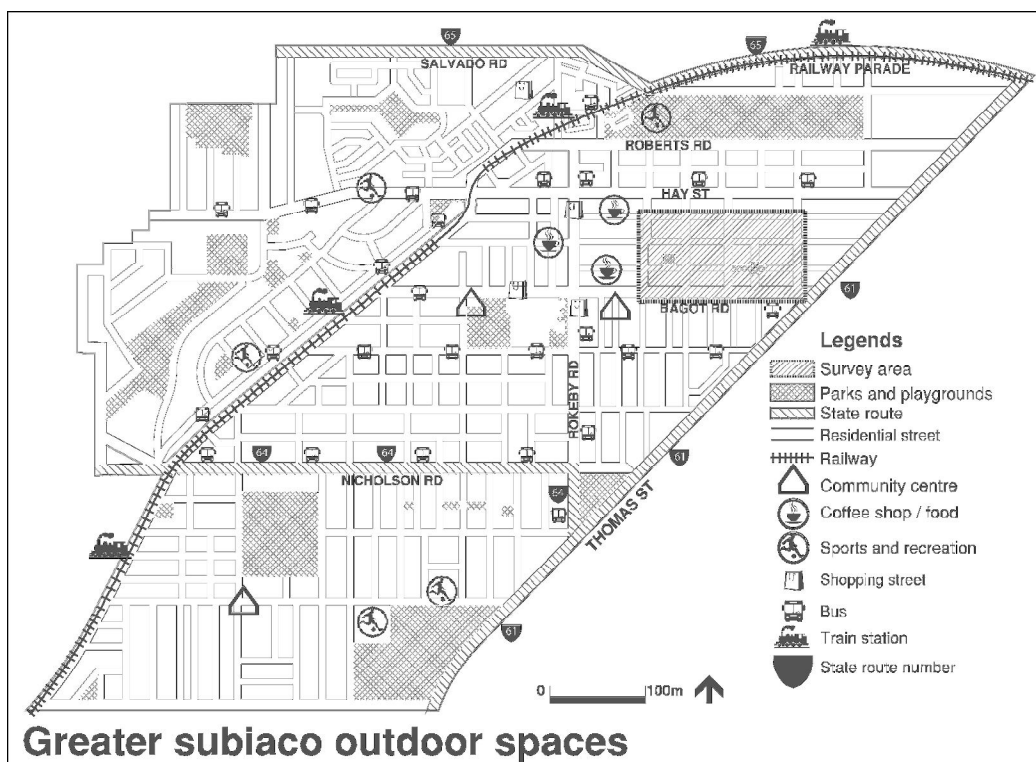


Figure 3. Subiaco outdoor destinations around the surveyed neighbourhood.

According to the Australian Bureau of Statistics, the total land area of Subiaco is 558 hectares (5.6 square kilometres) and its population was 17,238 in 2017 [121], with a density of 30.89 persons per hectare. The average resident wages and salary income for Subiaco was AUS\$ 68,931 in 2009 with an annual growth rate of 6.7% [122]. Nowadays Subiaco remains a relatively wealthy area with a higher proportion of people earning a high income compared to the rest of Perth [123].

4.3. Analysed Neighbourhood within Subiaco

The surveyed area in Subiaco was narrowed down to a manageable size for a detailed analysis (see Figure 4). It excludes commercial areas or industrial enterprises and public open spaces and includes several residential streets, namely Axon Street, Townshend Road, Olive Street, Bedford Avenue, Barker Road, Park Street and Bagot Road (see Figure 4). All streets have house front yards in a face to face and side by side manner, that is each house has a front yard and is surrounded by other houses in the same street and across the street. Such physical settings ensure ultimate probabilities for social interaction between neighbours within their immediate vicinity. As already indicated, the frequency of social interaction is directly related to the sense of community. The study of this neighbourhood analyses the physical and visual accessibility of the different space types on the seven residential streets.

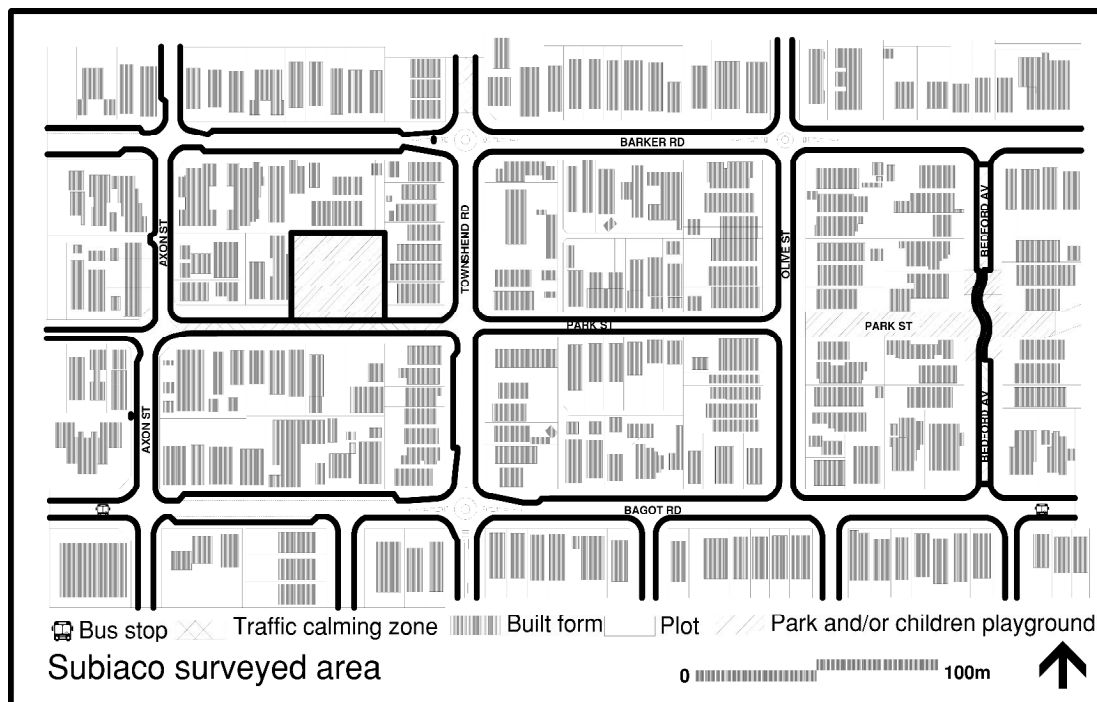


Figure 4. Analysed neighbourhood in Subiaco.

4.4. Interviews

Interviews are based on individual perception by local residents as a way to inform the study of the residential neighbourhood of Subiaco. A semi-structured interview design was adopted which contains questions related to demographic information (age, profession, use hours of front-yards, etc.), opinion (based on a Likert scale) and open-ended questions (allowing local residents to share comments, suggestions and recommendations). The survey which had approval by the Curtin University Research Ethics Committee was conducted door to door in different suitable locations only on residential streets in Subiaco (refer to Figure 4) excluding any commercial or public enterprises and at convenient times. Residents were informed about the purpose and aim of the survey, ensured about their anonymity and requested to sign a written consent form. The survey was conducted during the spring and summer seasons of 2016 and 2017 in different daytimes of weekdays and weekends.

A total of 61 residents responded to the survey which took at least 15 min and no more than 25 min to complete. Most respondents found it easy to visualise the answer to the questions while standing in their front yard, front deck or stoop (a small porch with a few stairs ending with a platform in front of the house entrance). Jane Jacobs refers to the stoop [19] as a space for natural surveillance which is able to prevent crime on the street. A few residents were comfortable to respond in the nearby sidewalk, park and corner of the street.

4.5. Observation

Observation was carried out of: (a) the front yards and (b) the street in a small area (see Figure 4) covering seven different streets. The physical and visual accessibility patterns in the front yards of these streets were recorded. Creating a new typology that enhances socialising in the front yard and the concepts of accessibility [83], such as level of physical accessibility and visual connectivity, is crucial in influencing the level of social interaction which is directly related to sense of community.

4.6. Neighbourhood Front Yard Taxonomy in Subiaco

For the Subiaco neighbourhood, three types of front yards were identified in relation to physical accessibility, namely A1—highly accessible, A2—accessible or somehow accessible, and A3—not accessible (see Table 2); and visual permeability, namely V1—highly visible, V2—visible or somewhat visible, and V3—not visible (see Table 3).

Physical accessibility through boundary walls, gates, hedges and other features, is a factor influencing social interaction in a residential area. Jan Gehl [2] identified walls as a factor influencing contacts and intensity of interaction between people. A boundary wall resembles the owner's attitude towards public. Open front yards without any boundary walls give an inviting impression while gated and locked front yards are just the opposite. The degree of openness is a factor that allows neighbours to get into the semi-private-public realm of the front yards. When a postal or pizza delivery person can get access to the front door's bell, it is considered welcoming. Some front yards have unlocked gates and are considered as "somehow accessible" as outsiders are still allowed access to the front yard. Closed gates with or without an intercom are considered "not accessible". A solid boundary wall higher than 6 feet is considered a complete barrier between residents and visitors and the front yard is not suitable for social interaction.

The human being has a 180-degree front-facing horizontal visual field [124]. Both downward and upward visions are narrower than the horizontal one. Upward vision is much narrower as humans have a tendency of looking downward while walking which makes the axis of vision 10 degrees further downward. Such a walking person practically can see only activities at ground level, streets, sidewalks and front yards. The level of perception about visibility depends on the visual permeability of the front yard. Walls, fences, vegetation and screens control the visual permeability level between the street and front yard as outlined in the three categories.

Table 2. Types of physical accessibility.

Boundary Features	Boundary Height	Intensity Scale	Code	
<p data-bbox="461 338 588 365">No boundary</p> 	0'0"	Highly accessible	A1	
<p data-bbox="221 645 828 719">Low wall/fence/hedge (usually without any gate/control; anyone can get into the front yard; low wall is just a sense of boundary and means of sitting and easy to tip over even for a child)</p>	3'0" maximum	Accessible	A2	
	<p data-bbox="221 1003 828 1050">Gate closed but unlocked, so that meter reader can enter to reach the front door at the veranda</p>	4'0" maximum	Somehow accessible	
	<p data-bbox="221 1332 828 1379">Gated/with intercom or calling bell/without any option to knock on the door.</p>	4'0" to 6'0" or more	Not accessible	A3
				

Table 3. Types of visual permeability.

Visibility Features	Boundary Height	Intensity/Scale	Code
<p>No visual barrier/screen/plant/tree</p> 	0'0"	Highly visible	V1
<p>Low height visual barrier (wall/fence/hedge)</p> 	3'0" maximum	Visible	V2
<p>Medium height visual barrier (wall/fence/hedge)</p> 	4'0" maximum	Somewhat visible	V3
<p>Very high visual barrier (wall/fence/hedge)</p> 	4'0" to 6'0" or more	Not visible	V3

5. Case Study Results

Out of the seven neighbourhood streets included in the accessibility analysis, four—namely Axon Street, Townshend Road, Olive Street and Bedford Avenue—have a north–south orientation while the

remaining three—namely Barker Road, Park Street and Bagot Road—are along the east–west direction. The houses included for each street are based on their front yard orientation rather than physical address. For instance, in this research the front yard orientation of a corner plot works as a decisive factor for a street even if it falls under the other street according to postal address. Moreover, the front yard orientation is important to observe the face-to-face (houses opposite to each other) or side-by-side (houses adjacent to each other) interaction level among immediate neighbours. Table 4 shows the number of houses analysed in each street.

Table 4. Accessibility patterns in the analysed Subiaco neighbourhood.

Street	Number of Houses	Physical Accessibility			Visual Accessibility			Overall Accessibility ¹		
		High	Medium	Low	High	Medium	Low	High	Medium	Low
		A1	A2	A3	V1	V2	V3			
		%	%	%	%	%	%	%	%	%
Axon Street	9	0	56	44	0	67	33	0	61.5	38.5
Townshend Road	30	8	71	21	67	12	21	37.5	41.5	21
Olive Street	27	29	54	17	25	58	17	27	56	17
Bedford Avenue	17	21	72	7	50	43	7	35.5	57.5	7
Barker Road	50	10	77	13	58	29	13	34	53	13
Park Street	34	18	49	33	30	43	27	24	46	30
Bagot Road	52	17	67	16	27	58	15	22	62.5	15.5
All streets	219	16	65	19	40	42	18	28	53.5	18.5

¹ Overall accessibility is the average of Physical and Visual accessibility.

5.1. Physical Design and Accessibility

The link between the physical design and accessibility of the front yard was assessed based on a complete observation of all houses in this neighbourhood. None of the houses on Axon Street have high physical or visual accessibility. Nevertheless, 56% are physically accessible and 67% of the front yards are visible (see Table 4). The remainder are not accessible at all. When the physical and visual accessibility percentages are averaged for each category to represent the overall accessibility, just over 60% of the houses in this street have potential for socialising. Although there are houses with high accessibility in Park Street, the majority have medium accessibility and with the overall percentage for socialising at 70%, there is potential for social interactions (see Table 4).

By comparison, Townshend Road is very different as it has a much smaller number of houses with no accessibility at all and 79% of all houses are overall accessible (see Table 4). Thus, it can be concluded that this street has a high potential for socialising. Olive Street, Bedford Avenue, Barker Road and Bagot Road similarly have high potentials for socialising with the respective overall values being 83%, 93%, 87% and 84% (see Table 4). The value for the entire neighbourhood is also high at 82%.

Hence, the majority of front yards on the residential streets of the analysed Subiaco neighbourhood have potential for social interactions based on accessibility to this semi-private-public space. In six of these inner-city residential streets, the potential for socialising is high. Such a typology of the front yards can contribute to planning policy in its efforts to create sense of community. As far as the physical design of this Subiaco neighbourhood is concerned, it encourages social mixing and easy contact between people boosting membership, influence, reinforcement and shared emotional connections. Were the physical design deprived of front yards or were there to be an overwhelming share of houses with not-accessible semi-private-public places, the conditions for developing a sense of community would have been very different.

However, it is interesting to compare the findings about social interactions based on the physical design of the front yards with the actual perceptions people have about the place of this semi-private-public space in their lives.

5.2. Perception and Accessibility

The results from the perception survey of the Subiaco neighbourhood are presented in Table 5. According to the majority of people (67%), the physical condition of their front yard helps them socialising. About 60% of the residents think that the front yard works as an extension of their living area for socialising with neighbours. Most residents (80%) are very conscious about the visual accessibility of their front yards, which helps to communicate with their neighbours in public spaces like sidewalks and streets. Front yards are visible enough (67%) from the streets and sidewalks with their distinct “personal expression” (64%). These visual and physical characteristics of the front yards are helping create sense of community.

Most of the respondents (64%) actively maintain an interactive public–private relationship while communicating with their neighbours. Just under half of people (48%) spend at least one hour a day during weekdays and 52% use it two to five hours a day during weekends. That means the front yard is a frequently used immediate semi-private-public space which maintains a balance between public and private interactions. A significant number of residents (77%) feel a strong sense of ownership and belonging in relation to their front yard; almost all (97%) feel safe during daytime and a large majority (74%) also after dark.

Table 5. Perception survey of Subiaco neighbourhood.

Statement	Agree	Aspects
The overall physical condition of my front yard helps me socialising.	67%	Physical accessibility
The front yard is an extended living area for socialising with neighbours or guests.	60%	Physical accessibility
Front yard visibility from the street to communicate with neighbours in adjacent walkways or streets helps residents engage with neighbours for socialising.	67%	Visual permeability
The visibility of the front yard from the street allows natural surveillance and the feeling of safety.	80%	Visual permeability
The front yard has its own distinct “personal expression” which contributes to the physical or visual characteristics of the street.	64%	Visual permeability
The front yard works as part of the street which helps me maintain a good relationship between public and private domains.	64%	Interaction and communication
I like to spend at least 1 h during weekdays in my front yard.	48%	Activity
I like to spend 2 to 5 h during weekends in my front yard.	52%	Activity
I feel a strong sense of ownership and sense of belonging in the front yard of my house that help me engage with my neighbourhood community.	77%	Sense of belonging
I feel safe using the front yard while participating in activities during daytime.	97%	Sense of safety
I feel safe using the front yard while participating in activities after dark.	74%	Sense of safety

Overall, there seems to be a good match between how people feel about the front yard and its physical design in the context of socialising, establishing relationships and community building. Understanding the social mixing potential of the physical environment is vital, but it would not be put into good use unless residents also perceive these opportunities.

6. Discussion

Urban public place is most essential to make a city liveable. Quality urban spaces foster sense of safety, sense of belonging, increased consciousness, diverse activities, self-esteem and interest in the living environment [125]. People’s experiences in an urban environment are reinforced by symbols, myths, customs, faiths, conventions, ceremonies, vacations [82], stories, music and various symbolic expressions [89] which create a sense of community and provide deep intense links and strong integration.

Residential streets represent typical public space which can be extended with the opportunities for socialising provided by the semi-private-public place represented by the front yard. From the observation of Subiaco residential streets, it is evident that the boundary design (high wall–low wall), fencing style (material, design, transparency), front yard orientation, veranda design are clear symbols that can be attributed to various activities and behaviours of the local residents. The majority (64%) of Subiaco residents (see Table 5) think that the “personal expression” of their front yard is able to influence to the physical and visual characteristics of their streets and thus contributing to the community. Architecturally, the front yard—a small-scale built form type with distinct characteristics—is contributing to the overall streetscape and thus helps maintaining the entire street typology through a process of continuous evolution [126–128]. This study is one of the few to shed light on the present-day importance of residential streets and the annex between the public and private spaces in them.

Shared emotional connections related to history, common place, time together and similar experience help build sense of community. The front yard is the new frontier in this research as it allows enhanced social interaction which brings people closer [100–103]; quality experiences with positive interaction and stronger relationships and bonding [66]; investment in time spent together which increases the importance of neighbours and their value to the neighbourhood [93,129], generating a spiritual bond expressed through the sense of community. When communities are forming, members search for others to share issues and then bonding forms as they explore similarity among themselves and reach out for “consensual validation” [89]. The front yard offers such a valuable safe and intimate place [130].

Methodologically, this study showed coherent positive outcomes in two tiers of analysis. First, the selected case study Subiaco neighbourhood demonstrated the significance of the physical typology and second, the perception study of the front yard validated the importance of sense of community. As social elements are more suitable to measure sense of community than environmental ones [131], this study endorses the quality of the front yard as a high potential socially interactive outdoor space type to promote community building and community resilience [132]. It helped put the importance of the front yard in perspective in relation to the elements of sense of community identified by McMillan and Chavis [82,88,89], namely social interaction, attachment, identity and sense of ownership (refer also to Table 1). The role of this semi-open space as outlined by Bay [109] was extended to its functions as a semi-private-public place when there is suitable physical and visual accessibility. High quality physical space as described by Whyte [42,107] and prolonged outdoor stay as advocated by Gehl [108] are facilitated by the specific features of the front yards in the analysed neighbourhood. Finally creating a physical typology can assist in better planning of urban outdoor spaces [18,110] by taking into consideration the role of the front yards.

This research is in line with other previous work which shows that lower fences with more visual openness provide better socializing opportunities between neighbours [133]. Similarly, it supports findings that residential built form with semi-public open space promotes more social mixing between neighbours [134,135]. Furthermore, our results passively endorse the importance of safety and walkability [134] as well as closely articulated residential built form [136,137] which improve social interaction within a neighbourhood.

A limitation of this study was the data collection carried out by a single person. Better verification and triangulation of the results might have been achieved with multiple observation. Furthermore, the data collection was conducted during spring and summer which are the seasons with more outdoor activities. Although autumn activities are likely to be very similar, the winter season which is colder and with rainy periods might generate some unexpected results. Further research directions can include analysis of the front yards within mixed-use streets where residential and commercial properties co-exist.

7. Conclusions

Researchers and planners consistently acknowledge the importance of fostering sense of community [28,138–143]. In contrast, anti-suburban critique [144] condemns Australian suburbs for being isolated from real life, lack of community and one-dimensional consumer culture.

Most of the available studies looking at the relationship between built form and sense of community are focused on public spaces and plazas in commercial areas. There is very limited research on residential streets. This study helps fill this gap by looking at the relationship between physical settings and potential for socialising in residential areas. It emphasises the importance of the front yard as a semi-private-public space for community building and adds to an area that has been neglected in academic research and planning practice.

Advocates of public place [2,17,18,145] have realized that the front yard is a high-potential private space which can perform publicly. It provides the connection between the private and public realm and is categorised as a semi-private-public place. The analysis of the Subiaco neighbourhood confirmed this nature of the front yards as well as the role of accessibility in fostering social interactions.

In local laws, the importance of the front yard typology is neglected, except for some setback rules. It is important to understand the front yard types to maintain the homogeneity reflected in local planning policy objectives adopted by the City of Subiaco (Planning Policy No. 4.8) [146]. The desire for residential privacy is reflected in local building regulations (see clause 7.1 Visual Privacy, in R-Codes, Residential Design Codes of Western Australia) [147] which could be fulfilled in back yards and outdoor private domains. However, the front yard should be understood as a focused device to maintain interactive relationship between the private and public domain [106]. In architecture, a buffer space is required to ensure gradual and smooth transformation between private and public which is termed semi-public [145,148,149]. In a similar vein, the front yard can be defined as semi-private-public space which is capable to equally satisfy both private and public needs. Thus, this magnificent space has tremendous potential to enhance the quality of sense of community and promote community building in the neighbourhood.

Public spaces are often impersonal, and it is hard for a person to maintain individual identity while in the crowd [150]. Front yards work as a public space [18] where people do not lose their personal identity. Moreover, activities in and around the semi-private-public place can contribute to community building. This is the beauty of this amazing intermediate space where people can enjoy their full freedom of choice to participate in activities. The semi-private-public front yard thus accommodates various social activities without losing its distinct physical identity. Users do not feel inferior in this socially interactive physical setup. It is hoped that this research can not only bridge the existing gaps of understanding the front yard but that the new knowledge can help guide designers, developers, consumers and policy makers in making more attractive and resilient residential cities.

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Article

Built Form and Community Building in Residential Neighbourhoods: A Case Study of Physical Distance in Subiaco, Western Australia

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Abstract: With physical and social aspects being inseparable within urban environments, design for sustainability needs to include the link between the distance and sense of community. However, only a few studies examine residential suburbs and specifically focus on the physical and social interactions occurring within the streets and adjacent to them spaces, such as verges, sidewalks and front yards. Using a case study method, including observation and a perception-based survey in the inner-city suburb of Subiaco in Perth, Western Australia, this investigation opens up a new understanding of physical distance and social interaction. It develops a novel typology of physical distances and social closeness within a residential neighbourhood which allows better conceptualising the sense of community for achieving integrated sustainability.

Keywords: social sustainability; sense of community; quality of life; community building; built form typology; front yard; street; communication; social interaction; distance; closeness; social bonding

1. Introduction

The integration of all aspects of sustainability is attracting increasing attention, particularly in relation to urban environments [1,2] where the majority of the world population now lives (54% in 2014, expected to reach 66% by 2050 [3]). A major priority for 21st century living is urban areas to provide a good quality of life in terms of housing and health [4,5] but also regarding the more intangible properties which describe social cohesion and sense of community. The United Nations' Sustainable Development Goal 11 Sustainable Cities and Communities specifically emphasises safety and inclusivity of access to green and public spaces as places which integrate environmental, social and economic opportunities. Whilst there is a broad understanding of the importance of public open spaces, residential neighbourhoods also deserve attention.

Residential streets [6,7] are a typical example of public spaces that can contribute to the sense of community. Adjacent and connected to residential streets are house fronts which, although legally private, represent very unique semi-private–public spaces with the potential to enhance urban quality of life [8]. If properly designed, they not only make residential streets more attractive but also offer opportunities for socialising and social interactions. This study focussed on understanding the links between physical distance and social interactions within the context of residential streets with adjacent front yards using a case study from Perth, Western Australia. It aimed to develop a typology through examining linear distances (physical and perceived) and social interactions related to one particular built form, namely the front yard. Such neighbourhood-based studies are rare despite the obvious link between the physical and social factors and their influence on human behaviour. Understanding the

social dimension through the physical distance opens new opportunities to create more sustainable and resilient communities.

This paper first discusses the theoretical framework which connects the concepts of sense of community with the built form and human behaviour at a neighbourhood scale. The adopted methodology for the case study is then explained and the research findings are presented. A new typology of the link between physical distance and social interaction, referred to as typology of social closeness, is developed. This allows for better appreciation of the connection between urban built form and sense of community within residential neighbourhood settings.

1.1. Sense of Community and the Built Form

The built environment—the expression used to represent urban areas—is often juxtaposed to the natural habitat characteristic of rural settlements [9]. Its functions are not only to provide shelter for human activities but also “to define patterns of movements” as well as “patterns of encounter and co-presence” [10] (p. 26). Urban design, planning and architecture are projected to last for decades, if not centuries [11], potentially making cities a catalyst for sustainable development [12]. Sustainability as a conceptual urban framework also incorporates the development of sense of place and sense of community [13] which contribute to improved quality of life, social relationships and interactions between the physical form and city dwellers as well as among neighbourhood residents and visitors. Social cohesion within the built environment becomes a counteracting factor to urban decay and makes residential neighbourhoods desirable and attractive.

By definition, the sense of community is a “feeling” [14] of belonging and of individuals being important to each other; a shared faith that community members’ needs will be valued with commitment [15]. These relational feelings contribute to the quality of life defined by the relations between individuals and their physical and social environment [16]. Within a neighbourhood, residents develop both strong and weak relationships [17]. Physical distance can impact on the strength and nature of these relationship. The intensity of the relationships can also vary from, for example, saying hello to working as a group [18]. Both chance encounters between neighbours and more intimate social relationships within a neighbourhood reinforce the sense of community [18] (p. 192).

Urban design and typology shape the environment within which the feelings of community belonging and attachment develop. In fact, new urbanism calls for built form and urban space typologies which create modern cities of human scale and sense of community [19]. Scholars [20–24] strongly advocate for place-based social sustainability to foster interactive vibrant communities [5,25–27]. Sustainability thus becomes the outcome from the combined effort of creating the physical and social environment [28]. Urban design is used as a tool shaping human behaviour [29,30] and encouraging certain conduct and activities, such as in community celebrations, whilst discouraging others, such as for crime prevention [31]. Understanding the impact physical distance has on social interactions is one unexplored area of the built form design’s role for sustainability.

1.2. Built form Typology

The typology of the built form sheds light on how urban spaces function and the interface they provide between the public and private realms [19]. Being the study of types, in the field of urban planning and architecture typology refers to the taxonomic classifications of places and buildings in reference to various criteria, such as location (rural or urban), use (agricultural, commercial, residential, medical, educational, governmental, industrial, etc.), age (old or new), etc. An assembly of indoor and outdoor space types helps form the physical language of architecture by organising public–private zoning to achieve a desired architectural experience [32] (p. 14). Normally, building types are identified by their basic form, surroundings or scale but not by their architectural style [33]. The role of types in modern architecture allows to incorporate upcoming developments without mimicking historic expressions and styles emerged in the course of time [34] as well as maintain continuity in the

cityscape [33]. New urbanists recognise typology as a vital means to further define user-friendly places [33,35].

Moudon [34,36] identified blocks, lots and street patterns as essential for typological consistency in neighbourhood design. Normally, neighbourhood streets and lots are readymade infrastructures or the “building blocks” for the city. In the pre-design phase, the common urban tissue patterns—a combination of streets, lots and public open spaces—are identified to inter-relate and form the neighbourhood. This urban fabric provides the physical environment and surroundings for the sense of community to emerge and make neighbourhood areas socially active.

As there are no distinctive tools for measuring social sustainability in neighbourhood design, one possible way to analyse the sense of community is through creating a typology of the places perceived by people as contributing towards this. Within the well-defined boundaries which spatially position a neighbourhood, social interactions are the ones creating a sense of community as they allow for emotional connections and social relationships to build up. Hence, the front yard is an important space for social interactions.

1.3. Private–Public Interface

Within a residential neighbourhood, the front yard, which we describe as a “semi-private–public” place [8], is the interface between the public realm, represented by the streets and the private domain, represented by the blocks with houses. It is the extension of other forms of interface, such as public sidewalks, pedestrian paths, walkways, and access lanes, which balance power relations and where privacy acts as a stabiliser between private and public [37]. According to Simmel [38], this interface is a separating and connecting device, where strangers are greeted or excluded [39] and where exposure and confidentiality are frequent.

The front yard in all of its manifestations, such as front garden, veranda, porch, entrance deck, plinth, al fresco dining place, etc., represents a socialising and activity interstitial space which welcomes visitors as well as establishes boundary, transparency, identity and natural surveillance ensuring the feeling of safety [40]. This built form is something in between indoor and outdoor, leading from inward to outward to pedestrian areas and ending in the streets (or vice versa). Gehl [41] emphasised its importance in providing opportunities for prolonged outdoor stays and therefore increased social interaction among community members. Social interaction can also be intensified by adding stationary (ledges, stoops, steps, and low walls) or mobile (chairs, stools, and benches) sitting arrangements [42].

However, the line between the real and symbolic ownership [43] of the interface places can be blurred. For example, private space, if visible, can perform as public [43–45] even without physical accessibility. Furthermore, the residents’ sense of control over the privately owned front yard can extend towards the adjacent public space types, such as sidewalks, verges and streets. These activities interconnect neighbours not only through face-to-face encounters, but also through spiritual relationships [14] where the physical space works as a common ground for social interaction.

1.4. Physical Distance

The main defining characteristic of a neighbourhood is physical proximity. Residential neighbourhoods act as common places and “behaviour settings” [46] where community building tends to develop by way of familiarisation through seeing, meeting and greeting [47]. Residents’ daily life routines offer opportunities to create physical familiarity as well as social acquaintances and friendships [47]. Close juxtaposition also makes people interact more frequently [48] and this kind of regular mixing is adaptive rather than optional. The “mere exposure effect” [49] claims that repeated acquaintance creates positive familiarity between individuals.

In fact, in a neighbourhood the physical distance between individuals either brings them closer towards stronger intimate relationships, or helps them maintain a weak relationship of minimum interaction which is also needful to survive in a community (see Figure 1). Social space can be characterised objectively, namely through physical distance, or subjectively, for example through the

perception of distance. Observation is the method used to capture physical distance while perception surveys collect people's opinions which also predict future behaviour [50]. Applying observation and perception can provide insights as to how people relate to each other, their neighbours and the built form. This in turn can inform the potential for community building and quality of life in a residential neighbourhood.

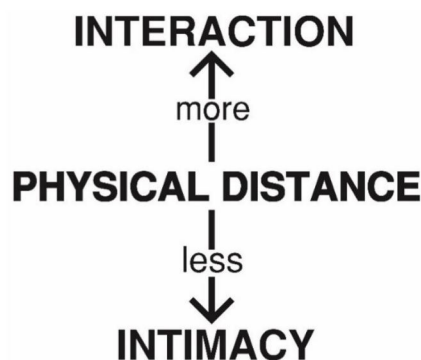


Figure 1. Relationship between distance, interaction and intimacy (Source: Authors).

Table 1 summarises the theoretical frameworks which link social interactions with physical distance together with the methods used for theory testing. According to Hall [51], physical closeness can be applied to measure the level of socialisation, including interpersonal communications and the use of senses (smell, hearing, sight, touch and taste in relation to food). He also explained that human perception works better horizontally for establishing personal space and relationships (rather than vertically where a sense of hierarchy or sub-ordination may be implied) [51]. Gehl [52] stressed the importance of passive participation, chance encounter and acquaintance as low-intensity contacts in the private–public interface which provide important opportunities for participation in public life. However, physical distance as a social indicator has been widely ignored [53], particularly in relation to socialising in a residential context [54]. Latané's [55] theory of social impact is a rare exception according to which “immediacy” (intimacy/closeness) is inversely affected by physical distance and social interactions—intimacy, time spent, recalling memories, attentiveness and persuasiveness—decrease as distance increases [56,57]. Studies of social behaviour related to physical space are also scarce, with Bay's [58–60] enquiry into the convenient size of semi-open spaces (such as forecourt) in multi-storeyed living being such an example.

Table 1. Theoretical frameworks linking social interactions with physical distance.

Theorist	Theory	Method Used
Hall [51]	Human perception works better horizontally and physical distance influences social relationships.	Literature review
Gehl [52]	Various social dimensions (based on linear physical distance) affect human perceptions during socialisation in public places.	Observation Perception survey
Latané et al. [54,56]	Social interaction is extensively determined by the physical distance between two individuals; immediacy is inversely proportional to physical distance.	Literature review
Wang and Bay [60]	Optimum size for semi-open forecourt/veranda/front-yard can ensure maximum positive socialising output in high-rise residential buildings of Singapore.	Observation Perception survey

Technological advantages, such as the telephone, Internet, computer, automobile and high-speed mass transit, have made communication easier than ever before. Nevertheless, face-to-face or chance encounters are still more appealing to people than emails or other electronic media [61]. Many argue that physical space is superior to virtual presence [62–64]. Therefore, this research explores the potential of physical distance to influence social relations and applies it as an indicator for interactions and community building using one particular case study—a neighbourhood in the Subiaco suburb of Perth, Western Australia. The study creates and explores a typology of places for social interactions based on physical distance.

2. Methodology and Case Study

The definition of the sense of community and its links to the built form provide the framework for studying residential front yards from a physical distance perspective. These semi private–public spaces are seen as essential in residential neighbourhoods for community building and good quality of life.

2.1. Methods

The aim of the study, approved by Curtin University Human Research Ethics Committee, was to analyse the contribution of the front yard to creating a sense of community by analysing the observed and perceived physical distance. A mixed-method approach [65,66] was applied which combined:

1. Neighbourhood selection and case study description [67];
2. Detailed observation [42,52,68,69], particularly of streets and front yards; and
3. Perception-based survey [70].

Using the mixed-method approach allows for cross-evaluation of observation and perception analysis within a neighbourhood case study [65–67]. This is utilised, among others, in architecture [42], urban design [52,69] and behavioural studies [66]. A case study is a well-defined unit of analysis which requires a detailed, in-depth depiction to generate new knowledge in complex social investigations which is very different from a numerical or statistical description of multiple items, places, events or phenomena. The choice of the case study is based on the researchers' interests and its ability to provide a basis for analytical development and conceptual generalisation [67]. After the residential neighbourhood in Subiaco was selected for the purpose of creating a new front-yard typology, the actual research steps taken followed those presented in Figure 2.

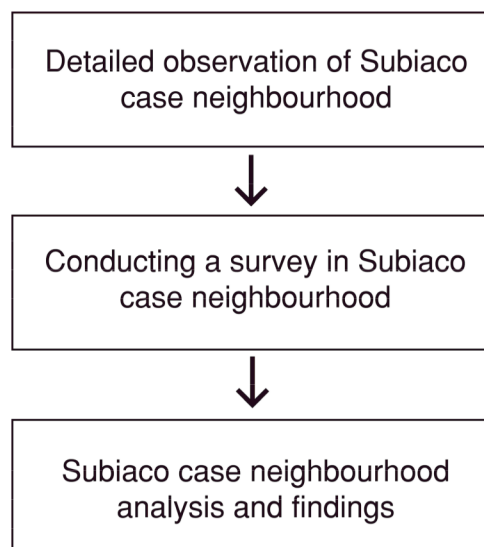


Figure 2. Research steps (Source: Authors).

Observation was conducted on all streets and front yards of the selected case neighbourhood. Activities in all front yards were observed on a street by street basis during the spring and summer seasons of 2016 and 2017 in different daytimes of weekdays and weekends. The physical distances between the edges of the verandas and the centre points of the sidewalks were measured for all houses with AutoCAD software. This allowed for the front yard—the most significant residential outdoor space—to be analysed from the point of view of physical distance which was then linked to the level of social closeness. For example, physical distance of 20 m was identified as recognisable as people’s gestures and postures are identifiable.

The perception survey was conducted with 61 residents in the case neighbourhood using semi-structured interviews. Based on the processed, organised and interpreted information acquired through the human senses [71] (p. 1604), perception influences people’s attitudes and lived realities in the neighbourhood context [72]. The residents’ perceptions [44,45] about the front yard’s usability can influence the activity patterns of socialising which are able to contribute for enhanced sense of community. Table 2 presents the demographic profile of the interviewees. It shows that the majority are homeowners (66%), female (59%), of working age (87% with 48% being people between 45 and 64) and working (85% with 41% on a full-time basis, 23% on a part-time basis and 21% self-employed or freelance) as professionals, including managers (54%).

Table 2. Demographic profile of the interviewees in Subiaco case neighbourhood.

Characteristic	Number	Percentage (%)
Home ownerships		
Homeowner	40	66
Tenant	17	28
Other	4	6
Gender		
Female	36	59
Male	25	41
Age		
18–23	3	5
24–35	8	13
36–44	13	21
45–64	29	48
>64	8	13
Employment		
Full-time	25	41
Part-time	14	23
Self-employed/freelance	13	21
Studying	5	8
Unemployed	4	7
Profession		
Managers	10	16
Professional	23	38
Other professions	12	20
Without an identified profession	16	26
TOTAL	61	100

Both, observation and perception analyses generated insights about the selected case neighbourhood. The findings, including the developed typology of closeness, are described below.

2.2. Case Study

The case study for this analysis is a neighbourhood in Subiaco—a suburb situated at the immediate west of the central business district of Western Australia’s capital city of Perth. Geographically, it is

five kilometres east of the Indian Ocean, 12 km northeast of the port of Fremantle, and is situated north of the Swan River (see Figure 3). According to the Australian Bureau of Statistics [73], the 2016 resident population of Subiaco was 16,234, with a density of 31 persons per hectare over a total land area of 562 hectares (6 km²).

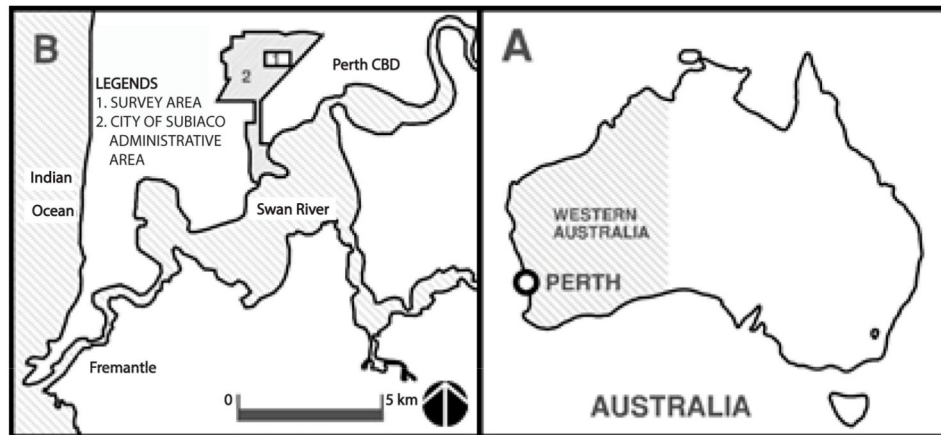


Figure 3. Maps of: Australia (A); and Subiaco (B) (Source: Authors).

Established in the 1880s as part of the development of the Swan Colony [74] and following its working-class origins in the early 20th century [75], Subiaco emerged as a culturally vibrant centre in the 1990s encouraged by the proximity to the University of Western Australia. It is a relatively wealthy and well-educated suburb. The personal median annual income was A\$59,592 in 2016 compared to A\$37,648 in Western Australia and AUS\$34,424 in Australia, and half of the people above 15 have university education compared to 20% for Western Australia and 22% for Australia [76].

2.3. Case Study Neighbourhood

The selected neighbourhood area includes several streets in Subiaco, namely Axon Street, Townshend Road, Olive Street, Bedford Avenue, Barker Road, Park Street and Bagot Road (see Figures 4 and 5). It is an entirely residential area with no commercial or industrial enterprises. Each street has house front yards in a face to face and side by side manner allowing for social interaction between neighbours within their immediate vicinity.

The selected neighbourhood for the case study is a traditional inner-city part of Subiaco. It is representative of the original area which has stood up and adapted to the challenges of time. In Figure 4, it is marked as “survey area”. Figure 4 also shows the main outdoor spaces and socialising places in Subiaco which include several parks and playgrounds, community centres, coffee shops, sports and recreation venues. The residents of the case neighbourhood have access to all of these places. This particular neighbourhood is relatively well-defined, unobstructed or divided by public open spaces making it distinctively local and relatively easy to explore the built form typology of social bonding for Subiaco residents.

Using a semi-structured questionnaire, the 61 interviews were conducted with residents in the selected neighbourhood about their front yards. The questionnaire canvassed demographic information (age, profession, home ownership, etc.; refer also to Table 2), opinions (on a Likert scale) and contained open-ended questions (comments, suggestions, recommendations, etc.).

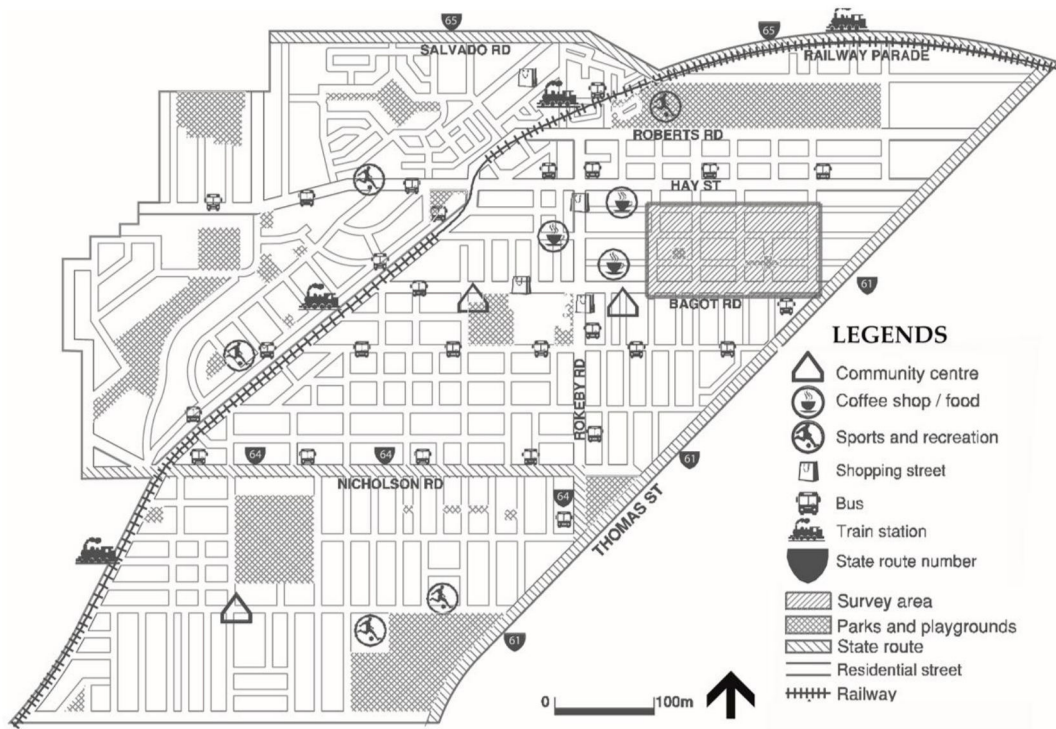


Figure 4. The suburb of Subiaco in Perth, Western Australia with the case neighbourhood (survey area) and public and outdoor places (Source: Authors).

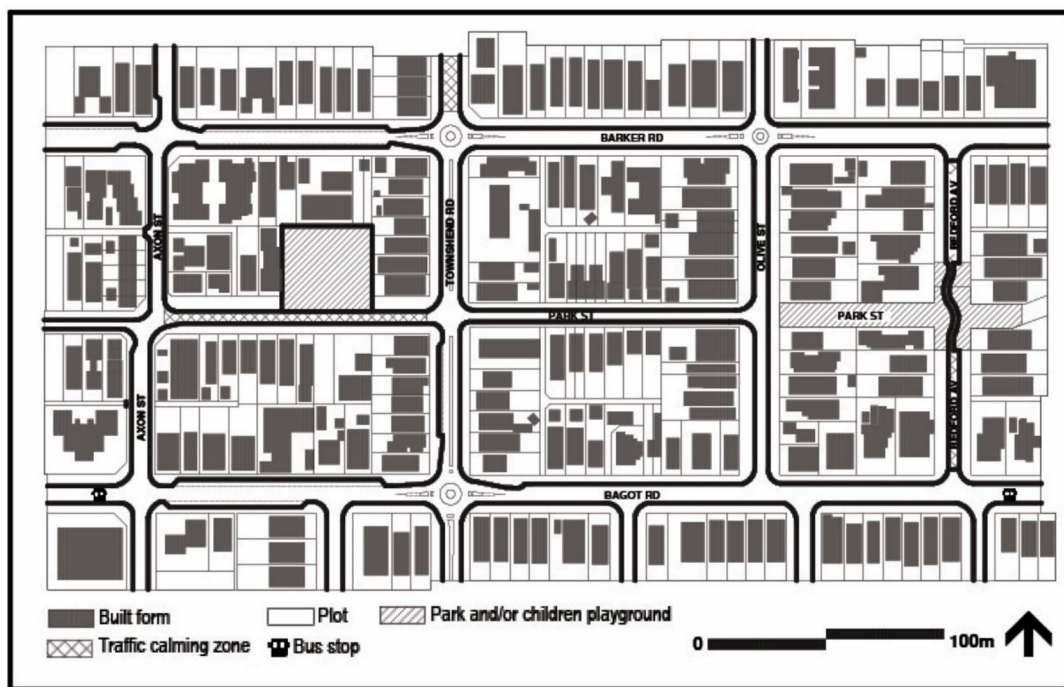


Figure 5. The case neighbourhood in Subiaco (Source: Authors).

2.4. Typology of Communication

Human interaction depends on the physical distance between people. It is based on immediate receptors such as skin, membrane and muscles, and distance receptors, such as eyes, ears and nose [51]. The former are used in close proximity while the latter enable people to see, hear and smell at a different

degree depending on the distance (see Table 3). With eye sight allowing people the longest distance communication, Gehl [41] described the range up to 100 m (325 feet) as the social field of vision. In this range, human beings might engage in various degrees of communication and social interaction with each other. The assumption is that human contact is not capable of passive communication beyond 100 m based on anatomical receptors (seeing/hearing/smelling). On a neighbourhood street scale, however, 25 m (or 80 feet) is the threshold for perceiving and understanding the feelings and moods of others and hence the limit of meaningful social interactions.

Table 3. Human perception and level of contact intensity (based on [41]).

	Receptor	Range	Purpose/Ability to Perform
Short distance ↓ Longer distance	Nose/Smell	1 m (39 inch)	Weak odour can be felt
		2 to 3 m (7 to 10 feet)	Strong smell like perfume can be felt
Shorter distance ↓ Long distance	Ear/Hearing	7 m (23 feet) (Maximum)	Normal conversation
		35 m (100 feet) (Maximum)	Lecture/question-answer session/one way communication
		0 to 0.5 m (0 to 2 feet)	Intense emotional contact
		0.5 to 7 m (2 to 20 feet)	Less intense contacts
Short distance ↓ Long distance	Eye/Sight	1 to 3 m (3 to 10 feet)	Normal conversation, meaningful human contact
		20 to 25 m (60 to 80 feet)	Understanding of feeling or mood
		30 m (100 feet)	Recognition of age/facial feature/hairstyle
		70 to 100 m (250 to 325 feet)	Recognition of age/sex/activity (e.g., people at the beach, football match)

Table 4 presents a communication typology based on social distance. The range of each category is determined based on a circle (see Figure 6a,b) that excludes any previous types. For example, social distance (category C3) excludes intimate (category C1) and personal (category C2) distances. Intimate (C1) and personal distances (C2) are limited to family and friends and useful for interactions in semi-private spaces (e.g., veranda).

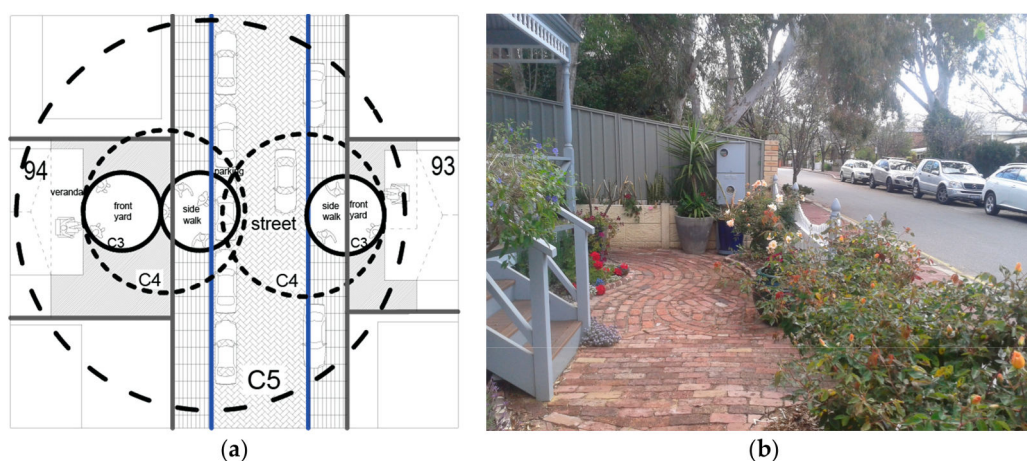


Figure 6. Section of Park Street in Subiaco, Perth, Western Australia: (a) top view of the inter-relationships between the front yards on both sides of Park Street showing the different distances, namely C3 (social distance), C4 (public distance) and C5 (recognisable distance); and (b) perspective view of Park Street showing different space types, including front-yard, sidewalk, street parking and street (Source: Authors).

Table 4. Communication typology based on social distances [51].

Sense	Level of Interaction	Distance Type	Diameter Range	Code
Smell + Hearing + Sight	High intensity contact (tenderness, comfort, love, anger)	Intimate distance	0.45 m (1.5 feet)	C1
Smell + Hearing + Sight	Normal conversation (close friends, family, e.g., family dinner table)	Personal distance	1.3 m (4.5 feet)	C2
Hearing + Sight	Ordinary conversations (friends, acquaintances, neighbours, co-workers, etc.)	Social distance	3.75 m (12 feet)	C3
Hearing + Sight	Formal contacts usually when someone watches, hears but may not want to participate (teaching, one-way communication)	Public distance	7 m (25 feet)	C4
Hearing + Sight	Normal voices are lost, facial expressions and movements are difficult to recognise; the main recognisable features are gestures and postures.	Recognisable distance	20 m (60 feet)	C5
Hearing + Sight	People are able to perceive feelings and moods while meeting others; this is the threshold of meaningful social interactions.	Identifiable distance	25 m (80 feet)	C6
Hearing + Sight	One-way communication (e.g., lecture with questions and answers or a theatre performance), visibility and participation in a conversation are difficult; only infrequent contacts are possible	Observing distance	35 m (100 feet)	C7
Sight	People can recognise others' gender, approximate age and type of activity.	Visible distance	100 m (325 feet)	C8

In a neighbourhood scale, the interactions within the semi-private–public (front yard) and public (e.g., sidewalk, verge, street parking, street, etc.) spaces are crucial for this study and they fall within the C3 (social distance) and C4 (public distance) categories. Social distances (C3) allow comfortable interactions between friends, neighbours and co-workers. Public distance (C4) is just double the size of social distance (C3). If a front yard and sidewalk fall within the range of social distance (C3), then the physical condition is considered as highly communicative for encouraging community interactions. When a front yard and sidewalk are within public distance (C4), this is seen as a medium communicative physical condition. Any distance beyond C4 is considered as low communicative physical conditions and typically falls within the distance range of C5 (recognisable distance). Recognisable distance (C5) helps to determine the level of social interaction between front yards across the street. In this range, people cannot talk comfortably as their voices are lost or fade. It is also difficult to clearly understand the facial expressions or movements of the other persons across the street. However, people can still identify the gestures and postures of others from this distance. Hence, a passive communication prevails. This situation is good for natural surveillance [29] but not for normal conversation. Natural surveillance is encouraged in planning schemes in various parts of the world with the aim to reduce crime. This is one of the main principles of Crime Prevention Through Environmental Design (CPTED) [77].

Categories C3–C5 are the ones of interest for analysing community building at a neighbourhood level. They can also represent the level of social closeness within the community based on the physical distance (see Table 5). The interaction and communication level is determined by the distance between the edge of the veranda and the centre point of the sidewalk.

Table 5. Scale of closeness based on distance categories.

Category	Physical Distance	Distance Category	Scale of Social Closeness
C3	From 1.3 to 3.75 m (4.5 to 12 feet)	Social distance	High closeness
C4	From 3.75 to 7 m (12 to 25 feet)	Public distance	Medium closeness
C5	From 7 to 20 m (25 to 60 feet)	Recognisable distance	Low closeness

3. Discussion of Case Study Results

Four of the seven streets in the case study neighbourhood have a north–south orientation, namely Axon Street, Townshend Road, Olive Street and Bedford Avenue, while the remaining three—Barker Road, Park Street and Bagot Road—are oriented along east–west (see Figure 7 for snapshots of the case neighbourhood). The house numbers considered for inclusion in the study for each street are based on the orientation of the front yard rather than the address. For instance, the orientation of the front yard of a corner plot, rather than the postal address, defines whether a house falls under a particular street. Moreover, the front yard’s orientation is important to observe the face-to-face (houses opposite to each other) or side-by-side (houses adjacent to each other) interaction level between immediate neighbours. The results from the detailed observation and the perception-based survey are presented below.

**Figure 7.** Cont.



Figure 7. Snapshots of Subiaco case neighbourhood: (a) Bagot Road view shows wider streets with bus routes; (b) Barker Road view shows a wide sidewalk along a fenced front yard; (c) Townshend Road view shows a sidewalk along different types of fenced front yards; (d) Townshend Road view from a veranda overlooking sidewalks, verge, parking and neighbouring front yards across the street; (e) Bedford Avenue view shows the use of the verge as an extended playground; and (f) traffic calming in Bedford Avenue (Source: Authors).

3.1. Detailed Observation

Table 6 shows the closeness patterns in the Subiaco case study neighbourhood. The majority of houses in the entire neighbourhood, and in all streets with the exception of Bedford Avenue, belong to the medium social closeness category (C4). At the two extremes are Olive Street, where all houses fall within this public distance category, and Bedford Avenue, where they are evenly spread between medium (C4) and low (C5) closeness. Hence, the front yards of Bedford Avenue have the lowest level of closeness compared to the other streets. The reason is the wider front yards which prevent residents and users to communicate with pedestrians. Although Bedford Avenue is a street controlled with traffic calming, it has the least pedestrian movement observed. The front yards in Olive Street have a uniform width. The observation showed this to be the least interactive street due to its quiet ambience. Being a cul-de-sac might hinder the level of social interaction.

Table 6. Social closeness patterns in the Subiaco case neighbourhood.

Street Name	Closeness		
	High	Medium	Low
	C3	C4	C5
	%	%	%
Axon Street	22	78	0
Townshend Road	17	79	4
Olive Street	0	100	0
Bedford Avenue	0	50	50
Barker Road	17	79	4
Park Street	39	52	9
Bagot Road	17	67	16
All streets	18	72	10

The front yards of the remaining five streets exhibit a combination between high and medium social closeness with social and public distances. Park Street has the highest share of high social closeness (C3) with 39% of its front yards belonging to this category.

It is important to stress that the front yard width and driveway width are crucial factors in this analysis. If the front yard is around 3.75 m (12 feet) wide, that is across the street or less, the possibility for social interaction is high. In such a situation, it is easy for relationships between the front yard, sidewalk, verge or parking to take place. On the other hand, the relationship between the house front yards across the street depends greatly on the width of the driveways. In the case of Park Street, both the front yards and driveways are narrow enough to facilitate high level of social interactions. Furthermore, traffic calming, low speed and comfortable shaded and paved amenities are all factors which make the physical environment suitable for fostering social interactions.

The above analysis shows that all streets in the surveyed area are able to accommodate medium level of social interactions. Park Street can be identified as the one with the highest social closeness while Bedford Avenue has the lowest.

Front yards with high levels of closeness (C3) can accommodate very effective social encounters between neighbours in close proximity. As medium closeness (C4) distances are just double the distance (diameter) of C3, people can communicate with each other in a moderately comfortable way. Based on physical distance, only a small share of the front yards in this Subiaco neighbourhood (namely 10%) have low social closeness.

Previous studies [43,62,63] have shown that physical distance is important in determining social contacts. The relationship between physical distance and social interaction between individuals is essential to better understand ordinary social life [47,54,55]. Our regular activities—going to work, children going to school, cleaning, moving rubbish bins, walking dogs, collecting the mail, strolling and so on—are predictable, which is a tremendous opportunity to design the urban social settings by manipulating the existing physical spaces and routes [47]. Bay's [58] study further extended this concept within a high-rise residential apartment context and similar patterns are observable in all neighbourhoods. A social reformation of the regular residential physical environment is predictable which is impossible in the public space because of its anonymous character. Familiar faces enable acquaintances and brings people closer. Regular and repeated interactions make people closer and create the sense of community.

3.2. Perception Survey

Table 7 presents the survey results from the 61 interviews conducted in the neighbourhood area. The first three questions indicate the degree of social interaction in terms of physical distance. Saying hello is a weak one-way communication which takes place when two persons communicate with each other from a distance where watching is comfortable but hearing is not (see Tables 2 and 3). It corresponds to public distance (C4) or medium closeness. On the other hand, "talking" or "chatting" is only possible where two-way communication takes place and corresponds to social distance (C3) or high closeness. Inviting neighbours, passers-by or visitors may be possible only with the house owner's permission at a personal distance (C2). These first three questions show that there is a strong and direct relationship between the linear physical distance and level of social closeness with residents from all streets, except Bagot Road, indicating that they are more likely to maintain a public distance than engage in closer interactions. Barker Road residents do not perceive any major differences between public and social distance with all happy to use both in relation to their front yards. Olive Street residents are similarly uniform in using the public distance while more Bagot Street residents prefer social to public distance.

Table 7. Social interaction in the Subiaco case neighbourhood.

Question	Axon Street	Townshend Road	Olive Street	Bedford Avenue	Barker Road	Park Street	Bagot Road
	% Yes	% Yes	% Yes	% Yes	% Yes	% Yes	% Yes
1. I like to say hello to my neighbours from my front yard (C4).	92	90	100	70	100	86	70
2. I like to talk to my neighbours in my front yard (C3).	87	80	86	59	100	86	80
3. I like to invite my neighbours in my front yard to participate in daily life or recreational activities (C2).	49	40	43	59	85	36	70
4. I feel the front yard is an appropriate place to participate in community life.	72	70	100	45	82	57	90
5. I made new friends in my front yard during the last few years.	64	80	71	96	43	50	90
6. I feel a strong sense of ownership and sense of belonging in the front yard of my house which help me to engage with my neighbourhood community.	77	80	100	62	87	50	100
7. I think my front yard allows building familiarity with my neighbours and encourages involvement in community activities.	64	70	72	45	75	72	40
Average level of closeness	72	73	82	62	82	62	77

It is interesting to see that the perceptions about the role of the front yards in creating sense of community can either mirror the physical distances or compensate for them. For example, all front yards on Olive Street have medium social closeness (see Table 6) and again all residents feel that the front yard is an appropriate place to socialise. On the contrary, Bedford Avenue is the street with the longest physical distance and while the front yard is perceived as a place to socialise only by 45% of the residents, 96% admit of having made new friends there in recent years. Park Street has the shortest distances but only 36% of its residents perceive the front yards as a socialising place. Overall, most residents feel a strong sense of ownership and belonging in the front yard of the house which helps them engage with their neighbourhood community. On Olive and Bagot Streets this perception is shared by all residents, while on Park Street only by half of them. The perceptions about the role of the front yards in developing closer relationships at the level of familiarity are shared by a smaller number of residents, as low as 40% for Bagot Road and 45% for Bedford Avenue. Hence, there are big differences in perceptions about the role of the front yards in creating a sense of community which not always align with the theoretical framework about the role of distance in creating social relationships.

3.3. Typology of Closeness

The typology of closeness based on the physical distance is perceived differently by the residents of the Subiaco case neighbourhood. In all residential streets, the number of front yards with medium level of social closeness is the highest. However, for three of them the perceived closeness was lower than the one determined based on the physical distance while for the remaining four, it was the

opposite (see Table 8). This discrepancy requires further understanding of the social factors influencing people's perceptions. Notwithstanding this, the difference between the medium level of societal closeness and the average perceived level was relatively low (maximum 18%). This shows that the physical distance can be used as a rough measure for social closeness.

Table 8. Medium level and average perceived social closeness in the Subiaco case neighbourhood.

Street Name	Social Closeness		
	Medium	Perceived	Discrepancy
	Level	Level	
	%	%	%
Axon Street	78	72	8
Townshend Road	79	73	8
Olive Street	100	82	18
Bedford Avenue	50	62	18
Barker Road	79	82	4
Park Street	52	62	16
Bagot Road	67	77	13

The three types of front yards based on physical distance allow for high (or social distance), medium (or public distance) and low (or recognisable distance) social closeness. They stimulate different types of interactions and social activities contributing to the sense of community. A distinctive feature of this typology is that it includes the link between the physical and social components which is rarely the case. Previous typology studies have ignored the role of the front yard as well as social aspects, and used only physical characteristics, such as scale and size (e.g., housing typology [78]), landscape features (e.g., parks [79]), traffic management (e.g., streets [80]), and architectural forms (e.g., buildings [81]) or used only social interactions (e.g., back alleys [82]). The study by Martin [82] mentions the front yard as a formal and uniform representation of the human personality with a desire to be seen from the public streets. This current study acknowledges the importance of both physical and social aspects in creating sense of community.

Understanding the typology of closeness also aligns with academic efforts to encourage safety and walkability in urban environments (e.g., [83]). It further emphasises the special role the front yards play as semi-private–public and socially interactive spaces.

4. Conclusions

The principles of sustainable development include resident-driven local communities [84] and the front yards in residential neighbourhood seem a logical place for initiating and maintaining social interactions. The distance-based observation study in the Subiaco neighbourhood confirmed the theory that social closeness is directly related to physical distance. There are however mixed results based on the residents' perceptions about the potential of the front yard. While overall the majority of residents on all seven streets gave some importance to the front yard in community building (ranging from 62% on Bedford and Park Streets to 82% on Olive Street and Barker Road), its place was perceived very differently. In some cases, it mirrored the physical distance, in others it was compensating for a longer or shorter distance by respectively being more or less used for socialising.

This study shows that theoretical understanding is not enough in design decision making during the planning process and testing of theory in application is required for proper diagnosis. Subiaco residents' behaviour in their semi-private–public front yards is a complex phenomenon that requires careful observation because the key to the design decisions lies beneath a blurred zone. Like every other case of human settlement around the world, Subiaco people have their own attitudes, practices, customs and beliefs which need proper understanding. Front yards in the selected Subiaco

neighbourhood play an important role in this cultural background and the understanding uncovered in this study enriches our knowledge.

Subiaco residents' conservative response to their neighbours in close proximity proves their careful nature of being selective in choosing friends. The overall medium closeness level represents their moderately open-minded attitude during social interactions. They are not only careful about closer interactions, but also maintain the necessary basic relationships with their neighbours. This careful interpretation of a balanced nature is a unique quality to be considered in the planning process. Hence, the typology of closeness is an important tool to boost better understanding by different interest groups, including planners, urban designers, architects, policy makers and users, and help the sustainability agenda towards better communities.

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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 metropolitan 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; Goldstein & 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, Roveri, & 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 January 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 manner 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 collective game (e.g. football, volleyball)	31	Taking bins out/in
2	Checking mail	12	Having coffee/tea	22	Playing games, cards, 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.

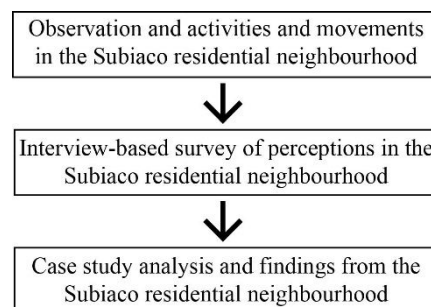


Figure 1. Research steps

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.

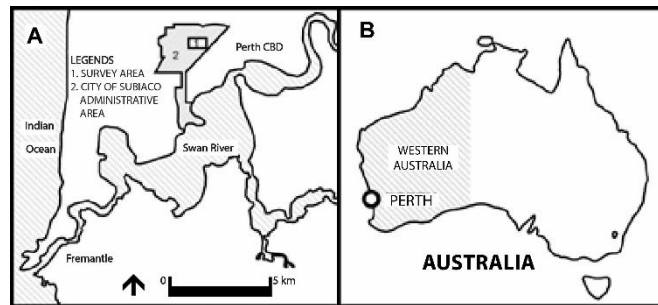


Figure 2. Subiaco and the residential neighbourhood area within Australia (A) and Perth (B)

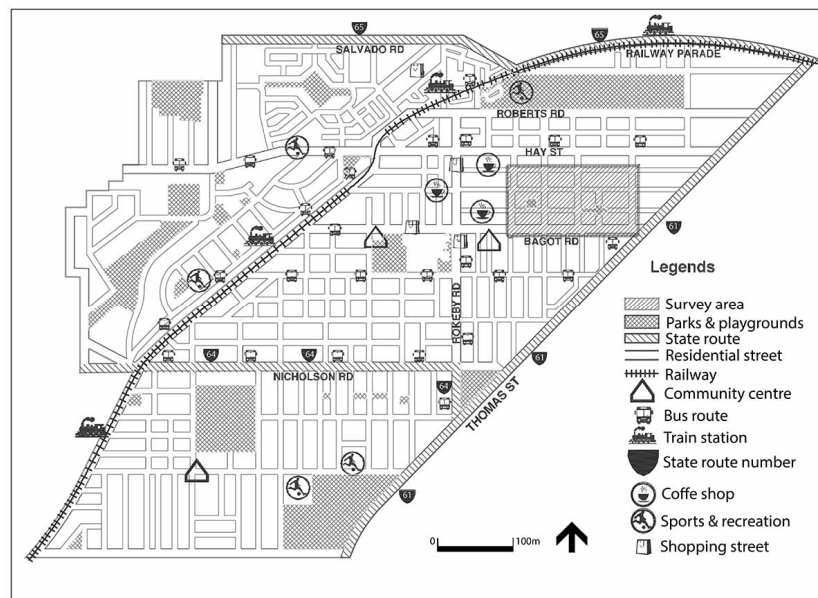


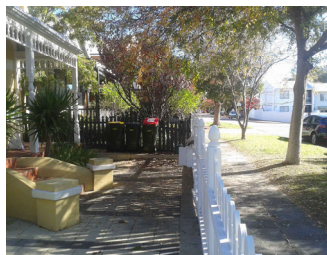
Figure 3. The case neighbourhood within the Suburb of Subiaco in Perth, Western Australia

3.2 Activities

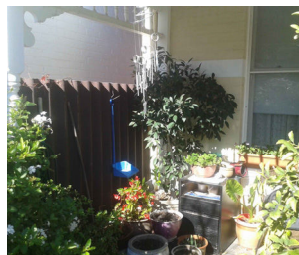
Table 4 shows the recorded activities in the case neighbourhood separately for weekdays and weekends. The distributions of the counts are according to location and by street. During weekdays, Park Street had the highest number of activities with the majority of them occurring in the front yards of the 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



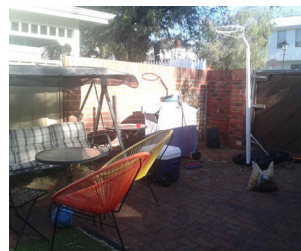
Park Street – looking for traces



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.

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
	<i>Number of activities</i>			<i>Number of vehicles/persons</i>			<i>Percentage</i>		
<i>Range</i>	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.

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APPENDIX A

STATEMENT BY CO-AUTHORS

Publication 1

I, Abu Yousuf Swapan, contributed 70 (seventy) percent to the paper/publication entitled “Importance of the residential front yard for social sustainability: Comparing sense of community levels in semi-private-public open spaces” (Swapan, A. Y., Bay, J. H., Marinova, D. (2nd Issue, 2019). Importance of the residential front yard for social sustainability: Comparing sense of community levels in semi-private-public open spaces, *Journal of Green Building*.)



Abu Yousuf Swapan

I, as a Co-Author, endorse that this level of contribution by the candidate indicated above is appropriate.



Dr. Joo Hwa Bay (Co-Author 2)

I, as a Co-Author, endorse that this level of contribution by the candidate indicated above is appropriate.



Prof. Dora Marinova (Co-Author 3)

Publication 2

I, Abu Yousuf Swapan, contributed 70 (seventy) percent to the paper/publication entitled “Understanding the importance of front yard accessibility for community building: A case study of Subiaco, Western Australia” (Swapan, A. Y., Marinova, D., & Bay, J. H. (2018). Understanding the importance of front yard accessibility for community building: A case study of Subiaco, Western Australia. *Urban Science*, 2(2), 41.)



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Prof. Dora Marinova (Co-Author 2)

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Dr. Joo Hwa Bay (Co-Author 3)

Publication 3

I, Abu Yousuf Swapan, contributed 70 (seventy) percent to the paper/publication entitled “Built Form and Community Building in Residential Neighbourhoods: A Case Study of Physical Distance in Subiaco, Western Australia” (Swapan, A. Y., Bay, J. H., & Marinova, D. (2018). Built Form and Community Building in Residential Neighbourhoods: A Case Study of Physical Distance in Subiaco, Western Australia. *Sustainability*, 10(6), 1703.)



Abu Yousuf Swapan

I, as a Co-Author, endorse that this level of contribution by the candidate indicated above is appropriate.



Dr. Joo Hwa Bay (Co-Author 2)

I, as a Co-Author, endorse that this level of contribution by the candidate indicated above is appropriate.



Prof. Dora Marinova (Co-Author 3)

Publication 4

I, Abu Yousuf Swapan, contributed 70 (seventy) percent to the paper/publication entitled “Understanding sense of community in Subiaco, Western Australia: a study of human behaviour and movement patterns” (Swapan, A. Y., & Marinova, D. (submitted). Understanding sense of community in Subiaco, Western Australia: a study of human behaviour and movement patterns. The Journal of Sustainable Development.)



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APPENDIX B

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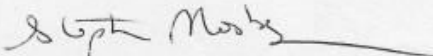
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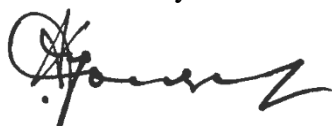
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Yours sincerely



Abu Yousuf Swapan



Abu Yousuf Swapan <swapan4794@gmail.com>

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Leanne Fan/MDPI <leanne.fan@mdpi.com>

Thu, Jul 19, 2018 at 12:16 PM

Reply-To: leanne.fan@mdpi.com

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Cc: freeland@mdpi.com, "Ms. Crystal Cheng/MDPI" <crystal.cheng@mdpi.com>, Sustainability Editorial Office <sustainability@mdpi.com>

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4. Journal of Sustainable Development

3 September 2018

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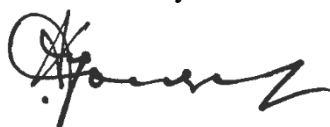
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APPENDIX C

QUESTIONNAIRES

PUBLICATION 1

Question 1: In a comfortable weather condition, in which outdoor spaces do you most get to know other people within your neighbourhood?

1. Front yard
2. Footpath/Walkway/Verge
3. Street
4. Park/Public space
5. Parking area
6. Coffee shop
7. Back lane
8. Backyard
9. Shopping street/mall
10. Swimming pool
11. Stadium
12. Balcony
13. Community club

Question 2: In a comfortable weather condition, in which neighbourhood outdoor spaces do you meet people most in a pre-planned manner?

1. Front yard
2. Footpath/Walkway/Verge
3. Street
4. Park/Public space
5. Parking area
6. Coffee shop
7. Back lane
8. Backyard
9. Shopping street/mall
10. Swimming pool
11. Stadium
12. Balcony
13. Community club

Question 3: In a comfortable weather condition, in which neighbourhood outdoor spaces do you meet people most in an unplanned manner?

1. Front yard
2. Footpath/Walkway/Verge
3. Street
4. Park/Public space
5. Parking area
6. Coffee shop
7. Back lane

8. Backyard
9. Shopping street/mall
10. Swimming pool
11. Stadium
12. Balcony
13. Community club

Question 4: Which outdoor space helps you most involve in socialising and thus enhancing the sense of community within your neighbourhood?

1. Front yard
2. Footpath/Walkway/Verge
3. Street
4. Park/Public space
5. Parking area
6. Coffee shop
7. Back lane
8. Backyard
9. Shopping street/mall
10. Swimming pool
11. Stadium
12. Balcony
13. Community club

Question 5: I think the overall physical condition of my front yard helps me socializing. (Please circle one)

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 6: I use my front yard as an extended living area for socializing with neighbours or guests. (Please circle one)

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 7: I think my front yard is ‘**visible**’ enough from the street to communicate with my neighbours in the adjacent walkways or streets that helps me to engage with neighbours for socializing. (Please circle one)

1. Strongly agree
2. Agree
3. Neither Agree or Disagree

4. Disagree
5. Strongly Disagree

Question 8: I am **conscious** about the **visibility** of my front yard from the street. (Please circle one) (*This question concerns about 'feeling of safety' & 'natural surveillance' etc.*)

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 9: I think my front yard has its own distinct 'Personal expression' which is able to contribute to the physical or visual characteristics of the street & thus involving to the community. (Please circle one)

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 10: I think my 'front yard' works as a '**part of the street**' that helps me to maintain a good relationship between public & private domains. (Please circle one)

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 11: During weekdays, I like to spend at least 1 hour in my front yard? (Please circle one) (*calculate approx. Per day*)

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 12: During weekends, I like to spend 2 to 5 hours in my front yard. (Please circle one) (*calculate approx. Per day*)

1. Strongly agree
2. Agree
3. Neither Agree or Disagree

4. Disagree
5. Strongly Disagree

Question 13: I feel a strong sense of ownership and sense of belonging in the front yard of my house which help me engage with my neighbourhood community.

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 14: I feel safe using my front yard while participating in daytime activities.

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 15: I feel safe using my front yard while participating in activities after dark.

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

PUBLICATION 2

Question 5: I think the overall physical condition of my front yard helps me socializing. (Please circle one)

6. Strongly agree
7. Agree
8. Neither Agree or Disagree
9. Disagree
10. Strongly Disagree

Question 6: I use my front yard as an extended living area for socializing with neighbours or guests. (Please circle one)

6. Strongly agree
7. Agree
8. Neither Agree or Disagree
9. Disagree
10. Strongly Disagree

Question 7: I think my front yard is ‘**visible**’ enough from the street to communicate with my neighbours in the adjacent walkways or streets that helps me to engage with neighbours for socializing. (Please circle one)

6. Strongly agree
7. Agree
8. Neither Agree or Disagree
9. Disagree
10. Strongly Disagree

Question 8: I am **conscious** about the **visibility** of my front yard from the street. (Please circle one) (*This question concerns about ‘feeling of safety’ & ‘natural surveillance’ etc.*)

6. Strongly agree
7. Agree
8. Neither Agree or Disagree
9. Disagree
10. Strongly Disagree

Question 9: I think my front yard has its own distinct ‘Personal expression’ which is able to contribute to the physical or visual characteristics of the street & thus involving to the community. (Please circle one)

6. Strongly agree
7. Agree
8. Neither Agree or Disagree
9. Disagree
10. Strongly Disagree

Question 10: I think my ‘front yard’ works as a ‘**part of the street**’ that helps me to maintain a good relationship between public & private domains. (Please circle one)

6. Strongly agree
7. Agree
8. Neither Agree or Disagree
9. Disagree
10. Strongly Disagree

Question 11: During weekdays, I like to spend at least 1 hour in my front yard? (Please circle one) (*calculate approx. Per day*)

6. Strongly agree
7. Agree
8. Neither Agree or Disagree
9. Disagree
10. Strongly Disagree

Question 12: During weekends, I like to spend 2 to 5 hours in my front yard. (Please circle one) (*calculate approx. Per day*)

6. Strongly agree
7. Agree
8. Neither Agree or Disagree
9. Disagree
10. Strongly Disagree

Question 13: I feel a strong sense of ownership and sense of belonging in the front yard of my house which help me engage with my neighbourhood community.

6. Strongly agree
7. Agree
8. Neither Agree or Disagree
9. Disagree
10. Strongly Disagree

Question 14: I feel safe using my front yard while participating in daytime activities.

6. Strongly agree
7. Agree
8. Neither Agree or Disagree
9. Disagree
10. Strongly Disagree

Question 15: I feel safe using my front yard while participating in activities after dark.

6. Strongly agree
7. Agree
8. Neither Agree or Disagree
9. Disagree
10. Strongly Disagree

PUBLICATION 3

Question 1: What is your home ownership type?

1. Homeowner
2. Tenant
3. Other

Question 2: What is your gender?

1. Male
2. Female

Question 3: What is your age range?

1. 18-23
2. 24-35
3. 36-44
4. 45-64
5. More than 64

Question 4: What is your employment type?

1. Full-time
2. Part-time
3. Self-employed/freelance
4. Studying
5. Unemployed

Question 5: What is your profession?

1. Managers
2. Professional
3. Other professions
4. Without and identified profession

Question 6: I like to say hello to my neighbours from my front yard.

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 7: I like to talk to my neighbours in my front yard.

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 8: I like to invite my neighbours in my front yard to participate in daily life or recreational activities?

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 9: I feel the front yard is an appropriate place to participate in community life.

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 10: I made new friends in my front yard during the last few years.

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 11: I feel a strong sense of ownership and sense of belonging in the front yard of my house which help me to engage with my neighbourhood community.

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 12: I think my front yard allows building familiarity with my neighbours and encourages involvement in community activities.

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

PUBLICATION 4:

Question 1: Does existing vehicular traffic in the street encourage socialising with your neighbours across the street?

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 2: Is vehicular traffic in your street encourage you to watch/ engage activities/movements taking place across the street?

1. Strongly agree
2. Agree

3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 3: Do existing activities or movements on the sidewalks encourage socialising with your neighbours across the street?

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 4: Do existing activities or movements on the verges encourage socialising with your neighbours across the street?

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 5: Do existing activities or movements in the street parking spaces encourage socialising with your neighbours across the street?

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 6: Is your front yard helping you socialise with your neighbours across the street?

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 7: Do the activities across the street generate attachment with your neighbours enhancing the sense of community?

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 8: Does the speed level in this street allow social interaction with your neighbours across the street?

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 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?

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 10: Is traffic calming beneficial for interaction with your neighbours across the street?

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 11: Are you satisfied with the pedestrian crossing across the street to socialise with your neighbours?

1. Strongly agree
2. Agree
3. Neither Agree or Disagree
4. Disagree
5. Strongly Disagree

Question 12: How many neighbours do you know by first name at the same side of your street?

Question 13: How many neighbours do you know by first name across the street?

Question 14: How many neighbours do you know by first name in your neighbourhood?

