Socialising in the suburbs: the impact of neighbourhood design on social interaction in low-density housing contexts

Zainab Ibrahim Abass

Principal supervisor: A/Professor Richard Tucker

Thesis submitted in total fulfilment of the requirements for the degree of Doctor of Philosophy

January 2018

School of Architecture and Built Environment

Deakin University

Geelong, Australia
I am the author of the thesis entitled

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Acknowledgements

To the people who have inspired and supported me during my PhD journey, I would like to express my deepest gratitude

I would like to dedicate this thesis to my mother, no words adequately express my sincere thanks, her great love, care, motivation and patience granted me the strength throughout my study and life. I thank you beyond words.

I would like to dedicate this thesis to my husband, Firas who has always supported me unconditionally and encouraged me a lot during the challenges of PhD. His generous and gentleness were helpful in valuable ways.

This dissertation would not have been possible if not for the thoughtful guidance and support of my principal supervisor A/Professor Richard Tucker. His encouragement, advice and constructive feedback inspired my thinking, guided me to keep going right till the end of study. I was extremely lucky to have a supervisor who cared so much about my work, his kindness and patience were considerably supportive to overcome difficulties throughout the term of this thesis.

I would also like to appreciate my associated supervisor, Dr Fiona Andrew for her guidance and expertise specifically on qualitative approach in advanced level of my PhD. I also thank my co-supervisor Dr Igor Martek for his support.

I indebted to my institute in Iraq, University of Technology and my sponsors Ministry of Higher Education for their financial support to pursue My PhD dream here in Australia.

To Deakin University, thank you for their support; and thanks, are for financing my contribution and conferences attendance.

I would like to thank people who gave of their time to be surveyed and interviewed.

I also grateful to Jane Allardycce and Mary Jo O’Rourke AE who helped me in editing my thesis, and offering me suggestions, critiques and advice as this thesis
moved towards completion. Mary-Jo is a professional and accredited editor who provided copyediting and proofreading services according to the university-endorsed national ‘Guidelines for editing research theses’.

I would next like to express my thanks to my friends and colleagues for their support.
List of publications:

1. Abass, Z & Tucker, R (2016) “Fifty shades of green: tree coverage and
neighbourhood attachment in relation to social interaction in Australian suburbs,”
50th International Conference of the Architectural Science Association, Adelaide,
7–9 December 2016,
http://dro.deakin.edu.au/view/DU:30093836

neighbourhood attachment and neighbourhood design characteristics of suburbs,”
Landscape and Urban Planning, 170, 231–40, [C1-A*] [SCImago Q1]
http://dro.deakin.edu.au/view/DU:30104757

neighbourhood satisfaction in the suburbs” BACK TO THE FUTURE: THE NEXT
50 YEARS] 51st International Conference of the Architectural Science Association
(ANZAScA), Victoria University of Wellington, 29 Nov – 2 Dec 2017.

4. Abass, Z & Tucker, R (submitted 17 April 2018) “Block parlé: the impact of
neighbourhood form on social interaction in low-density suburbs”, Landscape and
Urban Planning [C1-A] [SCImago Q1]

suburbs: Role of dwelling, neighbourhood, neighbouring and length of residence on
neighbourhood contentment,” Journal of Environmental Psychology [C1-A*]
[SCImago Q1] [https://doi.org/10.1016/j.jenvp.02.005]

6. Abass, Z & Tucker, R (submitted 14 December 2017) “Socialising in the suburbs:
Relationships between neighbourhood design and social interaction in low-density
housing contexts,” Journal of Urban Design [C1-A*] [SCImago Q1]

The full paper and the abstract for these publications can be found in Appendix A.
Statement of Authorship

This is to certify that this thesis comprises my original work, except where due acknowledgement is made, and is less than 100,000 words in length. This thesis has not been submitted for a higher degree at any other institution.

___________________

Zainab Ibrahim
January 2018
Abstract

Social sustainability is increasingly recognised as an important aim of sustainable development. Social interaction has been identified as a key component of social sustainability due to its impacts on sense of community, social cohesion and social capital. While Australian suburban neighbourhoods have been criticised for a lack of liveability, civility, neighbourhood character and vibrancy, the validity and reasons behind this claim are disputed due lack of empirical evidence on the relationship between the built environment and social interaction in low-density contexts. The question remains whether a lack of suburban social interaction is related to inadequate urban design. While much research has investigated the impact on social interaction of the physical environment in high-density contexts, few studies have found evidence elucidating if and how neighbourhood design can improve suburban social interaction. Thus, this study investigates if neighbourhood design characteristics impact social interaction and its correlates in low-density suburbs. The thesis addresses this gap via two steps; (1) developing a theoretical framework relating social interaction to suburban design characteristics; and (2) answering the specific question: What is the impact of the provision of different neighbourhood design characteristics on social interaction and its correlates in low density Australian suburbs?

To answer this question, a mixed methods approach was adopted using qualitative and quantitative methods of data collection with the support of measured observations of physical neighbourhood characteristic variables using on-street photography and high-resolution satellite Photomaps by Near Map. A survey of 247 residents was conducted in three low-density suburbs with similar socio-demographic characteristics in the City of Greater Geelong, Australia. Data was collected on four established scales that are considered correlates of social interaction (neighbourhood attachment; neighbourhood satisfaction; neighbouring and walking and safety) and on.
direct measures of residents’ levels of social activity. While phone interviews were carried out with residents from the three suburbs to provide qualitative elucidation of the possible impact of neighbourhood design on social interaction, the data collected via this method was limited.

Factor analysis revealed that the four correlates of social interaction used in the survey could be reduced in the context of the three study suburbs to three more powerful factors – Neighbourhood contentment; Active socialising and Accessibility. The impact was measured on these factors of five urban form characteristics: (1) street layout; (2) pedestrian environment; (3) neighbourhood connectivity; (4) public space provision; and (5) dwelling form.

Quantitative data was analysed using statistical tests including: (1) one-way between-groups analysis of variance to investigate differences in the neighbourhood experience factors between the three suburbs; (2) Pearson correlation to investigate the relationships between socio-demographic factors and social interaction, and also to explore the relationships between levels of social activity, the three neighbourhood experience factors, and neighbourhood design characteristics; and (3) hierarchical multiple regression to examine the extent to which five groups of physical characteristics impacted the three neighbourhood experience factors when socio-demographics variables were controlled for.

The findings showed that:

- Social interaction correlates were significantly different between the three suburbs.
- Socio-demographics variables were strongly correlated with the three factors of social interaction.
- Physical design characteristics significantly predicted Neighbourhood contentment and Accessibility, even allowing for the interaction of sociodemographic variables.
• Physical design characteristics did not significantly influence Active socialising.
• Neighbourhood characteristics such as street type, tree coverage, footpaths and community spaces, and neighbourhood connectivity were the most powerful predictors of Neighbourhood contentment.
• Street type and open spaces were the most important predictors of Accessibility.
• Of the dwelling form variables, only dwelling type significantly contributed to Neighbourhood contentment and to Accessibility;
• Open spaces were the best predictor of Neighbourhood contentment, confirming that open spaces within walking distance enhance attachment and satisfaction.
• Level of social activity was strongly associated with social interaction correlates and with provision of some neighbourhood design characteristics.

Overall, findings suggest that the physical design characteristics of suburban neighbourhoods can have a significant impact on social interaction through residential satisfaction. Thus, it can be argued that, in Australian suburbs, design should prioritise a number of indicators of friendly and walkable neighbourhoods: grid street types with good connectedness; higher numbers of open and community spaces within walking distance; higher degrees of tree canopy; and good footpaths. All these characteristics were found in the three suburbs to be associated with increased attachment and satisfaction, and thus by extension with improved quality of life and social sustainability. It can be concluded that well-designed low-density neighbourhoods are more attractive for residents and create environments that facilitate better social connection.

These results can inform planning, urban and architectural strategies that adequately provide such physical neighbourhood characteristics when designing for sustainable communities in contemporary suburban contexts.
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Chapter One – Introduction
1.1. Background: Social sustainability in the suburbs

Australian suburbs, which are home to approximately 70% of the population (Davison, 2006), have been criticised for a lack of liveability, civility (Johnson, 2007; Richards, 1994; Yiftachel and Hedgcock, 1993), neighbourhood character and for uniformity; for a lack of greenery and identity (Boyd, 1960; Richards, 1994) and for poor social sustainability (Davison, 1993; Yiftachel and Hedgcock, 1993). While new focus on socio-cultural sustainability has aimed to advance suburbs as places for positive social experiences (Yiftachel and Hedgcock, 1993), the design of new suburbs continues to largely neglect the social needs of residents (Freeman, 2001; Richards, 1994). Moreover, while much research has investigated the impact on social interaction of the physical environment in high-density contexts (Arundel and Ronald, 2017; Peters et al., 2010; Raman, 2010; Williams, 2005), few studies have found evidence elucidating if and how neighbourhood design can improve suburban social interaction (Brown and Cropper, 2001; Freeman, 2001; Lund, 2002). This thesis addresses this gap by identifying the physical characteristics of the built environment that most influence social interaction and its correlates in Australian suburban neighbourhoods. Before considering how these characteristics can be identified, a number of associations need acknowledging that relate the built environment to social sustainability and social interaction.

It is argued that “design should as far as possible be used to encourage high levels of social interaction” (Williams, 2005: 196). This is because social interaction is said to contribute to a sense of community and hence social cohesion, social capital and thus social sustainability. The issue of social sustainability has gained increasing attention in planning theory (Burton et al., 2013). Dempsey et al. (2011) suggest that social sustainability depends on two spheres of local context – the physical (i.e., the built environment) and the non-physical. Research has recognised that the non-
physical dimensions that can impact the sustainability of communities include perception of: social interaction; sense of place; stability of community; and harmony with the environment. Additionally, the provision and quality of the built environment impacts another dimension of social sustainability – quality of life (Dempsey et al., 2011).

Galster (2001) identified the types of physical spatial characteristics contributing to social interaction, suggesting that absence of social interaction can be identified with an absence of neighbourhood essence. Indeed, the concept of neighbourhood has been an essential focus of the analysis of new sustainability approaches (Colantonio, 2010). While (Brower, 1996) argued that ‘neighbourhood’ is simply comprised of residential units and non-residential facilities, other scholars have suggested that neighbourhood is comprised not just of the physical but also the psychosocial attributes of residential contexts that define living territory for individuals. Therefore, neighbourhood includes the facilities and services that can determine the social activities of residents (Jenks and Dempsey, 2007).

Thus, socially sustainable neighbourhoods should have suitable amenities for education, medical services and various leisure activities, and should satisfy physical and psychosocial needs by providing open public spaces that have the characteristics of protection and safety so that active social interaction is encouraged (Bonaiuto et al., 1999; Chan and Lee, 2008). The correlates of social interaction include neighbouring (“the activities engaged in by neighbours as neighbours and the relationships these engender among them”) (Keller, 1968: 29), neighbourhood attachment (defined as a social-psychological process that involves individuals’ emotional connection to their social and physical surroundings) (Bonaiuto et al., 1999; Brown et al., 2003; Buckner, 1988), walkability (“the extent to which the built environment is friendly and safe to the presence of people living, shopping, visiting, enjoying or spending time in an area”
(Abley, 2005), feeling safe (from traffic and crime when walking) (Leyden, 2003; Lund, 2002; Owen et al., 2004) and neighbourhood satisfaction (the degree between residents’ ideal neighbourhood aspirations and actual residential environments) (Bonaiuto, 2004; Kweon et al., 2010; Lovejoy et al., 2010). These five factors are strongly impacted by physical characteristics of neighbourhood such as pedestrian environment, easy access and presence of services, provision of public and open space and greenery (Bonaiuto et al., 1999; Cao and Wang, 2016; Kim and Kaplan, 2004; Skjaeveland and Garling, 1997; Zhang et al., 2017). Although it has been argued that relationships with neighbours do not essentially depend on level of social interaction, neighbourhood characteristics can engage residents to improve community sustainability.

1.2. Problem statement
Social sustainability is increasingly recognised as an important aspect of sustainable development that has environmental and economic as well as social aspects. However, there is a lack of empirical studies on the relationship between built environment and social interaction (Bramley and Power, 2009; Dempsey et al., 2011; Mak and Peacock, 2011; Thompson and Kent, 2014). Thus, while the sustainable development literature has sought urban design solutions that are socially responsive, research-informed design strategies remain lacking, especially for the types of low-density suburbs that ring Australian cities. The literature on the shortcomings of suburban contexts identifies problems in relation to three groups of issues: (1) density; (2) sociability; and (3) sense of place and neighbourhood character. These problems can be the result of neighbourhoods with poor provision, for example, of: services, facilities, greenery, public open spaces, and pedestrian-oriented walking environments.
1.2.1. High density v low density

In Australia, policy trends have changed from advancing traditional lower density living to higher density living. This important redirection of the urban environment has required significant change in community perceptions of higher density living (Buys and Miller, 2012; Mak and Peacock, 2011). The need to advance high-density living has informed research investigating how design in high-density urban contexts can positively influence neighbourliness and informal local social interaction through public space provision and location, and well-planned social infrastructure (Raman, 2010). However, this shift in focus has been to the neglect of research informing better urban design in low-density contexts.

1.2.2. Sociability

Due to increased attention on neighbourhood quality, lifestyle and liveability in contemporary communities, there has been significant research interest shown in the social life of neighbourhoods (Forrest and Kearns, 2001; Gans, 1961; Talen, 1999; Unger and Wandersman, 1985). However, the role of neighbourhood design in promoting social interaction has had little focus in the wider context of social sustainability (Dempsey et al., 2011), with a lack in particular of empirical studies on social interaction in suburban neighbourhoods (Francis et al., 2012; Freeman, 2001). This is despite the acknowledgement in recent statistical Australian studies that social interaction has been in decline (Mak and Peacock, 2011) and that poor suburb design is one reason for limitation of social connections (Kelly et al., 2012).

1.2.3. Sense of place and neighbourhood character

Research in the USA has shown that the typical characteristics of low-density neighbourhoods there have led to poor social interaction, in particular due to hierarchy of private space over public space. The need for further research has been recognised to explore the relationship between neighbourhood design, sense of community, social
interaction (Freeman, 2001; Talen, 1999) and neighbourhood character – or what is identified with sense of place. Neighbourhood character is said to comprise the collection of physical form features in relation to sense of belonging and attachment, which in turn can determine the relationships between neighbours (Woodcock et al., 2009). Sense of place is a complex concept relating people’s feelings, attachment, behavioural intentions and perceptions towards their place (Hidalgo and Hernandez, 2001; Shamai, 1991; Stedman, 2003).

Boyd (1960) was the first critic of Australian suburbs when expanding architectural critique to sociological investigation of sense of place. He identified the need to design houses that can help create sense of place in the shared spaces between them, highlighting that the neglected consideration in architectural and urban design of social interaction had resulted in characterless neighbourhoods he described with the term Australian ugliness (Boyd, 1960) to sum up their “empty, uniform, depressing and forbidding” nature. Later, Rapoport (1977), and then Salingaros (2008), similarly pointed out that suburbs are lacking in identity because they need local characteristics that should support place attachment and social contact. It was argued that what residents desire, in support of social contact and sense of community, are neighbourhoods creating a feeling of safety, satisfaction and sense of belonging (Lawrence, 1987).

Still, research has largely neglected to consider the relationships between social interaction and sense of place (Francis et al., 2012) or its correlates such as neighbourhood satisfaction, sense of belonging and identification (Riger and Lavrakas, 1981; Rosenblatt et al., 2009; Unger and Wandersman, 1985). Thus, there is a deficiency of empirical evidence of how neighbourhood character can impact social interaction and correlates of sense of place.
1.3. Research gaps

While the three issues identified above align with gaps in the research on the impact of neighbourhood design on social interaction within low-density suburban developments (Boyd, 1960; Dempsey et al., 2011; Forrest and Kearns, 2001; Mak and Peacock, 2011; Raman, 2010; Rosenblatt et al., 2009; Talen, 1999), there are studies that have considered aspects of this relationship. Indeed, research on social interaction in the community has increased considerably in recent years in different disciplines. For example, physical and psychosocial factors of neighbourhoods have been explored in health, social and psychological studies (Francis et al., 2012; Fried, 1982; Sampson et al., 2002; Skjaeveland and Garling, 1997; Unger and Wandersman, 1985), with some investigations showing that different recreational places in neighbourhoods can positively affect health outcomes by providing opportunities for walking, chatting in cafés and having informal encounters (Cattell et al., 2008; Day, 2008). However, the majority of research in this area has been limited to demographic factors (Farrell et al., 2004) with little focus on neighbourhood characteristics, including the physical qualities that may affect frequency of social contacts and sense of community (Semenza and March, 2009; Wilkinson, 2007).

The impact has also been examined of the built environment on social interaction and a sense of community (Burton et al., 2005; French et al., 2013; Nasar and Julian, 1995; Talen, 1999). However, there have only been a few empirical studies investigating the relationships between architectural design, urban design and social interaction, and these are mostly limited to the micro-scale of design as dwelling elements, rather than the design of neighbourhoods as an integrated series of spaces (Abu-Ghazzeh, 1999; Al-Homoud and Tassinary, 2004; Owens, 1993; Williams, 2005). Moreover, the relationship between social sustainability and neighbourhood design has been little studied in the context of low-density housing, in contrast with
much research in this area for high-density housing (Dempsey et al., 2011). Social interaction in low-density suburbs has been particularly neglected (Brown and Cropper, 2001). Social interaction and sense of community have been predominantly studied within a US context via investigations of the relationships between psychosocial factors and urban design characteristics such as density and mixed-use development (Freeman, 2001; Mehta, 2013; Owens, 1993; Patricios, 2002; Rogers and Sukolratanametee, 2009). The situation is similar in the UK (Bramley and Power, 2009; Burton et al., 2005; Dempsey, 2009; Raman, 2010). In Australia, there has been little research into social interaction in suburbs, which is related in turn to a lack of research into sense of place in these contexts (Mak and Peacock, 2011; Wood et al., 2010). Importantly, within the Australian context there has been negligible empirical research on how the typical characteristics that vary between Australian suburbs (e.g. dwelling type, relationship between dwellings, provision of open spaces) impact social interaction and the psychosocial characteristics of neighbourhoods that are recognised correlates of social interaction.

1.4. Significance of the study

Thus, the significance of this thesis can be outlined as:

1. It develops a framework for understanding via empirical study the effect of different neighbourhood design elements on social interaction.

2. The findings determine if neighbourhood design can facilitate social interaction towards the broader aim of social sustainability.

3. The findings also can be used to provide strategies for suburban design to improve social interaction, neighbourhood satisfaction and sense of community.

4. This study informs the measurement of how people perceive the values of place that facilitate social interaction in low density suburbs.
1.5. Research aim and objectives

The primary research aim is to determine the impact of neighbourhood design on correlates of social interaction in low-density suburbs.

The outcomes of the study will inform design strategies for architects, urban designers and planners to enhance social interaction. The following three objectives are identified to achieve this outcome:

1. To identify the neighbourhood design factors that influence social interaction
2. To investigate the hypothesised interrelationships between neighbourhood design and correlates of social interaction
3. To measure the power of urban design characteristics in predicting correlates of social interaction and identify which of these characteristics have the stronger contribution.

1.6. Research questions

The primary research question of this thesis is:

What is the impact of different neighbourhood design characteristics on correlates of social interaction in low density suburbs?

In order to answer this question, four sub-questions are posed:

1. How do different neighbourhood design characteristics impact correlates of social interaction in low-density suburbs?
2. How do socio-demographic factors impact correlates of social interaction in low-density suburbs?
3. How do neighbourhood design characteristics impact correlates of social interaction with controlling of socio-demographic variables?
4. What is the relationship between levels of social activity and correlates of social interaction, and how much are levels of social activity impacted by urban design characteristics?
Thus, the following four hypotheses are posed:

1.7. Hypotheses

1. Different neighbourhood design characteristics impact correlates of social interaction in low-density suburbs.

2. Socio-demographic factors impact correlates of social interaction in low-density suburbs.

3. Neighbourhood design characteristics impact correlates of social interaction with controlling of socio-demographic variables.

4. Level of social activity is correlated social interaction and it can be impacted by urban design.

1.8. Research design

Quantitative and qualitative methodologies were used to investigate the impact of neighbourhood design on correlates of social interaction in low-density suburbs. Data was collected from residents in three suburbs with equivalent socioeconomic profiles. Surveys were conducted in Victoria, Australia, to examine how urban design characteristics impact the social and physical experiences and perceptions of residents. Three suburbs were selected in the City of Greater Geelong according to criteria discussed in the methodology chapter. Qualitative data was also collected via interview to provide further explanation for the possible influences that different features of neighbourhoods might have on improving social connection between residents.

Four correlates of social interaction, each with established scales, were used to measure residents’ social and physical experiences and perceptions: Neighbourhood attachment, Neighbourhood satisfaction, Neighbouring and Walkability and safety. Questionnaires were delivered to three neighbourhoods that were largely built during different eras, so that the characteristics of each suburb varied. Each suburb has similar
socioeconomic profiles to partly control for the impact of socioeconomic variables. On-street face-to-face surveys were also carried out in public spaces adjacent to neighbourhood libraries in the three suburbs. Phone interviews were conducted, after analysis of the questionnaires, with residents in the streets with the highest and lowest scores for the four correlates of social interaction. Interview questions investigated perceptions of respondents towards their physical and social environment to explore their positive and negative feelings towards their neighbourhood and identify the strengths and weaknesses of their neighbourhoods. It should be noted, however, that the interview participation was low and hence the data collected can only partly elucidate the quantitative data.

Scores for the four correlates of social interaction were subjected to factor analysis to explore variability among observed, correlated variables and as a method for data reduction. The results reduced the four correlates of social interaction in the context of the studied suburbs to three neighbourhood experience factors i.e., the dependent variables – (1) Neighbourhood contentment, (2) Active socialising and (3) Accessibility. Socio-demographic variables and five groups of urban design characteristics were considered as the independent variables of this study. In addition, two-way relationships between social interaction, the three identified factors and the five groups of urban design characteristics were also explored. Figure 1.1 illustrates the research design.
Introduction

Stage 1

Identifying Research Questions

Stage 2: Theoretical Framework

Social sustainability

Change of suburban neighbourhood

Built environment and social interaction

Identifying Influential factors

Stage 3

Methodology

Data Collection

Stage 4

Neighbourhood Attachment

Neighbourhood Satisfaction

Neighbouring

Walkability and Safety

Stage 5

Extracting the New Indicators of Social Interaction

Factor Analysis of the collected data

Active Socialising

Accessibility

Stage 6

Data Analysis

Neighbourhood comparison

Socio Demographics Variables

Design Characteristics and Socio Demographics Variables

Level of Social Activity

Correlation

ANOVA

Multiple Regression

Correlation

Stage 7

Interpretation and Conclusion

Figure 0.1: Research design
1.9. Outline of chapters

Chapter One has introduced the main concepts and described the significance of the research, including background, problem statement, research gaps, thesis aims and objectives, and research questions. Chapter Two presents a background overview of the linked topics to this research. It is comprised of three sections: (1) social sustainability, (2) social interaction, and (3) built environment and social interaction. Here the literature is discussed on social sustainability and social interaction in relation to neighbourhood design. The aim is to understand the complex relationships between design and social interaction. Section 2 of Chapter Two considers four factors impacting social interaction: (1) urban design, (2) psychosocial characteristics, (3) physical characteristics and (4) dwelling design. Chapter Three elaborates on the methodology and describes in detail the suburbs studied, the social interaction correlate scales used to measure residents’ perceptions of their social and physical experience, and the data collection procedure. Chapter Four details the results of the analyses, including explanation of the statistical techniques carried out to test the thesis hypotheses. Chapter Five, the discussion, looks at the potential implications of the research findings. Chapter Six, the conclusion chapter, reflects on whether the research gaps identified have been addressed and the research questions have been answered, provides an overview of the research, states the research limitations and suggests future research.
Chapter Two – Literature Review
2.1. Introduction to the literature review

The concept of sustainability originated from the environmental movement of the 1960s, which was concerned with the preservation of natural resources for the long term. This concept focused on the maintenance and preservation, rather than consumption, of natural resources. According to the Brundtland Commission (1987), sustainability is defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (McKenzie, 2004: 2).

This chapter on social sustainability establishes the conceptual framework for study of the relationship between neighbourhood design and social interaction through a review of secondary sources on social sustainability and the areas of study that are encompassed by social sustainability: sense of community, sense of place and social interaction. In doing so, the chapter describes the chief variables related in the analysis and gives theoretical justification for the selection of these variables. The review is comprised of six sections. Following this Introduction, Section 2.2 details the different definitions of social sustainability and its relationships to residential development. It also provides an overview of two terms strongly related to social interaction and commonly mentioned in built environment research: sense of community (in relation to its physical and psychosocial influences) and sense of place. Section 2.3 presents social interaction definitions and explores the correlated components. Section 2.4 focuses on concepts of neighbourhood and provides the historical, economic and social contexts of the changing nature of suburbs. In addition, issues are discussed here of suburban sprawl in relation to sustainability, social life and isolation in Australian low-density suburbs. Section 2.5 discusses the role of the built environment in relation to social interaction, focusing on the relationships between physical neighbourhood
design characteristics and social interaction. Section 2.6 concludes the literature review with a brief synopsis.

Figure 2.1: Literature review framework
2.2. Social sustainability

This section defines social sustainability before discussing its relationships to residential development via its two component dimensions – social equity and sustainability of community. Via this discussion, the theorised relationships will be detailed between social sustainability, built environment qualities, and the aspect of social sustainability that is the focus of this thesis; namely, social interaction. Two terms are discussed that are commonly investigated in built environment research on social interaction: sense of community (in relation to its physical and psychosocial influences) and sense of place (exploring the levels of sense of place and urban qualities of place). Research from the built environment and urban design disciplines has increasingly sought to inform the goal of sustainable communities via the integration of the three dimensions of sustainable development: environmental, economic and social. While these dimensions are interrelated and have equal importance (Dempsey et al., 2011; McKenzie, 2004), the economic and social dimensions have received much less attention (Bramley and Power, 2009; Vallance et al., 2011). This shortfall has prompted growing interest in the dimension of social sustainability as a fundamental characteristic of cultural development (Vallance et al., 2011).

Social sustainability is a key aspect of sustainable development, since it is considered a precondition for the sustainability of environmental conditions, as well as of cultural sustainability. Social sustainability is interrelated to cultural sustainability, which can be seen when cultural features and values play a crucial role in establishing social criteria and in turn affect individuals’ activities (Chiu, 2004). Socio-cultural sustainability is strongly linked to the conservation and development of quality of life for current and future generations.
Chiu (2004) defined culture based on three major aspects: (1) the aesthetic and artistic aspect that involves fine and performing arts, music, and popular culture; (2) the cultivation of mind and spirit that includes knowledge, belief, religion and ideologies; and (3) the anthropological perspective, which refers to the way of life in relation to the social behaviour including morals, values, laws, customs and traditions, heritage, and life styles. These aspects indicate the socio-cultural convention inherent in a specific society, which interrelate and impact one another in different ways. Although social and cultural sustainability have characteristic aspects of concern, including the social wellbeing of individuals in previous times and the sustaining of culture into the future, cultural sustainability and social sustainability overlap through socio-cultural limitations as well as being preconditions for sustainable development. In addition, there is a difference between social and cultural dimensions in terms of some of their manifestations. For instance, aspects of the social dimension may not be tangible — including levels of social cohesion, social stability, social equality, and social inclusion – while those of culture may be tangible – such as fine and performing arts, music, literature and religion (Chiu, 2004).

These concepts can also be established in the social and cultural sustainability of housing, since the physical form of housing is related to the adaptation of dwellers to the natural environment and is correlated with technological progress. In this sense, social and cultural sustainability are important aspects in housing development, particularly when they combine to determine residential activities in terms of the use of environmental resources (Chiu, 2003).

2.2.1. Definition of social sustainability

Social sustainability is a wide-ranging multidimensional concept that is highly contested. Some authors describe social sustainability in terms of conditions and objectives. Yiftachel and Hedgcock (1993) defined social sustainability as the ability
of a city to sustain in the long term viable community interaction and cultural and communication development. They argued that the socially sustainable city is characterised by “vitality, solidarity and a common sense of place among its residents”.

Similarly, Polèse and Stren (2000: 15-16) defined social sustainability as:

development (and/or growth) that is compatible with harmonious evolution of civil society, fostering an environment conducive to compatible cohabitation of culturally and socially diverse groups while at the same time encouraging social integration, with improvements in the quality of life for all segments of the population.

Other definitions, developed via the measurement of quality of life, have identified two dimensions of social sustainability with positive goals: this first represents non-physical attributes (e.g. quality of life, safety, social interaction, sense of community, sense of place and residential stability) (Dempsey et al., 2011; Yiftachel and Hedgcock, 1993); the second represents physical indicators (e.g. the public realm, walkability, decent housing, accessibility to amenities and green spaces). These indicators, which include the physical and social environment, can support the cultural spirit of a place (Yiftachel and Hedgcock, 1993). Similarly, Bacon et al. (2012: 18) identified social sustainability “as being about people’s quality of life, now and in the future”. Thus, social sustainability describes the extent to which a neighbourhood supports individual and collective wellbeing. It combines design of the physical environment with a focus on how the people who live in and use a space relate to each other and function as a community (Dixon and Woodcraft, 2013).

Other studies have identified social sustainability as comprising two dimensions: social equity, which is related to services, access and opportunities; and sustainable community, which involves social interaction, community attachment, safety and sense of place. All these concepts are strongly impacted by urban form and neighbourhood design (Bramley and Power, 2009; McKenzie, 2004).
Ancell and Thompson-Fawcett (2008: 432), inspired by Maslow’s hierarchy of human needs (Figure 2.2) classified social sustainability as a general concept for needs, which include “fundamental needs, intermediate needs and ultimate needs”. Hence, the authors identified a model of socially sustainable residential requirements within the concept of ultimate needs. They provided two concepts: neighbourhood quality and quality of interaction in the community.

![Conceptual model of social sustainability](image)

**Figure 2.2**: Conceptual evaluation model social sustainability of housing (source: Ancell & Thompson-Fawcett, 2008)

In sum, there are several classifications for social sustainability, and these are similar for neighbourhood and individual interaction. These classifications have been simplified in the conceptual framework of Bramley and Power (2009) and McKenzie (2004), which is consistent with the general definition of sustainable development and which suggests two dimensions of social sustainability. These dimensions, which will be discussed in the next section, are social equity and sustainability of community.

**2.2.2. Dimensions of social sustainability**

This section discusses social equity and sustainability of community as the two key dimensions of social sustainability in the context of residential development.
2.2.2.1. Social equity

Social equity indicates a fair apportionment of resources, and an avoidance of exclusionary practices, that allow all residents to contribute completely in society – socially, economically and politically (Burton, 2000; Dempsey et al., 2012). Social equity in relation to the built environment can be measured by accessibility for residents to public services and amenities, social infrastructure and the degree to which places are pedestrian friendly. Improved social equity equates to improved living conditions and enhanced accessibility, which in turn reflects social justice achievements (Bramley and Power, 2009; Burton, 2000). Thus, attention to housing design can promote the social equity of residential developments (Burton, 2000). In terms of urban design, Burton (2000) argued that a compact city improves social equity through indicators of compact form, such as accessibility to services and facilities, provision of green spaces, sustainable transport, walkability and adequate living space – all of which lead to improved mental health. This supports a recent health study finding that the physical features of residential neighbourhoods, including the characteristics mentioned above, enhance health and wellbeing and play an essential role in reducing social inequities (Giles-Corti et al., 2013).

Chan and Lee (2008) identified six design factors that should be considered for improving social equity and social sustainability as a whole: (1) satisfaction of welfare requirements; (2) preservation of resources and surroundings; (3) provision of a harmonious life environment that meets physical and psychological requirements; (4) facilities for daily living approaches; (5) Form of development; and (6) availability of open spaces. Moreover, they indicate the extent to which urban design can promote social interaction For example, provisions of social infrastructure and public facilities can contribute to social well-being by meeting physical and psychological needs and thus improving quality of life (Chan and Lee, 2008).
2.2.2.2. Sustainability of community

Sustainability of community has been defined as the second dimension of social sustainability. The term refers to “the ability of society itself, or its manifestation as local community, to sustain and reproduce itself at an acceptable level of functioning” (Dempsey et al., 2011: 293). Sustainability of community has different aspects that are impacted by features of the built environment (Bramley and Power, 2009). According to Dempsey et al. (2011), sustainability of community has five measurable dimensions associated with shared features of social life: (1) social interaction; (2) participation in collective groups and networks in the community; (3) community stability; (4) sense of place and pride; (5) safety and security. Three of these dimensions are more clearly impacted by built environment qualities: social interaction, sense of place, and perception of safety.

Social interaction is represented as an essential dimension of sustainability of community because it includes neighbourliness, social networks in the neighbourhood, relationships with friends and walking activities (Bramley and Power, 2009; Burton, 2000; Dempsey et al., 2011). Talen (1999) identified two dimensions of the social aspects of urban areas: level of neighbouring and psychological sense of community. These dimensions are claimed to be associated with the physical features of the built environment (Bramley and Power, 2009). While levels of neighbouring are correlated with levels of social interaction, psychological sense of community is related to the influential components of neighbourhood social life such as shared emotional connections, neighbourhood attachment, reinforcement and sense of place (Talen, 1999). A cohesive community is claimed to be sustainable through social interaction because without social interaction, individuals can live in a particular area with little sense of community and sense of place attachment (Dempsey, 2009).
Neighbourhood theory research has identified three aspects related to place and affected by neighbourhood design: social interaction, sense of place and sense of community (Dempsey, 2009; Jenks and Jones, 2010). Physical design can afford these aspects considering functionality and efficiency. Thus, “overlapping areas of physical and social spaces may occur where designers seek not to determine human behaviour but to provide opportunities for social interaction in selected small-scale settings” (Patricios, 2002: 17).

In summary, social interaction is a substantial process in the formation of human life and social order, since psychological sense of community components are said to impact by nature of social interaction (Easthope and McNamara, 2013; Talen, 1999). According to Dempsey et al. (2011), sustainability of community has five measurable dimensions; three of which are more clearly impacted by built environment qualities: social interaction, sense of place, and perception of safety.

The next section will discuss the aspects of sustainability of community that are strongly related to social interaction – sense of community and sense of place – to identify the interrelationship between these aspects.

2.2.3. Sense of community

In this section, two factors are discussed that impact a sense of community: the physical and the psychosocial.

McMillan and Chavis (1986) defined sense of community as the extent of an individual’s feelings and interaction with the community that reflect their levels of safety and belonging to place. The definition involves four dimensions, the first being membership, which comprises a sense of belonging, feelings of safety, personal investment and identification. The second is influence, which refers to the importance of the relationships between members or groups, and their effect on each other; i.e. the concept of community attachment. Reinforcement and fulfilment of needs is the third
dimension and refers to the perception of the fulfilment of needs associated with effective behaviours of the members, which in turn creates a sustainable community. The last dimension is a shared emotional connection, which stresses the significance of neighbourhood as a characteristic in promoting the social interaction of residents. This dimension depends on spatial design and determines the sharing of life experiences and place in the neighbourhood alongside the provision of positive opportunities for members’ investment in community (Chavis et al., 1986; McMillan and Chavis, 1986). Each of these dimensions significantly affects a sense of community (Kim and Kaplan, 2004).

According to Talen (1999), sense of community is an expression of shared feeling and connection through interactions with community groups, and thus is related to community attachment. Therefore, a sense of community can develop opportunities for residents to interact in their neighbourhoods, and this positive interaction improves the shared emotional connections that contribute to a sustained sense of community (Chavis and Wandersman, 1990).

To sum up, research has revealed that physical design and psychosocial factors are correlated with sense of community. The factors that affect sense of community can be divided into two categories of: eight physical and four psychosocial factors (Figure 2.3). As is discussed below, the physical factors are: (1) architectural style and layout; (2) density and scale; (3) landscaping; (4) mixed use; (5) townscape design; (6) public and open spaces; (7) walkability; and (8) community identity. The psychosocial factors are: (1) community attachment; (2) social interaction; (3) safety; and (4) sense of belonging.
2.2.3.1. Physical factors and sense of community

Several studies have explored how the residential environment can enhance a sense of community by encouraging residents to use the spaces around their houses and interact with each other (French et al., 2013; Kim and Kaplan, 2004). Hence, strategies that develop walkability (e.g., walking for leisure or transport), and positive perceptions of neighbourhood qualities, can improve a sense of community (French et al., 2013). Lund (2002) and Kim and Kaplan (2004) have examined the physical factors that affect a sense of community, adding pedestrian environment as a significant factor. Both studies have stated that neotraditional neighbourhoods are more likely to support a sense of community than conventional suburban development through be designed specifically to provide safe, pedestrian-friendly and walkable streets claimed to inspirit community through social diversity and social interaction in public spaces (Podobnik, 2011; Talen, 1999) Similarly, Rogers and Sukolratanameete (2009) found that ecologically designed features, such as shared spaces in the neighbourhood and a
pedestrian-friendly environment, strengthen a sense of community more than in typical suburbs.

The density of a neighbourhood affects sense of community, since a smaller area enables a neighbourhood to be more defined and clearer in its planning (Rogers and Sukolratanametee, 2009). The growth of residential density combined with small-scale community promotes direct interaction among neighbours (Talen, 1999). Thus, high-density neighbourhoods support membership, which is the first element of sense of community in the theory of McMillan and Chavis. However, there have been contrary findings on the relationship between density and sense of community. For example, French et al. (2013) found high residential density can be negatively associated with sense of community. Similarly, it has also been argued that low-density areas facilitate opportunities for informal social encounters since large lot sizes enable more outdoor activities (Brueckner and Largey, 2008).

Mixed use has been also linked to sense of community. For example, Kim and Kaplan (2004) found that a sense of community is identified with good architectural and urban design, including traditional architectural style, overall layout and mixed uses of buildings. On the other hand, Wood et al. (2010) suggest that mixed uses that attract more outsiders to a neighbourhood lead to a reduced sense of community, since residents will be not able to identify who belongs from who does not.

Townscape design has an effect on sense of community through street connectivity (defined as “distribution between intersect short, alternative routes for walking” (French et al., 2013)), traffic flow, lighting and footpaths, and street furniture – all of which impact pedestrians’ environment and promote activities and community ties (Chan and Lee, 2008; French et al., 2013; Gehl, 1987).

Pedestrian-oriented neighbourhoods can increase public interaction through ‘visual forms’ in the street and street connectivity (French et al., 2013; Pendola and
Gab, 2008). Here, visual forms include wide footpaths (sidewalks) and soft edges, the provision of seating and shop facades on the street frontage – all of which increase community activities (Mehta, 2007; Mehta, 2013).

Public and green spaces are essential elements of ‘extension’ spaces in residential neighbourhoods, as they facilitate social encounters and activities and create strong community ties. Francis et al. (2012) have explored the role of presence and qualities of public spaces in supporting a sense of community. Their study is based on a conceptual framework that includes four factors: policy, physical environment, individual and social. They argue that a high-quality neighbourhood, in particular with good provision of public open spaces and shops, has a positive relationship with sense of community, whether it affects sense of community directly or encourages public space usage. In this context, public and green spaces that are appropriately designed are more likely to be used, since they satisfy physical and psychological needs (Sullivan et al., 2004; Talen, 1999).

Community identity refers to personal or group identity which is determined through the specific physical boundaries of a neighbourhood. Community identity is also identified as a domain of a sense of community (Kim and Kaplan, 2004), and involves local and physical characteristics of place. Hence, these features influence individual identity (Lynch, 1960). Community identity requires sustainable physical features and the preservation of residents’ historical environment (Glynn, 1986). In such a way, outdoor activities can be encouraged by these features and, in turn, support aspects of a sense of community (Chavis et al., 1986; Kim and Kaplan, 2004; Rogers and Sukolratanametee, 2009).

2.2.3.2. Psychosocial factors and sense of community

Kim and Kaplan (2004) identified community attachment and social interaction as two psychological aspects of residents’ feeling sense of community. Community
attachment indicates to residents’ emotional bonding or ties to their community. These emotional bonding involve residents feeling at home within their community or neighbourhood and can be clearly observed through neighbourhood satisfaction (Brown and Cropper, 2001; Chavis and Wandersman, 1990; Lewicka, 2010). Community attachment is different to place attachment and community identity. Whereas community attachment is based on an individual experience and interaction with community, place attachment is seen as resulting from long-term relationship and experience with natural and built environments that generates identification with place (Trentelman, 2009). In contrast, community identity is related to identifiable community character perceived by residents or outside people (Kim and Kaplan, 2004).

Riger and Lavrakas (1981) found that sense of community could be achieved via factors of community attachment, such as belonging to the neighbourhood and neighbouring – which involves knowing neighbours. These factors are related to levels of social interaction and to neighbourhood rootedness, and play a major role in the sense of safety and promoting sense of community (Riger and Lavrakas, 1981).

A feeling of safety has been found to be associated with sense of community and the physical features of built environment, such that negative perceptions of safety and crime negatively impact sense of community (Appleyard et al., 1981; Francis et al., 2012; French et al., 2013). In this way, perception of safety can be improved via good design of neighbourhood spaces such as open public spaces and streets (Francis et al., 2012; Kim and Kaplan, 2004).

The last psychological aspect of sense of community is social interaction, which is defined as formal and informal interactions between residents (Kim and Kaplan, 2004) and is comprised of four dimensions: (1) neighbouring interactions with residents living next door or on the same block (Glynn, 1986; Nasar and Julian, 1995);
(2) casual interactions involving informal social contact between residents who are not neighbours; (3) community participation, which refers to interactions about community problems (Kim and Kaplan, 2004) and which can be a positive predictor of sense of belonging (Chavis and Wandersman, 1990); and (4) social support and friendship networks (Al-Homoud and Tassinary, 2004; Glynn, 1986; Pretty et al., 1996). Social interaction dimensions have a crucial role in promoting a sense of community (Pretty et al., 1996).

2.2.4. Sense of place

This section discusses two aspects of sense of place commonly discussed in the literature: levels of sense of place and the urban qualities that contribute to sense of place.

A sense of place is described as the connection between place and individuals’ behaviour (Dempsey et al., 2011). Sense of place has been defined through various perspectives. Norberg-Schulz (1980) adopted a phenomenological view to define place in architecture through the concept of ‘genius loci’, which refers to the identification and expression of spirit and to the character of a place associated with memories and meaningful activities. Genius loci comprise physical and symbolic values within the cultural environment (Norberg-Schulz, 1980). In other words, this does not refer directly to place as a physical characteristic but to the quality of physical features, and to the psychological, social, emotional and aesthetic effects. Hence, sense of place can be said to be a feeling of belonging reflecting an individual’s emotional bonds, and is thus an essential motive for place identity. However, sense of place is less tangible than place identity.

Sense of place is also defined as a complex construct of meanings, symbols, and qualities that an individual associates with a particular place (Jacobs, 1961). These symbols imply cultural, historical, identification, emotional and spiritual meanings.
Sense of place is different to place attachment. For while place attachment refers to emotional and functional bonds that people develop with place, sense of place is a comprehensive concept involves collective and individual experiences in the place and the history of that place (Sime, 1986; Teo and Huang, 1996). Both sense of place and belonging include the experiential relevance of place, which arguably enhances social interactions among the community (Teo and Huang, 1996). The concept of sense of place is based on three elements that involve: the physical location; human activities that happen there; and psychosocial processes (meanings and attachments) rooted in the location (Stedman, 2003).

According to Shamai (1991), sense of place is an ambiguous concept, which makes it difficult to identify factors to measure it since it is connected to human behaviour and to place as a phenomenological concept. Shamai (1991) defined sense of place as a combination of: (1) feeling and behaviour towards place, which are dependent differences of individuals; and (2) a variety of place scales. Sense of place is can thus be said to have two major dimensions: levels of sense of place (Figure 2.4) and urban qualities of place (Figure 2.5).

![Figure 2.4: Levels of sense of place according to Shamai (1991)](image-url)
2.2.4.1. Levels of sense of place

There are seven levels of sense of place suggested by Shamai (1991: 349):

1. *Not having a sense of place.* This phase refers to the absence of individuals’ feelings regarding any specific sense of place.

2. *Knowledge of being located in a place.* This level refers to when individuals have identified the place but they have no connected feelings or sense of belonging to this place. In other words, the place is just a location and does not reflect symbolic meanings.

3. *Belonging to a place.* In contrast to the previous level, individuals have a sense of belonging to their place and, besides their knowledge of a place’s location, the place has important symbols for them.

4. *Place attachment.* Strong spiritual attachment to place is implied in this stage, since cognitive bonds, meaningful events and common experiences happen, and unique identity is reflected in the place related to the physical environment, in addition to symbolic meaning.

5. *Identifying with the place goals.* Individuals have deep attachment to place through clear identification of the objectives of place according to their aspirations. This phase also involves the incorporation of a place’s requirements. Identification is the fundamental sense of belonging.
6. *Involvement in a place.* At this level, residents have actual participation and an effective function; in other words, it does not just concern their attitudes, but they are willing to serve their community. Because of their attachment and devotion to place, development is addressed in the place through the skills and abilities of individuals.

7. *Sacrifice for a place.* This represents the highest level of sense of place. It implies maximum commitment to the community through residents’ sacrifice of significant values in their lives as well as willingness to leave their interests in order to benefit community.

Sense of place increases from the lowest to the highest phase if ‘place’ has the qualities that meet the various aspirations of residents for involvement and attachment to place. The features that achieve quality of place will be identified in the next section.

2.2.4.2. Urban qualities and sense of place

Ewing and Clemente (2013), in their book Measuring urban design, identified five physical qualities of urban design features that are measurable and reliable. They concluded that fostering a person’s experiences at the place and place characteristics could be described by the following qualities:

*Imageability:* Lynch (1960) identified imageability as the quality of physical form that invites a sense of place. It presents a quality of place that makes it more identifiable and distinct. This quality can be achieved by the configuration of specific physical features, such as street and public spaces to engage attention, and to create feelings and impressions that require a combination of elements; for example, colour and planning that employ powerful images, and a sense of individuality that correlates imageability to a sense of place (Ewing and Clemente, 2013).

*Complexity:* Visual richness reflects a complexity that depends upon the diversity of the physical environment, in particular the numbers, shapes and types of
buildings, architectural variety, landscape features, street furniture and human activities. High complexity is preferred by individuals because creating aesthetically pleasing things, such as building details, signs, pedestrian areas and surfaces, prevents a dull sameness. Trees are significant features of the built environment and provide complexity by restoring the rich textural detail and giving life to space. Signs also are major elements of complexity in suburban spaces since, by adding visual delight, public spaces can be more attractive and inspire a sense of place. Landscaping is critical for creating a sense of visual unity; unbroken patterns of light and shade, and unification of a scene are achieved by shade trees planted close together. In this sense, density types and hierarchies of public spaces give a coherence of form that constructs a sense of place (Ewing and Clemente, 2013).

**Human scale.** The relationship of buildings to humans can define the human scale, which is determined by the size, texture and articulation of architectural elements. This corresponds to the size and human proportions and, of equal importance, the details of buildings, furniture and street trees. Human scale is also defined by the width and height of buildings, which requires a homogenised ratio that is lacking in many suburban buildings. Human scale affects sense of place through close identification of the place related to individuals. This relationship determines the feeling of safety and place attachment.

**Transparency.** This involves imagination and perception of the degree of human activities which are expanded behind the street edges and public spaces. Physical elements have influenced transparency, particularly walls, windows, doors, fences, landscaping, and openings into midblock spaces. Transparency is most critical at the street phase, since a strong interaction occurs between indoor and outdoor spaces when internal activities expand to the footpath, such as outdoor dining.
Enclosure. The extent of the visual definition of spaces, such as streets and other public spaces, is defined by vertical elements or boundaries, such as buildings, walls, ceilings and trees. These boundaries make the spatial structure visible in a continuous or discontinuous direction (Norberg-Schulz, 1980). Physical qualities such as enclosure and complexity appear through a resident’s spatial experience. In such a way, specific place features, like sufficient space, are linked to agreeable social behaviour that leads to the promotion of social contacts (Nasar, 1994). In the case of low-density suburbs, trees on both sides of a street define the spaces horizontally and vertically, while vertical architectural elements are less significant in defining space. Additionally, trees bring the height-to-width proportion within a human scale and contribute to a strong sense of place. There are other elements that can also define a suburban scene spatially, such as scaled walls and fences, which enhance residents experience when walking along suburban streets (Ewing and Clemente, 2013).

It is apparent that sense of place leads to an increased place attachment, which in turn enhances sense of community and social interaction (Figure 2.6). This emphasises the importance of character in city or suburban neighbourhoods, as such qualities of physical design can create emotional and social relationships with the environment as a meaningful place, not just a geographical relation.

Figure 2.6: Interrelationship between three dimensions of social sustainability
In conclusion, definition of social sustainability and its dimensions highlight three aspects that are claimed to be influenced by the physical and social environment: sense of community, sense of place and social interaction. These three aspects are interrelated and linked to neighbourhood experience. Furthermore, review of social sustainability dimensions indicates these dimensions are related to aspects of social life and are meaningful concepts at the neighbourhood level. The following section discusses social interaction and related components within different research contexts.

2.3. Social interaction

In the previous section, the wider research contexts of social sustainability were described, and the way in which social interaction is related to these contexts. In this section, the focus is narrowed to a discussion of social interaction research via four areas: (1) definitions; (2) social interaction components; (3) socio-demographic factors and social interaction; (4) social interaction in disciplines outside the built environment.

2.3.1. Definitions

As mentioned above, social interaction has been identified as one non-physical dimension of social sustainability (Dempsey et al., 2011). Further, social interaction
as one of the seven dimensions of social cohesion is identified (Dempsey, 2009). Social interaction is also identified as an aspect of social capital, and is seen as a precondition for social cohesion (Forrest and Kearns, 2001). Social capital and social cohesion are concepts that overlap with social sustainability. Each of these three concepts have received considerable attention in the literature.

2.3.1.1. Social cohesion and social capital

Social cohesion refers to common values and civic culture, interaction and social control, social solidarity and a shared sense of belonging (Kelly et al., 2012). Social cohesion indicates wider intertwined societal qualities: (1) the absence of potential social conflicts such as racial and ethnic conflict, and income and wealth inequality; and (2) the presence of strong social ties indicated, for example, by trust and norm levels (i.e. social capital) and the presence of institutions of conflict management (Kawachi and Berkman, 2000). Research has identified several domains of social cohesion related to both the physical and social contexts of neighbourhood influence. Forrest and Kearns (2001) identified five domains of social cohesion: (1) common values and a civic culture; (2) social order and social control; (3) social solidarity and reductions in wealth disparities; (4) social networks and social capital; and (5) place attachment and identity. Dempsey (2009) identified seven dimensions: (1) social interaction; (2) social networks; (3) sense of community; (4) participation in organised activities; (5) trust and reciprocity; (6) perceived safety; and (7) sense of place attachment. All these dimensions can enhance community support and interests (Forrest and Kearns, 2001; Kawachi and Berkman, 2000). Smith (1975: 146) classified four dimensions of social cohesion: (1) use of physical facilities; (2) personal identification; (3) social interaction; and (4) value consensus. Social interaction is identified as one elementary level of these dimensions. These aspects have positive interrelationships, which means social interaction may increase when another
dimension level becomes a higher value (e.g. physical facilities and use of the spaces, personal identification and consensus among neighbours). The study also found that social interaction is the dimension that affects neighbourhood stability and leads to a sense of community (Smith, 1975).

The concept of social capital was reinterpreted by Jacobs (1961) when she used it to define norms of: social responsibility, shared knowledge, social trust, interaction forms that individuals build up to, and any productive activity that contributes to strong community setting (Roseland, 2000). Social capital has also been described as the social networks and shared norms and values that facilitate coordination for mutual trust and reciprocity among citizens (Forrest and Kearns, 2001; Leyden, 2003). Social capital is thus impacted by the physical design characteristics of social networks (Leyden, 2003). Accordingly, social capital in this study refers to features of social life relationships and neighbourhood networks that shape residents’ social interaction.

2.3.1.2. Social interaction

In his book A theory of social interaction, Turner (1988) defined social interaction as “situation where the behaviours of one actor are consciously reorganized by, and influence the behaviours of another actor and vice versa” (Turner, 1988: 13). According to Unger and Wandersman (1985), social interaction is social support that occurs between individuals who are proximate in their living and includes borrowing tools, casual visiting and requesting assistance from neighbours if there is an emergency. This definition is often referred to in the literature as neighbouring (Keller, 1968; Unger and Wandersman, 1985). Easthope and McNamara (2013: 2) defined social interaction as “all types of interactions that occur between people, which can be verbal or non-verbal, friendly or threatening, and brief or long-lived”. These interactions can enable positive or passive relationships between community members, and are represented through social contacts between neighbours. Of course, social
interactions can also enable negative relationships. Thus, the meaningful and affirmative connections between individuals afforded by social interaction are said to occur at three levels: (1) personal interactions at a family level, (2) relationships with friends and (3) connections within the community leading to a sense of belonging (Kelly et al., 2012).

Gehl (2010) studied social life in the context of a city centre and classified outdoor activities into three types (from low to high level of social contacts): necessary activities, optional activities and social activities. He suggested that optional and social activities are strongly related to increased physical environment qualities, as shown in Figure 2.7. Social activities involve active contacts between individuals of the city, such as greeting, meeting, talking and getting to know each other.

Research into the role of design in addressing residents’ behaviour and social interaction indicates that social interaction can be enhanced by three conditions: opportunities for contacts, proximity between community members and the provision of sufficient spaces to encourage interaction (Abu-Ghazaleh, 1999; Williams, 2005).

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**Figure 2.7**: The relationship between quality of physical environment and outdoor activities (Gehl, 2010).
2.3.2. Social interaction components

Community is generally defined using two components: (1) the social aspect, which refers to social interaction including support and social network; and (2) the effective aspect, which indicates the level of psychological and emotional reactions beyond social interaction (Farrell et al., 2004). Hill (1996) and Unger and Wandersman (1985) identified the social interaction component in relation to neighbouring from social support and from social networks.

Here, social support refers to individual and emotional support, which can contribute towards enhancing psychological adjustment and thus achieving social interaction. This in turn includes borrowing, casual visiting and asking for help in an emergency. These are regarded as potential factors for neighbouring (Farrell et al., 2004; Unger and Wandersman, 1985). Some research has argued that social support is represented as informal relations or contacts outdoors with neighbours, while another form is social support is through close relationships between friendships and kinship relatives in the neighbourhood. For that reason, social support is correlated with neighbourhood attachment and satisfaction (Fried, 1982; Gans, 1961; Unger and Wandersman, 1985).

Social networking is the extent of contacts between individuals. This includes social relations, linkages, social bond patterns and mobility of resources between persons, without regard to the nature of the connections in a community or whether the interactions between members are positive or negative (Unger and Wandersman, 1985). A social network can present as individual connections that occur between neighbours via sharing information about the linkages, promoting services, safety and making decisions.

It has been suggested that knowing residents in the street and in the community with mutual interests has an important role in building a community’s social capital (Rosenblatt et al., 2009). A wide social network is vital to provide outdoor social
support and reflects the significance of neighbourhood in sustaining social ties and community attachment (Chavis et al., 1986). However, community attachment can be a challenge for designers and planners (Rosenblatt et al., 2009) because creating opportunities for individuals in civic activities is a complex process. In turn, advanced methods are needed to encourage interaction and support greater involvement to generate a vigorous community (Talen, 1999).

2.3.3. Socio-demographic factors and social interaction

Socio-demographic factors must be considered when identifying the neighbourhood according to behaviours and attitudes. Thus, this section outlines the context of the effect of social and demographic factors on social interaction. These include social homogeneity versus social diversity, length of residence, housing stability and social class associated with other socioeconomic factors such as income level and the presence of children.

Williams (2005), adopted Clitheroe et al. (1998) definition of social factors that can affect social interaction; these include formal, informal and personal factors. Formal factors involve decision-making processes and social structure; informal factors include social support between individuals and community participation. Personal factors comprise personal characteristics, social dynamics and behaviour related to the social background of residents and their social class. These factors can enhance social interaction, people’s participation in the community and involvement in its organisation, and maintenance of the community (Brower, 2013). Theories about the impact of social characteristics of individuals have increasingly emphasised the importance of social factors in creating the social environment of a neighbourhood, including a direct effect on residents’ behaviour and social lives (Skjaeveland et al., 1996). This in turn can enhance the stability of individuals in neighbourhoods by
encouraging positive interactions and supporting social networks between neighbours (Galster, 2003).

According to the historian and social observer Peel (1995), a neighbourhood can be beneficial if it includes residents from different social classes. Shared connections and a balanced neighbourhood provide a good social mix. However, community construction endeavours have historically been connected with promoting social homogeneity to achieve balanced communities. Social circumstances such as growing social differentiation, discrimination, the consumer economy (Brindley, 2003) and technological progress have contributed to increased mobility, and reduced social interaction and attachment to place (Rosenblatt et al., 2009; Unger and Wandersman, 1985). The findings of Farrell et al. (2004) show that loss of community has been associated with increased mobility of residents in neighbourhoods. However, although social interaction can be positive in homogeneous neighbourhoods with the same socioeconomic features, compared with diverse neighbourhoods (Unger and Wandersman, 1985), socioeconomic status may not be correlated directly with neighbouring behaviours (Farrell et al., 2004).

Nevertheless, results show that residents of socially mixed suburbs, in particular renters and owners, are less likely to make contact with neighbours in the same area (Van Kempen and Bolt, 2009), since these residents have different activity patterns and diverse lifestyles (Arthurson, 2007; Van Ham and Feijten, 2008). For example, empirical research has shown that homeowners are more likely to take part in casual connections and to be more attached to their neighbourhood than are tenants (Austin and Baba, 1990). While these findings might seem to suggest that social homogeneity develops more social interaction than social heterogeneity (as has been found elsewhere (Van Kempen and Bolt, 2009)), the point should be made that a neighbourhood comprised all of tenants could also said to be socially homogenous. An
early study of Gans (1961), who documented that heterogeneous neighbourhoods are more likely to produce problems between neighbours. Thus, residents with spatial proximity could be expected to increase positive social interaction if they have homogeneous backgrounds. However, changing social conditions and contemporary lifestyles have not supported community engagement because residents become less likely to participate and take interest in their community, but instead pay attention to private relationships with their families (Rosenblatt et al., 2009).

Neighbourhoods are places where interactions, meetings of individuals and a variety of activities can take place; however, some studies have argued that social factors, more than physical features, can be significant for residents’ interaction. For instance, length of residence and neighbourhood stability were found to be have greatest impact on social networks (Adams, 1992) and residents’ social interaction (Dave, 2011; Farrell et al., 2004). In other words, stable neighbourhoods are more likely to support sociability than less stable neighbourhoods (Brower, 2013).

Kleit (2001) argued that, while neighbourhood interactions negatively correlate with mixed residents’ income, neighbouring could be more effective in equal-income communities. For instance, low-income individuals are more likely to have close relationships with their neighbours and experience strong social support in their neighbourhood than are residents in middle-class neighbourhoods. This raises the question of whether socially mixed community is sustainable and whether residents here can indeed become a community. However, it has been suggested that social interaction occurs more in similar socioeconomic neighbourhoods, while social mix residents tend to have weak social interaction and have different levels of attachment at different spatial scales (Arthursen, 2007).

Social interaction has also been linked to having children, particularly young children, who may enhance neighbouring by encouraging families to participate in outdoor
activities. Significant sharing and helping can occur during these activities (Riger and Lavrakas, 1981; Skjaeveland et al., 1996; Unger and Wandersman, 1985).

In line with other researchers, Wilkinson (2007) argued that social interaction is impacted by marital status. Thus, greater numbers of married people or couples, for example, have been found to increase neighbouring and sense of community (Buckner, 1988; Nasar and Julian, 1995). Other studies have shown that, although the assumption is that higher socioeconomic status (e.g. married people with high education and income) leads to more social networks, social interactions has no correlation with income and education (Nasar and Julian, 1995; Rogers and Sukolratanametee, 2009).

In summary, socioeconomic factors can influence social interaction, either directly or indirectly, via their effect on determining the frequency of contacts, social support, numbers of networks and level of neighbouring.

2.3.4. Social interaction research in disciplines outside the built environment

As discussed above, social interaction has been examined and measured in diverse approaches across psychological, health and social studies. These studies have identified the factors that influence social interaction.

2.3.4.1. Psychological studies

As long as sixty years ago, Martin (1956) argued that physical characteristics of suburbia impact formal and casual relations (including density, the accessibility of the central city and availability of daily transport), while social characteristics, in particular social homogeneity, have a major role in creating high levels of social interaction. Skjaeveland and Garling (1997) declared that urban density does not only influence social contact in residential neighbourhood, it also influences residents’ behaviour and reduces the incidence of crime. Furthermore, the study found that social interaction is influenced by physical neighbourhood attributes such as provision of semi-open spaces, surveillance and the size of open private spaces and streets.
Likewise, in a study by Fried (1982), physical features of housing, such as spatial arrangements, were found to have a major role in facilitating social interaction. Buckner (1988) suggested that adequate measures are needed to determine to what extent the physical environment can affect sense of community and social cohesion that consider the full range of different physical variables as well personal variables. Hence, psychological tools have been developed to measure social cohesion. These have shown greater levels of social cohesion in communities with long terms of residence and tenure and high level of homogeneity than in communities with neighbourhood heterogeneity, unstable living and rental property.

2.3.4.2. Health studies

Brown et al. (2009) found that the physical housing features impacting social interaction are a private balcony, window and front entrance. The study also suggested that, alongside enhancing social interaction, those features promote surveillance to create safe spaces.. Brown et al. (2009) argued that windows had a negative effect on perceived social support, for while they may provide a wider vision of the outside, they can reduce direct contact between neighbourhood residents and elders, which in turn can contribute to psychological disorder. Higher levels of ground-floor parking were also found in this study to be related to reduced visual and physical connections between residents and pedestrian, which reduced perceived social support and thus impacted mental health. However, the study concluded that positive effects of some architectural features contribute to reduced psychological distress via social support. Therefore, physical design could be a significant contributor to mental wellbeing.

Frumkin (2003) considered social interaction and sense of place key to public health, and suggested that the design of the suburban neighbourhood could pay more attention to how the physical design features of buildings and places impact both. Thus, Frumkin argues that public spaces, streets, infrastructure, accessibility and
proximity to diverse land uses and transportation are important for a variety of physical and social activities that have clear health outcomes. However, the study argued that the built environment features that increase social interaction are limited to walkable neighbourhoods and quality of public spaces including location and connectivity with dwellings. Wood et al. (2010) examined the association between walking behaviour, the physical environment and social interaction, finding that walkable neighbourhoods of low-level mixed use were more likely to invite people for interaction. High levels of mixed use, with large amounts of car parking and traffic, were found to have a negative effect on perceptions of sociability and safety, which in turn reduced leisure walking and inhibit social interaction and sense of community.

Sugiyama et al. (2008) showed that neighbourhood green spaces were more strongly associated with psychological health than physical health. Moreover, the study suggested that walkability, social cohesion and local social interaction occurred when residents perceived there were more green spaces. Their survey found that there is an indirect correlation between the number of public spaces and social interaction. Francis et al. (2012) found that the quality of public spaces is more significant in determining social interaction in residential neighbourhoods than the number of public spaces. Another study by Wilkerson et al. (2012) examined correlations between neighbourhood physical design, neighbourliness, and health and wellbeing. Neighbourliness refers to behaviour patterns based on interactions among neighbours and perceived social support as an aspect of psychological health. The findings indicate that front porches and connectivity with footpaths were positively associated with neighbourliness, while high traffic and the presence of litter were negatively associated with neighbourliness. Moreover, physical features create pedestrian-friendly areas that support walking in the neighbourhood and hence promote informal interactions among residents and improve human health.
2.3.4.3. Social studies

Riger and Lavrakas (1981) argued that social factors such as community attachment, which involves social ties and physical rootedness, impact social interaction. Sampson et al. (2002) claimed that the social attributes that have an influence on neighbourhood interactions are social bonds, social control, mutual confidence and activity types. They also showed that powerful neighbourhood ties can provide social control and social cohesion and thus can reduce crime levels. Unger and Wandersman (1985) identified both physical and social characteristics as having an effect on neighbouring components that include social interaction. Social factors involve homogeneity and neighbourhood structure, while physical characteristics include physical arrangements such as cul-de-sac dwellings and street design. Other social studies have pointed out that in suburban areas socio-psychological factors, such as a sense of belonging and community support, have an influence on social interaction in conjunction with demographic and socioeconomic factors, in particular length of residence. Recently, Podobnik (2011) found that physical layout and social environment increased social interaction in a New Urbanist community compared to neighbourhood suburbs. One of the goals of the New Urbanist developers is the enhancement of community engagement and social interaction through physical design, including the provision of public transport, accessibility to amenities and pedestrian-friendly layout. (Table 2.1) shows these factors according to their disciplines.

In summary, this section has defined social interaction and its related components as an essential aspect of social sustainability that determines the nature and extent of social capital, social cohesion and impacts sense of community. Discussion of social interaction in a wide research of different fields, including sociology, psychology and health, suggests that both social and physical environment impact social interaction in addition to socio-demographic features. However, this impact is direct or indirect
based on different contexts and researchers. The following section identifies the significance of suburban community change in shaping social life and explores the differences between sprawl and sustainable areas that may be considered in contemporary suburbs.

Table 2.1: Factors impacting social interaction in disciplines outside of built environment design

<table>
<thead>
<tr>
<th>Social factors</th>
<th>Physical factors</th>
<th>Dwelling design</th>
<th>Discipline</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homogeneity</td>
<td>Accessibility and density</td>
<td>Connectivity; quality of street layout/seating environment/ housing density/structured open space</td>
<td>Social study</td>
<td>Martin (1956)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visual appearance/ living space/private, semiprivate space</td>
<td>Psychological study</td>
<td>Skjaeveland &amp; Garling (1997)</td>
</tr>
<tr>
<td>Homogeneity/sense of belonging</td>
<td>Street layout</td>
<td>Physical arrangement</td>
<td>Psychological study</td>
<td>Unger and Wandersman (1985)</td>
</tr>
<tr>
<td>Social bonds, social control/mutual confidence/activity types.</td>
<td>Quality of public spaces, land use, transportation, streets, accessibility, proximity</td>
<td>Social study</td>
<td>Sampson et al. (2002)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Health study</td>
<td>Frumkin (2003)</td>
</tr>
<tr>
<td></td>
<td>Green spaces</td>
<td>Health study</td>
<td>Sugiyama et al. (2008)</td>
<td></td>
</tr>
<tr>
<td>Sense of belonging/community support</td>
<td>Housing features/balcony/windows/front entrance</td>
<td>Health study</td>
<td>Brown et al. (2009)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Green spaces/street design/parks and access to facilities</td>
<td>Social study</td>
<td>Rosenblatt et al. (2009)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Walkability, less mixed use and low amount of car parking and traffic</td>
<td>Health study</td>
<td>(Wood et al., 2010)</td>
<td></td>
</tr>
<tr>
<td>Contacts with neighbours and number of friends</td>
<td>Public transport/accessibility/pedestrian-friendly/dense areas</td>
<td>Social study</td>
<td>Podobnik (2011)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Front terraces/footpaths/connectivity/win dows</td>
<td>Health study</td>
<td>Wilkerson et al. (2012)</td>
<td></td>
</tr>
</tbody>
</table>
2.4. Change of suburban neighbourhood

The previous section defined social interaction, its components and the impact that socio-demographic factors have on social interaction. The next section discusses the impacts as described in the literature on social interaction due to historical changes to Australian neighbourhoods. Here, five aspects of change are considered: (1) the historical evolution of Australian suburbs; (2) the social and economic background to these changes; (3) sprawl versus sustainability; (4) social life in suburbs and isolation; (5) design of contemporary Australian suburban housing.

Historically, suburban neighbourhoods have: been socially organised and characterised by an informal social mechanism; been low-density with detached and private housing and safe environment; been stable and characteristically homogenous both visually and formally; and had strong social norms and little social disorder (Davison, 2006). As Australian social life is affected by industrial progress associated with changes in social, cultural and economic aspects, people are becoming less engaged and involved in the community (Gleeson, 2006). In discussion of the history and changing function that has shaped Australian contemporary suburbs, Davison stated that “interest in urban sustainability promises not techniques by which to prove the best way to live, but skills of informed debate and wise judgement” (2006: 213).

Harris and Larkham (2003: 17) identified five dimensions of contemporary suburbs in different contexts including Australia: (1) “peripheral location in relation to a dominant urban centre; (2) a partly (or wholly) residential character; (3) low densities, often associated with decentralised patterns of settlement and high levels of owner
occupation; (4) a distinctive culture, or way of life; and (5) separate community identities, often embodied in local governments”.

In this section, discussion of the role of suburbs in contributing to sustainable community is divided into three sections: the historical, social and economic aspects that have led to suburban social change. Sprawling suburbs versus sustainability, quality of social life and isolation are also discussed.

2.4.1. Historical background

The concept of Australian suburbs emerged from Europe and developed significantly throughout the early colonial era, after increased number of immigrants – particularly immigrants from Britain – were accompanied by good living standards. In particular, Sydney and Melbourne grew quickly and became centres of cultural and commercial urbaniy. In the nineteenth century, suburbs became prominent places of private investment via the governance of British capital, immigration, local credit progress and the land-ownership system (Johnson, 2012). According to Davison (1993), liveability of the early Australian suburb involved the satisfaction of five key needs: ‘domestic privacy; natural, semi-rural surroundings; a healthy environment; private ownership and social exclusiveness’. Thus, these five needs are satisfied in the ideal suburb, while they varied in value, in terms of priority, a good deal from one social class or ethnic group to another.

Davison (1993) explored the history of Australian suburbs and identified three characteristics of suburbs in the colonial era:

1. Australian suburbs placed a high value on local particularity compared with US suburbs, such as installing fences around houses. “Strict Australian and British libel and privacy law” reflects public life features compared with unrestricted US freedom (Davison, 1993).
Australian new suburbs have less social homogeneity than American and British suburbs in relation to private property ownership, domestic class order, and isolation between home and work. Conversely, the economic, social and environmental costs of sustained suburbs have promoted a revaluation of suburban housing towards living in high-density areas.

Individuals prefer their own house in a suburb rather than a rented terrace in the city, not just for acquiring a dwelling for the long term, but also for social, economic and environmental advantages (Davison, 1993). Therefore, most new housing designs have a similar paradigm of domestic life that results in a sense of loneliness and isolation, especially in new suburbs, which tend to have social and cultural problems due to a shortage in public transport and social amenities. Further, there is a lack of accessibility to services such as health, education and neighbourhood resources (Davison, 1993).

Richards (1994) supported this finding in her investigation of the outer suburbs of Melbourne, arguing that the changing of suburbs caused social isolation, particularly among women.

The federal government has played a role in supporting house ownership. Johnson (2012) reported that there was an increase in the level of home tenure from 50% in 1911 to 71% in 1966. Post-war federal policy has supported detached housing type via small and controlled loans and adequate tax management. Conversely, Australian public housing, which was established as a type of social wellbeing payment to help the poor, has been gradually privatised and neglected. However, this type of housing has generated entire suburbs by the activities of state establishments that have a significant role in creating low-density public housing in large suburbs, such as Heidelberg in Melbourne. Accordingly, public housing has led to social and economic discrimination. The suburbs that were once limited to the wealthy have become
available to the working class owning low-density, single and detached dwellings (Johnson, 2012: 118).

2.4.2. Social and economic background

According to Bryson and Winter (1999: 3), a combination of “reducing size of family, increasing female employment, culture diversity and increasing an ageing population, changing shopping type and growing the consumption aspects” have led to significant changes in Australian social life in the past three decades. Importantly, all of these changes have in turn affected social networks, which is where most social activities take place outside of the neighbourhood.

Likewise, suburbs have witnessed social changes since the early nineteenth century. At that time the middle class became more isolated through recognition and embrace of their social exclusiveness from working class neighbours, a process which led to increasing class segregation (Davison, 1993). The class division was accentuated when suburban housing became costlier with the increase in interest rates to around 17% in the 1980s. At this time, large working class and migrant households were forced by rising housing costs out of the inner suburbs, a migration which in turn informed boundaries of urban growth policy and encouraged urban development. As the previous style of low-density single family suburban bungalow was increasingly ‘demonised’, medium-density townhouses and inner-city apartments were systematically supported (Johnson, 2012). This process of change continued, according to Davison (2006: 209), when “the glamour of inner city renewal in Australia over the past 25 years, driven substantially by the flight of middle-class professionals from childhood suburbs into bohemian terraces and gated vertical communities” came to dominate “media representations of consolidation processes”.
2.4.3. Sprawl versus sustainability

There has been widespread debate on the merits of living in suburban versus urban areas. The argument relates to whether living in an urban area has positive or negative effects, or no effect, on social interactions, networks and quality of life compared with living in suburban areas (Adams, 1992). It has been suggested that there are two main psychological consequences of living in suburban neighbourhoods: quality of life perception and self-efficacy (Adams, 1992). Despite their relationship, improved quality of life does not necessarily lead to high self-efficacy, and vice versa (Adams, 1992). Moreover, a number of studies have argued that sprawl associated with low density and car dependence weakens social ties between neighbours and diminishes sense of community (Freeman, 2001; Nasar and Julian, 1995).

In Australian suburbs, although several development issues have played a role in creating the diverse patterns of urban growth, such as procedures of uneven development, migration and agricultural alterations, it has been recognised that these processes cannot meet sustainable living needs (Richards, 1994). In particular, urban sprawl has been correlated with lack of walkability, sociability and a sense of community, and recognised as negatively affecting housing affordability, pedestrian orientation and the quality of suburban community life (Davison, 1993). Moreover, rapid growth of Australian suburbs has contributed to unplanned development and led to insufficient services, unhealthy environments, low aesthetic appeal, mundane housing and a lack of greenery and identity (Johnson, 2007; Richards, 1994; Yiftachel and Hedgcock, 1993). A main character of Australian suburban development in the post-WWII period is detached dwellings around cul-de-sacs or curvilinear streets that connect to main roads through a hierarchy network. This has led to suburbs that are unfriendly to pedestrians, lack variety of housing type and have insufficient local facilities; characteristics that all contribute to car dependence. In turn, car dependence
has led to larger suburban lots for dwellings with a garage and a driveway to provide access from the street to the garage. These changes further accentuate reduced pedestrianism and increased car dependence, contributed in isolation of women from social and employment opportunities and reinforced the stereotype of women as housewives and child-rearers, which in turn is associated with inhibition of social interactions on streets (Harris and Larkham, 2003). Although planners and environmentalists have, to counteract these problems, encouraged compact and centralised city planning (Richards, 1994), the preference in Australia for detached housing in suburbs makes high-density housing less likely to be acceptable as the long-term preference (Troy, 1995).

### 2.4.4. Suburban social life and isolation

According to Richards (1994), Australian suburbs face two challenges: first, the ‘dream’ portrayed by the real estate advertiser; and second, the reality of the ‘nightmare’ of dreary living, deprivation and isolation, which is said to be more acute for Australian women, for whom insufficient accessibility and a lack of services have led to a lack of community involvement outside the house (Richards, 1994). These factors affect quality of life and self-efficacy for those, like women and the aged, who lack mobility. Richards argued that social structure could reduce isolation. For example, having children makes a young family more likely to be visible and use the outside space and thence build friendships, particularly for women by providing shared conversation. However, Robin Boyd, argued that ‘bald, raw, sun-beaten drabness’, were the salient feature of post-war Australian housing (Boyd, 1960). Thus, suburban neighbourhoods have long lacked liveability (Davison, 1993).

The dream, on the other hand, is owning a detached home on a large block with a backyard and countryside charm for raising children with friendly neighbours. Richards (1994) argues, however, that in reality, when privacy is reduced social
problems emerge between families, which in turn reduces community involvement. In other words, neighbourliness conflicts with privacy requirements and hence the ideal form of neighbouring is social support between neighbours when required without interfering with privacy. Thus, social isolation leads to weaker social ties and fewer neighbouring interactions.

To sum up, there are conflicting theories of life in the suburbs, concerning not only people’s needs but also the economic and social costs to achieve the dream. People need places that improve community life, and that are liveable, social and environmental sustainable. Such sustainable suburbs should foster a sense of place for residents, allowing them to be more emotionally attached to their environment. Compared to residential areas in the city, which are livelier and convenient and provide for mixed use and good access to amenities, the suburbs largely have limited benefits to residents, particularly in terms of providing facilities that are important to support housing affordability.

2.4.5. Design of contemporary Australian suburbs

In a comparison of twentieth- and twenty-first-century suburban housing, Johnson (2006: 264) suggests that “the dominant suburban house forms in twentieth-century Australia conform to five floor plans and styles derived from Britain (the bungalow, rural cottage) and the US (Californian bungalow, Spanish mission, L-shaped and ranch house). All are single-storied, set back with private front and back gardens, detached, on standardised blocks. Over the century, houses gradually increase in size. From the 1950s, cultural critics agree that 'style' is absent from the suburbs.” However, this situation is now changing as new suburban housing in the twenty-first century is increasingly double-storeyed, semi-attached houses, with a range of block sizes, less private open space and more public open space, in an increasingly master-planned neighbourhood, which has been associated with identifiable connection between
housing streets and open spaces. Increased dwelling size with rooms for leisure activities has led to the sacrifice of rear gardens replaced by the outdoor room. Average dwelling size has increased from 13 squares in 1970 to 22 squares in 2005. In parallel with household form and urban planning, the politics and sociology of the suburb have also shifted (Johnson, 2006).

In summary, this section has discussed how suburban sprawl is linked to social isolation and the historical, social and economic transformation of suburbs. Here, the urban characteristics were identified that have negative impacts on social life and liveability. This is followed by discussion of common housing features in contemporary suburban Australia. Accordingly, sprawl-effects in suburban contexts must be addressed when designing for sustainable communities. The next section argues that built environment contributes to social life and can counter the negative impacts of sprawl in suburban areas through good neighbourhood design. Here is explored how provision of different physical design characteristics are connected to interaction and its correlates. The final section also develops a theoretical framework for identifying the physical design variables of suburban neighbourhoods that impact social interaction.

2.5. Built environment and social interaction

The relationship between the built environment and human behaviour has received an increasing amount of attention in relation to the various meanings of building design – that is, the syntactic, semantic and pragmatic meanings (Lawrence, 1987). Studies have argued that the built environment affects social behaviour and improves social life by creating places that meet individuals’ needs, with particular attention paid to whether places are car dependent or pedestrian oriented. The role of built environment design in this relationship is to encourage social activities by increasing perceptions of safety, a sense of community and attachment to place. These dimensions strength the
sustainability of the built environment by meeting future generations’ requirements. Therefore, studies have focused on the effect of the spatial design of neighbourhoods on human behaviour and social interactions (Burton et al., 2013; Burton et al., 2005; Gehl, 1987; Lawrence, 1987).

The previous section explored a transformation in Australian suburbs that has been associated with social isolation and poor social life. The shift has been in part due to the historical, social and economic changes leading to urban sprawl. In the following section, the role of the built environment in social interaction is investigated via six sub-sections: (1) neighbourhood as place and how it is connected to social interaction; (2) the theoretical concept of neighbourhood design; (3) sustainability of neighbourhood via design factors commonly discussed in the literature; (4) the negative impact of neighbourhood on sociability; (5) the psychosocial and physical attributes of urban design that impact social interaction; and (6) the proposal of a theoretical framework of the relationship between social interaction and neighbourhoods design.

2.5.1. Neighbourhood as a place of interaction

Neighbourhood has been identified in varied ways in the literature. Lee (1968: 142) identified the neighbourhood as “an area in which people can reach within easy walking distance (ten of fifteen minutes) those institutions which serve the local community and so foster a neighbourly social life”. Both social and spatial environment affect the neighbourhood (the mental representation of physical-social space). Thus, Lee (1968) has identified three types of neighbourhoods that are varied in size, level of friendliness and inhabitant heterogeneity: the social acquaintance neighbourhood; the homogeneous neighbourhood; and the unit neighbourhood. Rossi defined neighbourhoods as urban forms that create their meaning from conventional
presence over time and in turn create familiar and meaningful places and not only settlements for living (Rossi, 1982).

Banerjee and Baer identified three dimensions of neighbourhood that include cultural and intellectual beliefs (2013): context values (e.g. the historical setting); manifest values (which are important to designers in relation to the physical manifestation of concept); and tacit values (social and economic). Lawton identified these dimensions as institutional, social and physical design forces (2009). While Brower (1996) argued that “neighbourhood is simply comprised of residential units and non-residential facilities”, other scholars have suggested that neighbourhood is comprised not just of physical but also psychosocial attributes. The physical attributes include the facilities and services that can determine the social activities of residents (Brower, 1996; Dempsey, 2009; Jenks and Dempsey, 2007). Rapoport (1977) and Kelly et al. (2012) pointed out that neighbourhood not only represents a physical setting but includes social concepts such as social norms and associations. At the same time, neighbourhoods reflect conservation of the collective memory as a unique function that is achieved from stability of conventional residential environment. In this sense, neighbourhood is an important expression of residents’ identity through experience in place (Kallus and Law-Yone, 2000). However, while it can be argued that direct interaction is considered an essential condition for friendly relationships, it does not necessarily always provide positive friendships (Dempsey et al., 2012). Thus, while neighbourhood cannot control human behaviour, it might create chances for people to interact socially via good spatial design.

With recent attention to neighbourhood, lifestyle and liveability in contemporary communities, there has been significant research into the social life of neighbourhoods (Forrest and Kearns, 2001; Gans, 1961; Henriksen and Tjora, 2014; Talen, 1999; Unger and Wandersman, 1985). Fischer (1982) stated that people do not
live in spaceless realms, but neighbourhoods are emphases of emotional and financial investments and potential sources of friends for children and adults. While there is recognition of the impacts that the spatial characteristics of neighbourhood have on quality of life, the social impacts of neighbourhood design have attracted little focus recently in comparison to social interaction in other contexts such as online environments (Brower, 2013; Unger and Wandersman, 1985). Yet, despite technological progress leading to greater non-face-to-face connectivity, it is clear that the physical neighbourhood still provides an essential context for face-to-face social interaction.

2.5.2. Neighbourhood design as a theoretical concept

The concept of neighbourhood design was established by Ebenezer Howard, who suggested the English ‘garden city’ model to develop healthy communities and a sense of pride (Patricios, 2002). Garden cities were planned as self-contained areas bounded by greenbelts, and included relative zones of residences, industry and agriculture. Thus, garden cities offered amenities that were absent in urban centres that had since the Industrial Revolution faced increased population density. The garden city aimed to address a lack of social and spatial design through improved environmental infrastructure, reduced congestion and creation of safe and healthy places. Increased social interaction was one motivation behind the garden city and the new ‘neighbourhood unit’ by Clarence Perry (1929). Perry’s neighbourhood model, influenced by the garden city, considered that neighbourhood was a place with an identity and a place for “family-life community”. This neighbourhood, bounded by major streets, centred on the presence of an elementary school, shopping areas and a community centre. These features created neighbourhood identity and were intended to provide opportunities for social interaction – face-to-face contacts that are
significant facets of neighbourliness (Lawhon, 2009). What Howard’s concept (Figure 2.8) attempted in the suburbs, the Perry model attempted in the city (Figure 2.9).

The Perry model has been criticised by scholars for physical determinism limited to social homogeneity which overlooked the historical importance of neighbourhood (Lawhon, 2009). In 1966, Perry’s neighbourhood unit was scaled up by Clarence Stein in the Redburn design (Figure 2.10) This neighbourhood served 10,000 persons, had more than one school and had open spaces with a cul-de-sac layout that reduced through traffic.

Figure 2.8: Ebenezer Howard’s ward (source: Howard, 2003)
2.5.3. Sustainable factors of neighbourhood

Investigating the role that the built environment plays in shaping social life, various studies have considered which design factors of neighbourhoods influence social interaction and neighbourhood attachment. These factors are complex and interrelated. Jacobs (1961) noted the importance of safety and security for creating active interactions and a sense of belonging in neighbourhoods. Jacobs suggested several neighbourhood design strategies for the planning of liveable cities, such as employing...
different activities in streets via communal facilities alongside their primary function and designing districts to activate a constant street network of short blocks, which offer choices for movement and increase chances for social connectedness. Similarly, Gehl (1987) identified four behavioural criteria that should be prioritised when planning public spaces for sustainable environments: human dimension; human movements; human senses; and human interaction. Talen (2011) suggested five strategies to promote sustainable urban form and address sprawl suburbs: accessibility, connectivity, density, diversity and nodality. For example, she stated connectivity promotes sustainability “in that higher connectivity leads to higher levels of interaction between residents and the environment, society, and cultural and economic activity, all of which is believed to improve neighbourhood stability in the long term” (Talen, 2011: 955).

These human behaviour criteria, along with public space qualities such as street liveability, good transportation and walkability, can create sustainable and safe cities. When considering the infill development of inner Melbourne, Johnson (1994) suggested qualities for creating pedestrian-friendly suburbs, for example, active street life, feeling of safety and provision of private and public open space. These factors contribute to creating socially inclusive neighbourhoods and sense of community, and help the aim of ecological sustainability via enhanced pedestrian experience and reduced car dependence.

Davison (1993) indicated the roles of planners and designers in providing strategies to improve lifestyle in Australian suburbs, including increased density in suburbs to create opportunity for social interaction and cultural creativity. The design of public and open spaces can promote creative connection between residents. They can be friendly, safe and diverse places for neighbours to meet and share activities and
for children to play, which can allow people to better cope with challenges and contribute to socially and culturally aware neighbourhoods.

Within the Australian context, Mee (2010) added to these components of a good neighbourhood the provision of detached houses, adequate services and facilities, and opportunities for high levels of social interaction. Unfortunately, many of these factors have been largely neglected in Australian low-density suburbs, which have thus been criticised for having unfriendly environments, poor accessibility, limited opportunity for neighbourly interactions and thus poor sociability and lack of a sense of place. Williams and Dair (2007) have also suggested sustainable design features that enable and reinforce human sustainable behaviours associated with neighbourhood developments. Table 2.2 shows the qualities of liveable neighbourhoods’ according to the abovementioned studies.
Table 2.2: Sustainable neighbourhoods’ criteria from different viewpoints

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<td><strong>Urban form</strong></td>
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<td><strong>Density</strong></td>
<td>Enhance dense areas</td>
<td>Enhance dense housing</td>
<td>Improve density to provide good accessibility</td>
<td>Increased density</td>
<td>High-density development for social activities</td>
<td>Support family in housing suburbs</td>
<td>More dense suburbs are more sustainable</td>
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<td><strong>Neighbourhood layout</strong></td>
<td>Functional identity should be achieved in the wider neighbourhood context</td>
<td>Human dimension should be considered in design</td>
<td>Improve sense of pride, neighbouring, and foster local identity and cultural life to engage residents via neighbourhood layout</td>
<td>Maintain local vitality and social capital</td>
<td>Detached housing to improve cohesive neighbourhood identity and provision of large backyards</td>
<td>Neighbourhood-scale centralised spaces for activity and provide a physical form of community</td>
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<td><strong>Land use</strong></td>
<td>Construction of complexity and land-use diversity by developing use of public spaces and buildings</td>
<td>Provision of mixed land use</td>
<td>Provision of public and open spaces for neighbours</td>
<td>Mixed-use development</td>
<td>Provision of diverse facilities such as recreational spaces, including green spaces, playgrounds and parks</td>
<td>Land-use diversity supports accessibility, and walkable provision of diverse services</td>
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<tr>
<td><strong>Public transport</strong></td>
<td>Efficient transportation system</td>
<td>Provision of good public transport</td>
<td>Efficient transport network for good accessibility</td>
<td>Easy access to transport</td>
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<td><strong>Neighbourhood form</strong></td>
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<td><strong>Streets</strong></td>
<td>Develop lively and attractive streets using short blocks</td>
<td>Lively street and soft edges</td>
<td>Good street layout</td>
<td>Support street activity by providing roads, paths,</td>
<td>Quiet street</td>
<td>Gridded street networks and short blocks connected without dead-ends</td>
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<td>Greenery</td>
<td>Provide green spaces for social and ecological value</td>
<td>Provide green paths for spaces via greenery</td>
<td>Action use of spaces via greenery</td>
<td>Maintain and encourage biodiversity</td>
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<tr>
<td>Walkability and accessibility</td>
<td>Create unceasing network of streets and design short blocks that offer choices for movement</td>
<td>Careful planning for walking and public life; encourage people to walk and cycle</td>
<td>Consider human and walking scale in planning suburbs, including all civic life aspects, not only housing</td>
<td>Create friendly environment for pedestrians</td>
<td>Clear roads and easy orientation for pedestrians</td>
<td>Friendly access to services and facilities</td>
<td>Walkable access between residents and services are essential for sustainability</td>
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<tr>
<td>Diversity</td>
<td>Support social mix</td>
<td>Diverse social activities in streets</td>
<td>Develop social and cultural diversity</td>
<td>Social mix</td>
<td>Enhance social stability</td>
<td>Support people interaction and friendly relationships</td>
<td>Socially diverse neighbourhoods meet community wellbeing and social equity goals</td>
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<tr>
<td>Safety</td>
<td>Provision of natural surveillance</td>
<td>Reduce traffic flow</td>
<td>Pedestrian environments</td>
<td>Safety spaces for children</td>
<td>Create safe environment to Improve quality of life and personal well-being</td>
<td>Create safe places</td>
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<tr>
<td>Environment features (e.g. water recycling and energy efficient heating)</td>
<td>Sustainable environment</td>
<td>Sustainable environment</td>
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2.5.4. Negative impacts on sociability of badly designed neighbourhoods

Negative interaction between neighbours has been explored in social research (Cheshire and Buglar, 2016; Labianca and Brass, 2006; Nieuwenhuis et al., 2013), where it is argued that adverse interaction can emerge from other social factors, particularly network distance, diversity, uncertainty and social influence, all of which have broader negative effects on social cohesion (Labianca and Brass, 2006; Nieuwenhuis et al., 2013). However, negative interaction has been largely ignored in theoretical and empirical architectural and built environment studies. For these reasons, it is generally recognised that recently created suburbs often fail to provide places for social encounters, such as parks, shops and even footpaths, a neglect that is related to too great a supply of single-use developments ahead of more socially sustainable mixed-use developments (Dempsey, 2009; Lund, 2002). Suburban sprawl has led to more isolated living and therefore suburbs tend to be less transit-friendly than more established suburbs and more likely to depend on car ownership (Leyden, 2003; Thompson and Kent, 2014; Youngentob and Hostetler, 2005). This can inhibit opportunities for face-to-face contact and undermine social ties among neighbours (Freeman, 2001; Youngentob and Hostetler, 2005). Since Boyd first wrote about the Australian ugliness of suburbs, scholars have identified social problems in new suburbs identified with urban sprawl. Here, negative impacts on suburban social life are associated with a lack of neighbourhood character (Boyd, 1960; de Jong et al., 2013) and poor social sustainability (Davison, 1993).

To address the failures of many existing suburban designs resulting from urban sprawl, a movement known as New Urbanism emerged in the UK, USA and Australia. Here ‘neo-traditional development’ began with the idea that the role of the architect is that of the social change agent through a design strategy that is focused on the provision of safe pedestrian access, the use of the grid street layout to enhance
walkability and the protection of green spaces as key features of a development. Thus, architects and planners have endeavoured to promote community in sprawling suburbs through high density, mixed use and encouragement of social interaction in public spaces (Grant, 2006; Talen, 1999; Youngentob and Hostetler, 2005). This argument is similar to the concept of sustainability proposed by Jabareen (2006), which suggests compactness to support concepts such as increased density, sustainable transport, mixed land use and diversity to address the effects of urban sprawl.

Although New Urbanism’ has robust impact of neo-traditional design in both layout and style, it has been criticized for its apparent focus on external architectural appearance and its neglect of social concerns and wider regional planning-related issues (Harris and Larkham, 2003). Moreover, it has been argued that New Urbanism was less ecologically friendly than the post-war suburbs because of lack of greenery restricting opportunity for social interaction (Youngentob and Hostetler, 2005). A study linked to urban sprawl and social capital, for example, found that high density and street accessibility were unfavourable to social interaction and social capital in New Urbanist neighbourhoods (Nguyen, 2010).

Other research has argued that, although physical features may facilitate opportunities for unplanned interaction between residents, they may not necessarily impact social interactions and sense of community (Du Toit et al., 2007). In particular, a comparison of walkable neighbourhoods and traditional suburbs found that, despite social interactions being linked with pedestrian-friendly streets, there is no significant difference in a growing sense of community (Brown and Cropper, 2001; Du Toit et al., 2007; Nasar and Julian, 1995). It is argued that design may create opportunities to proximate residents but it cannot provide adequate environments for positive social interactions (Lund, 2002).
In architecture and built environment research, the relationship between social interaction and urban form physical features is ambiguous, with evidence of the effects of density, mixed use, physical proximity, dwelling type and street layout on social interaction mostly conflicting. High density and mixed use in particular have been found to create social problems and thus have negative impacts on social sustainability (Bramley and Power, 2009; Jenks and Jones, 2010). These characteristics may reduce social interaction and walking activity through the introduction of ‘outsiders’ to local neighbourhood (Foord, 2010; French et al., 2013). Although physical proximity can help to developing neighbourly connections, it can also be a source of annoyance (e.g. loud noise), which leads to weak interactions with neighbours (Abu-Ghazaleh, 1999; Cohen and Lezak, 1977; Talen, 1999), a lack of privacy (Skjaeveland and Garling, 1997) and crowding (Baum et al., 1978). All these impacts are negatively correlated with social support (Skjaeveland et al., 1996) and have resulted in withdrawal from social interaction (Sullivan et al., 2004).

Streets also have a key role in shaping social contacts (Gehl, 2010; Raman, 2010). For example, high traffic has been shown to adversely affect perceptions of safety, and thus reduce walking and socialising (Appleyard and Lintell, 1972). In contrast, Bosselmann et al. (1999) found that residents in streets with a medium amount of traffic were more likely to have many friends and social contacts compared with residents in streets with light traffic.

Housing type can also impede social contacts with neighbours. For instance, an empirical study in the UK found that residents of high-rise flats were likely to feel unsafe and socially isolated compared with those in low-rise housing, and this significantly contributed to their perceived safety and intimacy with neighbours (Mawby, 1977). Farrell et al. (2004) also argued that single-family dwellings offered more opportunities for social interaction with neighbours than high-rise housing. In
order to address modern city problems through effective use of spaces and resources, Le Corbusier designed high-rise housing with single-land use. However, this type of design failed due to ignoring the human scale and resulting in more social isolation (Jin et al., 2010). Thus, neighbourhood features need to be measured precisely to determine the nature of the relationship between qualities of different features and encourage social interactions (Lund, 2003; Owen et al., 2004).

The following sections explain the impact of some of these features in detail.

2.5.4.1. Social housing as negative experience

After World War I and World War II, European countries suffered from a housing shortage because many cities were bomb-damaged. To resolve this shortage, local authorities managed and constructed housing for the middle and working classes. In Australia, social housing developed generally in a similar way to the USA and UK, with the Commonwealth Government building large amounts of social housing in large estates in Australia’s cities (Groenhart, 2013). However, local authorities and voluntary housing institutions, particularly in the UK and Australia, largely failed to establish clear strategic objectives for social housing. This failure included prices that were too high for low-income earners, and insufficient numbers of dwellings (Malpass, 2001). Coupled with the economic transformation of social housing renters, Arthurson (2010) argued that a social mix in social housing led to anti-social behaviour, crime and a welfare dependence likely to create conflicts rather than the predicted social cohesion.

While it was believed that social housing could connect residents to promote a sense of community and cohesion and therefore reduce anti-social behaviour (Scanlon, 2014), social housing did not include socially acceptable requirements and generally failed to meet housing needs, thus contributing to problems such as increased crime,
an unsafe feeling, social isolation and a lack of social cohesion (Manoochehri, 2012). In a comparison between social housing projects in Brownsville and Van Dyke in New York, it was found that crime rates in the high-rise buildings of the Van Dyke project were higher than in the low-level buildings of Brownsville (Cozens et al., 2001). However, in 1961 the famous Park Hill social housing project in the UK, which engaged people to design the streets, failed after ten years when social and economic problems appeared. For example, local authorities faced financial limitations and maintenance problems that affected infrastructure and reduced safety, which led to a lack of social cohesion and community spirit (Scanlon, 2014). Thus, while architectural design is not necessarily the main reason for failed social housing experiences and a lack of social cohesion (Harloe, 1994), poor design can certainly add to these problems.

To sum up, it can be argued that there is a paradox in terms of determining the nature of the relationship between the built environment and social interaction, even in the case of social housing, which has mostly failed to meet the social needs of residents. Thus, whether features of the physical environment affect social interaction or not is still uncertain. Designers need to adopt strategic processes that can motivate residents to be involved in the community and support meaningful social interactions. Thus, this research examines whether design affects social interactions, and how these effects can facilitate or inhibit social interaction in the low-density context. This in turn can determine neighbourhood functions in building a liveable community. Thus, this research: (1) develops a theoretical framework that identifies the neighbourhood design factors of low density Australian suburbs that have theoretical impact on social interaction, (2) measures the impact of different characteristics on encouraging social interactions, and (3) provides evidence elucidating if and how neighbourhood design can improve suburban social interaction.
2.5.5. *Neighbourhood characteristics impacting social interaction*

The previous section discussed the relationship between built environment and human behaviour, particularly social interaction and the neighbourhood as the focal point of this relationship. This section discusses the literature on which neighbourhood design characteristics impact social interaction.

Brower (1996) suggested there are three qualities that create good neighbourhoods: (1) ambience, which relates to land use and appearance of physical environment; (2) engagement, which refers to the extent of social interaction among inhabitants in relation to provision of features and facilities that encourage the interactions and in turn reflect the relationship between private home and neighbourhood public spaces; and finally (3) variability, which enables residents to live with a high quality of life and offers different places and lifestyles. He described the spaces around housing as extended housing units that are considered places for social encounters between residents and others. In other words, neighbourhood is comprised of residential units and non-residential facilities. According to this perspective, social interactions take place in a neighbourhood in residential dwellings, streets, transport and public spaces. Peel (1995) argued that the physical form of a neighbourhood could provide community only if that form includes sufficient members of social groups needed to sustain social ties. Moreover, neighbourhoods tend to be meaningful places when social relationships occur in spaces that encourage social activities and create symbolic meaning to reflect the significance of a functioning community (Jenks and Dempsey, 2007).

Nasar (1994) classified space into two aspects: space related to psychosocial characteristics that have symbolic meanings and result from individuals’ experiences; and aesthetic responses resulting from the physical appearance of architecture, such as style, proportion, rhythm, human scale and building shape. Thus, physical design
contributes to neighbourhood objectives such as sense of community, sense of place and functional design. Patricios (2002) identified three features of neighbourhood quality – physical design, level of social interaction between residents and lifestyle quality – and discussed how they interrelate in the neighbourhood to determine social interactions.

Different policies have been adopted to enhance social life in cities. Studies indicate a range of policies associated with the concept of increasing the density and variety of dwellings and the supply of mixed-use development (Abu-Ghazleh, 1999; Brown and Cropper, 2001; Burton et al., 2005). These strategies are seen to create successful neighbourhoods through better place-making or improved sense of place – a notion that includes characteristics not just of physical space but also the experiences, local knowledge and folklore of place, which play an essential role in promoting sense of community (Kim and Kaplan, 2004).

Williams (2005) proposed a framework to measure social interaction in a cohousing community that included: personal factors; formal factors; informal factors; physical factors; and social and demographic factors. Thus, the study suggested a framework that focused on the contribution of two categories of factors – psychosocial and physical factors (Figure 2.11) – as described in the following sections.
2.5.5.1. Psychosocial attributes

The psychological factors that enable social interaction have been investigated in the research generally largely via four correlates: neighbourhood attachment, neighbourhood satisfaction, neighbouring and feeling of safety. The following passages consider the interrelationships of these four variables and how they relate to social interaction.

Neighbourhood attachment

Neighbourhood attachment refers to residents’ emotional connection related to social and physical place. This can be achieved through strong satisfaction with neighbourhood and place identity (Comstock et al., 2010; Kim and Kaplan, 2004). It is one domain of sense of community (Kim and Kaplan, 2004) and one dimension of social cohesion (Dempsey, 2009; Wilkinson, 2007). Social interaction can be increased when the design of the neighbourhood enhances attachment (Kelly et al.,
2012). This explains the correlation between place attachment and social interaction (Talen and Koschinsky, 2014). Level of community ties, social participation and length of residence are considered the main factors influencing neighbourhood attachment, which in turn creates emotional and spiritual meanings for residents (Austin and Baba, 1990). Lewicka (2010) found attachment was predicted by the ownership of an apartment or house, neighbourhood ties and a sense of security. Neighbourhood attachment is also associated with effective social ties between neighbours (Rogers and Sukolratanametee, 2009), because strong social bonds are found in residents who interact with their neighbours and attach to their neighbourhood. Thus, physical rootedness is seen as key to greater levels of neighbourhood attachment (Riger and Lavrakas, 1981). It has been argued that fewer ties and lower investment may lead to reducing the length of residence (Comstock et al., 2010). Additionally, positive perception of neighbourhood qualities is a significant contributor to neighbourhood attachment (Bonaiuto et al., 2003).

Neighbourhood satisfaction

Neighbourhood satisfaction defined as the degree between residents’ ideal neighbourhood aspirations and actual residential environments (Kweon et al., 2010). It refers to residents’ overall evaluation of their neighbourhood (Hur and Morrow-Jones, 2008). It is also identified as one indicator of life satisfaction and so is often used to evaluate quality of life in neighbourhoods (Fried, 1984; Parkes et al., 2002). Neighbourhood satisfaction is one of the most investigated issues in neighbourhood research, with studies indicating that the higher satisfaction, the higher social interaction and sense of community, as well as other contributors to the sustainability of communities. Neighbourhood design contributes to quality of life via increased resident satisfaction (Brower, 2013; Grogan-Kaylor et al., 2006; Hur and Morrow-Jones, 2008). Social interaction is correlated with satisfaction with neighbour relations,
quality of neighbourhood spaces and the provision of facilities, which then leads to overall neighbourhood satisfaction. In this case, social interaction could be assessed, particularly, by evaluation of satisfaction with social relationships between family and friends (Abu-Ghazneh, 1999; Buys and Miller, 2012; Lawrence, 1987). In addition, individuals’ satisfaction can be impacted by density, height, colour and layout of buildings (Chan and Lee, 2008).

*Neighbouring*

Neighbouring refers to “the activities engaged in by neighbours as neighbours and the relationships these engender among them” (Keller, 1968: 29). Neighbouring is a behavioural aspect (Abu-Ghazneh, 1999; Unger and Wandersman, 1985), and refers to social support and connections that occur between individuals who are in close proximity (Farrell et al., 2004; Skjaeveland and Garling, 1997). Unger and Wandersman (1985) defined three components of neighbouring: (1) the social component (e.g. social networks and support), which is similar to the Farrell et al. (2004) definition; (2) the cognitive component (e.g. cognitive mapping, the physical environment and symbolic communication); and (3) the affective component (e.g. sense of community and place attachment). Research has shown that neighbouring is related to social homogeneity – the degree to which the preferences of individuals in a society tend to be alike. This homogeneity is required to establish friendships, contributes to a sense of community and identification with place (Gans, 1961), and can be facilitated via the creation of adequate places for gathering activities (Appleyard and Lintell, 1972; Gans, 1961). Psychological and social researchers have also found that the psychosocial environment – including neighbourhood attachment (Riger and Lavrakas, 1981) and homogeneity (Rosenblatt et al., 2009; Unger and Wandersman, 1985) – can lead to high levels of neighbouring by encouraging social interaction (Podobnik, 2011). Neighbouring can also be influenced by conflicts and annoyances.
emerging through ‘dislike’ connections, due to disputes over issues such as car parking, housing maintenance and loud music. Greeting and visiting rates between residents are also used to measure neighbouring (Skjaeveland et al., 1996).

Studies of neighbouring levels have focused on evaluating social interaction between neighbours living in the same place, casual social contacts between inhabitants who are not neighbours, and exchange visits between neighbours. It is argued that neighbourhood physical characteristics (e.g. physical proximity of neighbours and of entertaining facilities) are related to increased neighbouring via reducing the distance between resident interaction opportunities (Abu-Ghazneh, 1999; Farrell et al., 2004).

*Feeling of safety*

A feeling of safety is essential for encouraging social interaction. Several authors have suggested that the connection between the physical environment and social objectives must recognise the significance of indirect impacts on interaction. They have argued that increased neighbouring, for example, can improve sense of safety (Newman, 1973). Social interaction has, particularly in walkable and mixed-use neighbourhoods, been found to be positively related to neighbouring and an increased feeling of safety (Kim and Kaplan, 2004; Lund, 2002). Similarly, a sense of belonging promotes perceptions of safety, which in turn fosters physical activity; both impacts that are positively correlated with improved mental health outcomes (Thompson and Kent, 2014). These findings are consistent with the study of Wood et al. (2008), who found that perceived safety affects walkability, particularly in suburban areas, and that walkability creates chances for informal interactions. It has been argued that neighbours can have an important role in enhancing safety through preventing crime in neighbourhoods by increased surveillance, thus increasing social interaction and feeling of safety (Unger and Wandersman, 1985).
2.5.5.2. Physical factors of urban form

According to Dempsey et al. (2010), urban form consists of five physical features: density, housing type, neighbourhood layout, land use and transport infrastructure (Figure 2.12). These environmental qualities, when integrated through good urban design, create socially cohesive communities. Urban form has been recognised as integral to achieving social sustainability (Burton et al., 2013; Dempsey et al., 2010; Jenks and Jones, 2010), and as directly affecting social cohesion by providing opportunities for social interaction (Gehl, 2010). This section investigates the potential role of urban form in improving social cohesion by exploring the relationships between social interaction and the five categories of urban form.

Figure 2.12: Urban design elements, source (Dempsey et al., 2010).

**Density**

One of the most widely discussed elements of urban form is density, since other urban elements are interrelated with density and its social impacts. As mentioned above, suburbs which are pedestrian unfriendly have resulted in declining social interaction and increased social isolation (Jacobs, 1961; Talen, 2000; Talen, 1999). Thus, New
Urbanists claimed that high-density development and walkable neighbourhoods can better support social interaction (Pendola and Gen, 2008; Talen, 2000; Talen, 1999; Youngentob and Hostetler, 2005). Denser neighbourhoods positively affect some features of social sustainability, such as access to facilities and services. However, density has also been shown to lead to negative social impacts, such as decreased neighbouring, increased neighbour annoyance, perceived overcrowding (lack of space, lower dwelling quality) and even reduced social interaction (Bramley and Power, 2009; Buckner, 1988; Burton, 2000). This can lead to residents avoiding each other (Dave, 2011; Dempsey et al., 2012). Similarly, Burton (2000) argued that, while a denser neighbourhood has positive effects on some features of social sustainability, it can negatively affect other features, such as social interaction, and level of crime. While low-density suburban sprawl can reduce walkability and mobility leading to long-term effects on a neighbourhood’s social capital (Ewing et al., 2008; Freeman, 2001).

However, Freeman (2001) argued that density may not impact local ties in low-density neighbourhoods, but it is associated with reduced walking and increased car dependence. Raman (2010) found differences between social ties and structures of social network in high- and low-density neighbourhoods; residents in high-density areas have significantly stronger social ties with small networks, while in low-density neighbourhoods they have broader social networks and activities with few local social ties.

Accordingly, there is a clear argument for the perception of density influencing socialising behaviour and its impact on social interaction. As Thompson and Kent (2014) suggest, to facilitate social interaction a threshold should be found between high and low density, a balance which can provide private space to residents and at the same time offer opportunities for casual interaction in residential spaces.
Neighbourhood layout can also affect communication between residents. For example, spatial configurations of buildings, housing, streets and open spaces have been shown to influence social interaction (Dempsey et al., 2010). Layout can determine travel behaviour, and streets that are more pedestrian friendly lead to greater chances of social interaction when social interaction is measured by numbers of pedestrian contacts (Barton, 2013). Neighbourhood layout has been found to affect residents’ behaviour through increasing social interaction (Abu-Ghazaleh, 1999) by facilitating walkability in streets and encouraging neighbours to get to know each other and participate in street activities. Moreover, when the design of streets provides visibility to increase safety and support social connections, this creates identity and a sense of place (Gehl, 2010).

Land use
Diversity in land use has been found to support social equity, especially in high-density suburbs where diverse use provides proximity and accessibility to various facilities. Thus, the combination of diverse use and density can promote social interaction and community attachment (Jenks and Jones, 2010). Nasar and Julian (1995) have argued that social interaction is more likely to increase in mixed-use areas compared to single-use areas. Similarly, mixed-use design is seen to invite residents from diverse backgrounds for social activities and provide opportunities for social contact, which strengthens sense of community (Talen, 1999). Mixes in land use can also encourage walkability, which in turn allows residents to interact socially (Mehta, 2013) more than residents who live in car-oriented neighbourhoods (Lund, 2002). Both mixed land use and walkability have been statistically significantly related to higher social capital and sense of community (Arundel and Ronald, 2017).
Housing type

Dempsey et al. (2010) have indicated that housing type – the fourth of our five categories of urban form – impacts resident behaviour through variation in social experiences. For instance, they argue that detached housing with gardens creates opportunities for the various activities that encourage social contacts between neighbours compared to residents who live in high-rise dwellings. It is also suggested that diversity in housing type may strengthen social bonds through reflection of the diverse needs of residents, which vary according to socio-demographic characteristics (Brown and Cropper, 2001). It has also been found that uniformity of housing type, such as increased detached dwelling type, is associated with greater satisfaction (Parkes et al., 2002; Yang, 2008).

Transport infrastructure

The last element of urban form is transport infrastructure – the provision of adequate transportation to facilitate individuals’ access to buildings and spaces. Transportation impacts accessibility and connectivity (Dempsey et al., 2010) through, for example, access to services, leisure spaces and open spaces (Kelly et al., 2012). It is argued that access to transport directly affects quality of life, since poor transport impedes social contact between residents by increasing car dependence. Transit is strongly impacted by neighbourhood design, including physical arrangement of housing, street networks and accessibility, features that jointly impact resident behaviour and route options, which in turn impacts social interaction (Barton, 2013).

2.5.5.3. Neighbourhood form

Neighbourhood form can actively promote social interaction to improve quality of life (Lawhon, 2009). Research has identified four main factors that have the most effect on social interaction and hence wellbeing: (1) street layout; (2) pedestrian
environment; (3) walkability and accessibility; and (4) public and green spaces (Abu-Ghazaleh, 1999; Burton et al., 2013; Burton et al., 2005; Chan and Lee, 2008). This section considers each of these factors in turn to determine how they might impact social interaction.

Street layout

Streets are a vital element of public space that can facilitate accessibility and walkability in a neighbourhood (Mehta, 2007; Pendola and Gen, 2008). A review of the relationships between physical environments, health and wellbeing has suggested that the main impacts of street layout are via influences on social interaction (Thompson and Kent, 2014). Gehl (2010) and Mehta (2013) suggests that lively streets, i.e. those with high rates of social interaction, arise through the provision of pedestrian spaces, wide footpaths, seats, shade and walking for short distances between places. These in turn support residents’ social life (Gehl, 1987). Like most researchers on this subject, street layout is closely related by Gehl to the notion of walkability – “the extent to which the built environment is friendly to the presence of people living, shopping, visiting, enjoying or spending time in an area” (Abley, 2005: 2). Talen (2006) pointed out that street connectivity needs to be further examined in contemporary neighbourhood design because it fosters social interaction between neighbours. This concept is strongly connected to the McMillan and Chavis (1986) definition of sense of community, particularly the “shared emotional connection” dimension. In this sense, streets can positively impact perceptions of sense of community and neighbourly interactions in residential neighbourhoods (Chan and Lee, 2008; Uslu, 2010) and create a safe place to lower crime incidence (Kelly et al., 2012) (Figure 2.13)
The street serves as a place for face-to-face connections, such as recreation, conversation and entertainment, and thus can strengthen residents’ social ambitions via providing place for connection (Moughtin, 2003). Cul-de-sac streets, for example, can contribute to provision of safe places for playing and walking, reducing traffic and cost of infrastructure maintenance (Marcus, 2003). In contrast, Lund (2003) found within the American context that grid streets provide accessibility to facilities and create pedestrian-friendly environments that in turn can increase informal social connections more than cul-de-sacs. Cozens and Hillier (2008) compared grid streets and network layouts in Australian and European contexts and concluded that the “‘one-size-fits-all’ approach to the design of street layouts to encourage social interaction is ‘myopic and simplistic’” (Cozens and Hillier, 2008: 51).

Pedestrian environment

Pedestrian environment features, including footpaths, nature strips and trees, seem to impact social connection by promoting neighbourhood satisfaction. The footpaths used for connecting pedestrians to public spaces such as parks and playgrounds provide physical locations for social interaction (Kim and Kaplan, 2004; Rogers and

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Figure 2.13: Role of streets in providing safety place adopted from (Kelly et al., 2012)
Sukolratanametee, 2009). The nature strip is an important element of residential streetscapes that reflects the character aesthetics of the local area. It serves as a location for street furniture, such as seats, rubbish bins, lighting and trees, and thereby contributes to accessibility and safety, as well as opportunities for social contact (Meenachi-Sunderam and Thompson, 2007). In addition, greenery is seen to encourage social interaction. Trees, for example, play a key role in shaping and maintenance of shade, which creates space for community interaction and social activities where face-to-face connections take place (Comstock et al., 2010; Uslu, 2010). Research argues that pedestrian access features are associated with walkable suburbs and liveable neighbourhoods via the reduction of car traffic (Southworth, 1997; Talen, 2011; Talen and Koschinsky, 2013). Thus, pedestrian environments associated with public spaces can encourage outdoors activities and interactions, increase sense of community (Rogers and Sukolratanametee, 2009; Talen and Koschinsky, 2013), and enhance place identity with ecological and environmental benefits (Uslu, 2010).

Accessibility and walkability

Accessibility and walkability deal with proximity of dwellings in relation to individuals’ work, access to amenities and leisure activities (Burton et al., 2005). Accessibility is associated with urban form characteristics, particularly land use and neighbourhood layout, since neighbourhood layout determines the relationship between dwellings, services, amenities and open spaces (Dempsey et al., 2010; Talen, 1999). Furthermore, access to services and facilities is required to create a pedestrian-friendly environment (Brookfield, 2016; Owens, 1993; Talen, 2011). Accessibility to green spaces is associated with the promotion of good mental health and community wellbeing (Pincetl and Gearin, 2005; Uslu, 2010). It can enhance human activity and
increase sense of safety (Burton et al., 2005), removing social barriers between residents who are more likely to maintain local green spaces in their neighbourhood (Krellenberg et al., 2014; Thompson and Kent, 2014). This impact in turn enhances social cohesion in the community (Peters et al., 2010). Accessibility is also related to connectivity, which refers to the extent of connection between individuals and resources. It has been suggested that higher connectivity leads to increased levels of interaction between residents and their environment and socio-cultural activities, which in turn supports stable neighbourhoods (Raman, 2010; Salingaros, 2008).

Walkability is linked to notions of the pedestrian friendly and to the provision of good public transport so that car use is reduced – a mode of transport that prevents casual social interaction. (Freeman, 2001; Gans, 1961). Brown and Cropper (2001) have linked pedestrian-friendly neighbourhoods to reduced car dependence, improved public transport options and street layouts designed for accessibility with footpaths and street furniture that improve walkability. Whyte (1980) has argued that walkability can be impacted by the configuration of space, distribution of attraction facilities and the social environment. There is, however, debate about, and thus further research required on, which of these features have the greatest impact on residents’ spatial and social behaviour. Similarly, walkability is seen to be shaped by: high density and compact areas, mixed land use, provision of amenities and adequate pedestrian environments (Brookfield, 2016; French et al., 2013; Talen and Koschinsky, 2014). Walkable neighbourhoods have been linked to pedestrian environment features which are seen to enhance physical activity and health (Ewing et al., 2008). It has been also suggested that walking in relation to safety and parking is a significant factor influencing the choice of living in a specific neighbourhood (Brookfield, 2016; Kim and Kaplan, 2004).
Public and open green spaces

Public and open spaces are important features in neighbourhoods due to their functional, aesthetic, and social and wellbeing benefits. Neighbourhood attachment, informal encounters and sharing events may be facilitated by provision of these spaces, considering qualities such as location and visibility. Such public spaces in turn facilitate informal connections and socialising and develop community identity (Raman, 2010; Raymond et al., 2010; Thompson and Kent, 2014). Gehl (1987), in his book *Life between buildings*, explored the importance of creating public spaces for people meeting and participating in social activities. These spaces play a significant role in enhancing walkability in residential environments, which in turn promotes social interaction among residents. However, overlooking the human dimension in the design of public spaces leads to poor pedestrian environments that have contributed to a reduction of social life (Gehl, 1987).

Oldenburg (1999) identified the public spaces of playground, parks and cafe as ‘third places’ that provide for casual and unplanned social interaction and thus should be considered in design to enable casual connections with neighbours to sustain social life. The public and private spaces between residential buildings play an essential role in facilitating and maintaining social interaction (Zhang and Lawson, 2009). It is argued that the role of architects and planners is important because the relationship between designers’ intentions and residents needs’ should be considered a compatible relationship (Lawrence, 1987). According to Jenks and Jones (2010), open and green spaces create chances for contact between individuals and their environment. In a comparison of eco-friendly design and typical suburbs, it has been found that ecological design supports outdoor activities more than typical design (Rogers and Sukolratanametee, 2009).
The provision of green spaces is also important because interactions between humans and the environment impact neighbourhood satisfaction (Cao and Wang, 2016; Kearney, 2006). Moreover, green spaces can create buffers between residential dwellings and streets and thus reduce the impact of traffic on residents (Appleyard et al., 1981). Design of green spaces in the residential neighbourhood can also address the level of defensible spaces (Mehta, 2013). Other research summarises the green space benefits to health via contact with nature and increased social contact. For example, lack of open green spaces is seen to be associated with perceived reduction of social support (Thompson and Kent, 2014). Green areas and urban parks are particularly key in creating vital spaces in a neighbourhood associated with stronger ties to neighbours and numbers of people involved in social activity in these spaces (Sullivan et al., 2004). These are physical locations where informal interactions take place, which stimulate social cohesion and facilitate place attachment (Peters et al., 2010). Arnberger and Eder (2012) found that perceived provision and quality of green spaces can foster community attachment, which contributes to reinforcing relationships between residents and their community.

2.5.5.4. Dwelling form

Numerous studies have examined the effects of the micro-scale environment of neighbourhoods on social behaviour (Abu-Ghazzeh, 1999; Al-Homoud and Tassinary, 2004; Gans, 1961; Williams, 2005). Various micro-scale dwelling form characteristics are described in this section in relation to two sets of relationships: the physical arrangement of dwellings in relation to other dwellings; and the relationship of interstitial spaces and threshold spaces, including semi-private and outdoor spaces.

The physical arrangement of dwellings and the spaces shared by and/or between dwellings have important social functions because they can facilitate:
connection between neighbours, increased interaction (Talen, 1999), sharing of information about the neighbourhood, and thus community attachment. Additionally, security can be improved through physical arrangement supporting feeling of safety, which in turn can enhance place attachment (Abu-Ghazeh, 1999; Huang, 2006). For example, in comparison of housing designs, row apartments have been found to have ineffective outdoor spaces in terms of size, and unfamiliar and insufficient identification of common spaces, characteristics that reduce social activities (Abu-Ghazeh, 1999).

There has been increasing demand for design that enhances socialising behaviours (Al-Homoud and Tassinary, 2004; Talen, 1999). Outdoor spaces are considered a functional extension of the home, designed and managed to meet aesthetic and recreational preferences (Cook et al., 2012). For example, features of shared outdoors spaces such as passageways, green slopes and playing facilities have been found to reduce perceptions of density and overcrowding, and thus to engage residents in social and physical activities with their children and others. Such spaces have thus been found to increase chances for social interaction between residents (Kearney, 2006; Marcus, 2003). Other studies have shown that semi-private spaces – such as front balconies, front gardens (Abu-Ghazeh, 1999; Brown and Cropper, 2001; Gans, 1961), elements of front elevations including decorative elements, walls, fences, landscaping and signs – (Al-Homoud and Tassinary, 2004), and semi-private outdoor spaces can promote meetings between residents and thus foster social interaction (Rapoport, 1971). Semi-private spaces are described as soft edges, such as front yards, terraces and entrances, that enable residents to meet each other and connect socially. Housing type, social interaction and sense of community are linked via integrated design of public, semi-private and private spaces, (Figure2.14) (Kelly et al., 2012). Semi-private spaces have also been found to increase visibility between dwellings and
visual contact among residents (Gehl, 1987; Kelly et al., 2012), contact which is strongly correlated with increased security and feeling of safety. Housing development arguably should provide shared spaces related to local facilities in the neighbourhood to be actively engaged to the local community, particularly in low-density neighbourhoods (Chan and Lee, 2008). Thus, it has been suggested that the design of neighbourhoods should play close attention to the psychological effect of the built environment on resident interaction (Marcus, 2003). Social interaction can be also measured by the frequency of using semi-outside spaces that characterise neighbourhoods (Al-Homoud and Tassinary, 2004), which serve as connection and buffer zones between outdoor and indoor spaces to create a sense of place and social cohesion (Cook et al., 2012; Williams, 2005).

![Diagram of space types](image)

**Figure 2.14:** Private, semi-private and public space. Source: (Kelly et al., 2012)

### 2.5.6. Measuring the impact of the built environment on social interaction

While it is clear across disciplines that social interaction is impacted by neighbourhood design, a theoretical framework is required that describes the relationships between various measures of social interaction and the design characteristics of neighbourhoods and dwellings that impact social interaction. This deficit reflects that
most research on social interaction has focused on the socioeconomic factors that influence interaction. Such a framework is offered in this thesis (Figure 2.15). This indicates neighbourhood comprising two primary dimensions: psychosocial and urban design attributes. There are three orders of urban design attributes: urban form, neighbourhood form and dwelling form.

Four psychosocial attributes impact social interaction and can be categorised as reflecting neighbourhood experience in the framework: neighbourhood attachment, neighbourhood satisfaction, neighbouring, and feeling of safety. Urban form is comprised of five elements: density, land use, dwelling type, layout and transport connectivity. The four neighbourhood form characteristics are: street layout, pedestrian environment, neighbourhood connectivity and provisions of public and green spaces. Additionally, dwelling form can impact social interaction chiefly in relation to four dwelling form features of the interstitial spaces between dwellings that provide physical proximity: dwelling setback, fence height, garage location, and dwelling type. Thus, the impact of these urban form characteristics on social interaction can be measured via each of the four psychosocial correlates of social interaction. Each of these attributes has been found to significantly correlate with social interaction (Lovejoy et al., 2010; Rogers and Sukolratanametee, 2009; Unger and Wandersman, 1985). Moreover, these attributes have also been measured using established scales: neighbourhood attachment (Bonaiuto et al., 1999; Comstock et al., 2010), satisfaction (Bonaiuto et al., 2003), neighbouring (Buckner, 1988; Nasar and Julian, 1995), walking and safety (Can, 2012; Leyden, 2003; Lund, 2002). Thus, for example, neighbourhood satisfaction (Bonaiuto et al., 2003) has been used to examine residents access to neighbourhood spaces in relation to design qualities including: street width, space to walk, carparking availability and choice of road to exit the neighbourhood.
Thus, this study proposes a model to measure social interaction via four established correlates: (1) neighbourhood attachment; (2) neighbourhood satisfaction; (3) neighbouring; and (4) walking and safety. While a range of physical form characteristics can be seen to impact these four social interaction indicators, only five
neighbourhood and dwelling form characteristics are considered here as suburban neighbourhood variables that built environment professionals can readily change through design: (1) street layout (street type, traffic flow and on-street parking); (2) pedestrian environment (footpaths, nature strips, tree coverage); (3) neighbourhood connectivity; (4) provision of public spaces and green spaces; and (5) dwelling form (dwelling setback, fence height, garage location, and dwelling type). This is because some urban form elements are impacted by urban planning policies rather than being directly planned (such as density) e.g., regulations about the height of buildings, their typology and setbacks can define the density of an area. While other urban form elements can be seen to be associated with qualities and provision of physical built environment characteristics; particularly walkable and connected streets, well-designed public spaces, and mixed dwelling types (Jenks and Jones, 2010). However, provision of transport, for example, which is used in the measurement of accessibility and connectivity, is not directly influenceable by built environment professionals through design (Dempsey et al., 2010). At the same time, land-use diversity can determine accessibility, and also the walkable provision of the diverse services and facilities a neighbourhood needs (Talen, 2011).

It is also possible to directly measure social interaction through the level of social activity e.g. social connections, conversations, number of friendships. Such empirical measures (e.g. (Abu-Ghazze, 1999; Al-Homoud and Tassinary, 2004) have a two-way relationship with the correlates of social interaction – as social connections both impact and are impacted by neighbourhood experience. The relationship between these ten variables – four neighbourhood experience variables, five suburban physical design variables and a social activity variable – is illustrated in Figure 2.16.
Research has shown that, despite increased withdrawal from neighbourhood life due to increased use of technology and to social differences, neighbourhood design still critically impacts social interaction (Unger and Wandersman, 1985). However, while it is clear that good neighbourhood design can facilitate social interaction and sense of community, poor design can have negative impacts. While these negative impacts have been well documented in high-density city contexts, a lack of understanding and attention to the impacts of design in low-density suburbs has also created problems by creating lifeless places with little sense of community. Yet, despite the acknowledged and well-researched relationships between social sustainability, sense of community and social interaction, few studies have focused on the impact of neighbourhood design on social interaction in the suburbs. This is a clear research gap, but one which the above framework hopes to inform by establishing which variables might be related and the ways in which they may be related.
addition, the framework elucidates the relationships between these variables, sense of community and the broader objective of social sustainability.

In conclusion, a review of built environment research reveals that neighbourhood design can play an important role in developing sustainable communities. Moreover, human sustainable behaviours have been shown to be enhanced by neighbourhood design strategies. Although negative social interaction is linked to physical design, it is argued that social interaction is grounded on the physical characteristics of neighbourhood and that good design can address the debated relationship between built environment and social. Thus, this study identifies what neighbourhood characteristics can contribute to social interaction and how these characteristics can impact social interaction in low-density suburban context.

2.6. Summary of literature review

This chapter has explored social sustainability as a key aspect of sustainable development and has discussed the interrelationship between three dimensions of sustainability of community: sense of community, sense of place and social interaction. The chapter has described how the social life of neighbourhoods has been impacted by social changes, urban sprawl and other aspects of suburban change. The relationships between built environment and social interaction has also been discussed, in particular the research on how design characteristics of neighbourhoods and dwellings impact social interaction.

The findings of this review show that research across disciplines indicates that social interaction is closely related to neighbourhood design. However, a theoretical framework has been lacking that informs investigation of the role of neighbourhood design in social interaction in low-density Australian suburbs. This deficit reflects that most research has focused on the socioeconomic factors that influence interaction.
Moreover, research on the impact of suburban neighbourhood design on social interaction is scant since the literature has largely focused on micro-scale design in high-density areas.

This study has thus developed a framework of neighbourhood design factors that are comprised of two primary dimensions: psychosocial and urban design attributes. In this, there are three orders of urban design attributes that shape urban form characteristics, moving from the macro to the micro scale – urban form, neighbourhood form and dwelling form. Finally, this framework will be used to measure the factors that affect social interaction in order to identify strategies for urban designers and architects to create more socially sustainable neighbourhoods via the facilitation of social interaction. Accordingly, in the next chapter the methodology of this research will be discussed based on the literature review and the suggested framework. It also introduces the selected study area and how the factors identified can be measured in these suburbs as representative of the broader low-density context in Australia.
Chapter Three – Research Methodology
3.1. Introduction

This chapter describes the methodology used to answer the research questions on the impacts of neighbourhood design on social interaction in low-density Australian suburbs. Here, the four correlates of social interaction of neighbourhoods identified in the previous chapter are the dependant variables, and the five main physical suburban design characteristics that might impact social interaction are the independent variables. Section 3.2 discusses the choice of overall methodology and research design to collect and analyse data on these variables, plus other socio-demographic variables and more direct measures of social interaction. Section 3.3 describes the three residential suburbs in the City of Greater Geelong that have been selected as the case studies. Section 3.4 deals with data collection: identification of the participants; the survey questionnaire that measured perceptions of neighbourhood experience and levels of social activity; description of how the physical urban design variables were measured; explanation of the unstructured interviews; and finally, the ethics requirements. Section 3.5 provides a summary of the method.

3.2. Research design and methods

A review of empirical methods shows that mixed methods – a mix of qualitative and quantitative methods – are best to investigate social interaction (Simões Aelbrecht, 2016), specifically in low-density suburban developments (Andrews et al., 2015). In this context, a quantitative strategy can be used to verify a theoretical framework via analysis of the relationships and differences between a set of variables representing the conceptual framework, while a qualitative strategy provides a tool for examining social behaviour through understanding the complexities of thoughts, feelings and attitudes of participants (Bailey, 2008; Liamputtong, 2013).
This thesis research is initially framed considering the social interaction issues facing low-density suburbs related to physical design and the built environment. Thus, based on previous research, social interaction is seen as one issue of social sustainability (Chan and Lee, 2008; Dempsey et al., 2011; Johnson, 2012) such that physical design can affect social sustainability via social interaction.

3.3. Study area

As discussed earlier, housing in Australian cities is mainly in suburban areas characterised by low-density detached housing. Approximately 70% of the population lives in these areas (Davidson, 2006). These suburbs have been argued to be associated with a lack of liveability and community life (Johnson, 2007; Richards, 1994). This has contributed to what has been described as a nightmare of dreary living, deprivation and isolation (Richards, 1994).

Accordingly, to investigate the impact of neighbourhood design on social interaction, this study explores the social experiences of residents in three suburbs in the City of Greater Geelong (CoGG). Geelong is the second largest city in Victoria, located 75 km south-west of Melbourne, the state capital. It developed significantly during growth of the south-west of the city after WWII. The CoGG is bounded by Moorabool Shire in the north, Wyndham City and the Borough of Queenscliff in the east, Bass Strait in the south and Surf Coast Shire and Golden Plains Shire in the west. Data was provided by inhabitants in three suburbs in the south-west of Geelong.

The three suburbs – Belmont, Grovedale and Waurn Ponds – were selected for two primary reasons: (1) socioeconomic equivalence; (2) design variability, as each was developed during different periods of residential growth and thus they vary in urban design layout and architectural style. Eight residential streets in each of the three
suburbs were selected to give a spread of different types of design layout, meaning the spatial relationships between dwellings vary between streets.

Table 3.1, shows the area within each Greater Capital City Statistical Area (GCCSA) divided according to 6 population density classes, from no population to very high (Australian Bureau of Statistics, 2011).

Table 3.1: Total area in six population density classes in Greater Capital City Statistical Areas (km²)

<table>
<thead>
<tr>
<th>City</th>
<th>No population</th>
<th>Very low (Less than 500)</th>
<th>Low (500-2000)</th>
<th>Medium (2000-5000)</th>
<th>High (5000-8000)</th>
<th>Very High (More than 8000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sydney</td>
<td>6632</td>
<td>3936</td>
<td>788</td>
<td>834</td>
<td>126</td>
<td>48</td>
</tr>
<tr>
<td>Melbourne</td>
<td>2706</td>
<td>5271</td>
<td>938</td>
<td>1024</td>
<td>51</td>
<td>14</td>
</tr>
<tr>
<td>Adelaide</td>
<td>204</td>
<td>2362</td>
<td>407</td>
<td>277</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Perth</td>
<td>2492</td>
<td>2821</td>
<td>723</td>
<td>379</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hobart</td>
<td>500</td>
<td>1065</td>
<td>113</td>
<td>16</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Darwin</td>
<td>2148</td>
<td>955</td>
<td>50</td>
<td>19</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Canberra</td>
<td>1822</td>
<td>282</td>
<td>204</td>
<td>52</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* people per square kilometre

According to the Australian Bureau of Statistics (ABS), the 2016 estimated resident population for the CoGG was 238,603 with a population density of 195 persons per hectare and cover area of 1,252 Km². It has been predicted that in 2051 the population will be almost 485,600 (The State of Victoria, 2016). The density of the selected suburbs is between 1600 and 2200 people per square metre (Profile ID 2011). The three selected suburbs are thus representative of low-density suburbs in Melbourne. The percentage of population living in the outer suburbs is 65% while the population living in the inner suburbs is 35%, which indicates that outer suburb population is generally two times higher than the population living in the inner suburbs of Melbourne. Thus, housing in the selected neighbourhoods is considered low density: 1623 persons per square metre in Belmont, 2092 in Grovedale and 911 in Waurn Ponds (Profile ID 2011) (Table 3.2) shows demographic date of three suburbs.
The suburbs are predominantly of single-family housing. Belmont is the oldest suburb, having the most significant growth during the 1950s and 1960s. Further population growth in Belmont occurred in 2006 and 2011, when there was an increase in new dwellings. Grovedale has had significant development since the 1970s and 1980s, with its population growing during the early 1990s as a result of further housing development. The newest suburb is Waurn Ponds, which underwent rapid residential development in the 1990s and saw a marked increase in the number of new houses between 1991 and 2011 (de Jong et al., 2013). The three selected suburbs are representative of typical low-density suburban development within the CoGG (Figure

Table 3.2: 2011 Census data for the three suburbs

<table>
<thead>
<tr>
<th>Demographic data</th>
<th>Belmont</th>
<th>Grovedale</th>
<th>Waurn Ponds</th>
</tr>
</thead>
<tbody>
<tr>
<td>State / city</td>
<td>Victoria/Geelong</td>
<td>Victoria/Geelong</td>
<td>Victoria/Geelong</td>
</tr>
<tr>
<td>Era</td>
<td>1950-60s</td>
<td>1970-80s</td>
<td>1990-00s</td>
</tr>
<tr>
<td>Total Area</td>
<td>919 hectares</td>
<td>840 hectares</td>
<td>2,984 hectares</td>
</tr>
<tr>
<td>Population density</td>
<td>16.23</td>
<td>20.92</td>
<td>9.11</td>
</tr>
<tr>
<td>Population</td>
<td>14,054</td>
<td>14,308</td>
<td>5,046</td>
</tr>
<tr>
<td>Male</td>
<td>6727</td>
<td>6831</td>
<td>2455</td>
</tr>
<tr>
<td>Female</td>
<td>7324</td>
<td>7481</td>
<td>2593</td>
</tr>
<tr>
<td>Distance from Geelong CBD (km)</td>
<td>4.2</td>
<td>7.2</td>
<td>8.9</td>
</tr>
<tr>
<td>Household size</td>
<td>2.3</td>
<td>2.4</td>
<td>3.1</td>
</tr>
<tr>
<td>No. families</td>
<td>3548</td>
<td>3861</td>
<td>1030</td>
</tr>
<tr>
<td>Average children per family</td>
<td>1.8</td>
<td>1.8</td>
<td>2</td>
</tr>
<tr>
<td>Average Level of Education</td>
<td>4.2</td>
<td>3.0</td>
<td>3.7</td>
</tr>
<tr>
<td>Median age</td>
<td>39</td>
<td>40</td>
<td>25</td>
</tr>
<tr>
<td>Median weekly household income</td>
<td>$1,145</td>
<td>$1222</td>
<td>$1,902</td>
</tr>
<tr>
<td>Median weekly rent</td>
<td>$295</td>
<td>$300</td>
<td>$390</td>
</tr>
<tr>
<td>Dwelling type</td>
<td>78% separate house</td>
<td>85% separate house</td>
<td>95 % separate house</td>
</tr>
<tr>
<td>All private dwellings</td>
<td>6,660</td>
<td>7582</td>
<td>1448</td>
</tr>
</tbody>
</table>
3.1) and can be said to be representative of much low-density development in Victoria, New South Wales and South Australia – the most populous states in Australia.

Figure 3.1: Satellite view of three suburbs in the City of Greater Geelong

**Belmont**

Belmont is an established residential area located 4 kilometres south of the Geelong city centre, with some commercial zones along High Street. As stated in Australian census data 2016, Belmont’s population is 14,506. It is bordered by the suburbs of Grovedale, Highton, Marshall, Breakwater, Newtown, South Geelong, Wandana Heights and Waurrn Ponds (Figure 3.2). The population density in Belmont is 15.79 pers/hectare, meaning it is the densest suburb among the selected areas. Belmont has a mix of housing styles from heritage to modern, with housing plot sizes approximately 800–1000 m2. The selected streets have both ownership and rental units, but with ownership dominant.
The main streets of Belmont are varied in width and have significantly higher rates of traffic than the sub-streets linked to the main streets. The village centre of Belmont is comprised of supermarkets and restaurants, a medical centre, various shops, a grocery, real estate offices and a library. The main street in Belmont is High Street, a major commercial street with a shopping area and community services, while the main through road is Mount Pleasant Road. The area containing the eight streets is close to the Barwon River and Valley Park. Residential streets in Belmont are largely of the traditional grid pattern including different street types (e.g. short cul-de-sacs and cross streets) and overall have a clear Cartesian direction. The selected streets vary in width from 6.5 m to 8 m, have low to moderate traffic flow and on-street parking. The pedestrian environment differs between the streets in the widths of the footpaths and nature strips. While most footpaths are between 3.5 and 5 m, some streets have no footpaths, meaning pedestrians must use the nature strip for walking. The nature strips also vary in width (Figures 3.3 and 3.4).
Greenery consists of matured trees in streets and private gardens, and well-maintained vegetation that creates a leafy streetscape. The variety of established trees and bushes, flowers and lawns provides 50% shade and habitat for birds (Figure 3.5). Belmont has large green open spaces adjacent to the surveyed streets, which offer a variety of newly designed playgrounds for children (Figure 3.6). Belmont has marginally good access in relation to both walkability and public transport connectivity (please see Section 3.4.3 for details of how access was evaluated).
Figure 3.4: Typical residential streets and pedestrian environment in Belmont
Figure 3.5: Tree-lined streets and private gardens in the study area of Belmont
Figure 3.6: Open spaces close to the study area in Belmont

The dwelling type in the streets is largely single-storey detached with some duplex units, apartment buildings and semi-detached townhouses. The height of the front fences to the private front gardens varies little. Garages are largely highly visible from house façades or set further back from the street. Setbacks – the distance between the dwelling and street facade – vary from 5 to 8 m. In general, there are few shared spaces between houses in the streets (Figure 3.7).
Figure 3.7: Dwelling form features (dwelling type, placement of garage, fences and setbacks) observed in Belmont streets

*Grovedale*

Grovedale is a mainly residential suburb located 7 kilometres south of Geelong city centre, with some industrial and commercial areas. Most of the land to the east of the railway line is rural. According to Australian census data 2016, Grovedale’s population is 14,308. It is bounded by Belmont, Breakwater, Marshall, Wandana...
Heights and Waurn Ponds. The main roads close to the study area are Heyers Road and Burdoo Drive. Grovedale is served by two areas of community facilities and a major shopping centre. The population density in Grovedale is 4.94 pers/hectare. Grovedale has some variety in housing styles, but most are modern with some with heritage influence. The housing plot size is approximately 750 m². The selected streets have both ownership and rental units (Figure 3.8).

Figure 3.8: Grovedale location (Profile ID 2011)

The residential streets in Grovedale are typically of conventional cul-de-sac pattern with clear directions running east/west and north/south. The width of the selected streets varies from 6 to 6.5 m with low traffic flow and on-street parking. The pedestrian environment of footpaths and nature strips varies in widths from 3 to 4.5 m and is mostly on both sides of the streets (Figures 3.9 and 3.10). While there is no consistent tree planting, greenery is characterised by diverse established large shrubs and some mature trees, which provide 30–40% shade and habitat for birds. Front gardens are reasonably generous and there are few shared spaces between houses.
Grovedale has some open public spaces that lack facilities. The study area is within walking distance of Coolabah Park (Figure 3.12). While Grovedale is accessible via public transport, it can be considered a car-dependent suburb.

There is some variety in dwelling type, with most of a local modern vernacular with heritage influences. 90% are single- or double-storey detached houses. Dwellings mostly have no front fence. The garage is frequently attached to the façade, with some houses having garages set to the rear. Although there is consistency in setbacks and spacing, some dwellings have large setbacks up to 11 m (Figure 3.13).
Figure 3.10: Typical residential streets and pedestrian environment in Grovedale
Figure 3.11: Tree-lined streets and private gardens in the study area of Grovedale
Figure 3.12: Open spaces adjacent to the study area in Grovedale
Figure 3.13: Dwelling form features (dwelling type, placement of garage, fences and setbacks) observed in Grovedale streets

**Waurn Ponds**

Waurn Ponds, the most modern of the three suburbs, is located 9 kilometres south of Geelong city centre. It has rapidly changed from a rural area to a residential suburb with a substantial institutional area neighbouring (a university campus) and a large shopping complex opposite parkland and a skateboard park. On the south side of the Princes Highway, there is a growing housing estate flanked on one side by the Waurn
Ponds Creek linear park. The north side of the highway contains some of the state’s leading educational institutions – Deakin University, a campus of Geelong Grammar School and the private Marcus Oldham Farm Management College. It is bordered by Belmont, Ceres, Grovedale and Wandana Heights (Figure 3.14). As stated in Australian census data 2016, the Waurn Ponds population is 5046. The population density in Waurn Ponds is 1.7 persons/hectare, which is far less dense than Belmont and Grovedale.

Waurn Ponds has total uniformity of housing styles, with few heritage influences. Housing plot sizes are approximately 450–500 m². The selected streets have both ownership and rental houses.

Figure 3.14: Location of Waurn Ponds (Profile ID 2011)

Waurn Ponds is of a curvilinear loop pattern with many courts and no clear orientation of streets. The streets vary in width from 5 to 6.5 m, with low traffic flow in the all selected streets and on-street parking. The main road close to the selected area is Rossack Drive.

The pedestrian environment is comprised of narrow nature strips, with mostly gravel and artificial landscapes with some imported grasses. Footpaths are on one or both sides, and the footpath plus nature strip width varies from 3.5 to 4 m (Figures 3.15 and
Greenery consists of very few trees and shrubs offering 10–20% shade (Figure 3.17). There are very limited shared spaces. Two public open spaces are adjacent to the surveyed streets: Malbec Loop Reserve, a park with some playground equipment; and the small Vineyards, which has no greenery and limited amenities (Figure 3.18). Waurn Ponds is car-dominated and lacks pedestrian access, especially in comparison with Belmont and Grovedale.

Figure 3.15: Waurn Ponds layout and selected residential streets (source: NearMap)
Figure 3.16: Typical residential streets and pedestrian environment in Waurn Ponds
Figure 3.17: Tree-lined streets and private gardens in the study area of Waurn Ponds
In the selected streets, nearly 95% of the dwellings are single detached. Fences are varied in height. Setbacks and spacing between dwellings are small, while a few houses have deep setbacks of 12 m. Garages are typically highly visible from the house façades, with some houses with two car garages attached to their façades (Figure 3.19).
Figure 3.19: Dwelling form features (dwelling type, placement of garage, fences and setbacks) observed in Waurn Ponds streets
3.4. Data collection

(Salant et al., 1994) reported that mail survey is the best method of quantitative enquiries for three reasons: the researcher can obtain an adequate number of respondents; housing addresses are reliable and available; and recipients are more likely to have time for participation. However, face-to-face interviews can add data that supports the findings from a mail survey and are also more accurate (Bailey, 2008).

A quantitative methodology was used with the support of measured observations of physical neighbourhood characteristic variables using on-street photography and high-resolution satellite photomaps by NearMap. This study was undertaken from December 2015 to July 2016. Three methods were used to collect qualitative and quantitative data on the role of neighbourhood and house design in promoting social interaction: (1) questionnaires delivered to residential mailboxes by the author; (2) questionnaires handed out on the street at a local shopping centre; and (3) interviews via telephone with residents who lived in the best and worst streets (according to the questionnaire data).

3.4.1. Participants

Residents were selected randomly and anonymously. Two methods were used to collect information from them:

Questionnaires were distributed to residents’ mailboxes in each selected street. A plain language statement, consent form and questionnaire were delivered to a total of 600 households. Each of the three neighbourhood-areas selected for study was occupied by approximately 260 houses in eight streets. 80 households from the 260 (30%) were targeted as a representative sample. This response rate is considered good for a survey of this length, since the response rate for a survey administered to the
general population is typically between (10% 40%) Handy (2005). Predicting a 40% response rate, in order to receive 80 completed questionnaires from each of the three neighbourhood-areas, 200 households in each suburb, randomly selected, received the questionnaire via their mailboxes.¹

Participants were asked to return their responses using the supplied stamped and addressed envelope, which was a Deakin envelope addressed to the School of Architecture and Built Environment. Data was collected from 184 residents aged between 18 and 80 years old, with 68 questionnaires received from Belmont, 65 from Grovedale and 51 from Waurn Ponds, as shown in Table 3.3. Socio-demographic and residential variables were collected including household tenure, age, gender, income, length of residence, number of household members, number of children and level of education in years. These features were used to confirm the social homogeneity of the selected suburbs evidenced by census data.

In order to increase the sample size, a face-to-face survey was also carried out with participants recruited from public spaces adjacent to the neighbourhood libraries of each suburb. A plain language statement and consent form were provided to these participants, along with a brief description of the project. The questionnaires were matched to residential streets by asking the participants their address. Thus, the researcher recorded 29 face-to-face respondents from Belmont, 15 from Grovedale and 19 from Waurn Ponds. The total number of completed questionnaires from both methods of data collection was therefore 247.

¹ It should be noted that in total, 33,408 people live in the three suburbs. The more heterogeneous a population, the larger the sample size required to obtain a given level of accuracy. The less variable (more homogeneous) a population, the smaller the sample size. In a normal distribution, approximately 95% of the sample values are within two standard deviations of the true population value (e.g., mean). However, there is always a chance that the sample obtained does not represent the true population value Israel GD. (1992) Determining sample size. To test the hypotheses of this thesis, a 95% confidence level is used.
The questionnaire data was recorded by the researcher to facilitate the survey procedure and explain the questionnaire to the participants. However, data that was collected via face-to-face interviews was very limited.

Table 3.3: Return rate of questionnaires in each suburb

<table>
<thead>
<tr>
<th></th>
<th>Mailbox survey</th>
<th></th>
<th>On-street survey</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Belmont</td>
<td>Grovedale</td>
<td>Waurn Ponds</td>
<td>Belmont</td>
</tr>
<tr>
<td>No. of respondents</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>29</td>
</tr>
<tr>
<td>Belmont</td>
<td>68 (34%)</td>
<td>65 (32%)</td>
<td>51 (25%)</td>
<td></td>
</tr>
<tr>
<td>Grovedale</td>
<td></td>
<td></td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>Waurn Ponds</td>
<td></td>
<td></td>
<td></td>
<td>51</td>
</tr>
<tr>
<td>Total</td>
<td>184</td>
<td></td>
<td></td>
<td>247</td>
</tr>
</tbody>
</table>

3.4.2. Survey instrument

The instrument consisted of five scales: four measuring perceived neighbourhood social and physical qualities, and one directly measuring social interaction (see Appendix B).

3.4.2.1. Four neighbourhood scales

The correlates of social interaction measured perceptions of: neighbourhood attachment (Bonaiuto et al., 1999; Comstock et al., 2010), satisfaction (Bonaiuto et al., 2003), neighbouring (Buckner, 1988; Nasar and Julian, 1995), walkability and safety (Can, 2012; Leyden, 2003; Lund, 2002) and level of social activity (Abu-Ghazze, 1999; Nasar and Julian, 1995; Skjaeveland and Garling, 1997). These scales have been tested previously by the researchers. For example, neighbourhood attachment is measured using the scale developed by (Bonaiuto et al., 1999) and further validated by (Comstock et al., 2010). The satisfaction scale has been validated by (Bonaiuto et al., 2003). Exploratory Factor Analysis (EFA) was used to reveal the underlying structure of the 37 variables to inform a more manageable and dependable instrument.
1. **Neighbourhood attachment**: This scale essentially indicates residents’ emotional feelings of positive attachment to their neighbourhood. The five-item neighbourhood attachment scale reflects mobility, and involves the symbolic and self-identity ties to physical surroundings that have been found to benefit community interactions and health outcomes. Residents answered each item on a five-point Likert scale (from 1 ‘strongly disagree’ to 5 ‘strongly agree’) with a high score referring to a strong emotional connection with place or neighbourhood. This scale was selected for its specific focus on measuring residents’ degree of attachment to neighbourhood, when similar scales include other concepts such as sense of community, neighbouring and place attachment beyond neighbourhood level.

2. **Neighbourhood satisfaction**: The 14-item neighbourhood satisfaction scale was used to measure residents’ satisfaction with physical environment qualities in relation to external and internal connections between neighbourhood spaces. The residents responded to each item on a 5-point scale (‘strongly disagree’ to ‘strongly agree’). Answers scores were consequently recoded and thus high scores refer to physical connectivity and good accessibility in the neighbourhood and determine the quality of the streetscape.

3. **Neighbouring**: This variable was measured via an 11-item scale relating to residents’ behaviour, friendships and connections in their neighbourhood, such as meeting their friends in public places, chatting with neighbours, referring to weak social ties and asking for help in an emergency or exchanging support between neighbours. Thus, this reflects levels of social homogeneity via interaction with neighbours; the responses were ranked according to a 5-point scale (‘strongly disagree’ to ‘strongly agree’).
4. **Walkability and safety**: A 7-item scale was used to explore pedestrian environment quality and safety, examining how different physical characteristics in the three suburbs impact residents’ perception levels of safety and walking. The responses were ranked according to a 5-point scale (‘strongly disagree’ to ‘strongly agree’). All of the questionnaires in the previous groups consisted of closed-ended questions.

3.4.2.2. **Level of social activity**

Social interaction is frequently measured via the extent of engagement in social activities between neighbours (Abu-Ghazzeh, 1999; Appleyard and Lintell, 1972; Nasar and Julian, 1995; Skjaeveland and Garling, 1997). Gehl (1987) defined social activities as all activities that occur in public spaces, which are key places of physical and passive contact and depend on the presence of people, such as meeting, children playing, chatting, staying and watching pedestrians. Thus, level of social activity was measured via three groups: (1) a two-item scale of social connection (frequency of visits to people in the neighbourhood and frequency of social interaction; 1=Never, 2=Sometimes, 3=A lot); (2) a two-item scale measuring friendship (number of people known by name in suburb and number of people known by name in street); and (3) a question identifying places of interaction according to two categories (interaction around housing, e.g. entrance and balcony, and interaction around the neighbourhood (e.g. streets and sidewalks).

3.4.3. **Measurement of urban design characteristics**

As shown in Chapter Two, a framework has been developed for exploring the design variables of suburban neighbourhoods that impact social interaction. Five main physical features have been included that were measured to explore the neighbourhood qualities of the selected streets: (1) street layout (street type, traffic flow and on-street...
parking); (2) pedestrian environment (footpaths, nature strip, tree coverage); (3) neighbourhood connectivity (connectivity by walking and connectivity by transport); (4) provision of public spaces (number of open public spaces in each neighbourhood and number of community spaces); and (5) dwelling form (dwelling setback, fence height, garage location and dwelling type) (Figure 3.20).

Figure 3.20: Measures of the physical characteristics of neighbourhood suburbs

1. **Street layout**: Three variables – street type, traffic flow and on-street parking – were chosen because: (1) street type can shape perception and influence interaction; (2) high traffic volume is associated with lack of safety, noise, negative impacts on the street environment and thus reduced pedestrian street activities – in particular, children playing and contact between neighbours; and (3) street parking,
which has been observed to have both positive effects, allowing residents to contact with their street and connect socially during their departure and return to home (Appleyard and Lintell, 1972; Lund, 2002) and negative effects, creating unsafe places for walking and driving (Brookfield, 2016; Kim and Kaplan, 2004).

a. Street type: The suburb streets were categorised according to previous research (de Jong et al., 2013; Grammenos et al., 2002). Thus, Belmont had a traditional grid layout, Grovedale streets were designated as conventional cul-de-sacs and Waurn Ponds had streets of a curvilinear loop pattern.

b. Traffic flow: Traffic levels largely depended on public transport provision and dwelling relationships with intersections. Traffic volume was graded to three levels: low, moderate and heavy (Appleyard and Lintell, 1972).

c. On-street parking: Numbers of cars per house parked in each street were calculated by summing the total cars and then dividing by the number of dwellings. Cars were counted at the time when most people used street parking (7–8 pm).

2. Pedestrian environment: Three variables were investigated that impact perceptions of the walking environment: tree coverage, and provision of footpaths and nature strips (or verges, which are the grassed areas situated between the edge of a road and the dwelling or footpath). The footpath/nature-strip zone is where important street furniture is located, including seating, trees and light poles, and thus contributes to accessibility, safety and opportunities for social contact (Meenachi-Sunderam and Thompson, 2007).

a. Footpaths and nature strips varied in width and provision on one or both sides of streets. Thus, the footpath was divided into three groups (no footpath, footpaths on two sides and wide footpath on one side) and the
nature strip also had three groups (nature strip on one side, nature strip on two sides and gravel strip only).

b. Tree coverage: The three suburbs are of different developmental ages, which impacts the quality and quantity of greenery. Tree coverage was measured for the percentage area of each street under tree canopy according to recently taken high-resolution satellite photographs. Belmont had well-established mature trees, compared with diverse established large trees and shrubs in Grovedale and a scattering of undeveloped trees in Waurn Ponds.

The measurement of tree coverage was to the front-wall line of the houses and thus included front gardens, which were perceived to be part of the streetscape. The plan area of trees and large shrubs was compared to the overall street area to give a percentage of tree coverage (Nowak et al., 1996).

3. Neighbourhood connectivity: This indicates to the degree to which local environments provide points of connection and networks to people services and facilities regarding a diversity of scales with numerous purposes. High connectivity is also related to grid street networks, short blocks, streets connected without dead-ends and formation of central places which combine different activities with multiple services (Talen, 2011). As (de Jong et al., 2013: 11) stated, “one of the main determinants of physical connectivity is the street morphology of an area”. This is a measure of residents’ physical connectivity and accessibility to local services and community facilities via (1) walking 5 minutes; or (2) public transport. For suburb delineation and rating connectivity, the study adopted the methods of de Jong et al. (2013). Thus, a distance of 400 m was considered comfortable for walking catchment to local facilities (Talen and Koschinsky, 2013) and to any public transport stop. The proportion of residents who lived within
walking distance of community facilities was graded with 5 scores from 1 (low – 0–20% of residents) to 5 (high – 80–100%) (de Jong et al., 2013).

4. **Public space provision:** Public spaces are significant features in neighbourhoods for their functional, aesthetic, social and wellbeing contributions. Further, they facilitate informal connections and socialising, in particular if they have good location and visibility (Francis et al., 2012; Gehl, 1987; Zhang et al., 2017). Public space provision was measured according to availability and proximity to housing. Thus, it was identified according to two variables: (1) the number of open public spaces, which refer to the outdoor spaces adjacent to residential streets in each neighbourhood within walking distance measured by a binary scale (one space and more than one space); and (2) the numbers of community spaces and facilities as aforementioned including schools, churches, childcare centres, general practitioners and sports clubs, which are places where neighbours can meet and interactions take place. This second public space indicator was measured according to level of space provision within five minutes’ walking distance from the selected streets (no community spaces, 1–3 community spaces, and 4 or 5 community spaces).

5. **Dwelling form:** Four variables indicate the relationship of the dwelling to the street that research suggests affect neighbourhood attachment – dwelling setback, fence height, garage location and dwelling type:

   a. Dwelling setback: This is the distance between the street (delineated by the fence line) and the dwelling. The setback dictates the width of the semi-private garden between the front fence and the house that can enable social interaction while increasing security and feeling of safety. The front garden can serve as a perceived shared space between the street and private dwelling, allowing for connection between residents and the street
A large setback inhibits social contact and makes residents feel more isolated from their street (Gehl, 1987). This study identified three categories of setback: narrow, medium and wide.

b. Fence: This is the boundary between the street and the private garden. If not too high, a fence increases visual connection between residents; if too low, privacy and feeling of safety are reduced, which inhibits residents from using the front garden (Al-Homoud and Tassinary, 2004). While most of the selected streets in Belmont have around 1000–1500 mm high fences, some streets in the other two suburbs have low fences or no fences (with only gardens and setbacks). Some dwellings in Belmont have hedges behind the fences, but these were not differentiated as it is considered that hedges delineate zones in much the same way as fences. The study measured the height of the fence for each dwelling, summed the total fence heights and then divided this by the number of houses to calculate the average fence height in each street. Average fence height varied from 0 to 1.4 m.

c. Garage location: Highly visible garages in the front façades of dwellings are associated with less pleasing pedestrian environments, which in turn impacts perceived neighbourhood attachment in comparison with garages located in an alley or at the back of the dwelling (Kim and Kaplan, 2004; Rogers and Sukolratanametee, 2009). This variable was measured by giving a percentage for each suburb of the proportion of garages immediately adjacent to and facing the street. While 50% of the houses in Belmont and Grovedale have garages facing the street, in Waurn Ponds 95% of garages face the street.
d. Dwelling type: This dictates spatial proximity between residents and can promote or hinder contact between neighbours (Abu-Ghazze, 1999; Bramley and Power, 2009). Belmont has 80% detached houses, Grovedale 90% and in Waurn Ponds 100% are detached.

Table 3.4 presents the indicators of the urban design characteristics. The sign simply indicates the direction of scoring for the decoding variables; with street type, for example, traditional streets are given the decoding variable 1 and conventional loops (curvilinear) the decoding variable 3.

Table 3.4: Indicators of urban design characteristics (neighbourhood form and dwelling form).

<table>
<thead>
<tr>
<th>Independent variables Indicators</th>
<th>Decoding the variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Street layout</strong></td>
<td></td>
</tr>
<tr>
<td>Street type</td>
<td></td>
</tr>
<tr>
<td>Traffic flow</td>
<td></td>
</tr>
<tr>
<td>On-street parking</td>
<td></td>
</tr>
<tr>
<td><strong>Pedestrian environment</strong></td>
<td></td>
</tr>
<tr>
<td>Footpath</td>
<td></td>
</tr>
<tr>
<td>Nature strip</td>
<td></td>
</tr>
<tr>
<td>Tree-coverage</td>
<td></td>
</tr>
<tr>
<td><strong>Neighbourhood form</strong></td>
<td></td>
</tr>
<tr>
<td>Connectivity by walking to facilities</td>
<td></td>
</tr>
<tr>
<td>Connectivity to facilities by public transport</td>
<td></td>
</tr>
<tr>
<td><strong>Public space provision</strong></td>
<td></td>
</tr>
<tr>
<td>Open spaces closed to selected area</td>
<td></td>
</tr>
<tr>
<td>Number of community spaces and organisations</td>
<td></td>
</tr>
</tbody>
</table>

| Street type                       | Traditional grid | Conventional cul-de-sac | Curvilinear loop pattern |
| Traffic flow                      | Low traffic      | Moderate                 | Heavy traffic           |
| On-street parking                 | Number of cars per house |
| Footpath                          | No footpath      | Footpaths on two sides   | Wide footpath on one side |
| Nature strip                      | Nature strip on 1 side | Nature strip on 2 sides | Gravel strip |
| Tree-coverage                     | 0–10% tree-coverage | 20–30% tree-coverage | 30–40% tree-coverage | 40–50% tree-coverage |
| Connectivity by walking to facilities | 1 (0–20%) | 2 (20–40%) | 3 (40–60%) | 4 (60–80%) | 5 (80–100 %) |
| Connectivity to facilities by public transport |   |    |    |     |     |
| Open spaces closed to selected area | One space with walking 5 minutes | More than one space with walking 5 minutes |
| Number of community spaces and organisations | No community spaces with walking 5 minutes | 2–3 community spaces with walking 5 minutes | More than 3 community spaces with walking 5 minutes |
3.4.4. Interviews

In social science research, a qualitative strategy is appropriate for investigating social experience through addressing the questions of why, how and what correlate with social behaviour (Bailey, 2008). In addition, interviews as a qualitative strategy are generally used to collect data from small numbers of respondents (Liamputtong, 2013). Thus, interviews were adopted as one of the multiple approaches of the study to collect detailed descriptions from the interviewees and support the findings from the quantitative survey.

A set of questions was developed for the interviews after the completion of the questionnaire survey. The questions were informed by the results of the quantitative analyses that identified the highest and lowest rated items of the four neighbourhood scales. Residents in high-scoring and low-scoring streets were selected for interview in order to elucidate the reasons for the differences in scores. The questions asked residents: how they felt about their local neighbourhood; about their satisfaction with their neighbourhood; and how neighbourhood characteristics impacted the quality of their lives. For example, questions examined the main motives that had attracted residents to live in the street and to what extent they felt connected with the area. The questions also enquired about physical qualities such as access, feeling safe and
walkability, impact of presence of greenery, and barriers that may inhibit connection with neighbours. The interview questions were as follows:

1. What was it about this street that attracted you to living here?
2. Tell us about your emotional connections to this place. What is it about this street that makes you feel like you belong or not as the case may be?
3. Tell us about your connections with your neighbours. What is it about this street that makes it easy or hard to make friends?
4. Can you tell us about walking around in your area during the daytime and at night? What makes you feel safe or unsafe in your street? Tell us about who you might see walking? What makes it pleasant or unpleasant to walk in your street?
5. Tell us about the greenery in your street and to what extent they impact your feelings towards living here.
6. Now tell us about any things you would like to change in your street that might improve your interaction with your neighbours. (e.g. easy access to the city, presence of footpaths, playgrounds, availability of parking, traffic volume, public transport.)

Accordingly, an invitation, plain language statement and consent form were delivered to the mailboxes of residents in streets with the highest and lowest mean scores of the correlates of social interaction (collected via the questionnaire). Semi-structured open-ended interviews were conducted by telephone with eight residents from both high- and poor-quality streets. All of the respondents were asked to offer their agreement to participate in the interviews. Each interview typically lasted between 20 to 30 minutes, and was recorded and transcribed for analysing. Interview data was coded and major themes were developed, then compared with the data obtained from the questionnaire survey to explore whether social interaction was
correlated to the strengths and weaknesses of neighbourhood design or other variables.

Five residents were interviewed in the high quality streets (i.e., those that reported higher scores on the neighbourhood scale: four from Belmont and one resident from Grovedale. In addition, three residents were interviewed from the poor quality streets in Waurn Ponds (i.e, those with lower scores on the neighbourhood scales). Table 3.5 summarises the respondents’ demographics.

Table 3.5: Summary of respondents’ features

<table>
<thead>
<tr>
<th>Neighbourhood</th>
<th>Respondent</th>
<th>Gender</th>
<th>Age</th>
<th>Years of residence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belmont *</td>
<td>1</td>
<td>Female</td>
<td>70s</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Male</td>
<td>55</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Female</td>
<td>40s</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Male</td>
<td>38</td>
<td>4</td>
</tr>
<tr>
<td>Grovedale *</td>
<td>2</td>
<td>Female</td>
<td>43</td>
<td>6</td>
</tr>
<tr>
<td>Waurn Ponds**</td>
<td>3</td>
<td>Female</td>
<td>45</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Male</td>
<td>50s</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Female</td>
<td>40s</td>
<td>3</td>
</tr>
</tbody>
</table>

* A high quality street; ** low quality street

3.4.5. Ethics requirements

Ethics approval was obtained from the Human Ethics Advisory Group (HEAG), (STEC-57-2015), Faculty of Science, School of Engineering and Built Environment. The survey was thoroughly considered, including all approaches and stages. This application confirmed no adverse impacts or potential risks to the participants (National Statement on Ethical Conduct in Human Research, 2007).

Thus, HEAG approval was obtained to collect data from residents in the three suburbs. All the data was collected anonymously, and prior to data collection the plain language statement and consent form were given to all residents in mail questionnaires, face-to-face interviews and telephone interviews. According to the requirements of Deakin University ethics approval: (1) participants could withdraw from the project without any adverse consequences; (2) participants were informed that the whole data gathered
for study objectives could not be used for other purposes; and (3) the data collected through hard copies (participants questionnaires) was to be kept in a locked file cabinet to maintain confidentiality and information safety.

The ethics approvals granted by HEAG and the plain language statement and consent forms are presented in Appendix C.

3.5. Summary

This chapter has explicated the methodology and research design to collect and analyse data on the independent and dependent study variables. The selection criteria for the three suburbs used as the case studies have been explained and the profile suburbs described. The methods used in this study have been explained and data collection processes described. The chapter has then described the correlates of social interaction scales used for the participants, the physical variables readily measured by Near Map and observation, and the direct measures of social interaction. The chapter has concluded by discussing the ethics approval requirements.
Chapter Four – Results and Analyses
4.1. Introduction to analysis

This chapter describes the statistical analyses conducted to investigate the relationship between neighbourhood design and social interaction. The chapter determines if there are statistically significant relationships between different design characteristics (in three selected suburbs), resident self-estimated levels of social activity, and the correlates of social interaction used in this study. As such, this chapter represents evidence for understanding the impact of neighbourhood design on residents’ interaction via the quantitative analysis of residents’ perceptions and attitudes towards their neighbourhood.

This chapter is ordered as follows. First, Section 4.2 briefly describes an example of how the relationship can be explored between neighbourhood design characteristics and the pre-existing scales that this study uses; specifically, between Neighbourhood attachment and two categories of variable: (1) five groups of physical built environment characteristics; and (2) the socio-demographic characteristics of the residents.²

²This section is a summary of a paper published in Landscape and Urban Planning: “White picket fences and other features of the suburban physical environment: Correlates of neighbourhood attachment in 3 Australian low-density suburbs” (Appendix A).
Next, the relationships between the variables and the types of analysis used (as shown in Figure 4.1) is explained via five sections (4.3 to 4.8):

- Section 4.3 uses factor analysis to show that the correlates of social interaction used in the survey to measure residents’ psychosocial
perceptions of their neighbourhoods – Neighbourhood attachment, Neighbourhood satisfaction, Neighbouring and Walkability and safety – can be reduced in the context of three Geelong suburbs to three more powerful factors indicating neighbourhood experience – Neighbourhood contentment, Active socialising and Accessibility.³

- Section 4.4 describes whether the socio-demographic variables of the respondents are significantly different between the three suburbs.⁴

- Section 4.5 uses analysis of variance (ANOVA) to determine if there are statistically significant differences in the mean values of the three neighbourhood experience factors (Neighbourhood contentment, Active socialising and Accessibility) between the three suburbs. This analysis allows for a ready comparison of the impact on social interaction of three types of neighbourhood: traditional grid (Belmont), conventional cul-de-sac (Grovedale) and curvilinear loop pattern (Waurn Ponds).⁵

- Section 4.6 investigates the correlation between the socio-demographic variables and the neighbourhood experience factors. This analysis compares the influence of socio-demographics on the neighbourhood experience factors of social interaction and the influence of

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³ The results of this section have been published in “Residential satisfaction in low-density Australian suburbs: The impact of social and physical context on neighbourhood contentment,” Journal of Environmental Psychology.

⁴ The results of this section have been published in “White picket fences and other features of the suburban physical environment: Correlates of neighbourhood attachment in 3 Australian low-density suburbs” (Appendix A).

⁵ The results of these sections have been published in “Residential satisfaction in low-density Australian suburbs: The impact of social and physical context on neighbourhood contentment,” Journal of Environmental Psychology.
neighbourhood design characteristics on the neighbourhood experience factors.6

- Section 4.7 describes a series of hierarchical multiple-regression analyses determining the relationships between the neighbourhood experience factors of social interaction and the five urban form characteristics after controlling for socio-demographic variables. In this analysis, only those socio-demographic variables with a strong correlation with the neighbourhood experience factors are considered.7

- In Section 4.8, three independent variables are considered that were used in the survey to directly indicate residents’ self-rated levels of social activity: (1) social interaction frequency; (2) friendship; and (3) places of interaction. Here, two-way relationships are considered using correlation analysis between three groups of variables: (1) the three social activity independent variables; (2) the three neighbourhood experience factors; and (3) the neighbourhood design characteristics.8

Section 4.9 an analysis that is in addition to those required to test the hypotheses. This analysis compares the findings of the thesis to one by Rogers and Sukolratanametee (2009). This is achieved by repeating the method of the Rogers and Sukolratanametee (2009) study, namely, regression analyses, to investigate the relationship of the three dependent variables (neighbourhood experience factors) with: demographic variables, neighbourhood design characteristics, and the interaction of these two categories of independent variable.

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7 The results of this section have been published in “Block parlé: the impact of neighbourhood form on social interaction in low-density” Journal of Landscape and Urban Planning
8 The results of this section have been published in “Socialising in the suburbs: Relationships between neighbourhood design and social interaction in low-density housing contexts,” Journal of Urban Design
Finally, in Section 4.10 a summary of the analyses is presented.

4.2. Neighbourhood attachment and urban design characteristics

In Section 4.3, exploratory factor analysis (EFA) is used to find the underlying structure of the large set of variables that comprise the four previously established scales used in the survey. Before factor analysis was used, the relationships were investigated between each of the four correlates of social interaction and the urban design characteristics and socio-demographics of the three suburbs. One of these investigations, on Neighbourhood attachment, is described in detail in the paper “White picket fences and other features of the suburban physical environment: Correlates of neighbourhood attachment in 3 Australian low-density suburbs” (see Appendix A). Figure 4.2 describes the significant relationships between the variables analysed in this investigation.

![Figure 4.2: Regression analysis for predicting Neighbourhood attachment of all models (thicker arrows show stronger relationships) (Abass and Tucker, 2017)](image)

In summary, it was found that:

- Length of Residency
- Street type
- On street parking
- Provision of sidewalk
- Tree Coverage
- Connectivity by walking
- Open space provision
- Number of Community spaces
- Fence height
- Dwelling type

\( N_{\text{Neighbourhood Attachment}} \)
• **Neighbourhood attachment** was significantly different between the three suburbs, with residents in the older neighbourhoods categorised as traditional layouts (Belmont) and (Grovedale) reporting significantly higher attachment than in the newer neighbourhood (Waurn Ponds).

• **Neighbourhood attachment** had small significant correlations with age, education and home ownership, and significant correlation with length of residence.

• **Neighbourhood attachment** had significant correlations with a number of the physical urban design characteristic, in particular: street type, tree coverage, connectivity by walking and provision of open spaces.

• When five regression analyses were conducted for each of the five groups of physical characteristics (street layout, pedestrian environment, public space provision, neighbourhood connectivity and dwelling form), it was found that all five groups of physical characteristics significantly predicted **Neighbourhood attachment**. More specifically, it was found that: street type was the most significant predictor in the street layout model; in the pedestrian environment model, tree coverage and footpath provision were found to be significant contributors; in the third model, connectivity by walking accounted for the greatest variance; provision of open spaces and number of community spaces model were found to have greatest contribution to **Neighbourhood attachment**; and in the dwelling form model dwelling type accounted for the greatest variance, with fence height and on-street parking showing small contributions to **Neighbourhood attachment**.

• When comparing how much the physical urban design variables predicted **Neighbourhood attachment** to how much the demographic factors predicted **Neighbourhood attachment**, it was found that length of residence was the only
variable with a unique, significant contribution to *Neighbourhood attachment*, accounting in a 5-variable model for 18.6% of the total variance in a strong correlation ≥ 0.3 with *Neighbourhood attachment*.

4.3. Factor analysis of correlates of social interaction

![Figure 4.3: Analysis of neighbourhood perception factors](image)

As discussed in the previous chapter, the neighbourhood experience survey was constituted of four scales measuring residents’ correlates of social interaction: *Neighbourhood attachment, Neighbourhood satisfaction, Neighbouring* and *Walkability* and *safety*. EFA, an empirical technique within factor analysis, was used here to uncover the underlying structure of the relatively large set of variables included across these four previously established scales. This section describes how EFA identified the underlying relationships between these measured variables to reduce the four scales, when used in three Geelong suburbs, to more focused and more feasible proportions. As discussed, via EFA three neighbourhood experience factors were identified that were then used in subsequent analyses: (1) *Neighbourhood contentment*, (2) *Active socialising* and (3) *Accessibility* (Figure 4.3).

First, principal component analysis (PCA) was conducted for all scales using the Oblimin rotation method to create more reliable factorial solutions considering A
KMO value and Bartlett’s Test of Sphericity significance value of 0.000 that excluded any items not represented. The reliability of the scales was checked before the analysis using the values of Cronbach’s alpha coefficient and inter-item correlation (Pallant, 2013).

Principal component analysis

The 37 items of the 4-scale neighbourhood experience instrument were subjected to PCA using SPSS. Prior to performing PCA, the suitability of the data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients of 0.3 and above. The Kaiser–Meyer–Olkin value was 0.84, exceeding the recommended value of 0.6 (Kaiser 1970, 1974) and Bartlett’s Test of Sphericity (Bartlett 1954) reached statistical significance, supporting the factorability of the correlation matrix. PCA revealed the presence of ten components with eigenvalues exceeding 1, explaining 23%, 8.8%, 5.7%, 4.4%, 4.3%, 3.7%, 3.6%, 3.3% and 2.8% of the variance respectively. An inspection of the scree plot revealed a clear break after the third component. Using Catell’s (1966) scree test, it was decided to retain three components for further investigation.

Figure 4.4: Scree plot showing the eigenvalues of the components
The decision to extract three neighbourhood experience factors was further supported by the results of parallel analysis, which showed only five components with eigenvalues exceeding the corresponding criterion values for a randomly generated data matrix of the same size (37 variables × 243 respondents). Of these five components, the 4th and 5th only marginally exceeded the corresponding criterion values for the randomly generated data matrix.

Table 4.1: Parallel analysis

<table>
<thead>
<tr>
<th>Eigenvalue #</th>
<th>Random eigenvalue (Monte Carlo PCA for parallel analysis)</th>
<th>Initial study eigenvalue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.8257</td>
<td>8.288</td>
</tr>
<tr>
<td>2</td>
<td>1.7203</td>
<td>3.164</td>
</tr>
<tr>
<td>3</td>
<td>1.6410</td>
<td>2.046</td>
</tr>
<tr>
<td>4</td>
<td>1.5746</td>
<td>1.601</td>
</tr>
<tr>
<td>5</td>
<td>1.5161</td>
<td>1.542</td>
</tr>
<tr>
<td>6</td>
<td>1.4625</td>
<td>1.348</td>
</tr>
<tr>
<td>7</td>
<td>1.4176</td>
<td>1.314</td>
</tr>
</tbody>
</table>

Thus, on the balance of the above analyses it was decided to extract three components. Before final extraction, three variables were removed from the analysis – “I feel uncomfortable walking when street vendors or local shopkeepers exhibit their products on footpath,” “I like walking on the street where there are shops” and “Noise, which is done at the street, can occasionally be a big problem.” There were two reasons for the omission of the first two questions: (1) none of the streets surveyed have shops and there are very few shops in all three (predominantly residential) neighbourhoods; and (2) neither variable loaded higher than 0.3 onto the three components (a fact likely explained by reason 1). The “Noise” question was omitted because it did not load onto any of the three components, indicating it is not a variable of influence in the neighbourhoods surveyed.
The three-component solution explained a total of 39.3% of the variance, with Component 1 contributing 24.2%, Component 2 contributing 9.2% and Component 3 contributing 6.0%. These three factors had eigenvalues of 8.2, 3.1 and 2 respectively.

To aid in the interpretation of these three components, Oblimin rotation was performed. The rotated solution revealed the presence of a simple structure (Thurstone, 1947), with the three components showing a number of strong loadings and all variables loading substantially onto at least one component, but not more than two components. The correlations between the neighbourhood experience factors are indicated below.

Table 4.2: Component correlation matrix

<table>
<thead>
<tr>
<th>Component</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.0</td>
<td>0.173</td>
<td>-0.320</td>
</tr>
<tr>
<td>2</td>
<td>0.173</td>
<td>1.0</td>
<td>-0.015</td>
</tr>
<tr>
<td>3</td>
<td>-0.320</td>
<td>-0.015</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Extraction method: PCA
Rotation method: Oblimin with Kaiser normalisation

The Oblimin rotation is reported below because the correlation for C3 is above 0.3 – meaning discrepancies may be found between the results of the two approaches to rotation. While the interpretation of the three components was partly consistent with previous research on the correlates of social interaction – *Neighbourhood attachment, Neighbourhood satisfaction, Neighbouring* and *Walkability* and *safety* – the item clusters suggest here a slightly different reading in the context of the study suburbs. Thus, factor 1 represents a combination of *Neighbourhood attachment* and *Satisfaction* that is named *Neighbourhood contentment*, factor 2 represents *Active socialising* and factor 3 *Accessibility*. 
As some factors loaded at higher than 0.3 onto two components, five variables could be loaded onto alternative components to allow for greater theoretical consistency between the variables of each component. Table 4.3 shows the final loadings for each of the neighbourhood experience factors – (1) Neighbourhood contentment, (2) Active socialising and (3) Accessibility. Before conducting analyses, Cronbach’s alpha was used to assess the reliability of the three components. The Cronbach’s alpha for Neighbourhood contentment was 0.878, for Active socialising 0.766 and for Accessibility 0.776 (Table 4.3).

Table 4.3: Pattern and structure matrix for neighbourhood design scale items

<table>
<thead>
<tr>
<th>Scale items</th>
<th>Pattern coefficients</th>
<th>Structure coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Component 1</td>
<td>Component 2</td>
</tr>
<tr>
<td>1. I really care about this neighbourhood (N30)</td>
<td>0.787</td>
<td>0.746</td>
</tr>
<tr>
<td>2. This is an ideal neighbourhood to live in (NA1)</td>
<td>0.748</td>
<td>0.754</td>
</tr>
<tr>
<td>3. Now, this neighbourhood is a part of me (NA2)</td>
<td>0.739</td>
<td>0.723</td>
</tr>
<tr>
<td>4. Places in the neighbourhood to which I am very emotionally attached (NA3)</td>
<td>0.733</td>
<td>0.710</td>
</tr>
<tr>
<td>5. It would be hard for me to leave this neighbourhood (NA4)</td>
<td>0.690</td>
<td>0.707</td>
</tr>
<tr>
<td>6. The city centre can be easily reached from this neighbourhood (NS15)</td>
<td>0.593</td>
<td>0.626</td>
</tr>
<tr>
<td>7. I feel safe walking in my neighbourhood during the day (WS36)</td>
<td>0.574</td>
<td>0.627</td>
</tr>
<tr>
<td>8. I feel safe and comfortable in this neighbourhood (N32)</td>
<td>0.572</td>
<td>0.615</td>
</tr>
<tr>
<td>9. There is a large choice of roads to get out of the neighbourhood (NS18)</td>
<td>0.547</td>
<td>0.530</td>
</tr>
<tr>
<td>10. It is easy to go out from this neighbourhood (NS17)</td>
<td>0.538</td>
<td>0.597</td>
</tr>
<tr>
<td>11. I have made new friends by living here (N24)</td>
<td>0.530</td>
<td>0.392</td>
</tr>
<tr>
<td>12. This neighbourhood is well-connected with important parts of the city (NS14)</td>
<td>0.503</td>
<td>0.555</td>
</tr>
<tr>
<td>13. I am happy with the maintenance and management of our neighbourhood (N31)</td>
<td>0.449</td>
<td>0.526</td>
</tr>
<tr>
<td>14. I would willingly leave this neighbourhood (NA5)</td>
<td>0.418</td>
<td>0.486</td>
</tr>
<tr>
<td>15. This neighbourhood is too cut off from the rest of the city (NS16)</td>
<td>–0.409</td>
<td>0.371</td>
</tr>
<tr>
<td>16. I feel safe walking in my neighbourhood during the evening (WS37)</td>
<td>0.404</td>
<td>0.426</td>
</tr>
<tr>
<td>Scale items</td>
<td>Three hypothesised factors for neighbourhood design scales</td>
<td>Loadings 1</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td></td>
<td>Neighbourhood contentment</td>
<td></td>
</tr>
<tr>
<td>17. If I had an emergency, even people I do not know would be willing to help (N29)</td>
<td>0.382</td>
<td>0.338</td>
</tr>
<tr>
<td>18. There is a good availability of parking spaces</td>
<td>0.328</td>
<td></td>
</tr>
<tr>
<td>19. My friends in this neighbourhood are part of my everyday activities (N26)</td>
<td>0.724</td>
<td></td>
</tr>
<tr>
<td>20. If I feel like talking I can generally find someone in this neighbourhood to talk to right away (N23)</td>
<td>0.685</td>
<td>0.379</td>
</tr>
<tr>
<td>21. I usually participate in social activities in my neighbourhood (N28)</td>
<td>0.683</td>
<td></td>
</tr>
<tr>
<td>22. I meet with my friends in this neighbourhood mostly at public places (N27)</td>
<td>0.512</td>
<td>0.501</td>
</tr>
<tr>
<td>23. I often see neighbours I know when I walk (WS34)</td>
<td>0.496</td>
<td>0.343</td>
</tr>
<tr>
<td>24. This neighbourhood is well-suitied for handicapped people (NS12)</td>
<td>0.435</td>
<td>0.376</td>
</tr>
<tr>
<td>25. I know some people living here due to my child/children (N25)</td>
<td>0.312</td>
<td>0.353</td>
</tr>
<tr>
<td>26. Parked cars impede walking (N11)</td>
<td>0.611</td>
<td>0.317</td>
</tr>
<tr>
<td>27. Going into this neighbourhood means going around in circles (NS19)</td>
<td>0.609</td>
<td></td>
</tr>
<tr>
<td>28. It is easy to cycle around (NS6)</td>
<td>0.586</td>
<td></td>
</tr>
<tr>
<td>29. It is dangerous to cycle (NS10)</td>
<td>0.576</td>
<td></td>
</tr>
<tr>
<td>30. Parking places and parking lots are lacking (NS7)</td>
<td>0.561</td>
<td></td>
</tr>
<tr>
<td>31. Streets are wide enough (NS13)</td>
<td>0.542</td>
<td></td>
</tr>
<tr>
<td>32. There is not enough space to walk (NS9)</td>
<td>0.470</td>
<td>0.357</td>
</tr>
<tr>
<td>33. I feel uncomfortable walking where there are no footpaths (WS38)</td>
<td>0.452</td>
<td>0.468</td>
</tr>
<tr>
<td>34. I often see strangers who make me feel uncomfortable when I walk (WS35)</td>
<td>0.389</td>
<td>0.448</td>
</tr>
</tbody>
</table>

Note: Bold items indicate major factor loadings

Table 4.4: Identified factors for the neighbourhood design scale
<table>
<thead>
<tr>
<th>Item</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. This neighbourhood is well-connected with important parts of the city</td>
<td>0.503</td>
</tr>
<tr>
<td>12. I am happy with the maintenance and management of our neighbourhood</td>
<td>0.449</td>
</tr>
<tr>
<td>13. I would willingly leave this neighbourhood</td>
<td>0.418</td>
</tr>
<tr>
<td>14. I feel safe walking in my neighbourhood during the evening</td>
<td>0.404</td>
</tr>
<tr>
<td>15. My friends in this neighbourhood are part of my everyday activities</td>
<td>0.724</td>
</tr>
<tr>
<td>16. If I feel like talking I can generally find someone in this neighbourhood to talk to right away</td>
<td>0.685</td>
</tr>
<tr>
<td>17. I usually participate in social activities in my neighbourhood</td>
<td>0.683</td>
</tr>
<tr>
<td>18. I met with my friends in this neighbourhood mostly at public places</td>
<td>0.512</td>
</tr>
<tr>
<td>19. I often see neighbours I know when I walk</td>
<td>0.496</td>
</tr>
<tr>
<td>20. I have made new friends by living here</td>
<td>0.392</td>
</tr>
<tr>
<td>21. If I had an emergency, even people I do not know would be willing to help</td>
<td>0.338</td>
</tr>
<tr>
<td>22. I know some people living here due to my child/children</td>
<td>0.312</td>
</tr>
<tr>
<td>23. Parked cars impede walking</td>
<td>0.611</td>
</tr>
<tr>
<td>24. Going into this neighbourhood means going around in circles</td>
<td>0.609</td>
</tr>
<tr>
<td>25. It is easy to cycle around</td>
<td>–</td>
</tr>
<tr>
<td>26. It is dangerous to cycle</td>
<td>0.586</td>
</tr>
<tr>
<td>27. Parking places and parking lots are lacking</td>
<td>0.561</td>
</tr>
<tr>
<td>28. Streets are wide enough</td>
<td>–</td>
</tr>
<tr>
<td>29. There is not enough space to walk</td>
<td>0.542</td>
</tr>
<tr>
<td>30. I feel uncomfortable walking where there are no footpaths</td>
<td>0.470</td>
</tr>
<tr>
<td>31. I often see strangers who make me feel uncomfortable when I walk</td>
<td>0.452</td>
</tr>
<tr>
<td>32. This neighbourhood is well-suited for handicapped people</td>
<td>–</td>
</tr>
<tr>
<td>33. This neighbourhood is too cut off from the rest of the city</td>
<td>0.389</td>
</tr>
<tr>
<td>34. There is a good availability of parking spaces</td>
<td>–</td>
</tr>
</tbody>
</table>

**Active socialising**

**Accessibility**

### Eigenvalue

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>8.2</th>
<th>3.1</th>
<th>2</th>
</tr>
</thead>
</table>

### Percentage of variance

| Percentage of variance | 24.2 | 9.2 | 6 |

### Cronbach’s alpha

| Cronbach’s alpha | 0.878 | 0.766 | 0.776 |

4.4. Descriptive information of socio-demographic variables

To provide an overall picture of the data and to explore similarities and differences between the three neighbourhoods, the means and standard deviations of the collected
social and demographic characteristics from the survey of residents in the three suburbs were calculated. The results (see Table 4.5) show that while there is relative homogeneity, particularly for home ownership and age, numbers of children and of members in household are significantly lower for Belmont than for the other two suburbs. In addition, while length of residence and income were different across the three suburbs, these differences were not significant, which confirmed that the three suburbs have somewhat equivalent socioeconomic profiles.

Table 4.5: The socio-demographic features in the three suburbs

<table>
<thead>
<tr>
<th>Socio-demographic feature</th>
<th>Belmont</th>
<th>Grovedale</th>
<th>Waurn Ponds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent</td>
<td>Mean (std. deviation)</td>
<td>Mean (std. deviation)</td>
<td>Mean (std. deviation)</td>
</tr>
<tr>
<td>Household tenure</td>
<td>1.93 (0.26)</td>
<td>1.89 (0.32)</td>
<td>1.87 (0.34)</td>
</tr>
<tr>
<td>Length of residence</td>
<td>2.60 (1.06)</td>
<td>2.53 (1.04)</td>
<td>2.19 (0.85)</td>
</tr>
<tr>
<td>≤5 years (21%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5–10 years (30%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11–20 years (31%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>over 20 years (17.6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age group</td>
<td>3.22 (0.87)</td>
<td>2.96 (0.78)</td>
<td>2.99 (0.76)</td>
</tr>
<tr>
<td>18–24 (0.8%)</td>
<td>2 (0.8%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25–44 (25.3%)</td>
<td>62 (43.3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45–64 (43.3%)</td>
<td>104 (28.6%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65–79 (28.6%)</td>
<td>70 (28.6%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80 and over (2%)</td>
<td>5 (2%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>14.43 (2.15)</td>
<td>24.22 (2.17)</td>
<td>34.89 (2.24)</td>
</tr>
<tr>
<td>Female</td>
<td>15.45 (2.32)</td>
<td>24.17 (2.61)</td>
<td>34.19 (2.34)</td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$40k to 60k (14%)</td>
<td>3.65 (1.49)</td>
<td>3.82 (1.55)</td>
<td>3.72 (1.70)</td>
</tr>
<tr>
<td>$60,001 to 80k (18%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$80,001 to 100k (11%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>over $100k (6%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prefer not to state (53.9%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of members in household</td>
<td>2.54 (1.29)</td>
<td>3.04 (1.38)</td>
<td>3.12 (1.21)</td>
</tr>
<tr>
<td>1 (15%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 (31%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 (19%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.5. Neighbourhood comparison: Relationships between different suburbs and three indicators of social interaction

This study hypothesises that neighbourhood built environment differences impact social interaction. Hence, a one-way between-groups ANOVA was conducted to explore the impact of neighbourhood differences on three indicators of social interaction: *Neighbourhood contentment, Active socialising* and *Accessibility* (Figure 4.5).
This analysis aimed to determine if there were significant differences in scores for these three factors between the three types of neighbourhood – (traditional grid (Belmont), conventional cul-de-sac (Grovedale) and curvilinear loop pattern (Waurn Ponds). Preliminary analyses were performed to confirm that the assumptions of outliers, normality, linearity and multicollinearity were accepted values.

Analysis output showed that there was a statistically significant difference, $F(2, 240) = 18.7, p=0.000$, in *Neighbourhood contentment*. While residents in Belmont had a mean 3.98 (SD=0.50) for *Neighbourhood contentment*, residents in Grovedale had a mean 3.76 (SD=0.51) and in Waurn Ponds 3.48 (SD=0.54).

*Accessibility* also showed a significant difference ($F=5.3, p=0.006$), with residents of Belmont having a mean 3.6 (SD=0.51) compared to those from Waurn Ponds having a mean 3.3 (SD=0.56). Despite reaching statistical significance, the actual difference in mean scores between the two suburbs is small. Grovedale did not significantly differ from both Belmont and Waurn Ponds for *Accessibility* (M=3.45, SD=0.54). Hence, the results support the hypothesis that different neighbourhood design characteristics impacts both *Neighbourhood contentment* and *Accessibility*. Specifically, the analysis shows that traditional grid layout had the greatest impact on *Neighbourhood Contentment* and *Accessibility* compared to conventional cul-de-sac and curvilinear loop pattern. However, Active socialising revealed no difference in mean values between the three types of neighbourhood: Belmont (M=3.28, SD=0.62), Grovedale (M=3.20, SD=0.67) and Waurn Ponds (M=3.08, SD=0.60). Figure 4.6 summarises the results of the comparison.
As indicated by the effect size (calculated using eta squared as 0.13, which is considered a large effect (Cohen, 1988: 284), neighbourhood design differences had the greatest impact on Neighbourhood contentment. For Accessibility, eta squared was 0.04 (a small effect). Thus, comparison of the mean scores suggested that neighbourhood design differences impact residents’ perceptions of Neighbourhood contentment and Accessibility. The result supports (H-1) the different neighbourhood design characteristics impact correlates of social interaction in low-density suburbs. (Table 4.6).

Table 4.6: Mean differences in Neighbourhood contentment and Accessibility in three suburbs

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>F</th>
<th>Sig.</th>
<th>Belmont M</th>
<th>Grovedale M</th>
<th>Waurn Ponds M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neighbourhood contentment</td>
<td>18.7</td>
<td>000</td>
<td>3.98, SD=0.50</td>
<td>3.76, SD=0.51</td>
<td>3.48, SD=0.54</td>
</tr>
<tr>
<td>Accessibility</td>
<td>5.3</td>
<td>006</td>
<td>3.6, SD=0.51</td>
<td>3.45, SD=0.54</td>
<td>3.32, SD=0.56</td>
</tr>
</tbody>
</table>
4.6. Correlations of dependent variables with socio-demographic factors

The previous analyses were designed to compare the models of new factors between three suburbs with different physical variables. However, to investigate the relationship between socio-demographic variables and social interaction (Figure 4.7), Pearson correlation was used. This not only describes the strength of the relationship between variables, but also shows the direction of their linear relationship (Pallant, 2013). As other researchers have found that socio-demographic variables impact psychosocial perceptions of neighbourhoods, the bivariate relationships were determined between the socio-demographic variables and the neighbourhood experience factors (Table 4.7).
Table 4.7: Pearson correlations between socio-demographic factors and neighbourhood experience factors

<table>
<thead>
<tr>
<th></th>
<th>Mean (SD)</th>
<th>Correlation coefficient _ r</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Neighbourhood contentment</td>
<td>Active socialising</td>
</tr>
<tr>
<td>Household tenure</td>
<td>1.90 (.30)</td>
<td>0.196**</td>
</tr>
<tr>
<td>Length of residence</td>
<td>2.44 (1.01)</td>
<td>0.344**</td>
</tr>
<tr>
<td>Age</td>
<td>3.05 (.81)</td>
<td>0.234**</td>
</tr>
<tr>
<td>Gender</td>
<td>1.51 (.51)</td>
<td>–0.125</td>
</tr>
<tr>
<td>Income</td>
<td>3.70 (1.58)</td>
<td>–0.150*</td>
</tr>
<tr>
<td>Number of members in household</td>
<td>2.88 (1.32)</td>
<td>–0.145*</td>
</tr>
<tr>
<td>Number of children</td>
<td>1.32 (1.27)</td>
<td>–0.077</td>
</tr>
<tr>
<td>Level of education</td>
<td>2.99 (1.01)</td>
<td>0.131*</td>
</tr>
</tbody>
</table>

** 2-tailed significance at the 0.01 level.
* 2-tailed significance at the 0.05 level.

Here it was found that length of residence is positively correlated with neighbourhood experience factors: Neighbourhood contentment, Active socialising and Accessibility (r = 0.344, 0.219 and 0.133 respectively). Number of household members also is correlated to all components, but while it is positively related to Active socialising (0.145), it is negatively correlated with Neighbourhood contentment (−0.145) and Accessibility (−0.126). Income is also negatively correlated with both Neighbourhood contentment (−0.150) and Accessibility (−0.200). Level of education is positively related to Neighbourhood contentment (0.131) and Accessibility (0.138). Household tenure is positively related to Neighbourhood contentment (0.196) and Active socialising (0.166). Number of children is positively related to only Active socialising (0.170). Age is positively related to only Neighbourhood contentment (0.234). However, gender was not found to be significantly correlated with any of three factors. The result supports (H-2) Socio-demographics factors impact correlates of social interaction in low density suburbs. Figure 4.8 shows only significant correlations.
Figure 4.8: Significant relationships between neighbourhood experience factors and socio-demographic variables

Note that only the socio-demographic variables that were found to be strongly correlated (p-value < 0.05) with the three neighbourhood experience factors were explored via hierarchical regression analyses (as described in Section 4.7).

4.7. Multiple regression analyses

Figure 4.9: Relationships between neighbourhood design variables and neighbourhood experience factors

Multiple regression analysis is frequently used to investigate the predictive relationships between a dependent variable and a set of multiple independent variables (or predictors). Multiple regression indicates how much the set of independent
variables combined (the model) predicts the outcome variable, and which individual variable in the model is the best predictor. This study conducted hierarchical multiple regression, starting with intercept-only socio-demographic factors to determine to what degree suburban design variables predict the three neighbourhood experience factors when socio-demographic variables are controlled. Such analysis also identifies which design variables are the best predictors. Hence, the analyses explored how neighbourhood design impacts social interaction and which aspects of neighbourhood design should be prioritised in the planning and design of residential suburbs.

The following paragraphs thus detail how three dependent variables – the three social interaction indicants identified via the factor analysis (Neighbourhood contentment, Active socialising and Accessibility) – were impacted, after the effect of socio-demographic variables was controlled for, by five sets (hierarchical models) of independent (predictor) variables: (1) street layout; (2) pedestrian environment; (3) neighbourhood connectivity; (4) public space provision; and (5) dwelling form (Figure 4.9).

Due to the high number of variables and possible correlations involved, the relationships between dependent and independent variables were investigated via five regressions; that is, one regression for each of the five predictor models. As explained in the method chapter, the theoretical justification for this approach is that each set of neighbourhood design variables (e.g. pedestrian environment) can be hypothesised to impact social interaction in degrees and ways that are independent from the other sets of design variables (e.g. public space provision). Thus, the five regressions directly investigate five hypotheses; namely that:

1. Street layout impacts social interaction.
2. Pedestrian environment impacts social interaction.
3. Degree of neighbourhood connectivity impacts social interaction.
4. Provision of public space impacts social interaction.
5. Dwelling form impacts social interaction.

As this meant that five hypotheses were being tested simultaneously, the Bonferroni correction needed to be applied to set the significance cut-off at \( p = \alpha/n \) (see Pallant, 2010: 776). In this case, with 5 tests and \( \alpha = 0.05 \), the null hypothesis is only rejected if the p-value is less than 0.01.

4.7.1. Regressions for predicting social interaction from street layout

![Diagram](image)

Figure 4.10: Relationships between street layout variables and neighbourhood experience factors

1. Regression for predicting Neighbourhood contentment from street layout

Hierarchical multiple regression was used to find if street layout variables (Street type, Traffic flow and On-street parking) predict Neighbourhood contentment, after controlling for the influence of six socio-demographic variables (Length of residence, Household tenure, Age, Income, Number of household members and Level of education). Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Socio-demographic variables were entered at Step 1, explaining 18.6% of the variance in
perceived *Neighbourhood contentment*. After entry at Step 2 of *Street type*, *Traffic flow* and *On-street parking*, the total variance explained by the model as a whole was 26.8%, $F(9, 233) = 9.5$, $p < 0.001$. The three control measures explained an additional 8.3% of the variance in *Neighbourhood contentment* after controlling for socio-demographic factors, $R^2$ change = 0.83, $F$ change (6, 236) = 8.8, $p < 0.001$ (Figure 4.11).

![Figure 4.11: Regression analysis for predicting Neighbourhood contentment from street layout (dotted lines indicate non-significant relationships)](image)

In the final model, three variables were statistically significant, with *Street type* recording a higher beta value (beta = −0.30, $p < 0.001$) and *Length of residence* (beta = 0.25, $p < 0.001$) than *Income* (beta = −0.17, $p < 0.01$) (Table 4.8).
Table 4.8: Summary of hierarchical regression analysis – dependent variable: *Neighbourhood contentment*

<table>
<thead>
<tr>
<th></th>
<th>Unstandardised coefficients</th>
<th>Standardised coefficients</th>
<th>t</th>
<th>Correlations</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SEB</td>
<td>β</td>
<td></td>
<td>Zero-order</td>
<td>Partial</td>
<td>Part</td>
</tr>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.895</td>
<td>0.229</td>
<td>11.221</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of residence</td>
<td>0.155</td>
<td>0.040</td>
<td>0.281**</td>
<td>3.937</td>
<td>0.344</td>
<td>0.248</td>
<td>0.231</td>
</tr>
<tr>
<td>Household tenure</td>
<td>0.241</td>
<td>0.115</td>
<td>0.133</td>
<td>2.101</td>
<td>0.196</td>
<td>0.135</td>
<td>0.123</td>
</tr>
<tr>
<td>Age</td>
<td>0.048</td>
<td>0.049</td>
<td>0.070</td>
<td>0.978</td>
<td>0.234</td>
<td>0.064</td>
<td>0.057</td>
</tr>
<tr>
<td>Income</td>
<td>-0.067</td>
<td>0.022</td>
<td>-0.188*</td>
<td>-3.102</td>
<td>-0.142</td>
<td>-0.198</td>
<td>-0.182</td>
</tr>
<tr>
<td>Number of household members</td>
<td>-0.014</td>
<td>0.027</td>
<td>-0.032</td>
<td>-0.499</td>
<td>-0.145</td>
<td>-0.032</td>
<td>-0.029</td>
</tr>
<tr>
<td>Level of education</td>
<td>0.061</td>
<td>0.032</td>
<td>0.113</td>
<td>1.894</td>
<td>0.131</td>
<td>0.122</td>
<td>0.111</td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>3.559</td>
<td>0.310</td>
<td>11.467</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of residence</td>
<td>0.139</td>
<td>0.038</td>
<td>0.252**</td>
<td>3.687</td>
<td>0.344</td>
<td>0.235</td>
<td>0.207</td>
</tr>
<tr>
<td>Income</td>
<td>-0.062</td>
<td>0.038</td>
<td>-0.175*</td>
<td>-3.003</td>
<td>-0.142</td>
<td>-0.193</td>
<td>-0.168</td>
</tr>
<tr>
<td>Street layout</td>
<td>-0.206</td>
<td>0.040</td>
<td>-0.304**</td>
<td>-5.088</td>
<td>-0.368</td>
<td>-0.316</td>
<td>-0.285</td>
</tr>
<tr>
<td>Traffic flow</td>
<td>-0.034</td>
<td>0.046</td>
<td>-0.045</td>
<td>-0.733</td>
<td>-0.063</td>
<td>-0.048</td>
<td>-0.041</td>
</tr>
<tr>
<td>On-street parking</td>
<td>-0.171</td>
<td>0.186</td>
<td>-0.057</td>
<td>-0.917</td>
<td>-0.002</td>
<td>-0.060</td>
<td>-0.051</td>
</tr>
</tbody>
</table>

Note: $R^2=18.6$ for Step 1 & $R^2=24$ for Step 2, **p< 0.001

2. Regression for predicting Active socialising from street layout

Hierarchical multiple regression was used to find if street layout variables (*Street type, Traffic flow* and *On-street parking*) predict *Active socialising* after controlling for the influence of demographic variables (*Length of residence, Household tenure, Number of members in household* and *Number of children*). Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Socio-demographic variables were entered at Step 1, and contributed significantly to the regression model, $F (4,238) = 8.04$, $p < 0.001$, and accounted for 11.9% of the variation in *Active socialising*. After entry at Step 2 of *Street type, Traffic flow* and *On-street parking*, the total variance explained
by the model as a whole was 14.1%, F (7, 235) = 5.5, p < 0.05. The three control measures explained only an additional 2.2% of the variance in *Active socialising* after controlling for socio-demographic variables, R squared change = 0.22, F change (3, 235) = 2, p < 0.05 (Figure 4.12).

![Figure 4.12: Regression analysis for predicting *Active socialising* from street layout (dotted lines indicate non-significant relationships)](image)

However, in the final model only *Length of residence* and *Number of children* remained statistically significant, *Length of residence* recording a higher beta value (beta = 0.25, p < 0.001) than *Number of children* (beta = 0.22, p < 0.05). This suggests that *street layout* did not have an effect above and beyond the effects of demographic variables (Table 4.9).

**Table 4.9: Summary of hierarchical regression analysis – dependent variable: *Active socialising***

<table>
<thead>
<tr>
<th></th>
<th>Unstandardised coefficients</th>
<th>Standardised coefficients</th>
<th>t</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SEB</td>
<td>β</td>
<td></td>
</tr>
<tr>
<td><strong>Step 1</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.218</td>
<td>0.264</td>
<td>8.395</td>
<td></td>
</tr>
<tr>
<td><em>Length of residence</em></td>
<td>0.173</td>
<td>0.043</td>
<td>0.273**</td>
<td>4.076</td>
</tr>
<tr>
<td>Household tenure</td>
<td>0.200</td>
<td>0.135</td>
<td>0.097</td>
<td>1.481</td>
</tr>
<tr>
<td><em>Number of household members</em></td>
<td>0.012</td>
<td>0.055</td>
<td>0.025</td>
<td>0.223</td>
</tr>
<tr>
<td><em>Number of children</em></td>
<td>0.110</td>
<td>0.052</td>
<td>0.235*</td>
<td>2.096</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coefficient</td>
<td>Standard Error</td>
<td>t-Value</td>
<td>p-Value</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------</td>
<td>----------------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Constant</td>
<td>2.676</td>
<td>0.337</td>
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</tr>
<tr>
<td>Length of residence</td>
<td>0.165</td>
<td>0.042</td>
<td>3.875</td>
<td>0.128</td>
</tr>
<tr>
<td>Number of children</td>
<td>1.985</td>
<td>0.170</td>
<td>1.03</td>
<td>0.221</td>
</tr>
<tr>
<td>Street layout</td>
<td>-0.097</td>
<td>0.049</td>
<td>-1.783</td>
<td>0.126</td>
</tr>
<tr>
<td>Traffic flow</td>
<td>-0.084</td>
<td>0.057</td>
<td>-1.478</td>
<td>0.096</td>
</tr>
<tr>
<td>On-street parking</td>
<td>-0.215</td>
<td>0.231</td>
<td>-0.928</td>
<td>0.028</td>
</tr>
</tbody>
</table>

Note: $R^2$=11.9 for Step 1 & $R^2$=11.6 for Step 2, p < 0.001

3. Regression for predicting Accessibility from street layout

Hierarchical multiple regression was used to find if street layout variables (Street type, Traffic flow and On-street parking) predict Accessibility, after controlling for the influence of (Length of residence, Income, Number of household members and Level of education). Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Socio-demographic variables were entered at Step 1, explaining 8.5% of the variance in perceived Accessibility. After entry at Step 2 of Street type, Traffic flow and On-street parking, the total variance explained by the model as a whole was 10.6%, $F(7, 235) = 4, p < 0.01$. The three control measures explained an additional 4.1% of the variance in Accessibility after controlling for socio-demographic factors, R squared change = 0.41, $F$ change $(4, 238) = 3.8, p < 0.01$ (Figure 4.13).
Figure 4.13: Regression analysis for predicting *Accessibility* from street layout (dotted lines indicate non-significant relationships)

In the final model, two variables were statistically significant, with *Street type* and *Income* recording high beta values (beta = -0.19, p < 0.01) (Table 4.10).

Table 4.10: Summary of hierarchical regression analysis – dependent variable: *Accessibility*

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Unstandardised coefficients</th>
<th>Standardised coefficients</th>
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<th>Correlations</th>
<th></th>
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</thead>
<tbody>
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<td></td>
<td>B</td>
<td>SEB</td>
<td>β</td>
<td></td>
<td>Zero-order</td>
</tr>
<tr>
<td>Constant</td>
<td>3.445</td>
<td>0.181</td>
<td>19.071</td>
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<td></td>
</tr>
<tr>
<td>Length of residence</td>
<td>0.071</td>
<td>0.036</td>
<td>0.131</td>
<td>2.006</td>
<td>0.133</td>
</tr>
<tr>
<td>Income</td>
<td>-0.070</td>
<td>0.022</td>
<td>-0.199**</td>
<td>-3.162</td>
<td>-0.204</td>
</tr>
<tr>
<td>Number of members in household</td>
<td>-0.032</td>
<td>0.027</td>
<td>-0.076</td>
<td>-1.159</td>
<td>-0.126</td>
</tr>
<tr>
<td>Level of education</td>
<td>0.070</td>
<td>0.034</td>
<td>0.129</td>
<td>2.069</td>
<td>0.138</td>
</tr>
<tr>
<td>Step 2</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>4.018</td>
<td>0.181</td>
<td>14.405</td>
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<td></td>
</tr>
<tr>
<td>Income</td>
<td>-0.068</td>
<td>0.022</td>
<td>-0.195**</td>
<td>-3.088</td>
<td>-0.204</td>
</tr>
<tr>
<td>Street type</td>
<td>-0.133</td>
<td>0.042</td>
<td>-0.199**</td>
<td>-3.160</td>
<td>-0.205</td>
</tr>
<tr>
<td>Traffic flow</td>
<td>-0.013</td>
<td>0.050</td>
<td>-0.018</td>
<td>-0.267</td>
<td>-0.046</td>
</tr>
<tr>
<td>On-street parking</td>
<td>-0.019</td>
<td>0.202</td>
<td>-0.006</td>
<td>-0.093</td>
<td>0.026</td>
</tr>
</tbody>
</table>

Note: $R^2$=8.5 for Step 1 & $R^2$=7.9 for Step 2, p < 0.01

4.7.2. *Regressions for predicting social interaction from pedestrian environment*

Figure 4.14: Relationships between pedestrian environment variables and neighbourhood experience factors
1. **Regression for predicting Neighbourhood contentment from pedestrian environment**

Hierarchical multiple regression was used to find if pedestrian environment variables (Footpath, Nature strip and Tree coverage) predicted Neighbourhood contentment after controlling for the influence of Length of residence, Household tenure, Age, Income, Number of household members and Level of education. Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Socio-demographic variables were entered at Step 1, explaining 18.6% of the variance in perceived Neighbourhood contentment. After entry at Step 2 of Footpath, Nature strip and Tree coverage, the total variance explained by the model as a whole was 29%, $F(9, 233) = 10.6, p < 0.001$. The three control measures explained an additional 10.5% of the variance in Neighbourhood contentment after controlling for socio-demographic variables, $R^2$ change = 0.10, $F$ change (3, 233) = 11.5, $p < 0.001$ (Figure 4.15).

![Figure 4.15: Regression analysis for predicting Neighbourhood contentment from pedestrian environment (dotted lines indicate non-significant relationships)](image-url)
In the final model, three variables were statistically significant, *Tree coverage*, recording higher beta values (beta = 0.26, p < 0.001), *Length of residence* (beta = 0.24, p < 0.001) and *Footpath* (beta = −0.23, p < 0.001) than *Income* (beta = −0.19, p < 0.01) and *Household tenure* (beta = 0.12, p < 0.05) (Table 4.11).

Table 4.11: Summary of hierarchical regression analysis – dependent variable: *Neighbourhood contentment*

<table>
<thead>
<tr>
<th>Step</th>
<th>Unstandardised coefficients</th>
<th>Standardised coefficients</th>
<th>t</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
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<td>B</td>
<td>SEB</td>
<td>β</td>
<td>Zero-order</td>
</tr>
<tr>
<td>Step 1</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.895</td>
<td>0.258</td>
<td>11.221</td>
<td>0.231</td>
</tr>
<tr>
<td>Length of residence</td>
<td>0.155</td>
<td>0.039</td>
<td>0.281**</td>
<td>3.937</td>
</tr>
<tr>
<td>Household tenure</td>
<td>0.241</td>
<td>0.115</td>
<td>0.133</td>
<td>2.101</td>
</tr>
<tr>
<td>Age</td>
<td>0.048</td>
<td>0.048</td>
<td>0.067</td>
<td>0.978</td>
</tr>
<tr>
<td>Income</td>
<td>−0.067</td>
<td>0.022</td>
<td>−0.188*</td>
<td>−3.102</td>
</tr>
<tr>
<td>Number of household members</td>
<td>−0.014</td>
<td>0.027</td>
<td>−0.032</td>
<td>−0.429</td>
</tr>
<tr>
<td>Level of education</td>
<td>0.061</td>
<td>0.032</td>
<td>0.113</td>
<td>1.894</td>
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<tr>
<td>Step 2</td>
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<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.941</td>
<td>0.309</td>
<td>9.532</td>
<td>0.198</td>
</tr>
<tr>
<td>Length of residence</td>
<td>0.133</td>
<td>0.037</td>
<td>0.244**</td>
<td>3.590</td>
</tr>
<tr>
<td>Household tenure</td>
<td>0.229</td>
<td>0.108</td>
<td>0.126*</td>
<td>2.116</td>
</tr>
<tr>
<td>Income</td>
<td>−0.068</td>
<td>0.020</td>
<td>−0.190*</td>
<td>−3.339</td>
</tr>
<tr>
<td>Footpath</td>
<td>−0.209</td>
<td>0.056</td>
<td>−0.236**</td>
<td>−3.734</td>
</tr>
<tr>
<td>Nature strip</td>
<td>−0.067</td>
<td>0.072</td>
<td>0.070</td>
<td>0.924</td>
</tr>
<tr>
<td>Tree coverage</td>
<td>0.131</td>
<td>0.035</td>
<td>−0.261**</td>
<td>3.725</td>
</tr>
</tbody>
</table>

Note: R²=18.6 for Step 1 & R²=26.3 for Step 2, **p < 0.001

2. Regression for predicting Active socialising from pedestrian environment

Hierarchical multiple regression was used to find if pedestrian environment variables (*Footpath, Nature strip* and *Tree coverage*) predicted Active socialising after controlling for the influence of *Length of residence, Household tenure, Number of*...
members in household and Number of children. Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Socio-demographic variables were entered at Step 1, and contributed significantly to the regression model, F (4, 238) = 8.04, p < 0.001, and accounted for 11.9% of the variation in Active socialising. After entry at Step 2 of Footpath, Nature strip and Tree coverage, the total variance explained by the model as a whole was 14.5%, F (7, 235) = 5.7, p < 0.05. The three control measures explained an additional 2.6% of the variance in Active socialising after controlling for socio-demographic variables, R squared change = 0.026, F change (3, 235) = 2.3, p < 0.05 (Figure 4.16)

Figure 4.16: Regression analysis for predicting Active socialising from pedestrian environment (dotted lines indicate non-significant relationships)

However, in the final model only Length of residence and Number of children remained statistically significant, recording high beta values (beta = 0.25, p < 0.001) and (beta = 0.23, p < 0.05). This suggests the pedestrian environment did not have an effect above and beyond the effects of demographic variables (Table 4.12).
Table 4.12: Summary of hierarchical regression analysis – dependent variable: *Neighbourhood contentment*

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Unstandardised coefficients</th>
<th>Standardised coefficients</th>
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<th>Correlations</th>
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<td></td>
<td>B</td>
<td>SEB</td>
<td>β</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.218</td>
<td>0.264</td>
<td>8.395</td>
<td></td>
</tr>
<tr>
<td>Length of residence</td>
<td>0.173</td>
<td>0.043</td>
<td>0.273**</td>
<td>4.076</td>
</tr>
<tr>
<td>Household tenure</td>
<td>0.200</td>
<td>0.135</td>
<td>0.095</td>
<td>1.481</td>
</tr>
<tr>
<td>Number of household members</td>
<td>0.012</td>
<td>0.055</td>
<td>0.025</td>
<td>0.223</td>
</tr>
<tr>
<td>Number of children</td>
<td>0.110</td>
<td>0.052</td>
<td>0.235**</td>
<td>2.096</td>
</tr>
</tbody>
</table>

Step 2

<table>
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<th>Step 2</th>
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<tr>
<td>Constant</td>
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<td>0.368</td>
<td>6.910</td>
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</tr>
<tr>
<td>Length of residence</td>
<td>0.161</td>
<td>0.043</td>
<td>0.253**</td>
<td>3.775</td>
</tr>
<tr>
<td>Number of children</td>
<td>0.109</td>
<td>0.052</td>
<td>0.232*</td>
<td>2.088</td>
</tr>
<tr>
<td>Footpath</td>
<td>0.115</td>
<td>0.071</td>
<td>−0.088</td>
<td>−1.275</td>
</tr>
<tr>
<td>Nature strip</td>
<td>−0.085</td>
<td>0.091</td>
<td>−0.078</td>
<td>−0.938</td>
</tr>
<tr>
<td>Tree coverage</td>
<td>−0.023</td>
<td>0.044</td>
<td>0.040</td>
<td>0.530</td>
</tr>
</tbody>
</table>

Note: $R^2 = 11.9$ for Step 1 & $R^2 = 11.9$ for Step 2, ** $p < 0.001$

3. **Regression for predicting Accessibility from pedestrian environment**

Hierarchical multiple regression was used to find if pedestrian environment variables (*Footpath, Nature strip and Tree coverage*) predicted *Accessibility* after controlling for the influence of *Length of residence, Income, Number of household members* and *Level of education*. Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Socio-demographic variables were entered at Step 1, and contributed significantly to the regression model, $F (4, 238) = 5.5, p < 0.001$, and accounted for 8.5% of the variance in perceived *Accessibility*. After entry at Step 2 of *Footpath, Nature strip and Tree coverage*, the total variance explained by the model as a whole was 11%, $F (7, 235) = 4.1, p < 0.05$. The three control measures explained an additional 2.4% of the variance.
in *Accessibility* after controlling for socio-demographic variables, R squared change = 0.024, F change (3, 235) = 2.1, p < 0.05 (Figure 4.17).

![Diagram showing regression analysis](image)

**Figure 4.17**: Regression analysis for predicting *Accessibility* from pedestrian environment (dotted lines indicate non-significant relationships)

In the final model, two variables were statistically significant, with *Income* recording beta value (beta = −0.19, p < 0.01) and *Tree coverage* (beta = −0.19, p < 0.05) (Table 4.13).

**Table 4.13**: Summary of hierarchical regression analysis – dependent variable: *Neighbourhood contentment*

<table>
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<tr>
<th>Unstandardised coefficients</th>
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<th>t</th>
<th>Correlations</th>
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</thead>
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<td>β</td>
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</tr>
<tr>
<td>---</td>
<td>-----</td>
<td>------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Step 1</strong></td>
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<td></td>
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<tr>
<td>Constant</td>
<td>3.445</td>
<td>0.181</td>
<td>19.071</td>
</tr>
<tr>
<td><em>Length of residence</em></td>
<td>−0.071</td>
<td>0.036</td>
<td>0.131</td>
</tr>
<tr>
<td><em>Income</em></td>
<td>−0.070</td>
<td>0.022</td>
<td>−0.199**</td>
</tr>
<tr>
<td><em>Number of members in household</em></td>
<td>−0.032</td>
<td>0.027</td>
<td>−0.076</td>
</tr>
<tr>
<td><em>Level of education</em></td>
<td>0.070</td>
<td>0.034</td>
<td>0.122</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
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<td></td>
</tr>
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<td>3.382</td>
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<td>11.677</td>
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<tr>
<td><em>Income</em></td>
<td>0.061</td>
<td>.022</td>
<td>−0.199**</td>
</tr>
<tr>
<td><em>Footpath</em></td>
<td>−0.051</td>
<td>.062</td>
<td>−0.058</td>
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</tbody>
</table>
### 4.7.3. Regressions for predicting social interaction from neighbourhood connectivity

Figure 4.18: Relationships between neighbourhood connectivity variables and neighbourhood experience factors

#### 1. Regression for predicting Neighbourhood contentment from neighbourhood connectivity

Hierarchical multiple regression was used to find if neighbourhood connectivity variables (*Connectivity by walking* and *Connectivity by transport*) predicted *Neighbourhood contentment* after controlling for the influence of *Length of residence*, *Household tenure*, *Age*, *Income*, *Number of household members* and *Level of education*. Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Socio-demographic variables were entered at Step 1, and contributed significantly to the regression model, F (6, 236) = 8.9, p < 0.001, and accounted for 18.6% of the variation in *Neighbourhood contentment*. After entry at Step 2 of *Connectivity by walking* and
Connectivity by transport, the total variance explained by the model as a whole was 23%, $F(8, 234) = 8.8, p < 0.01$. The two control measures explained an additional 5% of the variance in Neighbourhood contentment after controlling for socio-demographic variables, $R$ squared change = 0.05, $F$ change = 6.8, $p < 0.01$ (Figure 4.19). However, in the final model only Length of residence, Income and Household tenure remained significantly contributing to Neighbourhood contentment, recording beta values ($\beta = 0.24, p < 0.01$), ($\beta = 0.20, p < 0.01$) and ($\beta = 0.13, p < 0.05$) respectively, while neither Connectivity by walking nor Connectivity by transport were significant predictors of Neighbourhood contentment, nor Household tenure or Age (Table 4.14).

![Figure 4.19: Regression analysis for predicting Neighbourhood contentment from neighbourhood connectivity (Dotted lines indicate to non-significant relationships)](image-url)
## Table 4.14: Summary of hierarchical regression analysis—dependent variable: *Neighbourhood contentment*

<table>
<thead>
<tr>
<th></th>
<th>Unstandardised coefficients</th>
<th>Standardised coefficients</th>
<th>t</th>
<th>Correlations</th>
<th>Zero-order</th>
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<td>SEB</td>
<td>β</td>
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</tr>
<tr>
<td><strong>Step 1</strong></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>2.895</td>
<td>0.258</td>
<td></td>
<td>11.221</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Length of residence</strong></td>
<td>0.155</td>
<td>0.039</td>
<td>0.281**</td>
<td>3.937</td>
<td>0.344</td>
<td>0.248</td>
<td>0.231</td>
</tr>
<tr>
<td><strong>Household tenure</strong></td>
<td>0.241</td>
<td>0.115</td>
<td>0.133</td>
<td>2.101</td>
<td>0.196</td>
<td>0.135</td>
<td>0.123</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>0.048</td>
<td>0.048</td>
<td>0.067</td>
<td>0.978</td>
<td>0.230</td>
<td>0.064</td>
<td>0.057</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td>-0.067</td>
<td>0.022</td>
<td>-0.188*</td>
<td>-3.102</td>
<td>-0.142</td>
<td>-0.198</td>
<td>-0.182</td>
</tr>
<tr>
<td><strong>Number of household members</strong></td>
<td>-0.014</td>
<td>0.027</td>
<td>-0.032</td>
<td>-0.499</td>
<td>-0.145</td>
<td>-0.032</td>
<td>-0.029</td>
</tr>
<tr>
<td><strong>Level of education</strong></td>
<td>0.061</td>
<td>0.032</td>
<td>0.113</td>
<td>1.894</td>
<td>0.131</td>
<td>0.122</td>
<td>0.111</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>2.539</td>
<td>0.272</td>
<td></td>
<td>9.346</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Length of residence</strong></td>
<td>0.131</td>
<td>0.039</td>
<td>0.238**</td>
<td>3.482</td>
<td>0.344</td>
<td>0.222</td>
<td>0.200</td>
</tr>
<tr>
<td><strong>Household tenure</strong></td>
<td>0.250</td>
<td>0.113</td>
<td>0.138*</td>
<td>2.213</td>
<td>0.196</td>
<td>0.143</td>
<td>0.127</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td>-0.071</td>
<td>0.021</td>
<td>-0.201**</td>
<td>-3.376</td>
<td>-0.142</td>
<td>-0.216</td>
<td>-0.194</td>
</tr>
<tr>
<td><strong>Connectivity by walking</strong></td>
<td>0.078</td>
<td>0.078</td>
<td>0.085</td>
<td>0.997</td>
<td>0.281</td>
<td>0.065</td>
<td>0.057</td>
</tr>
<tr>
<td><strong>Connectivity by transport</strong></td>
<td>0.074</td>
<td>0.040</td>
<td>0.151</td>
<td>1.859</td>
<td>0.226</td>
<td>0.121</td>
<td>0.107</td>
</tr>
</tbody>
</table>

Note: $R^2=18.6$ for Step 1 & $R^2=20.4$ for Step 2, ** $p < 0.01$

### 2. Regression for predicting Active socialising from neighbourhood connectivity

Hierarchical multiple regression was used to find if neighbourhood connectivity (*Connectivity by walking* and *Connectivity by transport*) predicted *Active socialising* after controlling for the influence of *Length of residence, Household tenure, Number of members in household* and *Number of children*. Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Socio-demographic variables were entered at Step 1, and contributed significantly to the regression model, $F (4, 238) = 8.04$, $p < 0.001$, and accounted for 11.9% of the variation in *Active socialising*. After entry at Step 2 of
Connectivity by walking and Connectivity by transport, the total variance explained by the model as a whole was 12.4%, F (6, 236) = 5.6, p < 0.05. The two control measures explained only an additional 0.5% of the variance in Active socialising after controlling for socio-demographic variables, R squared change = 0.005, F change (2, 236) = 0.6, p < 0.05 (Figure 4.20).

In the final model, only Length of residence and Number of children remained statistically significant, recording beta values (beta = 0.26, p < 0.001) and (beta = 0.23, p < 0.05). However, this suggests that neighbourhood connectivity did not have an effect above and beyond the effects of demographic variables (Table 4.15).

Table 4.15: Summary of hierarchical regression analysis-dependent variable: Active socialising

<table>
<thead>
<tr>
<th></th>
<th>Unstandardised coefficients</th>
<th>Standardised coefficients</th>
<th>t</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
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<td>B</td>
<td>SEB</td>
<td>β</td>
<td>Zero-order</td>
</tr>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.218</td>
<td>0.264</td>
<td></td>
<td>8.395</td>
</tr>
<tr>
<td>Length of residence</td>
<td>0.173</td>
<td>0.043</td>
<td>.273**</td>
<td>4.076</td>
</tr>
<tr>
<td>Household tenure</td>
<td>0.200</td>
<td>0.135</td>
<td>0.095</td>
<td>1.481</td>
</tr>
<tr>
<td>Number of household members</td>
<td>0.012</td>
<td>0.055</td>
<td>0.025</td>
<td></td>
</tr>
<tr>
<td>Number of children</td>
<td>0.110</td>
<td>0.052</td>
<td>0.235*</td>
<td>2.096</td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. Regression for predicting Accessibility from neighbourhood connectivity

Hierarchical multiple regression was used to find if neighbourhood connectivity (Connectivity by walking and Connectivity by transport) predicted Accessibility after controlling for the influence of Length of residence, Income, Number of household members and Level of education. Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Socio-demographic variables were entered at Step 1, and contributed significantly to the regression model, $F (4, 238) = 5.5, p < 0.001$, and accounted for 8.5% of the variance in perceived Accessibility. After entry at Step 2 of Connectivity by walking and Connectivity by transport, the total variance explained by the model as a whole was 9.5%, $F (6, 236) = 4.1, p < 0.05$. The two control measures explained an additional 1% of the variance in Accessibility after controlling for socio-demographic variables, $R^2$ change = 0.01, $F$ change $(2, 236) = 1.3, p < 0.05$ (Figure 4.21).
Figure 4.21: Regression analysis for predicting Accessibility from neighbourhood connectivity (Dotted lines indicate to non-significant relationships)

In the final model, only Income remained statistically significant, recording beta value (beta = 0.20, p < 0.01). However, this suggests that neighbourhood connectivity did not have an effect beyond the effects of Income (Table 4.16).

Table 4.16: Summary of hierarchical regression analysis-dependent variable: Accessibility

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Unstandardised coefficients</th>
<th>Standardised coefficients</th>
<th>t</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>B</td>
<td>SEB</td>
<td>β</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>3.445</td>
<td>0.181</td>
<td>19.071</td>
<td></td>
</tr>
<tr>
<td>Length of residence</td>
<td>0.071</td>
<td>0.036</td>
<td>0.131</td>
<td>2.006</td>
</tr>
<tr>
<td>Income</td>
<td>−0.070</td>
<td>0.022</td>
<td>−0.199**</td>
<td>−3.162</td>
</tr>
<tr>
<td>Number of household members</td>
<td>−0.032</td>
<td>0.027</td>
<td>−0.076</td>
<td>−1.159</td>
</tr>
<tr>
<td>Level of education</td>
<td>0.070</td>
<td>0.034</td>
<td>0.129</td>
<td>2.069</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 2</th>
<th>Unstandardised coefficients</th>
<th>Standardised coefficients</th>
<th>t</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SEB</td>
<td>β</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>3.301</td>
<td>0.202</td>
<td>16.327</td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>−0.072</td>
<td>0.022</td>
<td>−0.204**</td>
<td>−3.233</td>
</tr>
<tr>
<td>Connectivity by walking</td>
<td>0.040</td>
<td>0.082</td>
<td>0.044</td>
<td>0.480</td>
</tr>
<tr>
<td>Connectivity by transport</td>
<td>0.032</td>
<td>0.042</td>
<td>0.066</td>
<td>0.761</td>
</tr>
</tbody>
</table>

Note: R²=8.5 for Step 1 & R²=7.2 for Step 2, ** p < 0.01
4.7.4. *Regressions for predicting social interaction from public space provision*

Figure 4.22: The relationship between public space provision variables and neighbourhood experience factors

1. **Regression for predicting Neighbourhood contentment from public space provision**

Hierarchical multiple regression was used to find if public space provision (number of *Community spaces* and *Open spaces*) predicted *Neighbourhood contentment* after controlling for the influence of *Length of residence, Household tenure, Age, Income, Number of household members* and *Level of education*. Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Socio-demographic variables were entered at Step 1, and contributed significantly to the regression model, $F(6, 236) = 8.9, p < 0.001$), and accounted for 18.6% of the variation in *Neighbourhood contentment*. After entry at Step 2 of number of *Community spaces* and *Open spaces*, the total variance explained by the model as a whole was 26.5%, $F(8, 234) = 10.5, p < 0.001$. The two control measures explained an additional 8% of the variance in *Neighbourhood contentment* after controlling for socio-demographic variables, $R^2$ change = 0.080, $F$ change = 12.7, $p < 0.01$ (Figure 4.23).
In the final model, five variables were statistically significant, with provision of Open space recording a higher beta value (beta = 0.48, p < 0.001) than Length of residence (beta = 0.24, p < 0.001), Community spaces (beta = −0.29, p < 0.01), Income (beta = −0.18, p < 0.01) and Household tenure (beta = 0.12, p < 0.05) (Table 4.17).

Table 4.17: Summary of hierarchical regression analysis—dependent variable: Neighbourhood contentment

<table>
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<tr>
<th>Unstandardised coefficients</th>
<th>Standardised coefficients</th>
<th>t</th>
<th>Correlations</th>
</tr>
</thead>
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<td></td>
<td>B</td>
<td>SEB</td>
<td>β</td>
</tr>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.895</td>
<td>0.258</td>
<td></td>
</tr>
<tr>
<td>Length of residence</td>
<td>0.155</td>
<td>0.039</td>
<td>0.281**</td>
</tr>
<tr>
<td>Household tenure</td>
<td>0.241</td>
<td>0.115</td>
<td>0.133*</td>
</tr>
<tr>
<td>Age</td>
<td>0.048</td>
<td>0.049</td>
<td>0.070</td>
</tr>
<tr>
<td>Income</td>
<td>−0.067</td>
<td>0.022</td>
<td>−0.188*</td>
</tr>
<tr>
<td>Number of household members</td>
<td>−0.014</td>
<td>0.027</td>
<td>−0.032</td>
</tr>
<tr>
<td>Level of education</td>
<td>0.061</td>
<td>0.032</td>
<td>0.113</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 4.23: Regression analysis for predicting Neighbourhood contentment from public spaces provision (Dotted lines indicate to non-significant relationships)
2. Regression for predicting Active socialising from public space provision

Hierarchical multiple regression was used to find if public space provision (Number of Community spaces and Open spaces) predicted Active socialising after controlling for the influence of Length of residence, Household tenure, Number of members in household and Number of children. Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Socio-demographic variables were entered at Step 1, and contributed significantly to the regression model, F (4, 238) = 8.04, p < 0.001, and accounted for 11.9% of the variation in Active socialising. After entry at Step 2 of number of community spaces and Open spaces the total variance explained by the model as a whole was 13.3%, F (6, 236) = 6.1, p < 0.05. The two control measures explained only an additional 1.4% of the variance in Active socialising after controlling for socio-demographic variables, R squared change = 0.014, F change (2, 236) = 1.9, p < 0.05 (Figure 4.24).
Figure 4.24: Regression analysis for predicting *Active socialising* from public space provision (Dotted lines indicate to non-significant relationships)

In the final model, *Length of residence* and *Number of children* remained statistically significant, recording beta value (beta = 0.26, p < 0.001) for both. However, this suggests that public space provision did not have an effect above and beyond the effects of demographic variables (Table 4.18).

Table 4.18: Summary of hierarchical regression analysis—dependent variable: *Active socialising*

<table>
<thead>
<tr>
<th>Unstandardised coefficients</th>
<th>Standardised coefficients</th>
<th>t</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>B</td>
<td>SEB</td>
<td>β</td>
</tr>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.218</td>
<td>0.264</td>
<td>8.395</td>
</tr>
<tr>
<td><em>Length of residence</em></td>
<td>0.173</td>
<td>0.043</td>
<td>.273**</td>
</tr>
<tr>
<td>Household tenure</td>
<td>0.200</td>
<td>0.135</td>
<td>0.095</td>
</tr>
<tr>
<td><em>Number of household members</em></td>
<td>0.012</td>
<td>0.055</td>
<td>0.025</td>
</tr>
<tr>
<td><em>Number of children</em></td>
<td>0.110</td>
<td>.052</td>
<td>.235*</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>1.956</td>
<td>0.301</td>
<td>6.497</td>
</tr>
<tr>
<td><em>Length of residence</em></td>
<td>0.179</td>
<td>0.043</td>
<td>.265**</td>
</tr>
<tr>
<td>Household tenure</td>
<td>0.179</td>
<td>0.135</td>
<td>.085</td>
</tr>
<tr>
<td><em>Number of children</em></td>
<td>0.108</td>
<td>0.052</td>
<td>.230*</td>
</tr>
<tr>
<td>Community spaces</td>
<td>−0.126</td>
<td>0.093</td>
<td>−0.153</td>
</tr>
<tr>
<td><em>Open space</em></td>
<td>0.312</td>
<td>0.162</td>
<td>0.219</td>
</tr>
</tbody>
</table>
3. Regression for predicting Accessibility from public space provision

Hierarchical multiple regression was used to find if public space provision (Number of Community spaces and Open spaces) predicted Accessibility after controlling for the influence of Length of residence, Income, Number of members in household and Level of education. Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Socio-demographic variables were entered at Step 1, and contributed significantly to the regression model, F (4, 238) = 5.5 p < 0.01, and accounted for 8.5% of the variation in Accessibility. After entry at Step 2 of number of community spaces and open spaces the total variance explained by the model as a whole was 10.6 %, F (6, 236) = 4.7, p < 0.01. The two control measures explained only an additional 3 % of the variance in Accessibility after controlling for socio-demographic variables, R squared change = 0.03, F change (2, 236) = 4.7, p < 0.01 (Figure 4.25). In the final model, two variables were statistically significant, with Open spaces recording a higher beta value (beta = –0.25, p < 0.01) than Income (beta = –0.19, p < 0.01) (Table 4.19).

![Diagram: Regression analysis for predicting Accessibility from public space provision](image)

**Figure 4.25:** Regression analysis for predicting Accessibility from public space provision (Dotted lines indicate to non-significant relationships)
Table 4.19: Summary of hierarchical regression analysis – dependent variable: *Accessibility*

<table>
<thead>
<tr>
<th>Step</th>
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<th>Standardised coefficients</th>
<th>t</th>
<th>Correlations</th>
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<td>B</td>
<td>SEB</td>
<td>β</td>
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</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>3.445</td>
<td>0.181</td>
<td>19.071</td>
<td></td>
</tr>
<tr>
<td><strong>Length of residence</strong></td>
<td>0.071</td>
<td>0.036</td>
<td>0.131</td>
<td>2.006</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td>−0.070</td>
<td>0.022</td>
<td>−0.199*</td>
<td>−3.162</td>
</tr>
<tr>
<td><strong>Number of household members</strong></td>
<td>−0.032</td>
<td>0.027</td>
<td>−0.076</td>
<td>−1.159</td>
</tr>
<tr>
<td><strong>Level of education</strong></td>
<td>0.070</td>
<td>0.034</td>
<td>0.129</td>
<td>2.069</td>
</tr>
<tr>
<td>Step 2</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
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<td>0.162</td>
<td>14.852</td>
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</tr>
<tr>
<td><strong>Income</strong></td>
<td>−0.069</td>
<td>0.022</td>
<td>−0.197**</td>
<td>−3.143</td>
</tr>
<tr>
<td><strong>Community spaces</strong></td>
<td>−0.112</td>
<td>0.081</td>
<td>−0.159</td>
<td>−1.381</td>
</tr>
<tr>
<td><strong>Open space</strong></td>
<td>0.312</td>
<td>0.143</td>
<td>0.256**</td>
<td>2.181</td>
</tr>
</tbody>
</table>

Note: $R^2$=8.5 for Step 1 & $R^2$=8.3 for Step 2, ** p < 0.01

4.7.5. Regressions for predicting social interaction from dwelling form

Figure 4.26: The relationship between dwelling form variables and neighbourhood experience factors
I. Regression for predicting Neighbourhood contentment from dwelling form

Hierarchical multiple regression was used to find if dwelling form variables (Dwelling setback, Garage on façade, Average fence height and Dwelling type) predicted Neighbourhood contentment after controlling for the influence of Length of residence, Household tenure, Age, Income, Number of household members and Level of education. Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Socio-demographic variables were entered at Step 1, explaining 18.6% of the variance in perceived Neighbourhood contentment. After entry at Step 2 of the dwelling form variables, the total variance explained by the model as a whole was 28.2%, F (10, 232) = 9.1, p < 0.001. The four control measures explained an additional 9.7% of the variance in Neighbourhood contentment after controlling for socio-demographic factors, R squared change = 0.097, F change (4, 232) = 7.8, p < 0.001 (Figure 4.27).

Figure 4.27: Regression analysis for predicting Neighbourhood contentment from dwelling form (Dotted lines indicate to non-significant relationships)
In the final model, five variables were statistically significant, with *Length of residence* recording a higher beta value (beta = 0.25, p < 0.001) than *Dwelling type* (beta = −0.20, p < 0.01), *Income* (beta = −0.19, p < 0.01), *Fence height* (beta = 0.13, p < 0.05) and *Household tenure* (beta = 0.12, p < 0.05) (Table 4.20).

Table 4.20: Summary of hierarchical regression analysis – dependent variable: *Neighbourhood contentment*  

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<tr>
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<th>Unstandardised Coefficients</th>
<th>Standardised Coefficients</th>
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<th>Correlations</th>
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<td>B</td>
<td>SEB</td>
<td>β</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.895</td>
<td>0.258</td>
<td>11.221</td>
<td></td>
</tr>
<tr>
<td><em>Length of residence</em></td>
<td>0.155</td>
<td>0.039</td>
<td>0.281**</td>
<td>3.937</td>
</tr>
<tr>
<td><em>Household tenure</em></td>
<td>0.241</td>
<td>0.115</td>
<td>0.133*</td>
<td>2.101</td>
</tr>
<tr>
<td><em>Age</em></td>
<td>0.048</td>
<td>0.049</td>
<td>0.070</td>
<td>0.978</td>
</tr>
<tr>
<td><em>Income</em></td>
<td>−0.067</td>
<td>0.022</td>
<td>−0.188*</td>
<td>−3.102</td>
</tr>
<tr>
<td><em>Number of household members</em></td>
<td>−0.014</td>
<td>0.027</td>
<td>−0.032</td>
<td>−0.499</td>
</tr>
<tr>
<td><em>Level of education</em></td>
<td>0.061</td>
<td>0.032</td>
<td>0.113</td>
<td>1.894</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 2</th>
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<th>Standardised Coefficients</th>
<th>t</th>
<th>Correlations</th>
</tr>
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<td></td>
<td>B</td>
<td>SEB</td>
<td>β</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>3.035</td>
<td>0.330</td>
<td>9.206</td>
<td></td>
</tr>
<tr>
<td><em>Length of residence</em></td>
<td>0.139</td>
<td>0.038</td>
<td>0.253**</td>
<td>3.691</td>
</tr>
<tr>
<td><em>Household tenure</em></td>
<td>0.219</td>
<td>0.109</td>
<td>0.120*</td>
<td>2.003</td>
</tr>
<tr>
<td><em>Income</em></td>
<td>−0.067</td>
<td>0.021</td>
<td>−0.190*</td>
<td>−3.275</td>
</tr>
<tr>
<td><em>Dwelling setback</em></td>
<td>0.061</td>
<td>0.047</td>
<td>0.089</td>
<td>1.310</td>
</tr>
<tr>
<td><em>Garage on façade</em></td>
<td>−0.008</td>
<td>0.044</td>
<td>−0.012</td>
<td>−0.178</td>
</tr>
<tr>
<td><em>Average fence height</em></td>
<td>0.200</td>
<td>0.100</td>
<td>0.131*</td>
<td>2.013</td>
</tr>
<tr>
<td><em>Dwelling type</em></td>
<td>−0.141</td>
<td>0.052</td>
<td>−0.201*</td>
<td>−2.718</td>
</tr>
</tbody>
</table>

Note: R² =18.6 for Step 1 & R² =25.2 for Step 2, ** p < 0.001

2. *Regression for predicting Active socialising from dwelling form*

Hierarchical multiple regression was used to find if dwelling form variables (*Dwelling setback, Garage on façade, Average fence height* and *Dwelling type*) predicted *Active socialising* after controlling for the influence of *Length of residence, Household tenure, Income, Fence height* and *Age*.
tenure, Number of household members and Number of children. Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Socio-demographic variables were entered at Step 1, and contributed significantly to the regression model, $F(4, 238) = 8.04$, $p < 0.001$, and accounted for 11.9% of the variation in Active socialising. After entry at Step 2 of the dwelling form variables, the total variance explained by the model as a whole was 13.8%, $F(4, 238) = 4.7$, $p < 0.05$. The four control measures explained an additional 2% of the variance in Active socialising after controlling for socio-demographic factors, $R^2$ change = 0.02, $F$ change $(4, 234) = 1.3$, $p < 0.05$ (Figure 4.28).

In the final model, Length of residence and Number of children remained statistically significant, recording beta values ($\beta = 0.26$, $p < 0.001$) and ($\beta = 0.23$, $p < 0.05$). However, this suggests that dwelling form did not have an effect above and beyond the effects of demographic variables (Table 4.21).
Table 4.21: Summary of hierarchical regression analysis – dependent variable: *Active socialising*

<table>
<thead>
<tr>
<th></th>
<th>Unstandardised coefficients</th>
<th>Standardised coefficients</th>
<th>t</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SEB</td>
<td>β</td>
<td></td>
</tr>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.218</td>
<td>0.264</td>
<td>0.264</td>
<td>8.395</td>
</tr>
<tr>
<td><em>Length of residence</em></td>
<td>0.173</td>
<td>0.043</td>
<td>0.273**</td>
<td>4.076</td>
</tr>
<tr>
<td><em>Household tenure</em></td>
<td>0.200</td>
<td>0.135</td>
<td>0.095</td>
<td>1.481</td>
</tr>
<tr>
<td><em>Number of household members</em></td>
<td>0.012</td>
<td>0.055</td>
<td>0.025</td>
<td>0.223</td>
</tr>
<tr>
<td><em>Number of children</em></td>
<td>0.110</td>
<td>0.052</td>
<td>0.235*</td>
<td>2.096</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.655</td>
<td>.384</td>
<td>0.233</td>
<td>6.907</td>
</tr>
<tr>
<td><em>Length of residence</em></td>
<td>0.169</td>
<td>0.043</td>
<td>0.267**</td>
<td>3.955</td>
</tr>
<tr>
<td><em>Number of children</em></td>
<td>0.110</td>
<td>0.053</td>
<td>0.236*</td>
<td>2.099</td>
</tr>
<tr>
<td><em>Dwelling setback</em></td>
<td>−0.023</td>
<td>−0.059</td>
<td>−0.028</td>
<td>−.383</td>
</tr>
<tr>
<td><em>Garage on façade</em></td>
<td>−0.049</td>
<td>0.055</td>
<td>−0.064</td>
<td>−.880</td>
</tr>
<tr>
<td><em>Average fence height</em></td>
<td>−0.084</td>
<td>0.124</td>
<td>−0.048</td>
<td>−0.678</td>
</tr>
<tr>
<td><em>Dwelling type</em></td>
<td>−0.104</td>
<td>0.065</td>
<td>−0.129</td>
<td>−1.604</td>
</tr>
</tbody>
</table>

Note: $R^2 = 11.9$ for Step 1 & $R^2 = 19.9$ for Step 2, ** p < 0.001

3. **Regression for predicting Accessibility from dwelling form**

Hierarchical multiple regression was used to find if dwelling form variables (*Dwelling setback, Garage on façade, Average fence height* and *Dwelling type*) predicted *Accessibility* after controlling for the influence of *Length of residence, Income, Number of household members* and *Level of education*. Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Socio-demographic variables were entered at Step 1, and contributed significantly to the regression model, $F (1, 241) = 5.5$, $p < 0.001$, and accounted for 8.5% of the variance in perceived *Accessibility*. After entry at Step 2 of *Dwelling setback, Garage on façade, Average fence height* and *Dwelling type*...
The total variance explained by the model as a whole was 12%, $F(8, 234) = 4.5$, $p < 0.05$. The four control measures explained an additional 5% of the variance in Accessibility after controlling for socio-demographic variables, $R^2$ change = 0.05, $F$ change $(4, 234) = 3.2$, $p < 0.05$ (Figure 4.29).

In the final model, two variables were statistically significant, with Income recording a higher beta value (beta = $-0.19$, $p < 0.01$) than Dwelling type (beta = $-0.13$, $p < 0.05$) (Table 4.22).
Table 4.22: Summary of hierarchical regression analysis-dependent variable: *Accessibility*

<table>
<thead>
<tr>
<th>Step 1</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unstandardised</td>
<td>Standardised</td>
<td>t</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>coefficients</td>
<td>coefficients</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>SEB</td>
<td>β</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.445</td>
<td>0.181</td>
<td></td>
<td>19.071</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Length of</td>
<td>residence</td>
<td>0.071</td>
<td>0.036</td>
<td>0.131</td>
<td>2.006</td>
<td>0.133</td>
<td>0.129</td>
<td>0.124</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Income</td>
<td></td>
<td>−0.070</td>
<td>0.022</td>
<td>−0.199**</td>
<td>−3.162</td>
<td>−0.204</td>
<td>−0.201</td>
<td>−0.196</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Number of</td>
<td>household</td>
<td>−0.032</td>
<td>0.027</td>
<td>−0.076</td>
<td>−1.159</td>
<td>−0.126</td>
<td>−0.075</td>
<td>−0.072</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Level of</td>
<td>education</td>
<td>0.070</td>
<td>0.034</td>
<td>0.129</td>
<td>2.069</td>
<td>0.138</td>
<td>0.133</td>
<td>0.128</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td></td>
<td>3.589</td>
<td>0.295</td>
<td></td>
<td>12.185</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Income</td>
<td></td>
<td>−0.069</td>
<td>0.022</td>
<td>−0.197**</td>
<td>−3.129</td>
<td>−0.204</td>
<td>−0.200</td>
<td>−0.192</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dwelling</td>
<td>setback</td>
<td>0.036</td>
<td>0.051</td>
<td>0.052</td>
<td>0.702</td>
<td>0.137</td>
<td>0.046</td>
<td>0.043</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Garage on</td>
<td>façade</td>
<td>−0.014</td>
<td>0.048</td>
<td>−0.022</td>
<td>−0.296</td>
<td>−0.123</td>
<td>−0.019</td>
<td>−0.018</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average fence</td>
<td>height</td>
<td>0.060</td>
<td>0.109</td>
<td>0.040</td>
<td>0.554</td>
<td>0.103</td>
<td>0.036</td>
<td>0.034</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dwelling type</td>
<td></td>
<td>−0.09</td>
<td>0.056</td>
<td>−0.133*</td>
<td>−1.639</td>
<td>−0.221</td>
<td>−0.107</td>
<td>−0.101</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: $R^2=8.5$ for Step 1 & $R^2=9$ for Step 2, ** p < 0.01

The results support (H-3) Neighbourhood design characteristics impact correlates of social interaction with controlling of socio-demographic variables.
Table 4.23: Summarises the findings of the multiple regressions; indicating which neighbourhood design variables significantly predicted the three neighbourhood experience factors.

<table>
<thead>
<tr>
<th>Controlled variables</th>
<th>Physical variables</th>
<th>Neighbourhood contentment</th>
<th>Active socialising</th>
<th>Accessibility</th>
<th>Most impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sociodemographic variables</td>
<td>Open space provision</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Street type</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tree coverage</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Community space</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Footpath</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dwelling type</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fence height</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Neighbourhood connectivity</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Traffic flow</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td></td>
</tr>
<tr>
<td></td>
<td>On-street parking</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dwelling set back</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Garage on façade</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>Least impact</td>
</tr>
</tbody>
</table>

4.8. Levels of social activity

The surveys showed that residents in Belmont and Grovedale knew more of their neighbours, both in their wider suburbs and in their own streets (Table 4.24). This is likely simply because residents in those longer established suburbs had lived there longer and thus knew more people nearby. While frequency of visits did not differ significantly between the three suburbs, Belmont (the oldest suburb) had the highest frequency of social interaction.

Across the three suburbs nearly 67% of residents indicating that they “sometimes” interacted in neighbourhood spaces. While 26% in Belmont indicated they had a lot of interaction, compared to 14% in Grovedale and 6% in Waurn Ponds (the newest...
The frequency of interaction in the outdoors is also reported as ‘sometimes’, 76% of residents indicated that they visited their neighbours sometimes and 7.5% reported that they visited their neighbours a lot.

Table 4.24: Neighbours – frequency of interaction – visits means in three suburbs

<table>
<thead>
<tr>
<th>Level of social activity</th>
<th>Belmont</th>
<th>Grovedale</th>
<th>Waurn Ponds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of people known by name in suburb</td>
<td>21.80</td>
<td>19.69</td>
<td>15.26</td>
</tr>
<tr>
<td>Number of people known by name in street</td>
<td>10.98</td>
<td>9.18</td>
<td>8.30</td>
</tr>
<tr>
<td>Frequency of visits to neighbours in the neighbourhood (1–3 scale)</td>
<td>1.94</td>
<td>1.87</td>
<td>1.90</td>
</tr>
<tr>
<td>Frequency of social interaction (1–3 scale)</td>
<td>2.15</td>
<td>1.97</td>
<td>1.82</td>
</tr>
</tbody>
</table>

\(1=\text{Never, } 2=\text{Sometimes, } 3=\text{A lot}\)

As explained in the previous chapter, survey participants indicated levels of social interaction in one space immediately adjacent to their houses – the dwelling entrance – and in five neighbourhood places: (1) street and footpath; (2) parking spaces; (3) open spaces; (4) cafes and shops; and (5) gardens. 28% of residents in Belmont indicated they had interacted with neighbours at their dwelling entrance, 27% in Grovedale and 15% in Waurn Ponds. In terms of interaction around neighbourhoods, residents most commonly reported social activity in streets and footpaths (87% in both Belmont and Waurn Ponds, and 80% in Grovedale). Cafes and local shops showed similar percentages in Belmont and Waurn Ponds (both 72%) and in Grovedale (74%). Gardens were identified as locations of interaction by 49% of Belmont residents, 47% in Grovedale and 54% in Waurn Ponds. In Belmont 39% of residents indicated interaction in open spaces, compared to 45% in Grovedale and 28% in Waurn Ponds. Lastly, parking spaces were the least common venue of interaction across all three suburbs (27% in Belmont, Grovedale 25% and Waurn Ponds 11%).

Hence, in summary results indicated that the majority of residents experienced social
interaction around the neighbourhood, most commonly in the streets and in local shopping areas (Table 4.25).

Table 4.25: Interaction places in three suburbs

<table>
<thead>
<tr>
<th>Interaction space (housing – neighbourhood)</th>
<th>Belmont</th>
<th>Grovedale</th>
<th>Waurn Ponds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street and footpath</td>
<td>87%</td>
<td>80%</td>
<td>87%</td>
</tr>
<tr>
<td>Parking space</td>
<td>27%</td>
<td>25%</td>
<td>11%</td>
</tr>
<tr>
<td>Neighbourhood open space</td>
<td>39%</td>
<td>45%</td>
<td>28%</td>
</tr>
<tr>
<td>Cafes and local shops</td>
<td>72%</td>
<td>74%</td>
<td>72%</td>
</tr>
<tr>
<td>Garden and yard</td>
<td>49%</td>
<td>47%</td>
<td>54%</td>
</tr>
<tr>
<td>Dwelling entrance</td>
<td>28%</td>
<td>27%</td>
<td>15%</td>
</tr>
</tbody>
</table>

4.8.1. Correlations between levels of social activity and neighbourhood experience factors

Correlation analysis was conducted to investigate the relationships between perceived Neighbourhood contentment, Active socialising and Accessibility (as the dependent variables) and six social connection variables: (1) Number of people known by name

Figure 4.30: Relationships between levels of social activity and neighbourhood experience factors
in suburb; (2) Number of people known by name in street; (3) Frequency of visits to people in the neighbourhood; (4) Frequency of social interaction in neighbourhood; (5) Interaction around housing; and (6) Interaction around the neighbourhood.

Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity (Table 4.26).

Table 4.26: Summary of the correlations between the neighbourhood experience factors and level of social activity

<table>
<thead>
<tr>
<th></th>
<th>Neighbourhood contentment</th>
<th>Active socialising</th>
<th>Accessibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of people known by name in suburb</td>
<td>0.248**</td>
<td>0.384**</td>
<td>0.019</td>
</tr>
<tr>
<td>Number of people known by name in street</td>
<td>0.213**</td>
<td>0.433**</td>
<td>0.022</td>
</tr>
<tr>
<td>Frequency of visits to people in the neighbourhood</td>
<td>0.276**</td>
<td>0.496**</td>
<td>0.104</td>
</tr>
<tr>
<td>Frequency of social interaction</td>
<td>0.399**</td>
<td>0.258**</td>
<td>0.287**</td>
</tr>
<tr>
<td>Interaction around housing</td>
<td>0.191**</td>
<td>0.017</td>
<td>0.149*</td>
</tr>
<tr>
<td>Interaction around the neighbourhood</td>
<td>0.285**</td>
<td>0.280**</td>
<td>0.057</td>
</tr>
</tbody>
</table>

** 2-tailed significance at the 0.01 level.

* 2-tailed significance at the 0.05 level.

*Neighbourhood contentment* had positive correlations with all six measures of social interaction: (1) Number of people known by name in suburb ($r = 0.248$, $p < 0.000$); (2) Number of people known by name in street ($r = 0.213$, $p < 0.001$, $n=236$); (3) Frequency of visits to people in the neighbourhood ($r = 0.276$, $p < 0.000$); (4) Frequency of social interaction ($r = 0.399$, $p < 0.000$, $n=239$); (5) Interaction around housing ($r = 0.172$, $p < 0.01$, $n=239$); and (6) Interaction around the neighbourhood ($r = 0.285$, $p < 0.000$, $n=238$). Thus, *Neighbourhood contentment* clearly had the strongest correlation with Frequency of social interaction.

The factor *Active socialising* was significantly correlated with the five measures of social interaction: (1) Number of people known by name in suburb ($r =$
0.384, p < 0.000, n=236); (2) Number of people known by name in street (r = 0.433, p < 0.000, n=236); (3) Frequency of visits with people in the neighbourhood (r = 0.496, p < 0.000, n=239); (4) Frequency of social interaction (r = 0.258, p < 0.000, n=239); and (5) Interaction around the neighbourhood (r = 0.280, p < 0.000, n=239).

The factor *Accessibility* was significantly correlated only with: (1) Frequency of social interaction (r = 0.287, p < 0.000, n=239); and (2) Interaction around housing (r = 0.149, p < 0.05, n=239). Figure 4.31 describes the significant correlations for the neighbourhood experience factors and five variables.

There were significant positive correlations between the neighbourhood experience factors (Figure 4.32): *Neighbourhood contentment* with *Active socialising* (r = 0.433, p < 0.000, n=239); *Neighbourhood contentment* with *Accessibility* (r = 0.534, p < 0.000, n=239); and *Active socialising* with *Accessibility* (r = 0.199, p < 0.002, n=239).

Figure 4.31: Significant correlations between the variables
4.8.2. Correlations between levels of social activity and provision of urban design characteristics

The significant correlations between social activity and the provision of urban design characteristics were examined via correlation analysis (Table 4.27).

Table 4.27: Summary of correlations between level of social activity and physical urban design variables

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Correlation coefficient _ r</th>
<th>Number of people known by name in suburb</th>
<th>Number of people known by name in street</th>
<th>Frequency of social interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street layout</td>
<td></td>
<td>−0.171**</td>
<td>−0.168**</td>
<td>−0.235**</td>
</tr>
<tr>
<td>Physical environment</td>
<td></td>
<td>0.015</td>
<td>−0.056</td>
<td>−0.096</td>
</tr>
<tr>
<td>Neighbourhood</td>
<td></td>
<td>−0.049</td>
<td>0.040</td>
<td>0.021</td>
</tr>
<tr>
<td>Connectivity</td>
<td></td>
<td>−0.195**</td>
<td>−0.045</td>
<td>−0.171**</td>
</tr>
<tr>
<td>Public spaces provision</td>
<td></td>
<td>−0.129*</td>
<td>−0.201**</td>
<td>−0.146*</td>
</tr>
<tr>
<td>Dwelling form</td>
<td></td>
<td>0.167**</td>
<td>0.137*</td>
<td>0.164*</td>
</tr>
<tr>
<td>Street layout</td>
<td></td>
<td>0.144*</td>
<td>0.129*</td>
<td>0.168**</td>
</tr>
<tr>
<td>Physical environment</td>
<td></td>
<td>0.145*</td>
<td>0.088</td>
<td>0.152*</td>
</tr>
<tr>
<td>Neighbourhood</td>
<td></td>
<td>0.126</td>
<td>0.038</td>
<td>0.038</td>
</tr>
</tbody>
</table>

1- Number of people known by name in suburb
2- Number of people known by name in street
3- Frequency of visits to people in the neighbourhood
4- Frequency of social interaction
5- Interaction around housing
6- Interaction around the neighbourhood

Figure 4.32: Relationships between levels of social activity and provision of urban design characteristics
The results show that Number of people known by name in suburb had significant positive correlations with: Connectivity by walking \((r = 0.144, p < 0.02, n=240)\); Connectivity by transport \((r = 0.145, p < 0.02, n=240)\); Tree coverage \((r = 0.167, p < 0.01, n=240)\); and Open spaces \((r = 0.163, p < 0.01, n=240)\). Thus, number of people known increased with better connectivity both by walking and transport and with greater tree coverage and more open spaces. The same variable had significant negative correlations with: Street type \((r = −0.171, p < 0.008, n=240)\); Footpath \((r = −0.129, p < 0.04, n=240)\); Nature strip \((r = −0.195, p < 0.002, n=240)\); and Dwelling type \((r = −0.131, p < 0.04, n=240)\). This means that the number of people known in the suburb:

- changed significantly from one street type to the next i.e. from traditional type (most people known) to conventional cul-de-sac to curvilinear loop pattern (least people known)
- reduced with lesser footpath provision i.e. was greatest with one footpath on each to side and least with no footpaths at all
- reduced with lesser nature strip provision i.e. was greatest with a nature strip on each side and least with no nature strips; and
- changed significantly between dwelling type i.e. was greatest with 80% detached houses, then with 90% detached houses and least with 100% detached houses.
Number of people known by name in street was significantly positively correlated with: *Connectivity by walking* (r = 0.129, p < 0.04, n=240); and *Tree coverage* (r = 0.137, p < 0.03, n=240). Hence, the number of people known in the street increased with better connectivity both by walking and with greater tree coverage. Whereas the same variable had negative correlations with: *Street type* (r = −0.168, p < 0.009, n=240); *Nature strip* (r = −0.201, p < 0.002, n=240); and *Dwelling type* (r = −0.151, p < 0.01, n=240). This means the number of people known in the street:

- changed significantly from one street type to the next i.e. from traditional type (most people known) to conventional cul-de-sac to curvilinear loop (least people known)
- reduced with lesser nature strip provision i.e. was greatest with a nature strip on each side and least with no nature strip; and
- changed significantly between dwelling type i.e. was greatest with 80% detached houses, then with 90% detached houses and least with 100% detached houses.

Frequency of social interaction in neighbourhood was significantly positively correlated with *Tree coverage* (r = 0.164, p < 0.01, n=243); *Connectivity by walking* (r = 0.168, p < 0.009, n=243); *Connectivity by transport* (r = 0.152, p < 0.02, n=243); and *Open spaces* (r = 0.195, p < 0.002, n=243). Thus, frequency of social interaction increased with better connectivity both by walking and transport and with greater tree coverage and more open spaces. However, this variable had negative correlations with: *Street type* (r = −0.235, p < 0.000, n=243); *Footpath* (r = −0.171, p < 0.008, n=243); *Nature strip* (r = −0.146, p < 0.02, n=243); and *Dwelling type* (r = −0.227, p < 0.000, n=243); This means frequency of social interaction in neighbourhoods:
• changed significantly from one street type to the next i.e. from traditional type (greatest frequency of social interaction) to conventional loop and cul-de-sac to curvilinear loop pattern (least frequency of social interaction)
• reduced with lesser footpath provision i.e. was greatest with one footpath on each side and least with no footpaths at all
• reduced with lesser nature strip provision i.e. was greatest with a nature strip on each side and least with no nature strip; and
• changed significantly between dwelling type i.e. was greatest with 80% detached houses, then with 90% detached houses and least with 100% detached houses.

However, the frequency of visits to people in the street or neighbourhood, and interaction around neighbourhoods and housing showed no correlation with any physical features. The findings support (H-4) in that level of social activity is correlated with social interaction and it can be impacted by urban design characteristics. Figure 4.33 describes the significant correlations.

Figure 4.33: Significant correlations between variables
4.9. Regression analysis of neighbourhood experience factors investigating interaction terms of socio-demographic variables and neighbourhood design

In order to evaluate the method used in this study and compare its findings with a similar investigation, analysis was conducted following the method of Rogers and Sukolratanamete (2009). This study used multiple regression to explore if neighbourhood design impacts social interaction when taking into account the impact on social interaction of social and demographic variables, and of the interaction between neighbourhood design and socio-demographic variables. In other words, regression analyses were conducted to eliminate the difference explained by socio-demographic variables in social interaction between the different neighbourhood design variables. In doing so, and following the method of Rogers and Sukolratanamete (2009), a dummy variable for each neighbourhood design characteristic was created by determining a value of either 0 (for poor presence of physical features) or 1 (for good provision of physical features) (Table 4.28). Thence, a set of interaction terms between neighbourhood design and the selected socio-demographic variables were established to examine the significance of the differences between selected socio-demographic variables and neighbourhood design and those of their interaction terms.

In the first stage of each of the three regressions (one regression for each factor), it was determined if the factor under consideration was significantly correlated (at the 0.05 level) with: all selected socio-demographic variables, all neighbourhood design variables, and interaction terms between socio-demographic variables and neighbourhood design. Subsequently, the next models eliminated the non-significant predictors by only considering the independent variables that significantly (p < 0.05) contributed in the previous model. Through this process it was possible to identify which of the models was the best predictor for each neighbourhood experience factor.
It was found for all three sets of regressions that: all three models had significance at 
\( p < 0.01 \), and that the relative proportion of variance explained by each dependent 
variable was parallel across each of the three models (Tables 4.29, 4.30 and 4.31).

Table 4.28: Comparison of presence of physical design features between three 
neighbourhoods

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Variables</th>
<th>Belmont</th>
<th>Grovedale</th>
<th>Waurn Ponds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neighbourhood form</td>
<td>Street layout</td>
<td>Yes</td>
<td>1.0</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Traffic flow</td>
<td>Yes</td>
<td>1.0</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>On-street parking</td>
<td>Yes</td>
<td>1.0</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Footpath</td>
<td>Yes</td>
<td>1.0</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Nature strip</td>
<td>Yes</td>
<td>1.0</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Tree coverage</td>
<td>Yes</td>
<td>1.0</td>
<td>Partial</td>
</tr>
<tr>
<td>Pedestrian infrastructure</td>
<td>Connectivity by walking to facilities</td>
<td>Yes</td>
<td>1.0</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Connectivity to facilities by public transport</td>
<td>Yes</td>
<td>1.0</td>
<td>Yes</td>
</tr>
<tr>
<td>Neighbourhood connectivity</td>
<td>Open spaces</td>
<td>Yes</td>
<td>1.0</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Number of Community spaces</td>
<td>Yes</td>
<td>1.0</td>
<td>Yes</td>
</tr>
<tr>
<td>Public space provision</td>
<td>Dwelling setback</td>
<td>Big setback</td>
<td>0.0</td>
<td>Big setback</td>
</tr>
<tr>
<td>Threshold spaces</td>
<td>Garage on facade</td>
<td>1/2</td>
<td>0.5</td>
<td>1/2</td>
</tr>
<tr>
<td></td>
<td>Average of Fence height</td>
<td>1</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Dwelling type</td>
<td>3/4</td>
<td>0.5</td>
<td>Near all</td>
</tr>
<tr>
<td>Total design elements</td>
<td></td>
<td>12</td>
<td>7.5</td>
<td>5</td>
</tr>
</tbody>
</table>

DE = 1 if neighbourhood design element present, partially met design elements represented as fraction, 
else 0

1. Neighbourhood contentment

*Neighbourhood contentment* was explored in the first full model consisting of: six 
socio-demographic variables, neighbourhood design and six interaction term 
variables. The model accounted for 26.1% of the variance level of *Neighbourhood* 194
 CONTENTMENT, F (13, 229) = 6.2, p < 0.001, adj. R2 = 0.261. All independent variables were significantly correlated with Neighbourhood contentment. However, in this model only Length of residence significantly predicted Neighbourhood contentment. In the second model, four non-significant variables were excluded: (1) Number of members in household; interaction terms of neighbourhood design with (2) Household tenure; (3) Age; and (4) Number of members in household (which had the least t value). This model accounted for 25.9% of the variation in Neighbourhood contentment, F (9, 233) = 9.1, p < 0.001, adj. R2 = 0.259. The four variables in this second regression model with the least t value were omitted from the final model: (1) Age, (2) Level of education, interaction terms with (3) Income and (4) Level education. This final model consisted of five of variables and accounted for 24.5% of the variation of this factor (R2 = 0.245, F = 15.4, p < 0.001). In this model, all five variables significantly predicted Neighbourhood contentment: Home ownership (p = 0.02); Length of residence (p = 0.000); Income (p = 0.000); neighbourhood design (p = 0.001); and interaction terms of Length of residence (p = 0.0). Table 4.29 summarises the regression analysis of Neighbourhood contentment with neighbourhood design interaction terms.
Table 4.29: Summary of regression analysis of Neighbourhood contentment with neighbourhood design interaction terms

<table>
<thead>
<tr>
<th>Neighbourhood contentment</th>
<th>Full model</th>
<th>Reduced 1</th>
<th>Reduced 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b</td>
<td>β</td>
<td>t</td>
</tr>
<tr>
<td>Intercept</td>
<td>2.457</td>
<td>5.72</td>
<td>7.868</td>
</tr>
<tr>
<td>Household tenure</td>
<td>.159</td>
<td>.088</td>
<td>.78</td>
</tr>
<tr>
<td></td>
<td>.240</td>
<td>2.132</td>
<td>2.211*</td>
</tr>
<tr>
<td>Length of residence</td>
<td>.238</td>
<td>.434</td>
<td>2.83**</td>
</tr>
<tr>
<td></td>
<td>.276</td>
<td>.503</td>
<td>3.820**</td>
</tr>
<tr>
<td>Age</td>
<td>.080</td>
<td>.117</td>
<td>.79</td>
</tr>
<tr>
<td>Income</td>
<td>-.052</td>
<td>-.146</td>
<td>-1.35</td>
</tr>
<tr>
<td></td>
<td>-.074</td>
<td>-.207</td>
<td>-3.584*</td>
</tr>
<tr>
<td>Number of members in household</td>
<td>-.019</td>
<td>-.044</td>
<td>-.32</td>
</tr>
<tr>
<td>Level of education</td>
<td>.088</td>
<td>.162</td>
<td>1.47</td>
</tr>
<tr>
<td>Neighbourhood design</td>
<td>.102</td>
<td>.163</td>
<td>.41</td>
</tr>
<tr>
<td>N.D. Household tenure</td>
<td>.108</td>
<td>-.346</td>
<td>-1.39</td>
</tr>
<tr>
<td></td>
<td>-.149</td>
<td>-.390</td>
<td>-1.88*</td>
</tr>
<tr>
<td>N.D. Length of residence</td>
<td>-.030</td>
<td>-.084</td>
<td>-.263</td>
</tr>
<tr>
<td>N.D. Age group</td>
<td>-.032</td>
<td>-.123</td>
<td>-.709</td>
</tr>
<tr>
<td>ND. Income</td>
<td>.020</td>
<td>.061</td>
<td>.312</td>
</tr>
<tr>
<td>ND. Number of household members</td>
<td>-.088</td>
<td>-.260</td>
<td>-1.24</td>
</tr>
<tr>
<td>ND. Level of education</td>
<td>-.088</td>
<td>-.260</td>
<td>-1.24</td>
</tr>
<tr>
<td>N</td>
<td>243</td>
<td>243</td>
<td>243</td>
</tr>
<tr>
<td>R^2</td>
<td>0.26</td>
<td>0.25</td>
<td>0.24</td>
</tr>
<tr>
<td>Adjusted R^2</td>
<td>0.21</td>
<td>0.23</td>
<td>0.22</td>
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<tr>
<td>F</td>
<td>6.2</td>
<td>9.1</td>
<td>15.4</td>
</tr>
<tr>
<td>Sig.</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

* p < 0.05, ** p < 0.01, *** p < 0.001

2. Active socialising

Active socialising was explored in the first full model consisting of two social-demographic variables, neighbourhood design and two interaction term variables. This model accounted for 13.2% of the variance level of Active socialising, \( F(9, 233) = 3.9, p < 0.001 \), adj. R^2 = 0.131. All independent variables were significantly correlated with Active socialising. However, in this model no variable significantly predicted Active socialising. In the second model, four non-significant variables were excluded: (1) Household tenure; (2) Number of household members; interaction term with (3) Home ownership; and (4) Number of household members, which had the least t value.
This model accounted for 13.1% of the variation in *Active socialising*, $F(5, 237) = 7.1$, $p < 0.001$, adj. $R^2 = 0.131$. The result showed that *Length of residence* and *Number of children* significantly predicted *Active socialising*. Two variables in this regression model with least $t$ values were excluded from the final model: neighbourhood design and interaction terms with *Number of children*. This model consisted of three variables and accounted for 12.3% of the variation in *Active socialising*, $F(3, 239) = 11.14$, $p < 0.001$, adj. $R^2 = 0.123$. In this model, all three variables significantly predicted *Active socialising*: *Length of residence* ($p = 0.000$); *Number of children* ($p = 0.000$); and interaction terms with *Household tenure* ($p = 0.04$). Table 4.30 summarises the regression analysis of *Active socialising* with neighbourhood design interaction terms.

Table 4.30: Summary of regression analysis of Active socialising with neighbourhood design interaction terms

<table>
<thead>
<tr>
<th>Active socialising</th>
<th>Full model</th>
<th>Reduced 1</th>
<th>Reduced 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$b$</td>
<td>$\beta$</td>
<td>$t$</td>
</tr>
<tr>
<td>Intercept</td>
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<td>5.217</td>
<td>.166</td>
</tr>
<tr>
<td>Household tenure</td>
<td>.074</td>
<td>.035</td>
<td>.306</td>
</tr>
<tr>
<td>Length of residence</td>
<td>.162</td>
<td>.256</td>
<td>1.664</td>
</tr>
<tr>
<td>Number of members</td>
<td>.004</td>
<td>.009</td>
<td>.037</td>
</tr>
<tr>
<td>Number of children</td>
<td>.166</td>
<td>.355</td>
<td>1.477</td>
</tr>
<tr>
<td>Neighbourhood</td>
<td>−.134</td>
<td>−.094</td>
<td>−.241</td>
</tr>
<tr>
<td>design</td>
<td>−.078</td>
<td>−.159</td>
<td>−.609</td>
</tr>
<tr>
<td>N.D. Number of</td>
<td>.164</td>
<td>.228</td>
<td>.561</td>
</tr>
<tr>
<td>children</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.D. Household</td>
<td>.004</td>
<td>.008</td>
<td>.034</td>
</tr>
<tr>
<td>tenure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.D. Length of</td>
<td>.019</td>
<td>.051</td>
<td>.144</td>
</tr>
<tr>
<td>residence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND. Number of</td>
<td>243</td>
<td>243</td>
<td>243</td>
</tr>
<tr>
<td>household members</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>243</td>
<td>243</td>
<td>243</td>
</tr>
<tr>
<td>R2</td>
<td>0.13</td>
<td>0.13</td>
<td>0.12</td>
</tr>
<tr>
<td>Adjusted R2</td>
<td>0.09</td>
<td>0.11</td>
<td>0.11</td>
</tr>
<tr>
<td>F</td>
<td>3.9</td>
<td>7.1</td>
<td>11.14</td>
</tr>
<tr>
<td>Sig.</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
3. **Accessibility**

*Accessibility* was explored in the first full model consisting of four socio-demographic variables, neighbourhood design and four interaction term variables. The model accounted for 10.3% of the variance in *Accessibility*, $F(9, 233) = 2.9$, $p < 0.01$, adj. $R^2 = 0.103$. All independent variables were significantly correlated with *Accessibility*, excepting interaction terms with *Income* and *Number of household members*. However, in this model no variable significantly predicted *Accessibility*. In the second model, four non-significant variables were excluded: interaction terms with (1) *Income*; (2) *Number of household members*; (3) *Length of residence*; and (4) *Level of education*, which had the least $t$ value. This model accounted for 9.7% of the variance in *Accessibility*, $F(5, 237) = 5.1$, $p < 0.001$, adj. $R^2 = 0.097$. The two variables in this regression model with the least $t$ values were omitted from the final model: *Number of household members* and *Level of education*. This model consisted of three variables and accounted for 8.4% of the variance in *Accessibility*, $F(3, 239) = 7.3$, $p < 0.001$, adj. $R^2 = 0.084$. In this model, all three variables significantly predicted *Accessibility*: *Income* ($p = 0.001$); *Length of residence* ($p = 0.04$); and neighbourhood design ($p = 0.02$). Table 4.31 summarises the regression analysis of *Accessibility* with neighbourhood design interaction terms.
Table 4.31: Summary the regression analysis of Accessibility with neighbourhood design interaction terms

<table>
<thead>
<tr>
<th>Accessibility</th>
<th>Full model</th>
<th>Reduced 1</th>
<th>Reduced 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b</td>
<td>β</td>
<td>t</td>
</tr>
<tr>
<td>Length of residence</td>
<td>.122</td>
<td>.225</td>
<td>1.527</td>
</tr>
<tr>
<td>Income</td>
<td>-.076</td>
<td>-.218</td>
<td>-1.925</td>
</tr>
<tr>
<td>Number of members in household</td>
<td>-.048</td>
<td>-.115</td>
<td>-.882</td>
</tr>
<tr>
<td>Level of education</td>
<td>.096</td>
<td>.178</td>
<td>1.501</td>
</tr>
<tr>
<td>Neighbourhood design</td>
<td>.369</td>
<td>.302</td>
<td>.949</td>
</tr>
<tr>
<td>N.D_ Length of residence</td>
<td>-.073</td>
<td>-.192</td>
<td>-.809</td>
</tr>
<tr>
<td>N.D_ Income</td>
<td>.004</td>
<td>.017</td>
<td>.091</td>
</tr>
<tr>
<td>N.D_ Number of household members</td>
<td>.026</td>
<td>.081</td>
<td>.418</td>
</tr>
<tr>
<td>N.D_ Level of education</td>
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<td>-.178</td>
<td>-.782</td>
</tr>
<tr>
<td>N</td>
<td>243</td>
<td>243</td>
<td>243</td>
</tr>
<tr>
<td>R2</td>
<td>0.10</td>
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<td>Adjusted R2</td>
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<tr>
<td>F</td>
<td>3.1</td>
<td>5.1</td>
<td>7.3</td>
</tr>
<tr>
<td>Sig.</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

* p < 0.05, ** p < 0.01, *** p < 0.001

In summary of the comparison with Rogers and Sukolratanametee:

- The final regression model of Neighbourhood contentment consisted of five predictors: Household tenure, Length of residence, Income, neighbourhood design and one interaction terms with Length of residence.

- The final model of Active socialising consisted of two demographic variables (Length of residence and Number of children) and one interaction term with Household tenure. These three items significantly predicted Active socialising. None of the neighbourhood design variables predicted Active socialising.

- Accessibility was predicted by two demographic variables (Length of residence and Income) and neighbourhood design, but no interaction terms were in the final model of this factor.
The results therefore indicated that interaction terms with neighbourhood design adjusted the contribution of the socio-demographic variables. Although the interaction terms involved only two variables (*House tenure* and *Length of residence*), this finding indicates that neighbourhood design modifies the degree to which *House tenure* and *Length of residence* predict *Neighbourhood contentment*. While the ANOVA results show that there was no significant difference in *Active socialising* between the three suburbs, neighbourhood design was shown to change the degree to which length of residence predicts *Active socialising*. In contrast with the Rogers and Sukolratanametee (2009) study, it was found that no interaction terms with neighbourhood design predicted the sense of community factors extracted by the other study (supportive acts of neighbouring; lack of neighbourhood annoyance; and neighbourhood attachment and social ties) that equate with the neighbourhood experience factors used in this study (*Neighbourhood contentment*, *Active socialising* and *Accessibility*). This finding suggests that neighbourhood design cannot change the degree to which socio-demographic variables predict sense of community. However, in line with the previous study, the results show that neighbourhood design did not appear to change the degree to which socio-demographic variables predicted *Accessibility*, meaning socio-demographic variables impacted *Accessibility* both before and after the addition of neighbourhood design variables.

Consequently, it can be seen that while the Rogers and Sukolratanametee (2009) study adopted a more concise approach by considering neighbourhood design as one variable with socio-demographic factors and interaction terms between them, the method developed for this thesis provides for more nuanced insight about the relationship between neighbourhood design and social interaction. These nuances were achieved by adopting a methodology that reveals the individual contributions of all physical variables of neighbourhood design. Thus, it can be determined which of
these physical variables have the strongest impact when socio-demographic variables are controlled for.

4.10. Summary of all results

This chapter has analysed the relationship between neighbourhood design, resident self-rated levels of social activity, and three neighbourhood experience factors (the dependent variables): *Neighbourhood contentment*, *Active socialising* and *Accessibility*. The following nine tables present a summary of all the findings in relation to the thesis hypotheses and research questions: (1) comparison of the design characteristics of the three neighbourhoods (Table 4.32); (2) relationships between the socio-demographic variables and the neighbourhood experience three factors (Table 4.33); (3) the impact of street layout on social interaction measures with controlling of socio-demographic variables (Table 4.34); (4) the impact of pedestrian environments on social interaction measures with controlling of socio-demographic variables (Table 4.35); (5) the impact of neighbourhood connectivity on social interaction measures with controlling of socio-demographic variables (Table 4.36); (6) the impact of public space provision on social interaction measures with controlling of socio-demographic variables (Table 4.37); (7) the impact of dwelling form on social interaction measures with controlling of socio-demographic variables (Table 4.38); (8) the relationship of level of social activity with the neighbourhood experience factors (Table 4.39); and (9) urban design characteristics (Table 4.40). The tables also state the type of analysis used (based on the variables under consideration). The result of the analyses are briefly presented in a separate column in each table.

Thus, the main findings are:

- Neighbourhood design has an impact on *Neighbourhood contentment* and *Accessibility*. 
• Street type, Open spaces, Community spaces and Tree coverage are the variables that most significantly predict Neighbourhood contentment (after controlling for Length of residence, Household tenure, Age, Income, Number of household members and Level of education).

• No physical design variables significantly predict Active socialising (after controlling for Length of residence, Household tenure, Number of members in household and Number of children).

• Street type, Open space and Tree coverage are the variables that most significantly contribute to Accessibility (after controlling for Length of residence, Income, Number of household members and Level of education).

• Neighbourhood design and interaction terms with Length of residence significantly predict Neighbourhood contentment alongside socio-demographic variables.

• Length of residence, Number of children and interaction terms with Household tenure significantly predict Active socialising, while neighbourhood design did not predict this factor.

• Length of residence, Income and neighbourhood design significantly predict Accessibility, while there are no interaction terms involved in predicting this factor.

• Neighbourhood contentment and Active socialising are significantly correlated with levels of social activity.

• Accessibility are significantly correlated with frequency of social interaction.

• Street type, pedestrian environment, neighbourhood connectivity and Dwelling type are significantly correlated with friendship and social interaction frequency.

• The three neighbourhood experience factors are significantly positively correlated with each other.
Table 4.32: Summary of comparison neighbourhood experience factors in different neighbourhoods

<table>
<thead>
<tr>
<th>Neighbourhood design</th>
<th>H Research question</th>
<th>IV</th>
<th>DV</th>
<th>Method</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Different neighbourhood design characteristics impact correlates of social interaction in low density suburbs</td>
<td>(H-1) Different neighbourhood design characteristics impact correlates of social interaction in low density suburbs</td>
<td>Neighbourhood contentment</td>
<td>Active socialising</td>
<td>Accessibility</td>
<td>ANOVA</td>
</tr>
<tr>
<td>Traditional neighbourhood</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td></td>
<td>• There was a significant difference in Neighbourhood contentment between three suburbs</td>
</tr>
<tr>
<td>Convention al cul-de-sac</td>
<td>✓</td>
<td>×</td>
<td>×</td>
<td></td>
<td>• There was a significant difference in Accessibility between Belmont and Waurn Ponds while no significant difference in Grovedale</td>
</tr>
<tr>
<td>Curvilinear loop</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.33: Summary of results of testing socio-demographic variables on neighbourhood experience factors

<table>
<thead>
<tr>
<th>Research question</th>
<th>IV</th>
<th>DV</th>
<th>Method</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social demographic background</td>
<td>Household tenure</td>
<td>Neighbourhood contentment</td>
<td>Active socialising</td>
<td>Neighbourhood contentment and Active socialising are positively correlated with home ownership.</td>
</tr>
<tr>
<td>Socio-demographic factors impact correlates of social interaction in low density suburbs</td>
<td>.196**</td>
<td>166**</td>
<td>.021</td>
<td>All neighbourhood experience factors are positively correlated with length of residence. Only Neighbourhood contentment is significantly correlated to age.</td>
</tr>
<tr>
<td>(Q-2) How do socio-demographics factors impact correlates of social interaction in low density suburbs?</td>
<td>Length of residence</td>
<td>Neighbourhood contentment</td>
<td>Active socialising</td>
<td>Neighbourhood contentment and Accessibility is negatively correlated with income.</td>
</tr>
<tr>
<td></td>
<td>.344**</td>
<td>.219**</td>
<td>.133*</td>
<td>There was significant negative correlation between number of members in household with Neighbourhood contentment and Accessibility, while it is positively correlated with Active socialising.</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>Neighbourhood contentment</td>
<td>Accessibility</td>
<td>Neighbourhood contentment and Accessibility are positively correlated with number of children.</td>
</tr>
<tr>
<td></td>
<td>.234**</td>
<td>.050</td>
<td>.043</td>
<td>Active socialising is positively correlated with number of children.</td>
</tr>
<tr>
<td></td>
<td>Gender</td>
<td>Neighbourhood contentment</td>
<td>Accessibility</td>
<td>Neighbourhood contentment and Accessibility are positively correlated with education level.</td>
</tr>
<tr>
<td></td>
<td>-.125</td>
<td>-.075</td>
<td>-.080</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Income</td>
<td>Neighbourhood contentment</td>
<td>Accessibility</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-.150*</td>
<td>-.042</td>
<td>-.200**</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Research question</td>
<td>Sub-hypo</td>
<td>IV</td>
<td>Result</td>
</tr>
<tr>
<td>---</td>
<td>------------------</td>
<td>----------</td>
<td>----</td>
<td>--------</td>
</tr>
<tr>
<td>(H-3)</td>
<td>Neighbourhood design characteristics impact correlates of social interaction with controlling of socio-demographic variables</td>
<td>(Q-3)</td>
<td>How do the neighborhood design characteristics impact correlates of social interaction after controlling of socio-demographic variables?</td>
<td>Length of residence</td>
</tr>
<tr>
<td>(Q-3)</td>
<td></td>
<td></td>
<td></td>
<td>Household tenure</td>
</tr>
<tr>
<td>(Q-3-1)</td>
<td>How do the street layout impact correlates of social interaction and its correlates with controlling of socio-demographic variables?</td>
<td></td>
<td>Length of residence</td>
<td>Street type</td>
</tr>
<tr>
<td>(Q-3-1)</td>
<td></td>
<td></td>
<td>Household tenure</td>
<td>Traffic flow</td>
</tr>
<tr>
<td>Socio-demographic variables</td>
<td>Street layout</td>
<td>Neighbourhood contentment</td>
<td>Method</td>
<td>Street layout significantly impacts DV. But only street type can significantly predict Neighbourhood contentment in the final model with controlling of length of residence, household tenure and age.</td>
</tr>
<tr>
<td>Income</td>
<td>Street type</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic flow</td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-street parking</td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Street layout cannot impact Active socialising above and beyond the effects of length of residence and number of children.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio-demographic variables</td>
<td>Street layout</td>
<td>Active socialising</td>
<td>Method</td>
<td>Street layout couldn’t significantly impact DV. However, only street type can significantly predict Accessibility in the final model with controlling of income.</td>
</tr>
<tr>
<td>Income</td>
<td>Street type</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic flow</td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-street parking</td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.35: Summary of results for analyses of impact of pedestrian environment on neighbourhood experience factors with controlled socio-demographic variables

<table>
<thead>
<tr>
<th>Research question</th>
<th>Sub-question</th>
<th>IV</th>
<th>Method</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neighbourhood design</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(H-3) Neighbourhood design impact correlates of social interaction after controlling of socio-demographic variables</td>
<td>(Q-3) How do the neighbourhood design characteristics impacts correlates of social interaction with controlling of socio-demographic variables?</td>
<td>Length of residence</td>
<td>Pedestrian environment</td>
<td>Hierarchical Multiple Regression</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Household tenure</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Socio-demographic variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pedestrian environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedestrian environment impact correlates of social interaction after controlling of socio-demographic variables</td>
<td>(Q-3-2) How do the Pedestrian environment impact correlates of social interaction with controlling of socio-demographic variables?</td>
<td>Length of residence</td>
<td>Pedestrian environment</td>
<td>Active socialising</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Household tenure</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Number of children</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Socio-demographic variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pedestrian environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessibility</td>
<td></td>
<td>Income</td>
<td>Pedestrian environment</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nature strip</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tree coverage</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.36: Summary of results for analyses of impact of neighbourhood connectivity on neighbourhood experience factors with controlled socio-demographic variables

<table>
<thead>
<tr>
<th>H</th>
<th>Research question</th>
<th>Sub-hypo</th>
<th>IV</th>
<th>Method</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Neighbourhood design impact correlates of social interaction after controlling of socio-demographic variables</td>
<td>(Q-3) How do the Neighbourhood design impact correlates of social interaction after controlling of socio-demographic variables?</td>
<td>Length of residence Connectivity by walking ✓</td>
<td>Hierarchical multiple regression</td>
<td>Neighbourhood connectivity significantly impacts DV. But no physical variable can significantly predict Neighbourhood contentment in the final model with controlling of length of residence, household tenure and age.</td>
</tr>
<tr>
<td>(H-3)</td>
<td>Neighbourhood design impact correlates of social interaction after controlling of socio-demographic variables</td>
<td>(H-3-3) How do the Neighbourhood connectivity impact correlates of social interaction after controlling of socio-demographic variables?</td>
<td>Household tenure Connectivity by public transport ×</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Neighbourhood connectivity impact correlates of social interaction after controlling of socio-demographic variables</td>
<td>(Q-3-3) How do the Neighbourhood connectivity impact correlates of social interaction after controlling of socio-demographic variables?</td>
<td>Age ×</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Neighbourhood design impact correlates of social interaction after controlling of socio-demographic variables</td>
<td>(H-3-3-3) How do the Neighbourhood connectivity impact correlates of social interaction after controlling of socio-demographic variables?</td>
<td>Socio-demographic variables Neighbourhood connectivity Accessibility</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Neighbourhood connectivity impact correlates of social interaction after controlling of socio-demographic variables</td>
<td>(Q-3-3-3) How do the Neighbourhood connectivity impact correlates of social interaction after controlling of socio-demographic variables?</td>
<td>Income Connectivity by walking ✓</td>
<td>Hierarchical multiple regression</td>
<td>Neighbourhood connectivity cannot impact Accessibility above and beyond the effects of income.</td>
</tr>
<tr>
<td></td>
<td>Neighbourhood design impact correlates of social interaction after controlling of socio-demographic variables</td>
<td>(Q-3-3-3) How do the Neighbourhood connectivity impact correlates of social interaction after controlling of socio-demographic variables?</td>
<td>Income Connectivity by public transport ×</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.37: Summary of results for analyses of impact of public space provision on neighbourhood experience factors with controlled socio-demographic variables

<table>
<thead>
<tr>
<th>Research question</th>
<th>Sub-hypo</th>
<th>IV</th>
<th>Method</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neighbourhood design (H-3)</td>
<td>Neighbourhood design impact correlates of social interaction and its correlates after controlling of socio-demographic variables.</td>
<td></td>
<td>Neighbourhood connectivity significantly impacts DV. Both number of community and open spaces significantly predict Neighbourhood contentment in the final model with controlling of length of residence, household tenure and age.</td>
<td></td>
</tr>
<tr>
<td>Neighbourhood design (H-3-4)</td>
<td>Neighbourhood design characteristics impact correlates of social interaction with controlling of socio-demographic variables?</td>
<td></td>
<td>Neighbourhood contentment</td>
<td>Hierarchical Multiple Regression</td>
</tr>
<tr>
<td>Public space provision impact correlates of social interaction after controlling of socio-demographic variables</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Socio-demographic variables</td>
<td>Public space provision</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Length of residence</td>
<td>Community spaces</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household tenure</td>
<td>Open spaces</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Neighbourhood design (Q-3)</td>
<td>How do the neighbourhood design characteristics impact correlates of social interaction with controlling of socio-demographic variables?</td>
<td></td>
<td>Neighbourhood contentment</td>
<td>Hierarchical Multiple Regression</td>
</tr>
<tr>
<td>(Q-3-4) Public space provision impact correlates of social interaction after controlling of socio-demographic variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio-demographic variables</td>
<td>Public space provision</td>
<td>✓</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Length of residence</td>
<td>Community spaces</td>
<td>✓</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Household tenure</td>
<td>Open spaces</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of children</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neighbourhood design (Q-3-4)</td>
<td>How do the public space provision impact correlates of social interaction after controlling of socio-demographic variables?</td>
<td></td>
<td>Active socialising</td>
<td>Hierarchical Multiple Regression</td>
</tr>
<tr>
<td>Public space provision significantly impacts DV. But only open spaces significantly predict Active socialising above and beyond the effects of length of residence and number of children.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio-demographic variables</td>
<td>Public space provision</td>
<td>Accessibility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>Community spaces</td>
<td>✓</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Open spaces</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.38: Summary of results for analyses of impact of dwelling form on neighbourhood experience factors with controlled socio-demographic variables

<table>
<thead>
<tr>
<th>H</th>
<th>Research question</th>
<th>Sub-hypo</th>
<th>Sub- Q</th>
<th>IV</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>(H-3) Neighbourhood design</td>
<td>Neighbourhood design impact correlates of social interaction after controlling of socio-demographic variables</td>
<td>(Q-3) How do the neighbourhood design characteristics impact social interaction with controlling of socio-demographic variables?</td>
<td>(H-3-5) Dwelling form impact correlates of social interaction correlates after controlling of socio-demographic variables</td>
<td>Socio-demographic variables</td>
<td>Dwelling form</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Length of residence</td>
<td>Dwelling setback</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Household tenure</td>
<td>Garage on facade</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Age</td>
<td>Fence</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dwelling type</td>
<td>✓</td>
</tr>
<tr>
<td>Socio-demographic variables</td>
<td>Dwelling form</td>
<td>Active socialising</td>
<td></td>
<td>Length of residence</td>
<td>Dwelling setback</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Household tenure</td>
<td>Garage on facade</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Number of children</td>
<td>Fence</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dwelling type</td>
<td>×</td>
</tr>
<tr>
<td>Socio-demographic variables</td>
<td>Dwelling form</td>
<td>Accessibility</td>
<td></td>
<td>Income</td>
<td>Dwelling setback</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Garage on facade</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fence</td>
<td>×</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dwelling type</td>
<td>✓</td>
</tr>
</tbody>
</table>
Table 4.39: Summary of results for analyses of relationship between level of social activity and neighbourhood experience factors

<table>
<thead>
<tr>
<th>H Research question</th>
<th>Sub-hypo</th>
<th>Sub-Q</th>
<th>Level of social activity</th>
<th>IV</th>
<th>DV</th>
<th>Method</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>(H-4) Level of social activity is correlated to Social interaction and it can be impacted by urban design characteristics.</td>
<td>(Q-4) What is the relationship between levels of social activity and the correlates of social interaction, and how much are levels of social activity impacted by urban design characteristics?</td>
<td>(Q-4-1) What is the relationship between levels of social activity and the correlates of social interaction?</td>
<td>Friendship</td>
<td>Neighbourhood contentment</td>
<td>Active socialising</td>
<td>Accessibility</td>
<td>Method</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.185**</td>
<td>.358***</td>
<td>.019</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.197**</td>
<td>.429***</td>
<td>.022</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>.265***</td>
<td>.498***</td>
<td>.104</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.385***</td>
<td>.243***</td>
<td>.280***</td>
</tr>
<tr>
<td>Place</td>
<td>Interaction around housing</td>
<td>Interaction around the neighbourhood</td>
<td>( \rho )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>.172**</td>
<td>.267***</td>
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<td>.163*</td>
<td>.057</td>
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There was significant positive correlation between interaction around housing with Neighbourhood contentment and Accessibility.

There was significant positive correlation between interaction around neighbourhood with Neighbourhood contentment and Active socialising.

social interaction with Neighbourhood contentment, Active socialising and Accessibility.
Table 4.40: Summary of results for analyses of relationship between urban design characteristics and level of social activity

<table>
<thead>
<tr>
<th>Research question</th>
<th>H</th>
<th>IV</th>
<th>DV</th>
<th>Method</th>
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<tr>
<td>(H–4-2) Level of social activity can be impacted by urban designs characteristics?</td>
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<td>(Q–4-2) How much are levels of social activity impacted by urban design characteristics?</td>
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<td>Urban designs characteristics</td>
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<td>Street type</td>
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<td></td>
<td>Street type, tree coverage and connectivity by walking significantly correlated to three DV.</td>
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<tr>
<td>Traffic flow</td>
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<td>Nature strip and dwelling type negatively correlated to three DV.</td>
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<tr>
<td>On-street parking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Footpath negatively correlated to number of people known by name in suburb and frequency of social interaction, while they positively correlated to connectivity by transport.</td>
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<tr>
<td>Footpath</td>
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<td>Open space significantly correlated to frequency of social interaction</td>
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<td>Nature strip</td>
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<td>Tree coverage</td>
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<td>Connectivity by walking</td>
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<td>Connectivity by transport</td>
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<td>Community spaces</td>
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<td>Open space</td>
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<td>Dwelling setback</td>
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<td>Fence height</td>
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<td>Dwelling type</td>
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<tr>
<th>Friendships</th>
<th>Social connections</th>
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<tbody>
<tr>
<td>No. people known by name in suburb</td>
<td>No. people known by name in street</td>
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<tr>
<td>Street type</td>
<td>−.171**</td>
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<tr>
<td>Traffic flow</td>
<td>.015</td>
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<td>On-street parking</td>
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<tr>
<td>Footpath</td>
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<tr>
<td>Nature strip</td>
<td>−.129*</td>
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<tr>
<td>Tree coverage</td>
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<td>Connectivity by walking</td>
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<td>Connectivity by transport</td>
<td>.145*</td>
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<td>Community spaces</td>
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<td>Open space</td>
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<td>Fence height</td>
<td>.070</td>
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<tr>
<td>Dwelling type</td>
<td>−.131*</td>
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Chapter Five – Discussion
5.1. Introduction to discussion

This chapter explores the meaning of the results of the analyses carried out to investigate the relationships between neighbourhood design and social interaction. It discusses which physical design variables correlated with actual levels of social activity and which physical design variables most strongly predicted the three neighbourhood experience factors that were predicted to correlate with levels of social interaction: Neighbourhood contentment, Active socialising and Accessibility. The findings are interpreted and discussed in relation to the thesis hypotheses, and then compared with previous research.

The limited qualitative data provided by the interviews, in the form of residents’ comments, is used in the discussion to elucidate certain findings. Section 5.2 discusses the hypotheses of this thesis in relation to the results achieved. Section 5.3 discusses the impact on social interaction of different neighbourhood design characteristics. Section 5.4 discusses the impact on social interaction of socio-demographic variables.

Section 5.5 discusses the power of the physical design characteristics in predicting the three neighbourhood experience factors when controlling for socio-demographic impacts. Section 5.5 is subdivided into five subsections: (1) impact on social interaction of street layout; (2) impact on social interaction of pedestrian environment; (3) impact on social interaction of neighbourhood connectivity; (4) impact on social interaction of public space provision; (5) impact on social interaction of dwelling form. Section 5.6 discusses the relationships between levels of social activity, the neighbourhood experience factors and physical design. Figure 5.1 describes all these dependent and independent variables and their measures. Section 5.7 concludes by summarising and synthesising the interpretations. Section 5.8 states the limitations of the current study and makes recommendations for future research.
Figure 5.1: Framework of dependent and independent variables and their measures
5.2. Response to the hypotheses

This thesis examines the impact of neighbourhood design characteristics on social interaction in low-density Australian suburbs. This thesis hypothesises that:

1. Different neighbourhood design characteristics impact correlates of social interaction in low-density suburbs. The result of the ANOVA supports this hypothesis in finding that the means of the neighbourhood experience factors were significantly different between three neighbourhoods of contrasting suburban layout but equivalent socioeconomic metrics.

2. Socio-demographics factors impact correlates of social interaction in low-density suburbs. As might be expected, the findings indicate that some socio-demographic factors were strongly correlated with Neighbourhood contentment, Active socialising and Accessibility. For example, length of residence and income, while other variables such as age were not associated with any factors of social interaction.

3. The study also hypothesised that neighbourhood design characteristics impact correlates of social interaction when controlling for socio-demographic variables. The findings are consistent with this hypothesis. The results of the hierarchical regression analyses indicate that all five groups of physical urban design characteristics significantly contribute to social interaction and are varied in the extent of their relationship. Several physical design characteristics were found to be the most important predictors of the neighbourhood experience factors. Even allowing for the interaction of socio-demographic variables, some physical variables have no significant power, even though they are significantly correlated with social interaction. This may indicate that those variables make individual contributions to social interaction. Moreover, of the socio-demographic factors only length of
residence, income and number of children were found to significantly predict the
neighbourhood experience factors.

4. It was hypothesised that levels of social activity can be affected by urban design
characteristics and in turn contribute to social interaction. The findings are consistent
with this hypothesis. The results show there was strong correlation between level of
social activity and physical design characteristics, and level of social activity was
strongly associated with the three neighbourhood experience factors: *Neighbourhood
ccontentment*, *Active socialising* and *Accessibility*.

Hence, these findings suggest that neighbourhood planning should consider the
integration of all social and physical factors, and the provision of such neighbourhood
c characteristics can be used as strategies in designing contemporary suburban contexts.

5.3. Differences in the social interaction correlates between suburbs

This study hypothesised that correlates of social interaction are significantly different
between neighbourhoods that vary in their urban design and planning (H-1). The results
of the univariate analysis in Section 4.5 indicate that residents in a traditional grid
neighbourhood (Belmont) have higher levels of *Neighbourhood contentment* compared to
residents in a conventional cul-de-sac pattern (Grovedale) and curvilinear loop pattern
neighbourhoods (Waurn Ponds). Although *Accessibility* was significantly different
between Belmont and Waurn Ponds, there was no significant difference in *Accessibility*
between Grovedale and the other two suburbs (Figure 5.2). While the result indicates that
*Active socialising* has not been differentiated in the three suburbs, the overall findings still
support the first hypothesis that different urban design characteristics contribute to social
interaction.
This is in accordance with Lovejoy et al. (2010), who found neighbourhood satisfaction was higher in neighbourhoods with traditional layouts. Lund (2003) also found that in traditional-layout suburbs with diversity of dwellings types, a pedestrian-oriented environment contributed to access to facilities and supported walkability, which in turn increased informal social contacts compared to a cul-de-sac layout. The finding is also supported by Handy et al. (2006), who showed that socialising and accessibility were significantly higher in traditional neighbourhoods than suburban neighbourhoods. It has also been found that New Urbanist communities’ strengths are associated with more social interaction, higher levels of residential satisfaction and healthier lifestyles within urban environments compared to traditional suburbs and urban hills (Podobnik, 2011). The results suggest therefore that a traditional layout provides an interconnected street system, which creates pedestrian-friendly streets more than conventional loop and curvilinear streets do.

However, studies suggesting that cul-de-sac or dead-end street designs are more conducive to strong neighbourhood ties and children’s unstructured outdoor play because they limit traffic and are thus perceived as safer and more vibrant neighbourhoods (Hochschild Jr, 2013b; Marcus, 2003). While they have been criticised for reducing connectivity, walking and neighbourhood interaction (Lucy and Phillips, 2006; Lund, 2003), it is possible that when cul-de-sacs connect to main roads to a city centre, they enhance accessibility and social cohesion (Hochschild Jr, 2013a). Hence, neighbourhood layout can develop or obstruct opportunities for social connection. For example, studies show that design with good access from housing to communal spaces encouraged resident outdoor activities (Abu-Ghazzeh, 1999) and increased neighbourhood satisfaction (Bonaiuto et al., 2003; Cao and Wang, 2016).
On the other hand, the analysis reveals no significant differences in *Active socialising* between the three types of neighbourhoods. This finding might be seen to contrast with study finding that residents who live in traditional suburbs are more willing to interact socially (Lund, 2002), and that residents are more likely to live in contemporary suburbs if they want more privacy and dependence on a car (Lund, 2002). Moreover, within the Australian context a recent study found that mothers in a low-density outer suburb ranked the importance of relationships with neighbours lower than mothers in high-density inner suburbs (Andrews et al., 2016).

Of course, this thesis has also found that street type, pedestrian environment, neighbourhood connectivity and dwelling type are significantly correlated with numbers of friendships and social interaction frequency. This finding appears at first to be in conflict with a lack of difference between *Active socialising* between the three suburbs. This conflict might be explained by the fact that the role of the socio-demographic variables in determining *Active socialising* is greater than, and independent of, the impacts associated with neighbourhood design, while the analysis of relationships between actual levels of social activity and neighbourhood design did not control for socio-demographic variables.

Thus, this study suggests that inhabitants in older, more established neighbourhoods with layouts designated as traditional have higher levels of *Neighbourhood contentment* and *Accessibility* than residents in newer, conventional loop (curvilinear) suburban neighbourhoods. It may be concluded that, although there was no significant difference in *Active socialising* between the three suburbs, the findings partly support the first hypothesis.
5.4. Impact on social interaction correlates of socio-demographic factors

This thesis hypothesises that socio-demographics factors impact correlates of social interaction in low-density suburbs (H-2). This was tested by analysing the relationships between eight variables and neighbourhood experience factors (Figure 5.3). The findings indicate socio-demographic variables have a significant role in impacting neighbourhood experience factors. Thus, it was expected that social background contributes to residents’ perceptions of their neighbourhood experience. Using Pearson correlation analysis (Section 4.6), which measures the strength and direction of the relationships between
Neighbourhood contentment, Active socialising and Accessibility and socio-demographic variables, it was found that there was strong correlation between length of residence, household tenure, age and Neighbourhood contentment, while number of members in the household, income and level of education had small correlations with Neighbourhood contentment.

These findings are expected and are in line with studies that found that income (Adams, 1992; Bonaiuto et al., 1999; Lee et al., 2017; Parkes et al., 2002; Zhang et al., 2017), long term of residence, household size and age were correlated to neighbourhood satisfaction and attachment (Adams, 1992; Bonaiuto et al., 1999; Comstock et al., 2010; Parkes et al., 2002). They are also consistent with research showing that income, household size and education have positive correlation with neighbourhood satisfaction (Lovejoy et al., 2010).

According to Lewicka (2010), residence time and ownership have been associated with attachment considering increased attachment with increased place scale, controlling the direct effects of length of residence on place attachment. This is not surprising, as residents tend to reinforce closeness to places to which they are attached (Hidalgo and Hernandez, 2001).

Yang (2008) found age is significantly associated with neighbourhood satisfaction. It has been suggested that owners who have longer terms of residence and higher incomes are likely to be more satisfied, attached and actively socialise more than those with shorter residence times (Abu-Ghazzeah, 1999; Brown et al., 2003; Hur and Morrow-Jones, 2008; Mohan and Twigg, 2007).

A positive correlation was also found between length of residence, home ownership, number of household members and number of children with Active socialising.
These findings are in line with many studies that found long-term home-owners with children reported higher values of socialising with their neighbours and community that improved neighbouring (Keller, 1968; Mesch and Manor, 1998; Riger and Lavrakas, 1981; Rogers and Sukolratanametee, 2009; Semenza and March, 2009; Skjaeveland et al., 1996; Unger and Wandersman, 1985). Indeed, the presence of children increases the number of neighbours known in the community and develops local friendships, which in turn strengthens social interaction and sense of community in neighbourhoods (Michelson, 1977; Semenza and March, 2009; Unger and Wandersman, 1985).

In support of this, other studies found that stability of a neighbourhood was positively associated with neighbouring and encouraged socialising between neighbours (Adams, 1992; Brower, 2013; Farrell et al., 2004; Rosenblatt et al., 2009). Additionally, analysis of residents’ interviews revealed similar findings; the respondents who have lived in the neighbourhood long term and have children are more likely to know their neighbours because they have social homogeneity, in terms of tenancy longevity, age and having young children, and thus they are more socially connected with them. All respondents in Belmont described their neighbours as friendly people. In general, they knew their neighbours and chatted or often said hello when meeting them on the street. For example, one respondent stated that:

*Yes, probably, it would be hard to leave this neighbourhood because I have been lived here for so long, twenty-two years. I love the neighbours and I know number of people who live for some long time as well.* (R5-Belmont)

And another that:

*Because I have been living here for ten years, so I have talking with people and chatting with them. Even though I have number of friendships whether in my area or closed*
neighbourhoods, I meet my neighbours also when they go and back to home or when they use their garages. In my area, there is no huge thing that may prevent knowing people. In first years, I found that tricky thing because I don’t know many people but now because I can connect with them especially when my kids like to know my neighbour’s children and sometimes they are playing together, so we need to know people to be involved in local community. (R8-Belmont)

In relation to social homogeneity, one respondent said that:

I find our neighbours are same in terms of social class, age and age of kids, it would affect neighbours’ relations and our neighbour directly beside us have three kids who play with my kids and we often meet their family, we have a lot to share with them. (R6-Belmont).

Another resident reported that:

I have some neighbours from same culture which help to get friendships and other cultures share us many things. My daughters have a dog, so contact with our neighbour’s children about him. In general, our neighbour who are closest to us are amazing neighbours and care to each other. (R4- Waurn Ponds)

On the other hand, the respondents in the modern suburb (Waurn Ponds) are less attached to their neighbourhood and have few social connections; findings that are associated with their short-term residence. However, one respondent stated that despite moving to this street recently, she does not have a problem knowing her neighbours and talking with them or asking for help. Thus, she has positive feelings about her environment and good connections with neighbours, as well as the presence of children to facilitate the construction of friendships.
This finding supports research indicating that age of suburb contributes directly to social interaction. For example, (Williams et al., 2009: 26) found that “the passage of time – making a community takes historical sediment. Relationships are built over time, and suburbs themselves have a life-cycle, so they cannot all have the same depth of community given differences in their age”.

Although income was the variable that was most strongly related to Accessibility, other variables – length of residence, number of household members and education – appeared to have low impact on Accessibility. This finding is similar to that of Bonaiuto et al. (1999), who found income and length of residence in the neighbourhood made significant correlations to Accessibility. Similarly, Byrne and Wolch (2009) found that access to spaces such as parks was influenced by income. While recent research indicated that low income is relatively associated with poor accessibility to safe and well-maintained open spaces (Wang et al., 2015; Wolch et al., 2014), other studies found that those with lower incomes tend to have better access to public parks (Cutts et al., 2009; Lindsey et al., 2001; Nicholls, 2001).

Hence, it has been found that these results support the second hypothesis that social and demographic factors have a robust relationship with social interaction, which suggests that owners with more stability and higher income and education have higher levels of social interaction. Thus, Neighbourhood contentment, Active socialising and Accessibility play a significant role in the elucidation of the correlations between the socio-demographic variables and perceived social interaction. Figure 5.4 shows only significant correlation at (p < 0.01) between the three factors and socio-demographic variables.
5.5. Impact on three neighbourhood experience factors of neighbourhood design characteristics

The results relating to the hypothesised impact of neighbourhood design on social interaction after controlling for socio-demographic variables (H-3) were discussed in Section 4.7. The hypotheses were tested by analysing the relationships between five groups of physical design characteristics: street layout; pedestrian environment; neighbourhood connectivity; public space provision; and dwelling form.

Thus, the following five sections, 5.4.1–5.4.5, discuss the five hypotheses that explore the power of the five physical variables in predicting the three neighbourhood experience factors: Neighbourhood contentment, Active socialising and Accessibility.
Figure 5.5: Regression analyses - Investigating the power of the five groups for predicting each of the three neighbourhood experience factors (each coloured arrow is representative of five-regression analysis)

5.5.1. Impact on social interaction of street layout

Figure 5.6: Regression analysis for predicting social interaction from street layout (significant predictors shown with solid lines and non-significant predictors with dotted lines; thicker arrows show stronger predictors)
Hierarchical regressions examined the power of street type, traffic flow and on-street parking in predicting \textit{Neighbourhood contentment}, \textit{Active socialising} and \textit{Accessibility}. This was tested by analysing the relationships between nine variables and \textit{Neighbourhood contentment}; seven variables and \textit{Active socialising}; and seven variables and \textit{Accessibility} (Figure 5.6).

The results indicate that street layout significantly predicted \textit{Neighbourhood contentment} after accounting for socio-demographic variables: length of residence, household tenure, age, income, number of household and level of education. However, only length of residence, income and street type significantly predicted \textit{Neighbourhood contentment}. Street type was the stronger determinant variable in predicting \textit{Neighbourhood contentment}. Thus, although length of residence and income are significant predictors of \textit{Neighbourhood contentment} in both models, street type was the best contributor compared to length of residence and income.

The result of the power of street type, traffic flow and on-street parking in predicting \textit{Active socialising} indicate that street layout did not significantly predict \textit{Active socialising} after accounting for the socio-demographic variables: length of residence, household tenure, number of children and number of household members. Only length of residence and number of children were consistently the best positive predictors of \textit{Active socialising} in both models. Thus, length of residence and number of children showed a unique influence on \textit{Active socialising}.

The results of the third hierarchical regression indicate that street layout significantly predicted \textit{Accessibility} after accounting for socio-demographic variables: income, length of residence, number of members in household and level of education. Both income and street type were significant contributors to perceived \textit{Accessibility}, while
traffic flow and on-street parking were not associated with Accessibility. These findings largely support the hypothesis that street layout has impacts on correlates of social interaction (H-3-1) (Figure 5.7).

The results reveal that street type is related to the creation of safe streets and inspires residents to be more emotionally attached to their physical environment. The findings also indicate that street type could effectively contribute to the creation of places for resident interaction, which in turn enhances sense of community. This is consistent with studies that found residents who live in traditional streets layout are more likely to have strong attachment and satisfaction with their neighbourhood (Kim and Kaplan, 2004; Lovejoy et al., 2010; Marcus, 2003). A cul-de-sac layout is generally used by developers because of the flexibility of planning and housing layouts that can encourage social networks and neighbourhood interaction (Hochschild Jr, 2013a), reduce incidence of crime and provide a safer and quieter place than grid streets (Distel, 2015). However, research indicates that a grid street layout strengthens high social interaction because it improves street permeability, allows more accessibility for pedestrians, enhances safety, and encourages walking and more face-to-face interaction within the street environment (Cozens and Hillier, 2008; Lund, 2002; Thompson and Kent, 2014).

These findings are also supported by the interviews with residents who reported their perceptions of their streets and neighbourhoods. The respondents in Belmont believed that their streets were very attractive and they had emotional attachment to their neighbourhood. Moreover, they stated that it would be hard to leave their streets and neighbourhood and they would prefer to live in the same area, even if that meant moving from their current street. In contrast, although respondents in Waurn Ponds chose their street for its good location, they would not find moving from their area hard, particularly
if they found a safer environment that was close to their current area in relation to their
work and children’s school and with access to better facilities. As one respondent said:

*Probably, yes, I think If we can find better place that close to city and school because as*I
said I have kids and we will need house that quite close to school for them, this can be
more comfortable and safer specially to do everything easily like going to shopping and
sport club.* (R7- Waurum Ponds).

The finding that street layout was not a significant contributor to *Active socialising*
is consistent with that of Mayo Jr (1979), who found that neighbouring was not different
between cul-de-sac, grid and curvilinear street patterns. In contrast, other studies have
found that casual contacts and interactions are linked to the layout, design of streets, and
connectivity (Abu-Ghazze, 1999; Gehl, 2010; Rosenblatt et al., 2009; Skjaeveland and
Garling, 1997; Thompson and Kent, 2014; Unger and Wandersman, 1985; Whyte, 1980),
and hence support a sense of community (French et al., 2013).

In relation to the interview findings, most respondents stated the reasons for
choosing to live in their streets essentially related to perceptions of the neighbourhood
because it was a safe area, quiet, close to the city centre, playgrounds, schools and the
river, and close to family. As one respondent said:

*I have young children so I prefer to be in street that has no very busy traffic. I have been
lived here for four years. Initially, I chose this street for location but now it also because
the people and neighbours.* (R6- Belmont).

Another resident reported that:

*Well, I love this street, I have nice view that really attracted me to this house and live in
this street and it a nice open house, a friendly street with mixture people that all young,
yes, it is a nice at all, I really like this street.* (R2- Grovedale).
Accessibility appeared to be significantly predicted by the street layout, which indicates that street type plays a major role in the perception of the quality of residential connectivity with other neighbourhood spaces and can provide greater pedestrian flows. Such findings also suggest pedestrian-oriented streets with short blocks provide residents many choices to reach their destination and facilitate access to their neighbourhood, which in turn creates more opportunities for socialising. This is also consistent with my results (Section 4.5) that Accessibility is significantly associated with traditional layout. The result is consistent with previous studies indicated that neighbourly interaction is related to interconnected pedestrian streets and neighbourhood accessibility (Hochschild Jr, 2013a; Talen, 2011).

Interviews revealed how accessibility is important in attracting them to live in their street:

Because it quite close to shopping centre and shops have around and can go to cinemas, close to the beach as well but still in the city. It is like easy to go somewhere and I get family around and can find help, you know don’t get the kids away. (R2- Grovedale).

Additionally, layout can impact socialising via influences on travel behaviour. For example, a more pedestrian-friendly streets layout leads to greater chances of social interaction in the streets and contributes to sense of community, where social interaction can be measured by the number of pedestrian contacts (Barton, 2013; Francis et al., 2012; Rogers and Sukolratanametee, 2009). Few studies have identified how design addresses the role of street layout to enhance suburban environment and which street type has a greater contribution to connectivity. However, other research has recognised that neighbourhood street networks, which are characterised by a grid street type with short blocks, encourage walking and create friendly residential environments compared to disconnected and curvilinear street types (Lund, 2002).
However, while this study also found traffic flow in residential streets and on-street parking had no effect on the neighbourhood experience factors, this is counter to the general view that, as traffic reduces safety, people tend to withdraw from involvement in their neighbourhood. For example, Appleyard et al. (1981) argued that traffic negatively influences all features of perceived liveability: absence of noise, social interaction, quality of the street environment and safety. Indeed, it is found that heavy traffic is associated with less attachment and less social interaction (Bramley and Power, 2009). Car parking and traffic can also negatively affect perceptions of sociability and safety (Wood et al., 2010), and neighbourhood satisfaction (Howley et al., 2009; Hur and Morrow-Jones, 2008; Lee et al., 2017).

(Kim and Kaplan, 2004) argued that on-street parking is associated with unsafe walking and driving, while they found that on-street parking was the least important of characteristics that impact a sense of community. The inconsistency here with previous findings might simply be because none of the streets surveyed in this thesis had particularly high rates of traffic flow and on-street parking.

Figure 5.7: Regression analysis for predicting social interaction from street layout (Only the significant predictors are shown).
5.5.2. Impact on social interaction correlates of pedestrian environment

Hierarchical regression explored the power of footpath provision, nature strip and tree coverage in predicting *Neighbourhood contentment*, *Active socialising* and *Accessibility*. This was tested by analysing the relationships between nine variables and *Neighbourhood contentment*; seven variables and *Active socialising*; and seven variables and *Accessibility* (Figure 5.8). The results indicated that the pedestrian environment significantly predicted *Neighbourhood contentment* after accounting for socio-demographic variables. While length of residence and income significantly impacted *Neighbourhood contentment*, tree coverage and footpath provision were found to be the best predictors of *Neighbourhood contentment*.

The results of the hierarchical regression that explored the power of footpath provision, nature strip and tree coverage in predicting *Active socialising* indicated that pedestrian environment was not significant in predicting *Active socialising*. While the three physical
variables (footpaths, nature strips and tree coverage) significantly correlated with *Active socialising*, the three physical variables had no significant prediction after accounting for socio-demographic variables. Thus, length of residence and number of children still contributed significantly to *Active socialising* in both models.

The results of the hierarchical regression that investigated the power of footpaths, nature strips and tree coverage in predicting *Accessibility* indicated pedestrian environment was not significant in predicting *Accessibility*. The findings show that income is a much stronger predictor of *Accessibility* in the first and second model. This suggests that inclusion of income reduced the impact of pedestrian environment and this revealed no significant change in predicting *Accessibility*. However, tree coverage significantly predicted *Accessibility*.

Thus, these findings in part support the hypothesis that the pedestrian environment can impact correlates of social interaction (H-3-2) (Figure 5.9). The findings suggest that *Neighbourhood contentment* is higher with more trees and the presence of footpaths on both sides of the street, compared to streets with no footpaths. This concurs with previous research that pedestrian friendly neighbourhoods features can encourage residents’ pedestrian activities, which in turn increases attachment and satisfaction with neighbourhood, promotes social interactions than less transit-oriented neighbourhoods (Freeman, 2001; Lund, 2002; Rogers and Sukolratanametee, 2009), and create a safe and sociable environment (Gehl, 2010).

Increased trees and grassed areas also attract more people to use streets (Lovejoy et al., 2010; Sullivan et al., 2004), and are positively associate with neighbourhood satisfaction (Hur and Morrow-Jones, 2008; Kearney, 2006; Kweon et al., 2010; Zhang et al., 2017). This finding also reinforces previous research that claimed physical design is
related to level of satisfaction with neighbourhood environment (Grogan-Kaylor et al., 2006; Hur and Morrow-Jones, 2008; Leslie and Cerin, 2008), which in turn determines residents’ settledness and induces them to socialise with others (Hur and Morrow-Jones, 2008).

Research has claimed that a pedestrian environment maintains place-making features such as aesthetics, sense of enclosure, permeability and legibility. This is due, for example, to tree coverage that defines the space horizontally by visually completing an area of open space and vertically by creating greenery shading (Ewing and Clemente, 2013).

These results are reinforced by the interview results, which show that all respondents recognised the significance of the greenery in their street. They believed that a lot of trees and grass are important features for creating an aesthetic, attractive and clean environment, and shaping a habitat for birds alongside the presence of footpaths for improving the quality of neighbourhood and thus satisfaction. For example, one respondent in the established suburb (Belmont) with the greatest provision of greenery mentioned that:

*I think yes, the gardens really important to me and beautiful trees around and I just think it very pleasant place and I enjoy the greenery and the well maintain by the council and around the river.* (R1-Belmont).

Another resident mentioned that:

*Living in wide street with a lot of trees that really look very beautiful particularly in summer because they all green and lawn in around that make street is very cosy and in winter we have some trees that shape habitat for birds, which really fan and that also make me feel more attach.* (R6- Belmont).

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While all respondents in Belmont were satisfied with the number of trees in their streets and gardens, the respondents in Waurn Ponds complained about the lack of greenery due to the new area, which still requires landscape development. As one respondent complained:

*There is not really lots at the moment, so unfortunately, they really developed the greenery and the trees. Trees create nice area for living and make the neighbourhood but unfortunately, we don’t have a lot now and hopefully after years having more if gives a time to be more developed.* (R3-Waurn ponds).

It should be acknowledged that tree coverage increases with tree maturity and hence increases with the age of the suburb.

For instance, one resident in the oldest suburb highlighted that:

*I have been for long time with people in the street, so I am happy with all features. It’s attractive wide street with birds and a lot of trees that look pleasant, so I satisfy and hard to move and leave a lot of friend that I knew.* (R5- Belmont).

The findings indicating that pedestrian environment had no significant impact on *Active socialising* are inconsistent with previous research that showed pedestrian environment facilitates interaction. For example, footpaths and street trees improve the perception of residents towards their neighbourhood (Bonaiuto et al., 1999; Kim and Kaplan, 2004) and thus it is possible that interactions can develop between residents through providing outdoor spaces (Gehl, 1986). Prior research also indicates that provision of trees and landscape features strengthen sociability in the neighbourhood and provides health benefits through improved connection with nature. Trees also strengthen social ties and sense of place by creating places for social interaction (Coley et al., 1997;
Additionally, Sugiyama et al. (2008: 5) argued that “shade provided by trees may also encourage being outdoors in hotter climates”.

However, it is argued that social interaction in contemporary suburbs is more likely to take place in home spaces than outdoors because the perception is that for residents of suburbs, privacy and car dependence are highly valued. Thus, housing developers are less inclined to consider provision of footpaths, corner shops and parks in subdivisions of suburbs, which makes social interaction more likely to occur by invitation, not by chance encounter (Leyden, 2003). It should also be noted that some developers in contemporary suburbs can also place covenants on what is allowed to be planted, which in turn affects social interaction opportunities (Andrews et al., 2014).

This suggests that the design of a suburban neighbourhood should consider the provision of certain physical design characteristics to reduce the amount of driving and improve people’s perceptions of their area.

Figure 5.9: Regression analysis for predicting social interaction from pedestrian environment (Only the significant predictors are shown).
5.5.3. *Impact on social interaction correlates of neighbourhood connectivity*

Hierarchical regression examined the power of connectivity by walking and connectivity by transport in predicting *Neighbourhood contentment*, *Active socialising* and *Accessibility*. This was tested by analysing the relationships between eight variables and *Neighbourhood contentment*; six variables and *Active socialising*; and six variables and *Accessibility* (Figure 5.10). The results indicated that neighbourhood connectivity significantly predicted *Neighbourhood contentment* after accounting for socio-demographic variables. Although neighbourhood connectivity significantly predicted *Neighbourhood contentment*, only length of residence, income and household tenure significantly contributed to *Neighbourhood contentment* in both models (but was much stronger in the first model). However, while connectivity by walking and connectivity by transport did not predict *Neighbourhood contentment*, the findings indicate that neighbourhood connectivity was significantly associated with *Neighbourhood*
contentment. This suggests that neighbourhood connectivity improves perceived Neighbourhood contentment, also indicates that controlled variables reduce the individual contribution of neighbourhood connectivity variables.

The results of the hierarchical regression that examined the power of connectivity by walking and connectivity by transport in predicting Active socialising indicate that neighbourhood connectivity cannot significantly predict Active socialising after accounting for socio-demographic variables. Length of residence and number of children predicted Active socialising in first and second steps.

The hierarchical regression that examined the power of connectivity by walking and connectivity by transport in predicting Accessibility shows that neighbourhood connectivity did not predict Accessibility after controlling for socio-demographic variables. Although both variables significantly correlated with Accessibility, neither connectivity by walking nor connectivity by transport made significant individual contributions to Accessibility.

These findings partially support the hypothesis that neighbourhood connectivity impacts corelates of social interaction (H-3-3) (Figure 5.11). Such findings are congruent with research suggesting that connectivity improves the pedestrian environment, which is commonly associated with neighbourhood attachment (Lund, 2002), and enhances perceived residential environment characteristics associated with residents’ satisfaction (Bonaiuto et al., 1999; Cao and Wang, 2016; Hur and Morrow-Jones, 2008).

While neighbourhood connectivity might have been expected to impact on Active socialising and Accessibility, this was not found to be the case. Instead, the results (Section 4.7.3) showed that neighbourhood connectivity had no significant impact on Active socialising and Accessibility, and further supported the hypothesis that other physical
features of neighbourhood appear to be more important. These results are in contrast with previous research that claimed connectivity to attractive walking destinations in traditional suburbs with a safe environment was more likely to provide opportunities for socialising compared to conventional suburbs (Handy et al., 2006; Lund, 2002; Wood et al., 2008). For example, residents living in walkable neighbourhoods were more likely to know their neighbours and be socially interacted (Lund, 2003; Podobnik, 2011).

This is also reflected in residents’ experience of walking around their neighbourhood:

*Ok, there is nothing not pleasant to walk in my street, it’s very quiet and nice, there is a lot to see like other parks around so, there always many things are pleasant to see, beautiful trees to look at and everybody walking with the dog, and doing something like that, so it is quite nice to walk and in the evening if the weather nice can go outside because everybody happy if weather is a nice, yes, it's beautiful.* (R1- Belmont).

However, while it has been suggested that a walkable neighbourhood is positively related to social interaction by providing social spaces and reducing the sprawl effect in suburban areas (Frumkin, 2003; Leyden, 2003), walkability is more complex than usually defined and factors influencing neighbourhood sociability extend beyond issues of urban form (Du Toit et al., 2007). However, studies indicate that neighbourhoods with a pedestrian-oriented environment and good street networks improve *Accessibility*, which in turn influences social connectedness (de Jong et al., 2013; Lund, 2002). Similarly, argued that *Accessibility* associated with pedestrian friendliness might lead to reduced car dependence (Handy et al., 2005), as connected walking environments increase accessibility and enhance walkability of community members (Abley, 2005; Handy et al., 2006). At the same time, accessibility was found to facilitate more walking in
neighbourhood spaces (Owen et al., 2004). This argument is supported by recent research indicating residents preferred walkable neighbourhoods in relation to provision of greenery, pedestrian infrastructure and amenities within walking distance (Brookfield, 2016).

Despite the findings showing that neighbourhood connectivity had no significant association with *Active socialising* and *Accessibility*, most of the interviewees in the three suburbs stated that they would like to walk in streets especially with wide, safe and quite footpaths, presence of parks and the river, seeing people walk with their children or dogs, and scenery that can be enjoyed. In addition, all of these aspects encouraged them to go out and see neighbours while walking. They also felt safe during the day and relatively safe at night with claims that improved lighting helps to increase safety at night. One respondent, for instance, said that:

> As I said it pleasant to walk, it’s one reason to why I like it, I just walk down to the river and around, and I move other way from the bridge and there is usually a lot of people walk and I say hello even I don’t know them but it is very friendly atmosphere seeing people walking along the river. I don’t usually walk at the night time or go out in the evening but If I come late I do feel quite safe in this area because it very settled, there are no much people leave this for long time. So, I don’t feel unsafe. (R1- Belmont).

Another respondent from a modern suburb also stated that:

> Well, it seems very quiet neighbourhood and see young families walk night and walk the dogs, I always see people walk which suppose they feel safe in their area because other people around at same time, and there is not a lot of a traffic, which is good and I suppose when see neighbours walk that make me feel a lot safer. (R3- Waurn Ponds).
It can be suggested that neighbourhoods with a high level of safety have high levels of Neighbourhood contentment and Active socialising regardless of neighbourhood characteristics not related to feeling safe. This is due to social interaction being dependent to a high degree on neighbourhood safety. If residents feel physically unsafe in the streets, they withdraw from the outdoors, which leads to weak social ties and minimises sense of community (French et al., 2013; Rogers and Sukolratanametee, 2009).

While the results indicated that connectivity by transport did not predict neighbourhood experience factors, other research argued that provision of transport has a significant role in improving accessibility and proximity, and those features jointly impacted residents’ satisfaction and facilitated interaction directly compared with poor transport services (Dempsey et al., 2010; Kelly et al., 2012).

![Diagram](image.png)

Figure 5.11: Regression analysis for predicting social interaction from neighbourhood connectivity (Only the significant predictors are shown)
Hierarchical regression examined the power of provision of open and community spaces in predicting the three neighbourhood experience factors: *Neighbourhood contentment*, *Active socialising* and *Accessibility*. This was tested by analysing the relationships between eight variables and *Neighbourhood contentment*; six variables and *Active socialising*; and six variables and *Accessibility* (Figure 5.12). The results indicated that public space provision significantly predicted *Neighbourhood contentment* after accounting for socio-demographic variables. Provision of open spaces, number of community spaces, length of residence and income significantly predicted *Neighbourhood contentment*. However, provision of open spaces was shown to be the best predictor in this model compared to number of community spaces, length of residence and income in the second step. On the other hand, another finding indicated that public spaces cannot significantly predict *Active socialising* after accounting for socio-demographic variables.
Only length of residence and number of children continued their predictive power in the first and second models.

The results of the third hierarchical regression indicated that public space provision significantly predicted *Accessibility* when socio-demographic variables were controlled for. However, the findings revealed that income and provision of open spaces significantly contributed to *Accessibility*, whereas number of community spaces had no significant predictive power.

The findings support the hypothesis that public spaces can impact correlates of social interaction (H-3-4) (Figure 5.13). These results reinforce the findings of previous research indicating provision of open and community spaces and community services within walking distance has a key role in fostering residents’ attachment and satisfaction in their neighbourhoods and thereby advancing social interaction (Bonaiuto et al., 1999; Cao and Wang, 2016; Hur and Morrow-Jones, 2008; Kearney, 2006; Raymond et al., 2010; Thompson and Kent, 2014). For example, perceived provision and quality of open green spaces were found to be strong predictors that fostered attachment and satisfaction. These results also support the theory that the presence and quality of community services (Bonaiuto et al., 2015; Howley et al., 2009; Zhang et al., 2017) and public and open space qualities can address issues of sociability via easy access, connection with surrounding community, attractive scenery and providing peaceful environments, as all these features are associated with social interaction (Brookfield, 2016; Francis et al., 2012). It is claimed that public open spaces with easy access and the use of these spaces involving seeing and meeting people facilitate interactions, create more familiarity between people and stimulate a feeling of attachment (Peters et al., 2010; Rogers and Sukolratanametee, 2009; Skjaeveland and Garling, 1997; Uslu, 2010). It has also been suggested that the use of
public open spaces is more significant to neighbourhood attachment than personal large lots (Rogers and Sukolratanametee, 2009).

In the modern suburb, one respondent valued the presence of public spaces:

*We bought this house when we looked for new one, wide street, close to shopping centre and train station, as well as close to playground, we need actually to clean environments and safe street although the lack of plants and seats, still I can go with my kids to play and spend time with friends who come as well with their children.* (R7- Waurn ponds).

Recent research also found that physical features, particularly proximity, a pleasant walking experience and a sufficient number of open spaces such as parks in the neighbourhood, are the most important factors influencing perceived *Accessibility* (Wang et al., 2015). Although the number of community spaces did not show a significant relationship with *Accessibility*, the presence of community spaces within walking distance has been found to be related to *Accessibility* in neighbourhoods (Lovejoy et al., 2010; Lund, 2002), which in turn improves the sustainability of the neighbourhood and facilitates health-enhancing behaviours (Giles-Corti et al., 2013). However, within the Australian context one study found that higher proportions and more accessible green spaces may not improve residents’ attachment to their local community (Kimpton et al., 2014). Zhang and Lawson (2009) also found the size and number of public spaces were not significantly associated with social interaction but that it is the quality of the public spaces that is key to social interaction. Further research might practically explore whether such environmental and aesthetics qualities of public and open spaces facilitate accessibility in neighbourhoods.

In line with these results, interview respondents valued the provision and proximity of public spaces, in particular closeness to schools and city centre shopping
areas. One respondent highlighted how the provision of public spaces and facilities was significant to their selection of their neighbourhood:

*It is a wide a street and it is very close to school, it’s just walking distance to surrounding school, there are few playgrounds in the area and it also very close to river and close of city centre of Geelong and close work and easy access to ring road that connect to Melbourne as well.* (R6- Belmont).

The insignificance of public spaces in perceived Active socialising contradicts previous research on the significance of public spaces in encouraging socialising with neighbours. Earlier research argued that public spaces facilitate casual encounters among neighbours (Talen, 2000). Research found that the presence of public spaces such as common green parks and organisations within walking distance are the most important factors that determine social interaction (de Jong et al., 2013; Krellenberg et al., 2014; Rosenblatt et al., 2009; Uslu, 2010) and thereby a sense of community (Francis et al., 2012). Although these variables cannot predict Active socialising, they may contribute through qualities such as easy access, safety and visual attractiveness, which in turn improves residents’ perceptions of their neighbourhood (Francis et al., 2012; Peters et al., 2010). For example, more green space is associated with walkability, social cohesion and social interaction, while the number of these spaces was not significant to social interaction (Sugiyama et al., 2008). In other words, physical features of public space might impact a feeling of being a community by their qualities, such as location, aesthetics and pleasing walking and frequency of use, rather than merely by the presence of a public space (French et al., 2013; Peters et al., 2010; Raman, 2010; Wang et al., 2015).
5.5.5. Impact on social interaction correlation of dwelling form

Figure 5.14: Regression analysis for predicting social interaction from dwelling form
Hierarchical regression examined the power of dwelling form variables – dwelling setback, garage on façade, fence height and dwelling type – in predicting: Neighbourhood contentment, Active socialising and Accessibility (Figure 5.14). The results indicated that dwelling form significantly predicted Neighbourhood contentment after accounting for socio-demographic variables. However, only length of residence, income and dwelling type made a statistically significant contribution to the total $R^2$ and predicted Neighbourhood contentment.

Dwelling form was not significant in predicting Active socialising after accounting for socio-demographic variables. Only length of residence and number of children remained the best predictors of Active socialising in the first and second steps. The results for Accessibility indicated that dwelling form was not a significant predictor of Accessibility when income, length of residence, number of members in household and level of education were controlled for. While dwelling type was the only physical variable that significantly contributed to Accessibility, the predictive power was small compared to that of income, which seemed to be the best predictor in the first and second steps. This finding suggests that income makes a stronger contribution to Accessibility than dwelling form.

These findings partially support the hypothesis that dwelling form impacts correlates of social interaction (H-3-5) (Figure 5.15).

The results found that longer terms of residence are important to Neighbourhood contentment. However, of the dwelling form variables (dwelling setback, garage on façade, average fence height and dwelling type), only dwelling type significantly contributed to Neighbourhood contentment, with higher levels of contentment associated
with lower levels of detached houses. However, dwelling type has only a small impact on Neighbourhood contentment compared to length of residence. Most of the dwellings in typical Australian suburbs are detached houses, which is consistent with the proportion of streets surveyed (between 80% and 100% in streets) but the findings suggest that semi-detached houses with shared access are associated with higher levels of Neighbourhood contentment. It may be that in Australian low-density suburbs, the greater separation of detached houses leads to a lack of connection between residents, which in turn results in reduced levels of neighbourhood satisfaction. Thus, residents perceive semi-detached houses as places that provide physical proximity and create more semi-private spaces for causal social interaction with neighbours. The finding is in contrast with those of Parkes et al. (2002) and Yang (2008), who found that residents in detached houses were more satisfied with their neighbourhoods, whereas, Mohan and Twigg (2007) found that whether a house is detached or semi-detached has no association with neighbourhood satisfaction, but terraced houses are negatively associated with neighbourhood satisfaction. However, a recent study by Lewicka (2010) indicated that housing type, whether apartments or detached houses, was one of the significant environmental predictors of attachment to neighbourhood.

The findings of this study are also inconsistent with interview results that showed residents valued living in detached houses more than semi-detached, and linked their satisfaction, residential choice decision and feeling of safety to dwelling type. For example, one respondent stated that:

*I feel quite safe in my street because in this area there is not a lot of units and where I live there are homeowners and there are no rentals like in the next streets over.* (R5- Belmont).
However, only one resident mentioned a reason for selecting living in a unit that was part of a clustered single-entranced group:

*I wanted to buy a unit, and this consisted of five units that are safe. I have been here for five years and I hope this safe environment because I get away quite a lot, I feel don’t want to have many problems like burglaries.* (R1- Belmont).

Although dwelling form variables did not significantly affect *Active socialising*, previous findings showed that dwelling types with semi-private spaces provided more chances for social contact and encouraged residents to be more dynamically engaged with their neighbourhood (Kim and Kaplan, 2004; Marcus, 2003; Talen, 1999). For example, Gehl (1980) found in lively residential streets, outdoor activities for all age groups occurred in the edge of the street, which is the semi-private area directly adjacent to the dwellings. This is also supported by research indicating dwelling type, particularly row houses, contributed to social interaction and encouraged social life on the street more than multi-storey houses (Macdonald, 2005).

While the study findings indicate that dwelling setback did not significantly predict neighbourhood experience factors, previous research claimed that the distance between the dwelling and outdoor spaces, such as streets and footpaths, was the influential element on social interaction and privacy (Lindsay et al., 2010). For instance, in a study of Melbourne inner suburbs Gehl (1977) has suggested that a reasonable distance of setback is between 3 and 4.5 m, which provides privacy for residents and facilitates social interaction with neighbours or other people in their street.

The finding that garage location did not significantly affect social interaction contrasts with the research of Rogers and Sukolratanametee (2009), who argued that highly visible garages were associated with less pedestrian-friendly neighbourhoods and
were described as a barrier to social connectedness (Kelly et al., 2012; Williams et al., 2009). Other research found that communal car parking associated with shared yards in a housing area contributed to unplanned social interaction (Abu-Ghazzes, 1999; Marcus and Sarkissian, 1986).

Moreover, fences have been found to have a significant impact on social interaction (Brower, 2013) through their role in forming territorial signs through enclosure and defining the area between private and public spaces, whether spatially or symbolically and visually, in urban and suburban settings (Al-Homoud and Tassinary, 2004; Ewing and Handy, 2009). Moreover, in outer Australian suburbs that depend on cars, studies found that residents who used the garage and unfenced front yards to enter the house had less casual contacts with neighbours compared to inner suburbs (Andrews et al., 2015; Williams et al., 2009).

Figure 5.15: Regression analysis for predicting social interaction from dwelling form (Only the significant predictors are shown)
The overall findings on the power of the five categories of physical design characteristics in predicting the three neighbourhood experience factors, when controlling for socio-demographic impacts, largely support Hypothesis 3 that neighbourhood design impact correlates of social interaction variables. More precisely, it can be concluded that physical design can improve social interaction via its impact on perceptions of Neighbourhood contentment and Accessibility, but has limited impact on Active socialising after control for socio-demographic variables. Although length of residence had the greatest influence on Neighbourhood contentment, physical variables such as provision of open spaces, street type, numbers of trees, numbers of community spaces and footpath provision had the greatest impact on Neighbourhood contentment. Open space and street type were the strongest predictors of Accessibility, more than the significant influence of income, while tree coverage and dwelling type had the same predictive power as income. However, it was found that physical design did not influence Active socialising with the intervention of length of residence and number of children, which in previous research has consistently been found to more significantly predict Active socialising than physical design. Length of residence and number of children accounted in the results for more variance in Active socialising than any physical characteristics of the urban environment.

Thus, social background significantly impacts Active socialising and has independent influence compared to physical design variables. This also suggests that inclusion of physical variables cannot reduce the contribution of social and demographic factors: length of residence, number of children and income. It should, however, be noted that much research has shown that physical design has a significant relationship with social interaction. This is supported by the study interview results, since all interview respondents considered the location, access in the neighbourhood and presence of physical
variables theorised to facilitate interaction, such as trees, parks and walkable streets, in selecting their place, as well as social factors such as the amount of time spent in a neighbourhood and other non-environmental variables.

Furthermore, the results show that physical variables affecting neighbourhood experience factors differ in their prediction power. Of the 14 neighbourhood design variables, provision of public and open spaces, street type and tree coverage were much more significant influences on Neighbourhood contentment than length of residence and income level, while open spaces and street type had equal influence to income in predicting Accessibility. This in turn suggests that overall design of neighbourhoods can have a strong role in the perception of the factors that improve social interaction, even after controlling for socio-demographic and other characteristics in the context of low-density suburbs. Although the findings support the importance of physical features, the results of the interviews reveal that residents consider safety and neighbourhood attractiveness as critical determinants of choice of their residential location, and that social background is important as well.

In high-density contexts, the provision of open spaces, street type, tree coverage, connectivity and dwelling type have also been found to be associated with residential satisfaction (Bonaiuto et al., 1999; Cao and Wang, 2016; Hur and Morrow-Jones, 2008; Parkes et al., 2002), public transport and accessibility to city centre have a positive association with neighbourhood satisfaction (Mouratidis, 2017). Moreover, in Australian urban higher density neighbourhoods, it has been found that dwelling position, noise, community involvement, traffic rates, crowding and availability of parking significantly predicted residential satisfaction (Buys and Miller, 2012). Some of the variables previously found to influence residential satisfaction in Australian low-density contexts
differ from those that this thesis has found to be important. For instance, increased traffic rates have been found to impact resident satisfaction and perceived liveability in outer suburbs (McCrea and Walters, 2012), and it has been found that sense of community is positively associated with walking for transport (French et al., 2013). Higher proportions and proximity of residents to green spaces have also been shown not to improve residents’ attachment to their local community as much as other community characteristics such as social ties and ethno-racial heterogeneity (Kimpton et al., 2014). Hence, further research is needed to compare the impact of physical design features on residential satisfaction and other neighbourhood experience factors between lower density and higher density suburbs. The results suggest: (1) residential satisfaction with physical characteristics can increase social stability, determine resident location preferences and improve quality of life; (2) social interaction can be facilitated through suburban planning; and (3) pedestrian-oriented environments can meet the goal of community sustainability. Moreover, identifying the essential factors that support sustainable community in suburbs can provide understanding for future urban design and planning, and in turn offer insights into how contemporary neighbourhoods are functioning in low-density suburban residential contexts.

5.6. Social activity

As stated in Section 4.8, there is a strong correlation between three groups of variables: (1) the three social activity independent variables; (2) the three neighbourhood experience factors; and (3) the neighbourhood design characteristics (H-4). Social activity variables – social connections, friendships and places of interaction – have two directions of influence relationships (Figure 5.16). The following discussion addresses the relationships between these three groups of variables.
5.6.1. Relationship between actual levels of social activity and the three neighbourhood experience factors

According to H-4-1, it is hypothesised that levels of social activity impact correlates of social interaction. It was found from correlation analysis, which measures the strength and direction of the relationships between the levels of social activity and three new factors of social interaction, that there was a significant positive correlation between Neighbourhood contentment and all six measures of social activity: (1) number of people known by name in a suburb; (2) number of people known by name in the street; (3) frequency of visits to people in the neighbourhood; (4) frequency of social interaction; (5) interaction around housing; and (6) interaction around the neighbourhood. Of these six measures of social activity, only interaction around housing was not significantly correlated with Active socialising, suggesting that social interaction in suburbia does not take place immediately adjacent to houses. This is confirmed by the social activity data indicating that the majority of residents in the three suburbs socially interacted in places such as streets, footpaths,
cafes and local shops. These findings strongly reinforce the importance of such places of activity in Australian suburbs, where lack of density, and thus greater spatial separation of predominantly single-detached houses, make interaction between neighbours less likely. However, it also suggests that other dwelling groupings that allow for neighbourly exchange, such as terraces, low-rise apartments, clustered layouts and semi-detached houses, could make for better connected residents in these contexts.

There was significant correlation between Accessibility and frequency of social interaction in the neighbourhood and around housing, evidencing the relationship between accessibility and social opportunity, and confirming the validity of accessibility measures as social indicators (Forkenbrock et al., 2001; Geurs and Van Wee, 2004). Accordingly, it can be interpreted that residents who have more social connections and friendships are more likely to have more interaction with neighbours, particularly when interactions take place around the neighbourhood. This is confirmed by the results that indicate the majority of residents in the three suburbs socially interacted in streets, footpaths, and cafes and local shops. Additionally, the findings that interaction spaces, whether around housing or neighbourhood, are strongly correlated with neighbourhood experience factors are reinforced by the results of regression (Section 5.5.4.), indicating that public space provision significantly impacts social interaction.

The findings on the relationships between neighbourhood quality and social activity measures are in line with those of Hur and Morrow-Jones (2008) who found that residents with higher neighbourhood satisfaction had higher interaction through social activities, and vice versa. Social ties have direct effect on residents’ satisfaction and sense of community (Chavis and Wandersman, 1990; Skjaeveland et al., 1996) and neighbourly interaction is strongly correlated with satisfaction with neighbourhood (Mohan and
The finding that the number of people known impacts *Neighbourhood contentment* is also consistent with studies by Mesch and Manor (1998), and by Semenza and March (2009), who found that neighbourhood attachment increases with higher numbers of friends who are neighbours.

The patterns of social activity were confirmed by the interviews, in which some residents stated their desire to be involved with neighbours and community members, particularly in open and public spaces, even though most of these interaction opportunities are focused on general greetings. For example, one respondent said that:

*It’s pleasant to see people and have small chatting. Sometimes meet them at cafe or shops even people from other blocks can meet them in common areas.* (R8- Belmont).

However, interviews revealed that meaningful activities and interaction also take place in semi-private places such as gardens:

*Because I am doing garden in different time and see people that stop to look to my garden. These few things to do in neighbourhood like social community activities and that’s also help as well, and I don’t think this about design but about just more structure of suburb.* (R5- Belmont).

### 5.6.2. Impact of neighbourhood designs characteristics on actual levels of social activity

According to H-4-2, it is hypothesised that levels of social activity are impacted by urban design characteristics. The findings show strong correlation between levels of social activity and some physical urban design features. For, the number of people known by name in suburb and street and frequency of social interaction in neighbourhood are greater:

- with increased provision of open space
• with increased connectivity by walking and transport
• with better pedestrian environments through increased provision of footpaths, nature strips and tree coverage
• with higher numbers of semi-detached (as opposed to detached) houses; and
• when streets are of the traditional grid layout and thus better interconnected due to lower levels of cul-de-sac streets.

The finding that greater numbers of semi-detached dwellings increased numbers of people known by name and also frequency of socialising is aligned with research arguing that housing layouts with close proximity between neighbours lead to increased sociability by providing greater opportunity for interaction (Abu-Ghazaleh, 1999; Patricios, 2002; Williams, 2005). Similarly, Gehl (1987) and Marcus (2003) found that the majority of long-period activities in residential streets occurs in shared outdoors spaces, which Gehl (1987) calls “soft edges,” such as entrances and front yards.

According to (Abu-Ghazaleh, 1999: 57) “the more diverse the places designed for pedestrian use were, especially areas designed for circulation, the more opportunity people had to get acquainted with each other, greet one another, and, perhaps, develop social relations.” The finding that social interaction is strongly improved with provision of open public space is congruent with research finding that parks provide vital places for shared everyday experiences (Peters et al., 2010), and that neighbour interactions are promoted by presence of places such as parks and cafes (Lund, 2002; Zhang et al., 2017). The improved socialisation found with more trees, grass verges and open space is consistent with evidence suggesting that green features with outdoor common areas in neighbourhoods enhance social ties and sense of community, and that the presence of nearby nature reduces violence and increases overall satisfaction with one’s home.
(Kearney, 2006; Kweon et al., 1998; Sullivan et al., 2004). It is also consistent with research demonstrating that people living in walkable neighbourhoods are more likely to know their neighbours and be socially engaged, an association reinforced by the significant correlation in study data between connectivity by walking and transport and numbers of people known by name (Leyden, 2003).

Thus, it is said that physical design qualities such as presence of footpaths, and provision of open and green spaces within walking distance, create friendly and vital neighbourhood spaces and have a strong association with social interaction, since residents will be more likely to use these spaces and spend more time socialising with their neighbours alongside increased physical activity (French et al., 2013; Wolch et al., 2014). The finding that social interaction is better in traditional grid layout neighbourhoods than those dominated by cul-de-sac streets appears to support the New Urbanists’ for the permeability of interconnected gridiron-patterned streets over the cul-de-sac (Morrow-Jones et al., 2004).

In summary, results in relation to levels of social activity indicate that the suburban built environment influences social interaction at both a real level (as indicated by resident self-rated levels of social activity) and a perceived level (as indicated by levels of the three neighbourhood experience factors). Moreover, the study generally supports the precepts of New Urbanism, showing that neighbourhood contentment, perceptions of socialising, accessibility, numbers of people known and frequencies of interaction are higher in higher density, walkable, permeable grid-street neighbourhoods that are well connected to public transport, and have good provision of greenery and open space. However, the argument must also be acknowledged that that “any ‘one-size-fits-all’ approach is myopic and simplistic” (Cozens and Hillier, 2008: 51), but, rather, a more holistic approach to street
form planning is required that understands contextual dimensions of relationship between human behaviour and neighbourhood design in the suburbs.

The findings support the hypothesis that residents with higher levels of social activity have higher social interaction.

5.7. Concluding statement of discussion

The hypotheses of this thesis are mostly supported in that neighbourhood design is shown to influence both real and perceived social interaction and, further, provides evidence that some physical design characteristics have a greater role in determining social interaction in low density suburbs than some socio-demographic factors. In order to elucidate the implications and interpretations of the aforementioned results, the following diagrams (Figure (5.17) and (5.18) summarise the findings of the analyses conducted in this thesis. Figure 5.17 indicates that, although length of residence, household tenure, age, income, number of household members and education were significantly correlated with Neighbourhood contentment, only length of residence and income significantly predicted Neighbourhood contentment, while household tenure had very small power. Active socialising was also correlated with length of residence, household tenure, number of members in household and number of children, but only length of residence and number of children significantly predicted Active socialising. Moreover, length of residence, income, number of members in household and education were significantly associated with Accessibility, while only income was a consistent predictor of Accessibility. Among socio-demographic variables, length of residence was continuously a positive direct predictor of Neighbourhood contentment and Active socialising.
The findings confirm the contributing role of neighbourhood design in strengthening social interaction. The findings indicate a significant and powerful relationship, as
hypothesised, between the variables. Seven physical variables: (1) street type, (2) provision of community and (3) open spaces with walking distance, (4) degree of tree coverage, (5) footpath provision, (6) connectivity by walking and (7) dwelling type, were found to make a strong contribution to social interaction.

Open space provision was the best overall predictor of *Neighbourhood contentment* and *Accessibility*, compared to the other physical and socio-demographic variables. Community spaces, street type, tree coverage and footpath also had strong impacts on *Neighbourhood contentment* while length of residence and dwelling type had a less powerful impact when compared to income. Street type, open space provision, tree coverage and dwelling type also significantly impacted *Accessibility*, equal to the effect of income. Although the physical variables of street layout (traffic flow and on-street parking); pedestrian environment (nature strip); neighbourhood connectivity (connectivity by transport); and dwelling form (dwelling setback, garage location and fence height) made no significant contribution to all three neighbourhood experience factors combined, the results also show that some of these variables had significant correlation with the neighbourhood experience factors individually. For instance, nature strip, dwelling setback, garage location, fence height and connectivity by transport were strongly correlated with *Neighbourhood contentment*, while the provision of footpaths and nature strips were strongly correlated with *Active socialising* and nature strip and dwelling setback were correlated with *Accessibility*.

There was no significant impact on perceived *Active socialising* of physical design variables after controlling socio-demographic variables. However, the findings suggest that real levels of social activity are strongly correlated with neighbourhood design characteristics (Figure 5.9), although the apparent conflict between these findings may
simply be explained by the fact that the relationship between real levels of social activity and neighbourhood design did not control for socio-demographic variables. However, some of the relationships that were not found to be significant might change to becoming statistically significant when collecting large-scale empirical data.

Thus, social connection and friendship, whether in a street or suburb, are impacted by street type, footpath, nature strip, tree coverage, connectivity by walking, connectivity by transport, open spaces and dwelling type. In addition, the majority of respondents interacted with their neighbours in the streets, footpaths and cafes. These findings are confirmed by the interview results, which reveal that residents valued the design of neighbourhoods, such as proximity to open spaces and facilities, street layout and trees as physical features, and thus these had significant impact on their social interaction with neighbours.

In addition, Figure 5.18 shows a strong correlation between the neighbourhood experience factors of social interaction (perceived interaction) and real levels of social activity. *Neighbourhood contentment* and *Active socialising* had a strong correlation with social connection, friendship and place of interaction. However, while the respondents expressed their satisfaction with the street and neighbourhood, some of them complained about lack of lighting, which is important to safety at night. Residents in newly established suburbs also stated that these streets still need to develop greenery and trees.
Therefore, the findings suggest that neighbourhood design characteristics have a role in strengthening social interaction in the context of low-density suburbs. Thus, through the careful integration of dwelling form with all these physical features,
neighbourhood design can effectively contribute to strengthening social interaction associated with socio-demographic factors. Undoubtedly in Belmont, the old, more traditionally panned suburb, greenery is more mature, public spaces are more plentiful and facilities are within walking distance. This is either through good planning or through an organic process of gradual growth that has seen demand for community facilities met by supply. In such traditional suburbs, long-term, home-owner residents with higher incomes become more attached and satisfied with a neighbourhood and more socialised with neighbours, particularly with the presence of children. The overall finding is in agreement with the results of studies that found that residents in traditional neighbourhoods with a grid street type (even after controlling for socio-demographic and other characteristics) had higher neighbourhood satisfaction (Lovejoy et al., 2010), stronger attachment, increased social interaction and a pedestrian-friendly environment (Cozens and Hillier, 2008; Lund, 2002) and thus integration of physical and psychological factors plays a vital role in achieving sustainable communities.

However, that is not to say that newly created suburbs need to be places that lack the characteristics that shape social interaction. For with good design and urban planning, new suburbs can be instilled with some of the charm and life of those that are well established. However, while this study has focused on physical, psychosocial and socio-demographic factors and social activity to influence social interaction, it should be considered that social interaction can also be influenced by other factors, such as participation in organisations, alongside personal factors (attitudes, values and preferences). Accordingly, it can be argued that social interaction may be a multidimensional measure and an instrument that can be developed to include of all the potential relationships of these factors.
Chapter Six – Conclusion
6.1. Introduction to conclusion

This thesis has examined the relationship between neighbourhood design and social interaction via focus on the role of five groups of physical characteristics of low-density suburbs on social interaction contributors. While much research has investigated whether social interaction is influenced by socio-demographic factors and physical design characteristics of high density contexts, there is little evidence of the impact of such physical characteristics when socio-demographic variables are controlled for in suburban environments with lower population densities, such as the types of low-density suburbs that ring Australian cities. In this respect, this study has developed an analysis framework for measuring social interaction via investigating residents’ perceptions of their social and physical neighbourhood environments. The findings of this study identify which physical design characteristics have impacts on social interaction in low-density suburbs. In addition, a direct measure of social interaction through resident self-rated levels of social activity was included to broaden understanding of opportunities for achieving social sustainability. The findings of this study inform architectural design strategies for planners and urban designers to consider in the provision of such neighbourhood characteristics when designing for communities in contemporary suburban contexts.

This chapter concludes the thesis. Section 6.2 provides a precis of the findings of this study, summarising the methods employed and the findings achieved in relation to the research hypotheses, and the implications of the findings for addressing issues of social sustainability when designing modern suburban neighbourhoods. Section 6.3 discusses the original contributions of this study to the field of knowledge. Section 6.4 states the limitations of the current study and makes recommendations for future research. Section 6.5 provides recommendations for designers, architects and urban planners, whose
decisions will shape not only the social and physical environment of the future suburban context, but also enhance neighbourhood character. Section 6.6 closes this thesis with concluding statements drawn from the above findings.

6.2. What was researched and how it was done?

This study has sought to understand how neighbourhood design influences social interaction through perceived residential satisfaction as indicated by four scales theorised to correlate with social interaction. The aim was to determine the power of urban design characteristics in predicting social interaction. This thesis grew out of the criticism that low-density suburbs are characterised by a lack of liveability, civility and neighbourhood character, reflecting the neglect of social interaction in urban planning and housing design; and thus, the belief that architects and urban designers can play significant roles in addressing such deficiencies by considering residents’ social needs to strengthen social interaction and achieve the broader objective of social sustainability. However, a review of literature in this thesis has highlighted that consideration of social interaction in architectural and urban design is often overlooked.

A comprehensive study of the relationship between social interaction and physical characteristics of the built environment required the development of a framework as suggested by this thesis for identifying the design variables of suburban neighbourhoods that impact social interaction, and for understanding how social interaction is related to the wider context of research on social sustainability. This study has developed such a framework to investigate how design might impact social interaction in low-density suburbs. Thus, it creates an empirical bridge that fills the gap between two separated research contexts, namely, perceived residential satisfaction and physical neighbourhood qualities on the one side, and social interaction on the other side. The results confirm the
multidimensional nature required of researching social interaction and neighbourhood physical design (Bonaiuto et al., 1999; Bonaiuto et al., 2003; Buckner, 1988; Lund, 2002). Reliability and validity indices support the findings.

Two primary dimensions of neighbourhood—psychosocial and urban design attributes—have been identified that influence social interaction. This study has suggested a model to measure social interaction via four established correlates: (1) neighbourhood attachment; (2) neighbourhood satisfaction; (3) neighbouring; and (4) walking and safety. Eleven categories of urban design characteristics that comprise these factors form three groups: urban form (density, land use, dwelling type, layout and transport connectivity); neighbourhood form (street layout, walkability and accessibility to services and facilities, and provision of public and green spaces); and dwelling form (physical arrangement and interstitial spaces between dwellings). Only five of these characteristics were considered suburban neighbourhood variables that built environment professionals can change via design: (1) street layout; (2) physical environment (footpaths, nature strips, tree coverage); (3) neighbourhood connectivity; (4) provision of public spaces; and (5) dwelling form (dwelling setback, fence height, garage location and dwelling type).

There has been much research concerning the impact of the physical built environment and associated demographic factors in high-density contexts on social interaction. However, there is a paucity of research into the role of the physical built environment on social interaction within low-density suburban residential environments, or indeed into ways that this can be measured to provide strategies to address unsustainably planned areas.

To address these questions, an approach using both qualitative and quantitative methods was used for data collection, with the support of measured observations of
physical neighbourhood characteristic variables using on-street photography and high-resolution satellite photomaps by Near Map. A questionnaire and face-to-face survey were conducted to collect data on the four established scales, and these also measured residents’ levels of social activity, including social connection, friendship and places of interaction, which are impacted by neighbourhood design and neighbourhood experience. Data was collected from residents in three suburbs in the south-west of Geelong, Australia. Phone interviews were carried out with residents from the three suburbs to provide further evidence of the impact of neighbourhood design on social interaction via reflections on their neighbourhood experience.

Both questionnaire survey and interview aimed to answer the question: What is the impact of different neighbourhood design characteristics on correlates of social interaction in low-density Australian suburbs? Four main hypotheses were suggested to elucidate the interrelationships between neighbourhood design and correlates of social interaction. These hypotheses are:

(H-1) Different neighbourhood design characteristics impact correlates of social interaction in low-density suburbs. The thesis supports the hypothesis in finding that: social interaction was significantly differentiated between three neighbourhoods of contrasting suburban layout. Specifically: (1) residents in the traditional neighbourhood layout reported a higher level of neighbourhood contentment compared to conventional cul-de-sac and conventional curvilinear neighbourhoods; (2) accessibility was significantly higher in the traditional grid layouts neighbourhood compared to the conventional curvilinear neighbourhood, while there was no significant difference in the conventional cul-de-sac neighbourhood; (3) active socialising did not significantly differ between the three suburban neighbourhoods. These results in turn suggest that residents
in traditional neighbourhood grid layouts have a higher level of social interaction than residents in conventional cul-de-sac and curvilinear neighbourhoods – layouts that contribute to non-pedestrian-friendly environments due to obstruction of the interconnected street network. The results also suggest that there is a connection between neighbourhood age and social outcomes, with older neighbourhoods experiencing higher levels of social interaction. In addition, residents in longer established neighbourhoods are more likely to feel attached to their neighbourhood and more satisfied with overall residential environment quality.

(H-2) Socio-demographic factors impact correlates of social interaction in low-density suburbs. The thesis supports the hypothesis in finding that: (1) six socio-demographic variables (length of residence, home ownership, age, income, household size and level of education) were strongly correlated with *neighbourhood contentment*; (2) four socio-demographic variables (length of residence, home ownership, household size and number of children) were strongly correlated with *active socialising*; (3) there was a significant correlation between income, length of residence, household size, education and *accessibility*. The thesis therefore confirms that longer term home owners with greater numbers of members and children tend to have more established relationships with their neighbours, and more satisfaction and attachment. In addition, residents who were more educated with higher incomes had higher levels of *neighbourhood contentment* and *accessibility*. Gender had no significant relationship with all neighbourhood experience factors.

(H-3) Neighbourhood design characteristics impact correlates of social interaction with control of socio-demographic variables. The findings of this thesis support the argument that physical urban design characteristics significantly contribute to social
interaction, when socio-demographic variables are controlled for, and have varied predictive power. Factor analysis indicates that the four subjective scales used in the survey (neighbourhood attachment, neighbourhood satisfaction, neighbouring, and walkability and safety) could be reduced in the context of the three study suburbs to three more powerful neighbourhood experience factors – *neighbourhood contentment*, *active socialising* and *accessibility*. *Neighbourhood contentment* is mainly a combination of both scales – neighbourhood attachment and neighbourhood satisfaction – while *active socialising* includes supportive acts of neighbouring and social ties between residents. *Accessibility* includes items representing physical qualities of street design related to perceptions of walking, local access and safety in a neighbourhood. Thus, multiple regression was used to determine if five groups of physical characteristics influenced these three neighbourhood experience factors. The study used objective measures of neighbourhood and dwelling design characteristics. Thus, there were five hypotheses tested:

(H-3-1) Street layout impacts correlates of social interaction after controlling for socio-demographic variables. The thesis supports the hypothesis in finding that:

1- Street layout significantly predicted *neighbourhood contentment* and *accessibility* after accounting for correlated socio-demographic variables and it was not significantly associated with *active socialising*.

2- Street type was the most powerful predictor of *neighbourhood contentment* when compared to controlled variables, length of residence and income.

3- Of the seven variables, only street type and income significantly predicted *accessibility* with the same level of influence.
4- The three physical variables – street type, traffic flow and on-street parking – have not been shown to be predictors of active socialising.

5- Length of residence and the presence of children were the best predictors of active socialising.

(H-3-2) The pedestrian environment impacts correlates of social interaction after controlling socio-demographic variables. The thesis supports the hypothesis in finding that:

1- Pedestrian environment significantly predicted neighbourhood contentment and accessibility after accounting for correlated socio-demographic variables, but it was not significantly associated with active socialising.

2- Tree coverage and footpath provision most strongly influenced neighbourhood contentment, as well as length of residence and income, while household tenure made only a small contribution.

3- Only tree coverage and income significantly contributed to accessibility.

4- The three physical variables of pedestrian environment were not significant predictors of active socialising, while length of residence and number of children consistently contributed to active socialising.

(H-3-3) Neighbourhood connectivity impacts correlates of social interaction after controlling for socio-demographic variables. The thesis partly supports the hypothesis in finding that:

1- Neighbourhood connectivity significantly predicted neighbourhood contentment, but it did not significantly contribute to active socialising or accessibility.

2- Only socio-demographic variables were significant factors in predicting neighbourhood contentment, active socialising and accessibility.
(H-3-4) Public space provision impacts correlates of social interaction after controlling for socio-demographic variables. The thesis supports the hypothesis in finding that:

1- Public space provision significantly predicted *neighbourhood contentment* and *accessibility*, but not *active socialising*.

2- Open spaces were found to be the best influential variable on *neighbourhood contentment*, followed by community spaces, length of residence, income and household tenure.

3- Only provision of open spaces and income significantly influenced *accessibility*.

4- Both provision of community and open space have not been shown to be significant predictors of *active socialising* with the unique influence of length of residence followed by the presence of children.

(H-3-5) Dwelling form impacts correlates of social interaction after controlling for socio-demographic variables. The thesis partially supports the hypothesis in finding that:

1- Dwelling form most highly influenced *neighbourhood contentment* but did not significantly influence *active socialising* or *accessibility*.

2- Length of residence, income and dwelling type were the best predictors of *neighbourhood contentment*, while fence height and household tenure made small contributions.

3- Income continued as the most powerful predictor of *accessibility*, while dwelling type made a separate and small contribution.

4- All variables of dwelling form made no individual contributions to *active socialising* with significant prediction of controlled variables, length of residence and number of children.
Level of social activity is correlated with social interaction and it can be impacted by urban design characteristics. The findings of this thesis support the argument that level of social activity is strongly associated with correlates of social interaction and with provision of some neighbourhood design characteristics. Thus, *Neighbourhood contentment* and *Active socialising* are significantly correlated to social connection, friendship and place of interaction. Moreover, street social connection and friendship significantly are correlated to street type, pedestrian environment and neighbourhood connectivity.

The major findings of this thesis suggest that:

1. Social interaction correlates are significantly different between the three suburbs.
2. Socio-demographic variables are strongly correlated with the neighbourhood experience factors of social interaction associated with physical design.
3. Physical design characteristics significantly predict *neighbourhood contentment* and *accessibility*, even allowing for the interaction.
4. Physical design characteristics do not significantly influence *active socialising*; it may simply be that some of the audit measures are not good predictors of people’s rating of place or are too distal to people’s perceptions, so socio-demographic variables appeared independent from the impact of physical characteristics.
5. Neighbourhood characteristics such as street type, tree coverage, provision of footpaths and community spaces, and neighbourhood connectivity are the most powerful predictors of *neighbourhood contentment*.
6. Street type and provision of open spaces are the most important predictors of *accessibility*. 
7. Of the dwelling form variables, only dwelling type significantly contributes to *neighbourhood contentment* and *accessibility* with a small effect on *neighbourhood contentment* of fence height.

8. Provision of open spaces is the best predictor of *neighbourhood contentment*, confirming that open spaces within walking distance enhance attachment and satisfaction.

9. Neighbourhood connectivity is associated with street layout and that pedestrian environment can encourage more walking in a neighbourhood and provide friendly access to public and open spaces.

10. The more people known in the neighbourhood, the higher the frequency of social connection and increased numbers of interaction places, the more social interaction occurs in a neighbourhood.

Thus, the findings suggest that good neighbourhood design, in particular in relation to street layout, can help provide vital places where residents’ experiences are shared and social interaction is strengthened. Overall, the findings suggest that the design of the physical characteristics of suburban neighbourhoods can have a significant role in promoting social interaction through resident satisfaction. Thus, it can be argued that, in Australian suburbs, design should prioritise a number of indicators of friendly and walkable neighbourhoods: grid street types with good connectedness; high numbers of open and community spaces within walking distance; high degrees of tree coverage; and good footpath provision. All these characteristics have been found in the three suburbs to be associated with increased attachment and satisfaction, and thus by extension with improved quality of life and social sustainability. It can be concluded that well-designed neighbourhoods are more attractive to residents and increase the use of outdoor spaces.
and involvement in social interactions. All of these aspects can contribute to more sustainable housing environments.

6.3. Contribution to the field of knowledge

This thesis has developed a comprehensive understanding of the impact of different factors that can influence correlates of social interaction in typical low-density Australian suburbs. It has brought together fragmented research findings from across the fields of architecture, urban design and sustainable built environment to achieve a coherent understanding of the interrelationships between social interaction, resident satisfaction and neighbourhood design. A further unique contribution is the elucidation of the influence of psychosocial attributes and three categories of urban design attributes: urban form, neighbourhood form and dwelling form. While the interrelationships between social interaction and neighbourhood design have been studied previously, little or no research has addressed the impact on social interaction of all association variables identified in this thesis: dwelling, neighbourhood, neighbours and level of social activity alongside social background.

Furthermore, previous research has focused on social interaction in high-density design contexts (Arundel and Ronald, 2017; Peters et al., 2010; Raman, 2010; Williams, 2005), while few empirical studies have considered in particular the impact of these variables in new suburban environments with lower population densities (Brown and Cropper, 2001; Freeman, 2001; Lund, 2002). It is clear that to encourage socialising behaviour among neighbours in a way that supports neighbourhood social ties and builds sustainable community, specific design strategies should be considered in low-density neighbourhoods. Thus, this thesis has developed an analysis framework relating social interaction to suburban design characteristics that has been tested through a
comprehensive survey determining the design strategies that can address social sustainability.

6.4. Study limitations and recommendations for future research

A number of limitations were encountered in conducting this thesis; some of these limitations were identified in relation to data collection and other issues are beyond the scope of this study. In this study, the research question focused on the role of physical design characteristics in contributing to social interaction. Hence, there are some social factors that should be considered which were not within the scope of this thesis. However, further examination is needed with direct measures of how neighbourhood social events and organisations (Dekker, 2007), crime, and social and cultural diversity (Brown et al., 2003; Glynn, 1986; Peters et al., 2010) affect residents’ interaction in order to draw out direct relationships between social interaction and these social factors. This is beyond the scope of this study, particularly when this thesis has considered social homogeneity in the selection of the three study areas.

In terms of methodology, using a qualitative method was useful to provide wider insight and support the data that was collected by a questionnaire survey. For example, while the questionnaires were analysed in detail with statistical tools, the interviews were used to support the results. However, it should be acknowledged that although 30% of households responded to the survey, typicality and generalisation is limited by this response rate. Moreover, the limited number of interviewees did not provide enough qualitative data to analyse separately, and these results cannot therefore be generalised. Hence, there is a need to conduct extensive interviews with residents of residential streets to investigate social interaction in relation to residential satisfaction.
In addition, this study did not include observational study due to the practical limitation that in low-density neighbourhoods there are few people to observe in residential streets. In this sense, this suggests that long-term observation in commercial streets be conducted to examine social interaction and satisfaction focusing on qualities of these areas, particularly social interaction and activities in streets, cafes and local shops, which have been shown by this study survey to be the most likely places for interaction. On the other hand, it might be difficult to manage a larger amount of data in terms of collecting, analysing and combining it.

Although this study has investigated which physical built environment characteristics are contributors to the social interaction and satisfaction in neighbourhoods, and found provision of open spaces within walking distance make the greatest contribution, further research is required to explore the qualities of open spaces and their potential for social interaction, such as attractiveness, upkeep, safety, time spent in these spaces, and the nature of use and activities in parks and green spaces.

It was determined that, due to the overall sample size, there would be too few respondents per street to adequately model neighbourhoods at the street level. In addition, there was a low response rate and possible selection bias of the study participants. Thus, increasing the scope of the study area might provide more participants, which would enhance the sample size to reduce bias and increase the reliability of the data. However, in comparison with low-density populations in these areas, the sample size has allowed for meaningful analyses.

As this study has investigated physical features in residential streets in relation to social interaction, further research could be conducted in commercial streets since the
factors that contribute to social interaction might differ from those identified in this study and thus could be the focus of separate research.

This study has been completed in low-density residential areas with predominantly single-family detached houses. Future research could compare social interaction in other contexts with medium or high density and different dwelling types such as apartments and diverse physical variables. For example, such a study could compare the outer suburbs of Geelong with the inner suburbs of Melbourne.

6.5. Recommendations for architects, urban designers and planners

Neighbourhood design in low-density suburbs has been shown to be influential in enhancing residential satisfaction and social interaction. The presence of some physical environment features is associated with residents spending more time in the neighbourhood and having more casual interactions with neighbours. As such, designers need to consider social and physical design strategies in suburban planning to promote social connectedness and interactions that might be encouraged through the relationship between a neighbourhood’s physical environment and the strength of its social environment.

Thus, design strategies can address the deficiency of contemporary suburbs, such as by encouraging denser suburb developments with fewer detached houses to increase proximity between dwellings and allow visual access that provides for more accidental connections. This in turn would contribute to the reduction of isolation that has resulted from newly designed neighbourhoods that have the effect of reducing physical connection. Cul-de-sac street types could be addressed by considering both grid and cul-de-sac street types and connecting them to major roads and the neighbourhood centre. This might be more accessible and safer, control through traffic and allow for greater social interaction.
Based on the findings of this thesis, residents more positively regard low-density suburbs when: they live in grid-type streets with shorter intersection distances that are pedestrian-friendly, with more public and open spaces within walking distance and improved access, more large canopy trees and greenery, provision of footpaths on both sides of streets, and fence heights that are neither too high nor too low, which can provide both privacy and permeability that allows for more neighbourly interaction. All these strategies are associated with the promotion of greater walkability in residential neighbourhoods that would reduce car use and increase safety. Thus, street layouts and pedestrian environments should be encouraged to meet these socio-ecological aims.

Although the findings of this thesis show that setbacks and garages are not significant predictors of social interaction, they are correlated with neighbourhood attachment and satisfaction. Thus, both the location of garages and setback size should also be considered in design. For example, the provision of shared driveways to access garages encourages walking and meeting neighbours. Moreover, reasonable setbacks can provide privacy for residents and enable social interaction among neighbours and people in the street.

As there were very few houses in the selected streets with porches, this was not considered as a measured dwelling form feature. However, other research has found that porches significantly contribute to encouraging social connection between neighbours, create lively residential streets (Rogers and Sukolratanametee, 2009) and are positively related to neighbourliness (Wilkerson et al., 2012).

In addition, social attributes of residents need to be considered to explore how the physical design relates to the residents’ perceptions or attitudes, and how these perceptions and attitudes towards the neighbourhood might relate to social interaction.
Although this finding implies that, in suburban Australia, the lack of privacy and/or outdoor private spaces that are common to badly designed grouped dwellings is negatively viewed, this does not mean that the many benefits of higher density living in the suburbs cannot also be attained with clusters of dwellings that have well-designed private and shared open spaces. The importance of landscape design in the suburbs is reinforced by the significant relationship between higher levels of satisfaction and higher provision of greenery. This is an association that reflects the lack of planting in the newest suburb of the three examined in the study, a deficiency common to most new suburbs in Australia where landscaping is often very low on the list of the priorities of developers. Thus, considering eco-friendly strategies not only encourages social interaction but, if subdivision can address suburban sprawl, this could create vital residential streets and support sustainable communities.

6.6. Concluding statement

These findings improve our understanding of the physical design characteristics that contribute to social interaction among neighbours. Previous research has argued that some neighbourhood features, such as crowding, noise and a lack of privacy, impede social interaction (Baum et al., 1978; Cohen and Lezak, 1977; Skjaeveland and Garling, 1997; Talen, 1999). The hypotheses of this thesis are mainly supported, indicating that neighbourhood design impacts correlates of social interaction and resident-rated levels of social activity in low-density suburbs. This research has identified the neighbourhood design features that connect residents to their social and physical environment and to each other in positive ways to encourage social interaction. Social interaction is significantly different between the three suburban layouts. Physical design characteristics are found to
predict *neighbourhood contentment* and *accessibility*, and to be associated with social activities in residential streets.

However, the findings also indicate that social interaction is influenced by socio-demographic factors, in particular length of residence and income. In this sense, both physical and social factors should be considered in planning suburbs. Detailed analysis has also indicated that provision of open spaces has the greatest influence on *neighbourhood contentment* and *accessibility*, followed by tree coverage and street type. It is worth emphasising that physical design characteristics have not been shown to be predictors of *active socialising*, which can develop over time. Further analysis confirms that level of social activity is strongly associated with the four correlates of social interaction.

This study has not only developed an analytical framework to measure social interaction in low-density suburbs, but also used objective measures of neighbourhood and dwelling design characteristics for measuring perceived resident satisfaction and residents’ interaction with their neighbours and neighbourhood. It has also identified the most influential factors on social interaction of the physical built environment. As such, the results encourage architects, urban designers and planners to pay greater attention to all social and physical environmental elements in residential streets as effective and integral factors in influencing social interaction. Moreover, the results inform planning, urban and architectural strategies for the provision of such physical neighbourhood characteristics when designing for socially sustainable communities in contemporary suburban contexts.
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Appendices
Appendix A: Publications
White picket fences & other features of the suburban physical environment: correlates of neighbourhood attachment in 3 Australian low-density suburbs

Abass, Zainab, Tucker, Richard

*Landscape and Urban Planning Journal*

Abstract

This study examines the relationship between neighbourhood attachment and five groups of physical characteristics of low-density suburbs: (1) street layout, (2) pedestrian environment, (3) neighbourhood connectivity, (4) public space provision, and (5) dwelling form. Although much research has investigated whether neighbourhood attachment is influenced by the urban design characteristics of high density contexts, there is little evidence of the impact of such characteristics in suburban environments with lower population densities, such as the types of low-density suburbs that ring Australian cities. Surveys were conducted in Victoria, Australia, to examine how these five groups of characteristics might impact residents’ neighbourhood attachment in three suburbs with equivalent socioeconomic profiles. Questionnaires were delivered to eight streets of different layout in each suburb, and via on-street face-to-face surveys in public spaces adjacent to neighbourhood libraries. The results of five separate regression models indicated that all five groups of physical neighbourhood characteristics significantly predicted neighbourhood attachment. Home ownership, length of residence and age were also found to have strong correlation with neighbourhood attachment. When length of residence is controlled for, it was found that five physical variables were the best predictors of neighbourhood attachment: provision of open spaces, street type, trees coverage, sidewalk provision and number of community spaces. Only the provision of open spaces had greater impact on attachment than length of residence. Hence, the study findings suggest that both social and physical factors should be considered in the planning of suburban neighbourhoods.

**Keywords**: Neighbourhood attachment, neighbourhood design, socioeconomic factors, urban design characteristics, Australia, low density
Introduction

This paper investigates the relationship between neighbourhood attachment and the presence of a number of physical characteristics of suburban neighbourhoods in Australia. Neighbourhood attachment is one domain of sense of community (Kim and Kaplan, 2004), is one dimension of social cohesion (Dempsey, 2009; Wilkinson, 2007), is a significant determinant of neighbourhood satisfaction (Bonaiuto et al., 1999; Fried, 1982), and has even been suggested to be second only to satisfaction with family in determining a person’s satisfaction with life itself (Fried, 1982).

The study described in this paper asks, what physical design characteristics of neighbourhoods predict neighbourhood attachment in low-density Australian suburbs, and which are the best contributors when socioeconomic factors are controlled for? These research questions are in line with the argument that liveable neighbourhoods are beneficial for social life (Raman, 2010), and, as Dempsey reports (2009), that the provision of some physical characteristics contributes to socially cohesive communities. Neighbourhood attachment in this paper is measured using the Neighbourhood Attachment scale developed by Bonaiuto et al. (1999) and further validated by (Comstock et al., 2010). Both the role of neighbourhood form and dwelling form in impacting neighbourhood attachment are considered.

The findings suggest that neighbourhood attachment in low-density suburbs is affected by eight physical variables: (1) street layout, (2) tree-coverage, (3) number of community spaces with walking 5 minutes and open spaces (4) dwelling type, (5) fence height, (6) connectivity by walking, (7) the provision of sidewalks, and (8) access to on-street parking. Moreover, neighbourhood attachment is shown to be positively correlated with term of habitat, home ownership, and age. The implications of this research can inform strategies for architects, urban designers and planners concerning the provision of physical neighbourhood design characteristics that can improve neighbourhood attachment and social environment in suburban contexts.

Background

As two identified dimensions of attachment to place are social bonding and physical rootedness (Riger and Lavrakas, 1981; Taylor et al., 1985), neighbourhood attachment is associated with
and physical connectedness between individuals and their residential environment (Bonaiuto et al., 2003; Arnberger and Eder, 2012). Physically, neighbourhood is most commonly understood to refer to a residential area, while socially it is the place of social interactions (Jenks and Dempsey, 2007). While research identifies both socioeconomic and physical characteristics of neighbourhoods as contributing to attachment, this is not always confirmed in findings.

Neighbourhood attachment, as an aspect of place attachment usually pertaining to urban environments, is quantitatively measurable. Through such measurement neighbourhood attachment has been seen to contribute to social interaction in urban neighbourhoods (Bonaiuto et al., 2003), and at same time neighbourhood ties have been found to be the best contributor to neighbourhood attachment (Lewicka, 2010). It has also been suggested that residents who choose to live in place because of appealing physical features are more likely to be involved in the local community and develop social ties; activities which in turn correlated with shaping the emotional and functional attachments to that place (Anton and Lawrence, 2014). Moreover, studies have also found that positive perception of the quality of residential environments is significantly correlated with high levels of neighbourhood attachment in urban contexts (Bonaiuto et al., 1999), and also with long-term residence (Comstock et al., 2010; Bonaiuto et al., 1999; Raymond et al., 2010). For example, owners who are long-term residents tend to have a greater attachment to a neighbourhood, are more socially active and thereby have a greater sense of community (Brower, 2013).

Although attachment is often shaped by levels of emotional and physical bonds within neighbourhood environments (Fried, 1982), not all these ties are positive. For example, negative relationships can weaken social bonds with neighbours, which in turn can reduce neighbourhood attachment (Riger and Lavrakas, 1981). While, generally, urban design in low-density suburbs (meaning the design of dwellings and the spaces between them), has not commonly lead to the strengthening of social ties, neighbourhoods that have been designed with ecological sustainability in mind have been found to engage residents with outdoor activities and hence improve social interaction. For example, in USA context, suburbs designed to be pedestrian-friendly with
abundant green spaces have compared to typical suburban neighbourhoods, been found to enhance neighbourhood attachment and create opportunities for social contact, which in turn leads to greater sense of community (Rogers and Sukolratanametee, 2009; Lund, 2002; Kim and Kaplan, 2004). Typical low-density suburban neighbourhoods in Australia are of curvilinear or cul-de-sac street types with long blocks, with single use typology, are car dependent and have limited access to open green spaces. Thus, these suburbs tend to be less transit-friendly than more established higher suburbs that are generally of traditional grid street type with connected networks, are pedestrian oriented and have good access to large open space (de Jong et al., 2013; Davison, 2006). While association is acknowledged between neighbourhood attachment and the physical design of neighbourhoods (Mesch and Manor, 1998; Wilkinson, 2007), for instance in relation to street layout, the provision of greenery and pedestrian environment (Arnberger and Eder, 2012), research has rarely evidenced the relationship (Bonaiuto et al., 1999; Kim and Kaplan, 2004). Moreover, while neighbourhood attachment has been studied frequently in the context of inner-urban, high-density housing (Comstock et al., 2010; Bramley and Power, 2009; Dempsey, 2009), few empirical studies have measured the impact of urban design characteristics on neighbourhood attachment in low-density suburbs (Lovejoy et al., 2010; Lindsay et al., 2010), or the impact of neighbourhood differences on attachment in the types of low-density suburbs that ring Australian cities (Rogers and Sukolratanametee, 2009; Bramley and Power, 2009; Dempsey, 2009; Kim and Kaplan, 2004). Only recently has it been shown that provision of public and private green spaces, local facilities within walking distance, and increased provision of detached and semi-detached housing with gardens, are in low density suburbs correlated with well-being (Brookfield, 2016). The relationship between physical form and neighbourhood attachment is important to study in Australia because Australian low-density suburbs are home to approximately 70% of the population (Davison, 2006); a figure that continues to rise steeply as the cost of inner-city housing spirals (Roberts, 2007). In the year to 2015, six of the ten SA2s (Statistical Areas Level 2) with the largest population growth in Australia were outer suburbs of Greater Melbourne (STATISTICS, 2015).
The influence of socioeconomic demographics on neighbourhood attachment has been well researched. For instance, evidence has been found for the impact on attachment of home-ownership, level of education (Buckner, 1988; Anton and Lawrence, 2014), income (which can be determining residents’ selection of neighbourhood and their length of residence (Bonaiuto et al., 1999)), and term of residence and ownership (Skjaeveland et al., 1996; Bonaiuto et al., 1999; Brown et al., 2003; Comstock et al., 2010; Buckner, 1988; Anton and Lawrence, 2014). Evidence for the influence of resident age has been contradictory, with some studies finding a relationship (Riger and Lavrakas, 1981; Buckner, 1988) and others finding that this variable has no impact (Bonaiuto et al., 1999; Raymond et al., 2010).

The research presented in this paper examines the relative impacts on neighbourhood attachment of the chief socio-demographic variables identifies as important in the literature, and of five groups of urban design characteristics: (1) street layout, (2) pedestrian environment, (3) neighbourhood connectivity, (4) public space provision, and (5) dwelling form. These characteristics have been selected because of the importance attached to them in the literature, and because they can vary widely between Australian suburbs. The study uses the previously established neighbourhood attachment scale (NA) (Bonaiuto et al., 1999); a 6-item questionnaire based on the theoretical perspective of a previous study (Bonnes et al., 1997). The NA measures attachment by surveying feelings of affective bonds toward neighbourhood, and has been shown to be extracted on one factor (named neighbourhood attachment) with Cronbach’s alpha (0.86) (Bonaiuto et al., 1999). The later study of Comstock et al. (2010) also found correlation between the scale items indicating they are measuring the same factor i.e., neighbourhood attachment, with Cronbach’s alpha of 0.86 again. While other researchers have developed an alternative version of the scale to measure neighbourhood attachment (Bonaiuto et al., 2003), which includes eight items – four positive items from Bonaiuto et al., and four negative items added to evaluate the possibility of multi-dimensionality – the uni-dimensionality of the scale was confirmed. Other studies have included items related to neighbourhood attachment within scales measuring sense of community and neighbouring (Rogers and Sukolratanametee, 2009; Skjaeveland et al., 1996; Buckner, 1988).
This study utilises the original NA scale (Bonaiuto et al., 1999) to directly measured neighbourhood attachment, but in light of the repeatedly confirmed uni-dimensionality of the scale has excluded the last item for this merely opposes the meaning of a previous item in the scale.

**Methodology**

Three types of data were collected: (1) measurement of the independent variables i.e., physical urban design features such as tree coverage and fence height; (2) collection of the sociodemographic data of residents; and (3) measurement of the dependent variable neighbourhood attachment using the NA scale. Objective data of the physical environment was collected using on-street photography and high-resolution satellite Photomaps. Subjective data on demographics and neighbourhood attachment was collected using structured surveys.

**Participants**

Two methods were used to collect the information pertaining to the independent variables indicating neighbourhood attachment:

- Survey questionnaires, with plain language statement and consent form, were delivered to the mailboxes of 600 residents selected randomly – 200 in each of the three suburbs (Belmont, Grovedale and Wauurn Ponds). Survey was used as this is the most frequently adopted method for collecting quantitative indicators of a variable (i.e., Neighbourhood Attachment) that have an empirical structure. Participants returned responses using supplied stamped and addressed envelopes. Data were collected from 184 residents aged between 18 and 80 years old, with 68 questionnaires received from Belmont, 65 from Grovedale and 51 from Wauurn Ponds. Sociodemographic indicators were gathered to confirm the socioeconomic profiles of the residents: gender, age, income, household tenure, length of residence, number of house members and children, and educational level.
Face-to-face survey was also carried out to increase the sample size, as it was (correctly) predicted that mailbox survey alone would result in low participation rates. Participants were recruited from public spaces adjacent to the neighbourhood libraries of each suburb. A plain language statement and consent form were provided to these participants, along with a brief description of the project. The questionnaires were matched to residential streets by asking the participants their addresses. Thus, the researcher recorded 29 face-to-face respondents from Belmont, 15 from Grovedale and 19 from Waurn Ponds. The total number of completed questionnaires from both methods of data collection was therefore 247. The data from the two cohorts (mailbox and face-to-face) were analysed together after preliminary analysis indicated no significant neighbourhood attachment differences between them.

*Survey instrument*

The five-item neighbourhood attachment scale (Bonaiuto et al., 1999; Comstock et al., 2010) reflects mobility, and involves the symbolic and self-identity ties to physical surroundings that have been found to benefit community interactions and health outcomes. Residents answered each item on a five-point Likert scale (from 1 ‘strongly disagree,’ to 5 ‘strongly agree,’) with a high score referring to a strong emotional connection with place or neighbourhood. This scale was selected for its specific focus on measuring residents’ degree of attachment to neighbourhood, when similar scales include other concepts such as sense of community, neighbours and place attachment beyond neighbourhood level (see Table 1).

**Table 1: Neighbourhood attachment scale**

<table>
<thead>
<tr>
<th>Scale items</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. This is an ideal neighbourhood to live in</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. Now, this neighbourhood is a part of me</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. There are places in the neighbourhood to which I am very emotionally attached</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4. It would be hard for me to leave this neighbourhood.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5. I would willingly leave this neighbourhood*</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Physical urban design characteristics were measured according to five categories of objective indicators (Table 2): (1) street layout, (2) pedestrian environment, (3) neighbourhood connectivity, (4) public space provision, and (5) dwelling form.

1. Street layout: three variables – street type, traffic flow and on-street parking – were chosen because: (1) street type can shape perception and influence interaction; (2) high traffic volume is associated with lack of safety, noise, negative impacts on the street environment and thus reduced pedestrian street activities—in particular, children playing and contact between neighbours; and (3) street parking, which has been observed to have positive effects (allowing residents to contact with their street and connect socially during their departure and return to home (Appleyard and Lintell, 1972; Lund, 2002)) and negative effects (creating unsafe places for walking and driving (Kim and Kaplan, 2004).

- **Street type:** the suburb streets were categorised according to previous research (de Jong et al., 2013; Grammenos et al., 2002). Thus, Belmont had a traditional grid layout, Grovedale streets were designated as conventional loop or cul-de-sac, and Waurn Ponds had streets of the conventional loop (curvilinear) form.

- **Traffic flow-through:** traffic levels largely depended on public transport provision and dwelling relationships with intersections. Traffic volume was graded to three levels (low, moderate and heavy) (Appleyard and Lintell, 1972).

- **On-street parking:** numbers of cars per house parked in each street were calculated by summing total cars and then dividing by the number of dwellings. Cars were counted at the time when most people often use street parking (7–8 pm).

2. **Pedestrian environment:** three variables of pedestrian environment were investigated that impact perceptions of the walking environment: tree coverage, provision of footpath and nature strip (or “verge,” which is the grass situated between the edge of a road and the dwelling or sidewalk). The footpath/nature-strip zone is where important street furniture is located,
including seating, trees and light poles, and thus contributes to accessibility, safety, and opportunities for social contact (Meenachi-Sunderam and Thompson, 2007).

- Sidewalks and nature strip vary in width and provision on one or both sides of streets. Thus, the variable sidewalk is divided into three groups (no sidewalk, sidewalks on two sides and sidewalk on one side), and that of nature strip also has three groups (nature strip on one side, nature strip on two sides and gravel strip only).

- Tree coverage: the three suburbs are of different development ages, which impacts the quality and quantity of greenery. Tree coverage was measured for the percentage area of each street under tree canopy according to recently taken high-resolution satellite photographs. Belmont had well-established mature trees, compared with diverse established large trees and shrubs in Grovedale and a scattering of undeveloped trees in Waurn Ponds. The measurement of tree coverage was to the front-wall line of the houses and thus included front gardens, which were perceived to be part of the streetscape. The plan area of trees and large shrubs was compared to the overall street area to give a percentage of tree coverage (Nowak et al., 1996).

3. Neighbourhood connectivity: a measure of residents’ physical connectivity and accessibility to local services and community facilities, via (1) walking or (2) public transport. For suburb delineation and rating connectivity, the study adopted the methods of de Jong et. al. (2013). Thus, a distance of 400m was considered comfortable for walking catchment to local facilities and to any public transport stop. The proportion of residents who lived within walking distance of community facilities was graded to five scores (from 1 (low - 0–20% of residents) to 5 (high - 80–100%)) (de Jong et al., 2013).

4. Public space provision: public spaces facilitate informal connections and socialising, in particular if they have good location and visibility (Francis et al., 2012). Public space provision was identified according to two variables: (1) open public space provision in each street – such as parks, playgrounds and green spaces (excluding nature strips) – on a binary scale (one space and
more than one space); (2) community space provision – facilities and services, including schools, churches, childcare and sports clubs – measured according to accessibility within five minutes’ walking distance from the selected streets (no community spaces, one to three community spaces, and four or five community spaces).

5. Dwelling form: four variables were measured, dictating the relationship of the dwelling to the street, that research suggests affect neighbourhood attachment: dwelling setback, fence height, garage location and dwelling type:

- Dwelling setback: is the distance between the street (delineated by the fence line) and the dwelling. The setback dictates the width of the semi-private garden between the front fence and the house that can enable social interaction while increasing security and feeling of safety. The front garden can serve as a perceived “shared” space between the street and private dwelling allowing for connection between residents and street (Marcus, 2003). A wide setback inhibits social contact and makes residents feel more isolated from their street (Gehl, 1987). This study identifies three categories of setback: narrow, medium and wide.

- Fence: the boundary between the street and the private garden. If not too high, the fence increases visual connection between residents; if too low, privacy and feeling-of-safety is reduced, which inhibits residents from using the front garden (Al-Homoud and Tassinary, 2004). While most of the selected streets in Belmont have around 1000-1500mm high fences, some streets in the other two suburbs have low fences or no fence (with only garden and setback). Some dwellings in Belmont had hedges behind the fences, but these were not differentiated as it was considered that hedges delineate zones in much the same way as fences. The study measured the height of the fence for each dwelling, summed the total fence heights and then divided this by the number of houses to calculate the average fence height in each street. Average fence height varied from 0 to 1.4 m.
- Garage location: highly visible garages in the front façades of dwellings are associated with less pleasing pedestrian environments, which in turn impacts perceived neighbourhood attachment in comparison with garages located in an alley or at the back of the dwelling (Rogers and Sukolratanametee, 2009; Kim and Kaplan, 2004). This variable was measured by giving a percentage for each suburb of proportion of garages immediately adjacent to and facing the street. While 50% of the houses in Belmont and Grovedale have garages facing the street, in Waurn Ponds 95% of garages face the street.

- Dwelling type: dictates spatial proximity between residents and can promote or hinder contact between neighbours (Bramley and Power, 2009). Belmont had 80% detached houses, Grovedale 90%, and in Waurn Ponds 100% were detached.

Table 2: Indicators of urban design characteristics (Neighbourhood form and dwelling form)

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decoding the variables</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Neighbourhood form</td>
<td></td>
</tr>
<tr>
<td>Street layout</td>
<td></td>
</tr>
<tr>
<td>Street type</td>
<td>Traditional grid</td>
</tr>
<tr>
<td>Traffic flow-through</td>
<td>Low traffic</td>
</tr>
<tr>
<td>On-street parking</td>
<td>Number of cars per house</td>
</tr>
<tr>
<td>Sidewalk</td>
<td>No sidewalk</td>
</tr>
<tr>
<td>Nature strip</td>
<td>Nature strip on 1 side</td>
</tr>
<tr>
<td>Tree-coverage</td>
<td>0–10% tree-coverage</td>
</tr>
<tr>
<td>Neighbourhood connectivity</td>
<td></td>
</tr>
<tr>
<td>Connectivity by walking to facilities</td>
<td>1 (0–20%)</td>
</tr>
<tr>
<td>Connectivity by walking to public transport</td>
<td></td>
</tr>
<tr>
<td>Public space provision</td>
<td></td>
</tr>
<tr>
<td>Open spaces closed to selected area</td>
<td>One space</td>
</tr>
<tr>
<td>Number of Community spaces and organisations</td>
<td>No community spaces with</td>
</tr>
</tbody>
</table>
Results

Independent variables – the physical urban design characteristics

As mentioned, the survey data was provided by inhabitants in three suburbs in the southwest of Geelong, Australia. Geelong is the second largest city in Victoria, developing significantly after growth of the southwest of the city after the Second World War. The three suburbs were selected not just for socioeconomic equivalence, but also for design variability as each was developed during different periods of residential growth. Thus, the three suburbs vary in urban design layout and architectural style (Figure 1), meaning the spatial relationships between dwellings are quite different. Belmont is the oldest suburb, having the most significant growth during the 1950s and 1960s. Further population growth in Belmont occurred in 2006 and 2011, when there was an increase in new dwellings. Groovedale has had significant development since the 1970s and 1980s, with population growing during the early 1990s as a result of further housing development. The newest suburb is Waurn Ponds, which underwent rapid residential development in the 1990s and saw a marked increase in the number of new houses between 1991 and 2011 (de Jong et al., 2013). The Belmont streets follow a traditional grid type, with wide nature strips and mature trees in private gardens and lining the streets. Generally, the streets in Groovedale are of conventional loop and cul-de-sac form with no clear grid orientation, and have a diversity of established large shrubs, trees and grassed nature strips. The streets in Waurn Ponds are of conventional loop and curvilinear form with significantly fewer trees and with nature strips that are less green but instead are often topped with gravel, pebbles and artificial grass (de Jong et al., 2013). Eight residential
streets in each suburb were selected for greatest variety of planning layout, such that short cul-de-
sacs could be compared with long cul-de-sacs, with double-intersected streets, with single-
intersected streets, and with streets terminating at T-junctions with more major thoroughfares.

Relationships between sociodemographic, dependent and independent variables

This study hypothesises that neighbourhood form and dwelling form affect neighbourhood
attachment. The results are reported in three sections: (1) comparison of the three neighbourhoods,
(2) correlation with social-demographic variables, and (3) regression analyses. Figure 2 explains
the relationships between the variables investigated in this paper and the types of analysis used.

Comparison of the three neighbourhoods

When analysis of variance between groups was used to compare the Neighbourhood Attachment
scores of the three different suburbs, there was found to be a significant difference (F = 15.8, p <
0.001). While, residents in the traditional neighbourhood of Belmont returned a mean 3.9 for
neighbourhood attachment, residents living in the conventional loop and cul-de-sac suburb
(Grovedale) returned a mean of 3.73, and in the conventional loop (curvilinear) suburb (Waurn
Ponds) returned a mean of 3.3. Further analysis investigated if these
differences were due to socio-
demographic differences and/or differences in the urban design characteristics of the suburbs.

Correlations of neighbourhood attachment with social demographic variables

The impact of eight social and demographic variables were explored via their bivariate
relationships with neighbourhood attachment. Table 3 shows descriptive statistics of social and
demographic variables in three neighbourhoods. The zero-order Pearson correlations (Figure 3)
show that neighbourhood attachment has slightly weak significant correlations with age, education
and home-ownership, and high significant correlation with length of residence. However, other
social demographic variables such as income and number of members in household were shown
to have no significant correlation with neighbourhood attachment. Thus, only social and
demographic variables with a strong correlation (of ≥ 0.3) with neighbourhood attachment were
included in regression analyses.
Neighbourhood attachment was shown here to have a number of strong correlations with physical urban design variables; most strongly with street type, trees coverage, connectivity by walking and provision of open spaces.

Table 3: Descriptive statistics of social and demographic variables

<table>
<thead>
<tr>
<th>Socio-demographic features</th>
<th>Belmont</th>
<th>Grovedale</th>
<th>Waurn Ponds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household tenure</td>
<td>Mean (std. deviation)</td>
<td>Mean (std. deviation)</td>
<td>Mean (std. deviation)</td>
</tr>
<tr>
<td>Length of residence</td>
<td>1.93 (0.26)</td>
<td>1.89 (0.32)</td>
<td>1.87 (0.34)</td>
</tr>
<tr>
<td>≤5 years</td>
<td>2.60 (1.06)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5–10 years</td>
<td>2.53 (1.04)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11–20 years</td>
<td>2.19 (0.85)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥18 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age group</td>
<td>3.22 (0.87)</td>
<td>2.96 (0.78)</td>
<td>2.99 (0.76)</td>
</tr>
<tr>
<td>18–24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25–44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45–64</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65–79</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80 and over</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>14.43 (2.15)</td>
<td>24.22 (2.17)</td>
<td>34.89 (2.24)</td>
</tr>
<tr>
<td>Female</td>
<td>15.45 (2.32)</td>
<td>24.17 (2.61)</td>
<td>34.19 (2.34)</td>
</tr>
<tr>
<td>Income N= 115</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$40k to 60k</td>
<td>3.65 (1.49)</td>
<td>3.82 (1.55)</td>
<td>3.72 (1.70)</td>
</tr>
<tr>
<td>$60,001 to 80k</td>
<td>(14%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$80,001 to 100k</td>
<td>(18%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>over $100k</td>
<td>(6%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of members in household</td>
<td>2.54 (1.29)</td>
<td>3.04 (1.38)</td>
<td>3.12 (1.21)</td>
</tr>
<tr>
<td>1</td>
<td>(15%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>(31%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>(19%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>(23%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>(10%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>(3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of children</td>
<td>1.03 (1.32)</td>
<td>1.51 (1.45)</td>
<td>1.48 (1.29)</td>
</tr>
<tr>
<td>Non</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>(39%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>(11%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>(24%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>(16%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>(6%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of education N= 225</td>
<td>3.13 (0.94)</td>
<td>3.06 (1.04)</td>
<td>2.62 (1.00)</td>
</tr>
<tr>
<td>Less than high school</td>
<td>(4%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school graduate</td>
<td>(30%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>College graduate</td>
<td>(40%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>University graduate or professional degree</td>
<td>(17%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Multiple regression analyses

Each of five hierarchical multiple regressions started with intercept-only socio-demographics factors to determine to what degree five categories of suburban design variables predict neighbourhood attachment after the effect of socio-demographics variables was controlled for. The five categories of independent (predictor) variables were: (1) street layout, (2) pedestrian environment (3) neighbourhood connectivity, (4) public space provision, and (5) dwelling form. Figure 4 shows predictive power of independent factors. Each of the five analyses indicated highly significant relationships between each model and neighbourhood attachment, with $R^2$ between .186 and .272 ($p < .000$). Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, outliers, multicollinearity and homoscedasticity.

Due to the high number of variables and possible correlations involved, the relationships between dependent and independent variables were investigated via five separate regressions; that is one regression for each of the five predictor models. This approach is adopted because each set of neighbourhood design variables (e.g., pedestrian environment) can be hypothesised to impact social interaction in degrees and ways that are independent from the other sets of design variables (e.g., public space provision). As this means that five hypotheses are being tested simultaneously, the Bonferroni correction is applied to set the significance cut-off at $p = \alpha/n$ (see (Pallant, 2010)). In this case, with 5 tests and $\alpha = 0.05$, the null hypothesis is only rejected if the $p$-value is less than 0.01. The data from all five regressions is reported in Table 4.

Five hierarchical multiple regressions were used to find if five categories of (predictor) variables predict Neighbourhood attachment, after controlling for the influence of length of residence: (1) street layout; (2) pedestrian environment; (3) neighbourhood connectivity; (4) public space provision; (5) dwelling form). In every model, length of residence was entered at Step 1 and explained 18.6% of the variance in perceived Neighbourhood attachment.

In the first regression, after entry at Step 2 of street type, through traffic and on-street parking, the total variance explained by the model as a whole was 27.1%, $F(4, 238) = 54.9$, $p < .001$. In the final model, three variables were statistically significant, with length of residence a
recording a higher beta value (beta = -.38, p < .001) and street type (beta = .24, p < .001) than on-
street parking (beta = .12, p < .05).

In the second regression, after entry at Step 2 of sidewalk, nature strip and tree coverage, the total variance explained by the model as a whole was 28%, F (4, 238) = 54.9, p < .001. In the final model, three variables were statistically significant, length of residence recording a high beta value (beta = .39, p < .001), tree coverage (beta = .25, p < .001) and sidewalk (beta = -.22, p < .001).

In the third regression, after entry at Step 2 of connectivity by walking and connectivity by transport, the total variance explained by the model as a whole was 24.2%, F (2, 239) = 25.4, p < .001. In the final model, two variables significantly contributed to neighbourhood attachment, with length of residence recording higher beta value (beta = .39, p < .001), than connectivity by walking (beta = .23, p < .01).

In the fourth regression, after entry at Step 2 of number of community and open spaces with walking distance, the total variance explained by the model as a whole was 26%, F (2, 239) = 28, p < .001. In the final model, three variables were statistically significant, with provision of open space recording higher beta value (beta = .40, p < .001) than length of residence (beta = .39, p < .001) and community spaces (beta = -.22, p < .01).

In the final regression, after entry at Step 2 of the dwelling form variables, the total variance explained by the model as a whole was 26.2%, F (5, 237) = 16.8, p < .001. In the final model, three variables were statistically significant, with length of residence recording a higher beta value (beta = .400, p < .001) than dwelling type and fence height (beta = -.17, p < .05). Table 4 summarised five of hierarchical multiple regression analyses.

Table 4: Summary of hierarchical multiple regression analysis of neighbourhood attachment and urban design characteristics.

<table>
<thead>
<tr>
<th>Predictor variable</th>
<th>B</th>
<th>SEB</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>3.749</td>
<td>.222</td>
<td></td>
</tr>
<tr>
<td>Length of residence</td>
<td>.268</td>
<td>.039</td>
<td>.388***</td>
</tr>
<tr>
<td>Street type</td>
<td>-.245</td>
<td>.048</td>
<td>-.288***</td>
</tr>
</tbody>
</table>
Discussion

The results indicate that residents in older more established neighbourhoods with layouts categorised as traditional have higher neighbourhood attachment than residents in newer conventional loop (curvilinear) suburban neighbourhoods. No significant neighbourhood attachment differences were found between traditional type and conventional loop and cul-de-sac streets. This result is consistent with previous research finding that attachment varies between residents from different residential communities depending on their perception of different physical features (Kim and Kaplan, 2004), and indicates that neighbourhood layout can impact neighbourhood attachment.
While the socio-demographics are fairly well matched across the three neighbourhoods, with home ownership in particular being relatively homogeneous (at 89% across the suburbs), the results indicate that differences other than urban design variations influence attachment. In particular, older residents who are owners and have longer terms of residence are significantly more attached to their neighbourhoods. This result is not unexpected and is in line with Riger and Lavrakas (1981), who found physical rootedness determined by length of residence and home ownership enhances attachment, which in turn leads to greater levels of sense of community. Similarly, Bonaiuto et al. (1999), Brown et al. (2003), Comstock et al. (2010), Lewicka (2010) and Anton and Lawrence (2014) have found increased neighbourhood attachment is positively associated with length of residence. In line with this, Unger and Wandersman (1985) found that residents more rooted in terms of home ownership and stability are more likely to identify with their neighbourhood and connect symbolically with their physical environment. The finding that resident-age is positively related to attachment is in line with the results of Hidalgo and Hernandez (2001).

This study provides support for the hypothesis that neighbourhood design significantly contributes to neighbourhood attachment when sociodemographic features are controlled for. The regression models indicated that all five groups of physical characteristics – street layout, pedestrian environment, neighbourhood connectivity, public space provision, and dwelling form – predict neighbourhood attachment. Among all fourteen of the physical characteristics measured, provision of open public spaces was the greatest contributor to neighbourhood attachment, and number of community spaces within walking distance was also found to significantly predicted neighbourhood attachment. These results reinforce the findings of previous research that indicating provision of open and community spaces and within walking distance have a key role in fostering residents’ attachment (Brookfield, 2016; Raymond et al., 2010; Thompson and Kent, 2014; Kim and Kaplan, 2004). Street type was the greatest contributor in the street layout model and significantly predicted neighbourhood attachment. In addition, the degree of street parking had a small contribution to attachment in this model. Results showed that the traditional street-
types of Belmont were most positively correlated with increased neighbourhood attachment. This is in line with previous research finding that traditional streets contribute to more pedestrian oriented and safe environments (Lund, 2002; Kim and Kaplan, 2004). Though-traffic rates made no significant contribution to the variance of neighbourhood attachment, which is in contrast with previous research indicating that heavy traffic is associated with less attachment and less social interaction (Appleyard and Lintell, 1972; Bramley and Power, 2009).

Our results revealed that two characteristics of the more established and traditional street layout of Belmont predicted higher levels of neighbourhood attachment – namely good sidewalk provision and higher levels of tree coverage. Thus, attachment was higher with more trees and also with the presence of sidewalks on both sides of the street compared to streets with no sidewalks. Prior research has similarly found higher levels of neighbourhood attachment for pedestrian environments that encourage outdoors activities (Bonaiuto et al., 2003; Rogers and Sukolratnametee, 2009), and that include trees and grassed areas, which attract more people to use streets (Lovejoy et al., 2010; Sullivan et al., 2004). As well as providing health benefits through improved connection with nature, trees also strengthen social ties and sense of place by creating places for social interaction (Uslu, 2010). It should be acknowledged that tree coverage increases with tree maturity and hence increases with the age of the suburbs. In other word, in older suburbs residents have tended to have resided longer on-streets lined with mature trees. Thus, in such suburbs, it is possible that both a greener environment and longer connection with place lead in combination to greater neighbourhood attachment. Further research could elucidate these issues with the addition of qualitative data exploring attachment in relation to greenery (Bonaiuto et al., 1999; Comstock et al., 2010; Raymond et al., 2010).

Another of the regression models showed that neighbourhood connectivity by walking made a statistically significant contribution to neighbourhood attachment. In line with previous research, this suggests that walking may reinforce attachment by, for instance, such mechanisms as enhancing perceived safety (Kim and Kaplan, 2004), and providing opportunities to connect socially with neighbours and increase participation in social activities (Gehl, 1987). This argument
is supported by recent research indicating residents are more likely to walk in neighbourhoods with good provision of greenery, pedestrian infrastructure and amenities within walking distance (Brookfield, 2016). Two dwelling form variables – fence height and dwelling type – were also shown to significantly predict neighbourhood attachment. However, both dwelling type and fence height have only small impact on attachment compared to length of residence. The finding that garage location did not significantly affect neighbourhood attachment contrasts with the research of Rogers and Sukolrat'anametee (2009), who argue that highly visible garages are associated with less pedestrian friendly neighbourhoods.

While lower fences predicted higher rates of attachment, a comparison of the data between suburbs revealed that fence heights that are neither too high nor too low more positively enhanced attachment since, it might be concluded, this happy medium provides semi private threshold space that still allows for visual and social connection with neighbours. This result is aligned with research that has discussed the role of housing layout in providing proximity between neighbours that encourages greater sociability (Abu-Ghazaleh, 1999; Patricios, 2002). Several previous studies have also found that dwelling types that create semi-private spaces providing more chances for social contact encourage residents to be more dynamically engaged with their neighbourhood (Talen, 1999; Kim and Kaplan, 2004). This is in line with Lewicka (2010) who found that housing type is significant indirect predictor of neighbourhood attachment. Street design that is mindful of the impact of territorial boundaries can enhance social experience and sense of place by encouraging walking along suburban streets (Ewing & Clemente, 2013). Moreover, entrance location and fence design have been suggested to directly impact neighbour interactions (Brower, 2013).

Thus, to sum up, although length of residence had great influence on neighbourhood attachment, this study evidences that the physical environment also plays an important role in shaping feelings of attachment in the context of low-density suburbs. While street planning – layout, provision of public and open spaces with walking distance, degree of tree coverage, sidewalk provision and connectivity by walking – had the most impact on neighbourhood
attachment, it is through the careful integration of dwelling form with all of all these physical features of low-density suburbs that neighbourhood attachment can better contribute to strengthening social connection. Of course, in older more traditional suburbs, greenery is more mature, public spaces are often more plentiful and facilities are easier reached via walking. This is either through good planning or through an organic process of growth that has over time seen demand for community facilities met by supply. In such traditional suburbs residents remain longer and become more attached. This overall finding is line with the results of a study by Lovejoy et al., who found that neighbourhood satisfaction is higher among residents of traditional neighbourhoods (even after controlling for sociodemographic and other characteristics) (2010). However, that is not to say that newly created suburbs need be places that lack the characteristics that shape attachment, for with good design and urban planning new suburbs can be instilled with some of the ‘charm’ and life of those that are well established.

This research does of course have limitations that need acknowledging. First, this study has solely investigated the relationship between neighbourhood attachment and the provision of a number of neighbourhood design characteristics, and thus has not considered correlates of neighbourhood attachment such as neighbouring, neighbourhood satisfaction and walkability & safety. Next, this study was limited to the measurement of the provision – i.e., quantity of some urban design elements, such as open and public spaces, when their qualities might also be usefully considered. For example, other studies have considered the quality of green spaces in terms of upkeep, amount of greenery and standard of facilities (Comstock et al., 2010; Wolch et al., 2014; Francis et al., 2012; Arnberger and Eder, 2012). Further, beyond the scope of this study were the contributions of other social effects, such as: (1) the role of organizations in building community and participation in social activities (Dekker, 2007); (2) crime rates; and (3) cultural diversity – the latter two of which have well researched associations with neighbourhood attachment (Glynn, 1986; Brown et al., 2003). In addition, the low response rate and thus the possible selection bias of the study participants should also be acknowledged. Finally, while this research has been limited to neighbourhood attachment, other psycho-social correlates of attachment need
considering when researching the contribution of neighbourhood design to the sustainability of suburban communities, in particular neighbourhood satisfaction and neighbouring.

**Conclusion**

This study investigated the relationship between neighbourhood attachment and a number of urban design characteristics to provide an understanding of how neighbourhood design might affect neighbourhood attachment. The survey of residents explored their perceptions of their social and physical bonds towards their neighbourhood. The findings suggest that neighbourhood attachment was affected by physical design characteristics in all three suburbs in Geelong. Street type, public and open spaces, tree-coverage and neighbourhood connectivity had the most significant impact on neighbourhood attachment, followed by (in order of significance): sidewalk provision, dwelling type, fence height, and on-street parking. Hence, it is likely that these physical design characteristics of streets contribute to residents’ perceived sense of community and improve socio-spatial interactions. To conclude, our study has thus shown that residents more positively regard low-density suburbs when: provision of public and open spaces is better, tree coverage is higher, proportions of detached houses are lower, streets are pedestrian-friendly and fence heights are neither too high nor too low.

However, the limits of this study suggest the need to investigate further potential relationships between physical design and other contributors to social connectivity and sustainable communities that are readily measurable using pre-established scales, such as neighbourhood satisfaction (Bonaiuto et al., 2003), neighbouring (Nasar and Julian, 1995; Buckner, 1988) and feeling of safety (Leyden, 2003; Lund, 2002; Can, 2012). Future research also could directly explore the relationship between neighbourhood design and direct indicators of social interaction, such as numbers interaction places, numbers of people known in the neighbourhood and the frequency of social connections. In addition, this study was limited to three residential low-density suburban neighbourhoods of spatial layout that commonly represent Australian suburban development. Thus, further study is needed to examine neighbourhood attachment in neighbourhoods of less
traditional spatial layout and physical design; indeed, in neighbourhoods that have been designed with improved social interaction in mind.

References


Figures:

Figure 1. Suburbs layout and residential streets in selected neighbourhoods

Traditional suburb layout (Belmont)  
Source: Near Map, 2017

Belmont typical residential street

Conventional loop and Cul-de-sac layout  
(Grovedale) Source: Near Map, 2017

Grovedale typical residential street

Conventional loop and curvilinear layout  
(Waurn Ponds) Source: Near Map, 2017

Waurn Ponds typical residential street
Figure 2. The conceptual model of analyses and the relationships between them
Figure 3: Significant correlations between socio-demographic variables, neighbourhood attachment and urban neighbourhood characteristics

Figure 4. Regression analysis for predicting neighbourhood attachment from independent factors (only significant variables are shown. The thicker arrows show the stronger predictors)
**Fifty shades of green: Tree coverage and neighbourhood attachment in relation to social interaction in Australian suburbs**

Abass, Zainab, Tucker, Richard

Fifty years later: Revisiting the role of architectural science in design and practice:


Abstract:

Social interaction is seen as a key dimension of social sustainability and an essential feature of the social capital of cities. Yet social interaction in suburban neighbourhoods has been largely overlooked by researchers and designers; a neglect that has had negative impacts on social sustainability in the suburbs. In this paper, the impact is explored of tree coverage on neighbourhood attachment in residential, low-density suburban streets in Victoria, Australia. The research is part of a wider study considering the complex relationship between four contributors to social interaction – Neighbourhood attachment, Neighbourhood satisfaction, Neighbouring and Walkability and safety – and two categories of factors that influence social interaction: the psychosocial and physical characteristics of neighbourhoods. The residents of three suburbs in Geelong, Australia, were questioned via a survey that aimed to measure how physical design factors impact the residents’ interactions. To isolate as much as possible design factors from social factors, the three suburbs chosen had equivalent socioeconomic profiles. Two survey methods were used. First, questionnaires were delivered to six streets in each of the three suburbs. Each street had a different type of planning layout. Second, on-street face-to-face survey was carried out in the public spaces adjacent to neighbourhood libraries. The survey used multi-choice 5-point Likert scale questions to determine values for four scales that measure four contributors to social interaction. The wider research hypotheses that characteristics of neighbourhood form, such as tree coverage, can facilitate social interaction by increasing perceptions of neighbourhood attachment. The findings of the research reported on this paper indicated that Neighbourhood attachment scores significantly increase as tree coverage increases in the suburbs. It is concluded that an understanding of how neighbourhood form determines social interaction in the suburbs can inform strategies for architects, urban planners and other built environment professionals to design sustainable suburban neighbourhoods; particularly through designing streets that provide sense of place and community.

**Keywords:** Social interaction; Neighbourhood form; Neighbourhood attachment; Tree coverage.
The impacts of social and physical context on neighbourhood satisfaction in the suburbs

Abass, Zainab, Tucker, Richard


Abstract:

Neighbourhood satisfaction is a key contributor to psychological wellbeing and sustainable community. This paper asks whether physical built environment characteristics or social factors have the greater impacts on satisfaction with residential suburban neighbourhoods. Quantitative analyses via a survey of 247 residents living in three Australian suburbs were conducted. First, Pearson correlations was used to investigate the relationship between perceived neighbourhood satisfaction and a number of independent social and physical neighbourhood design variables. The results showed that neighbourhood satisfaction is strongly associated with physical design characteristics, even allowing for the interaction of sociodemographic variables. Hierarchical multiple regression was then conducted to examine the extent to which five groups of physical characteristics impacted neighbourhood satisfaction: (1) street layout, (2) pedestrian environment, (3) neighbourhood connectivity, (4) public space provision, and (5) dwelling form when socioeconomic factors are controlled for. Physical built environment characteristics such as provision of open spaces, street type and trees coverage were more significant predictors of residents’ satisfaction than socio-demographic factors (income, length of residence and number of household members). This indicates that well designed neighbourhoods can be more attractive for residents. The findings also suggest that satisfaction associated with the social and physical needs of residents can be critical influences that planners and decision makers need to consider when designing for sustainable communities in contemporary suburban contexts.

Keywords: Satisfaction, Physical environment, Neighbourhood, Sustainability, Socio-demographic factors, Suburbs.
Residential satisfaction in low-density Australian suburbs: the impact of social and physical context on neighbourhood contentment

Abass, Zainab, Tucker, Richard

Journal of Environmental Psychology

Abstract:
This paper asks whether physical built environment characteristics or social factors have the greatest impacts on residents’ satisfaction with low-density suburban neighbourhoods. Quantitative analyses of a survey of 247 residents living in three Australian suburbs was conducted to measure residential satisfaction. While the majority of research focuses only on one of three dimensions of residential satisfaction – satisfaction with dwelling or neighbourhood or neighbours – here we explore residential satisfaction in relation to all three dimensions. First, it was found that four scales used in the survey to measure satisfaction could be reduced in the context of suburban Australia to three more powerful factors – Neighbourhood Contentment, Active Socialising and Accessibility. Multiple regression examined the extent to which five groups of physical characteristics impacted Neighbourhood Contentment. Results indicated that Neighbourhood Contentment is significantly predicted by physical design characteristics, even allowing for the interaction of sociodemographic variables. Neighbourhood characteristics such as street type, tree coverage, and provision of sidewalks, shared open space and community spaces were found to be the most important predictors of Neighbourhood Contentment; indicating that well planned neighbourhoods are more satisfying places to live for residents. The findings suggest that planners and urban designers need to consider the provision of such neighbourhood characteristics when designing for communities in contemporary suburban contexts.

Keywords: Residential Satisfaction, Urban Design, Neighbourhood Attachment, Neighbouring
Appendix B: Questionnaires
Neighbourhood Design Questionnaire (mail-shot)

1.1 Household Information

**Household tenure**
☐ Renting  ☐ Owner

**Length of Residency**
☐ Less than 5 years  ☐ 5 to 10 years  ☐ 11 to 20 years  ☐ over 20 years

**Age group**
☐ 18-24  ☐ 25-44  ☐ 45-64  ☐ 65-79  ☐ 80 and over

**Gender**
☐ Male  ☐ Female  ☐ Prefer not to state

**Income**
☐ $40k to 60k  ☐ $60,001 to 80k  ☐ $80,001 to 100k  ☐ over $100k  ☐ Prefer not to state

**Number of members in your household** ________

**Number of Children** ______

**Highest level of education completed:**
☐ Less than high school  ☐ High school graduate  ☐ College graduate

☐ University graduate or professional degree  ☐ Prefer not to state  ☐ Other (SPECIFY) _______

1.2 Place attachment: rate your agreement with the following statements about your neighbourhood.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Extremely disagree</th>
<th>Slightly disagree</th>
<th>Neither agree nor disagree</th>
<th>Slightly agree</th>
<th>Extremely agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. This is an ideal neighbourhood to live in</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. Now, this neighbourhood is a part of me</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. There are places in the neighbourhood to which I am very emotionally attached</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4. It would be hard for me to leave this neighbourhood.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5. I would willingly leave this neighbourhood</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

1.3 Neighbourhood satisfaction: to what extent are you satisfied with each quality in your neighbourhood?

<table>
<thead>
<tr>
<th>Quality</th>
<th>Extremely disagree</th>
<th>Slightly disagree</th>
<th>Neither agree nor disagree</th>
<th>Slightly agree</th>
<th>Extremely agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. It is easy to cycle around</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>7. Parking places and parking lots are lacking</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>8. There is a good availability of parking spaces</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>9. There is not enough space to walk</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>10. It is dangerous to cycle</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>11. Parked cars impede walking</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>12. This neighbourhood is well-suited for handicapped people</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13. Streets are wide enough</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14. This neighbourhood is well-connected with important parts of the city</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>15. The city-centre can be easily reached from this neighbourhood</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16. This neighbourhood is too cut-off from the rest of the city</td>
<td>☐</td>
<td>☐</td>
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<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>17. It is easy to go out from this neighbourhood</td>
<td>☐</td>
<td>☐</td>
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</tr>
</tbody>
</table>
18. There is a large choice of roads to get out of the neighbourhood
19. Going into this neighbourhood means going around in circles

1.4 Neighbouring: to what extent do you agree that the following statements are being done in your neighbourhood?

20. If I feel like talking I can generally find someone in this neighbourhood to talk to right away
21. I have made new friends by living here
22. I know some people living here due to my child/children
23. My friends in this neighbourhood are part of my everyday activities
24. I met with my friends in this neighbourhood mostly at public places
25. I usually participate social activities in my neighbourhood
26. If I had an emergency, even people I do not know in this neighbourhood would be willing to help
27. I really care about this neighbourhood
28. I am happy with the maintenance and management of our neighbourhood
29. Noise, which is created in at the street, can occasionally be a big problem

1.5 Walkability and safety: to what extent do you agree with the following aspects in your neighbourhood?

31. I often see neighbours I know when I walk
32. I often see strangers who make me feel uncomfortable when I walk
33. I feel safe walking in my neighbourhood during the day
34. I feel safe walking in my neighbourhood during the evening
35. I feel uncomfortable walking where there are no sidewalks in my neighbourhood
36. I feel uncomfortable walking when street vender’s or local shopkeepers exhibit their products on sidewalk
37. I like walking on the street where there are shops

1.7 Social Interaction: indicate the places of your greeting/chatting/contact; you can tick more than one.

- [ ] Street/on sidewalks
- [ ] Parking lot
- [ ] Neighbourhood open spaces
- [ ] Cafes/Local Shops
- [ ] Garden/yard
- [ ] Staircase/ hall
- [ ] Dwelling entrance
- [ ] Balconies
- [ ] Windows
- [ ] Fence ..........................

1.6 Housing Layout Social Interaction

What is the number of people you know by name in your suburb? ................................
What is the number of people you know by name in your street? .................................
How frequently do you visit people living in your street/ neighbourhood?
☐ Never    ☐ Sometimes    ☐ a lot

How frequently do you experience social interaction outdoors (parks, public squares, streets, etc.) in your neighbourhood?
☐ Never    ☐ Sometimes    ☐ a lot

THANK YOU for taking the time to complete this survey and in doing so providing us with valuable research information

Neighbourhood Design Questionnaire (Face to face interview)

Address of the house you live in:

-----------------------------------------------------------------------------------------------------------------------------

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detach here
detach here

Household Information

Household tenure    ☐ Renting    ☐ Owner
Length of Residency    ☐ Less than 5 years    ☐ 5 to 10 years    ☐ 11 to 20 years    ☐ over 20 years
Age group
☐ 18-24    ☐ 25-44    ☐ 45-64    ☐ 65-79    ☐ 80 and over
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<td>10. It is dangerous to cycle</td>
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<td>11. Parked cars impede walking</td>
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<td>12. This neighbourhood is well-suited for handicapped people</td>
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<td>13. Streets are wide enough</td>
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<td>14. This neighbourhood is well-connected with important parts of the city</td>
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<tr>
<td>15. The city-centre can be easily reached from this neighbourhood</td>
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<td>16. This neighbourhood is too cut-off from the rest of the city</td>
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<td>17. It is easy to go out from this neighbourhood</td>
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<td>18. There is a large choice of roads to get out of the neighbourhood</td>
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<td>19. Going into this neighbourhood means going around in circles</td>
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1.4 Neighbouring: to what extent do you agree that the following statements are being done in your neighbourhood?

<table>
<thead>
<tr>
<th></th>
<th>Extremely disagree</th>
<th>Slightly disagree</th>
<th>Neither agree nor disagree</th>
<th>Slightly agree</th>
<th>Extremely agree</th>
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<tr>
<td>20. If I feel like talking I can generally find someone in this neighbourhood to talk to right away</td>
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<td>21. I have made new friends by living here</td>
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<td>22. I know some people living here due to my child/children</td>
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<td>23. My friends in this neighbourhood are part of my everyday activities</td>
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<td>24. I met with my friends in this neighbourhood mostly at public places</td>
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<td>25. I usually participate social activities in my neighbourhood</td>
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</table>
26. If I had an emergency, even people I do not know in this neighbourhood would be willing to help

☐ ☐ ☐ ☐ ☐

27. I really care about this neighbourhood

☐ ☐ ☐ ☐ ☐

28. I am happy with the maintenance and management of our neighbourhood

☐ ☐ ☐ ☐ ☐

29. I feel safe and comfortable in this neighbourhood

☐ ☐ ☐ ☐ ☐

30. Noise, which is created in at the street, can occasionally be a big problem

☐ ☐ ☐ ☐ ☐

1.5 Walkability and safety: **to what extent do you agree with the following aspects in your neighbourhood?**

<table>
<thead>
<tr>
<th>Extremely disagree</th>
<th>Slightly disagree</th>
<th>Neither agree nor disagree</th>
<th>Slightly agree</th>
<th>Extremely agree</th>
</tr>
</thead>
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</table>

31. I often see neighbours I know when I walk

☐ ☐ ☐ ☐ ☐

32. I often see strangers who make me feel uncomfortable when I walk

☐ ☐ ☐ ☐ ☐

33. I feel safe walking in my neighbourhood during the day

☐ ☐ ☐ ☐ ☐

34. I feel safe walking in my neighbourhood during the evening

☐ ☐ ☐ ☐ ☐

35. I feel uncomfortable walking where there are no sidewalks in my neighbourhood

☐ ☐ ☐ ☐ ☐

36. I feel uncomfortable walking when street vendor’s or local shopkeepers exhibit their products on sidewalk

☐ ☐ ☐ ☐ ☐

37. I like walking on the street where there are shops

☐ ☐ ☐ ☐ ☐

1.6 Social Interaction: **indicate the places of your greeting/chatting/contact; you can tick more than one.**

☐ Street/on sidewalks ☐ Staircase/ hall

☐ Parking lot ☐ Dwelling entrance

☐ Neighbourhood open spaces ☐ Balconies

☐ Cafes/Local Shops ☐ Windows

☐ Garden/yard ☐ Fence …………………

1.7 housing layout social interaction

What is the number of people you know by name in your suburb? …………………

What is the number of people you know by name in your street? …………………

How frequently do you visit people living in your street/ neighbourhood?

☐ Never ☐ Sometimes ☐ a lot

How frequently do you experience social interaction outdoors (parks, public squares, streets, etc.) in your neighbourhood?

☐ Never ☐ Sometimes ☐ a lot

The interview questions

1- What was it about this street that attracted you to living here?
2- Tell us about your emotional connections to this place? What is it about this street that makes you feel like you belong or not as the case may be?

3- Tell us about your connections with your neighbours? What is it about this street that makes it easy or hard to make friends?

4- Can you tell us about walking around in your area during the daytime and at night? What makes you feel safe or unsafe in your street? Tell us about who you might see walking? What makes it pleasant or unpleasant to walk in your street?

5- Tell us about the greenery in your street and to what extent they impact your feelings towards living here?

6- Now tell us about any things you would like to change in your street that might improve your interaction with your neighbours? (E.g., easy access to rest of city, presence of footpath, playgrounds, availability of parking, traffic volume, public transport, etc.).
Appendix C: Ethics approval and documentation
Zainab Abass  
School of Architecture and Built Environment (F)  
cc: Ass Prof Richard Tucker  
Dr Igor Martek  

November 26, 2015  

Dear Zainab  

STEC-57-2015-ABASS- Neighbourhood design strategies for increased social interaction in Australian suburbs  

Thank you for submitting the above project for consideration by the Faculty Human Ethics Advisory Group (HEAG). The HEAG recognised that the project complies with the National Statement on Ethical Conduct in Human Research (2007) and has approved it. You may commence the project upon receipt of this communication.  

The approval period is for three years. It is your responsibility to contact the Faculty HEAG immediately should any of the following occur:  
- Serious or unexpected adverse effects on the participants  
- Any proposed changes in the protocol, including extensions of time  
- Any changes to the research team or changes to contact details  
- Any events which might affect the continuing ethical acceptability of the project  
- The project is discontinued before the expected date of completion.  

You will be required to submit an annual report giving details of the progress of your research. Please forward your first annual report on 26/11/16. Failure to do so may result in the termination of the project. Once the project is completed, you will be required to submit a final report informing the HEAG of its completion.  

Please ensure that the Deakin logo is on the Plain Language Statement, Consent Forms and all other documentation provided to participants. You should also ensure that the project ID is inserted in the complaints clause on the Plain Language Statement and consent forms, and be reminded that the project number must always be quoted in any communication with the HEAG to avoid delays. All communication should be directed to sciethic@deakin.edu.au.  

The Faculty HEAG and/or Deakin University Human Research Ethics Committee (HREC) may need to audit this project as part of the requirements for monitoring set out in the National Statement on Ethical Conduct in Human Research (2007).  

If you have any queries in the future, please do not hesitate to contact me.  

We wish you well with your research.  

Kind regards  

Sandra Dunoon  
Secretary, Human Ethics Advisory Group (HEAG)  
Faculty of Science, Engineering and Built Environment  

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Signature Redacted by Library  

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Richard Tucker, Zainab Ibrahim Abass
School of Architecture and Built Environment.
Waterfront Campus
C.c Igor Martek and Fiona Andrews

21 October 2016

Dear Richard and Zainab

STEC-57-2015-ABASS Modification 1 titled “Neighbourhood Design Strategies for increased Social interaction in Australian Suburbs”

Thank you for submitting a modification to the above project for consideration by the Faculty Human Ethics Advisory Group (HEAG). The HEAG recognised that the project complies with the National Statement on Ethical Conduct in Human Research (2007) and has approved it. You may commence the project upon receipt of this communication.

The approval period is for three years. It is your responsibility to contact the Faculty HEAG immediately should any of the following occur:

- Serious or unexpected adverse effects on the participants
- Any proposed changes in the protocol, including extensions of time
- Any changes to the research team or changes to contact details
- Any events which might affect the continuing ethical acceptability of the project
- The project is discontinued before the expected date of completion.

You will be required to submit an annual report giving details of the progress of your research. Please forward your first annual report on 21/10/17 failure to do so may result in the termination of the project. Once the project is completed, you will be required to submit a final report informing the HEAG of its completion.

Please ensure that the Deakin logo is on the Plain Language Statement and Consent Forms. You should also ensure that the project ID is inserted in the complaints clause on the Plain Language Statement, and be reminded that the project number must always be quoted in any communication with the HEAG to avoid delays. All communication should be directed to sciethic@deakin.edu.au

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If you have any queries in the future, please do not hesitate to contact me.

We wish you well with your research.

Kind regards

Teresa Trefry
Secretary, Human Ethics Advisory Group (HEAG)
Faculty of Science Engineering & Built Environment

Signature Redacted by Library
TO: Dear residents

Plain Language Statement

Full Project Title: Neighbourhood Design Strategies for Increased Social Interaction in Australian Suburbs
Principal Researcher: Associate Professor Dr Richard Tucker
Student Researcher: Zainab Ibrahim Abass
Associate Researcher(s): Dr Igor Martek

You are invited to complete this survey on how neighbourhood design impacts social interaction and the sustainability of communities in low-density neighbourhoods. This Plain Language Statement explains the project.

This project examines how much you interact with friends and neighbours in your living area, how safe you feel, and how satisfied you are with your neighbourhood. Your answers can be helpful in understanding how Australian suburban neighbourhoods such as yours meet the needs of those who live there, and how such neighbourhoods might be better designed to improve social interaction so that people feel more connected to their communities.

This research forms part of the PhD study for Zainab Ibrahim Abass. The research is monitored by the Principal Researcher Associate Professor Dr. Richard Tucker (Richard.tucker@deakin.edu.au Phone: 03 52278308).

You have been selected as resident who lives in this area. The survey consists of questions about your opinions of living in your neighbourhood, and about how you interact with your neighbours. Your contribution is completely voluntary. If you agree to participate in the survey you will fill out an anonymous questionnaire. It should take about 10-15 minutes to complete. Please return your questionnaire responses to Deakin University using the provided stamped-addressed envelope by [date].

Your responses will be preserved confidentially. You are free to withdraw from the survey at any time before the submission of survey, after that it will not be possible to withdraw your information since the survey is anonymous. If we publish the results in any publication, information will be reported in such a way that you cannot be identified. The survey has no risk involved for participants.

The data obtained will be stored securely at Deakin University for least 5 years after the final publication of the research outcomes.

If you have any questions, please feel free to contact ZAINAB IBRAHIM (contact details at the end of this form). The ethical approval to conduct this project has been given by the Human Ethics Advisory Group (HEAG), Faculty of Science Engineering and Built-Environment, Deakin University.
If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact: The Manager, Ethics and Biosafety, Deakin University, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9251 7129, research-ethics@deakin.edu.au

Please quote: Project number / STEC-57-2015-ABASS

ZAINAB IBRAHIM (PhD Student)
School of Architecture and Built Environment
Deakin University / Email: zia@deakin.edu.au / Mobile: 0478849701
**PLAIN LANGUAGE STATEMENT**

**TO:** Dear participants

<table>
<thead>
<tr>
<th>Plain Language Statement</th>
</tr>
</thead>
</table>
**Full Project Title:** Neighbourhood Design Strategies for Increased Social Interaction in Australian Suburbs

**Principal Researcher:** Associate Professor Dr Richard Tucker  
**Student Researcher:** Zainab Ibrahim Abass  
**Associate Researcher(s):** Dr Igor Martek

You are invited to complete this survey on how neighbourhood design impacts social interaction and the sustainability of communities in low-density neighbourhoods. This Plain Language Statement explains the project. After you read the statement and complete the survey you can keep this document if you wish.

This project examines how much you interact with friends and neighbours in your living area, how safe you feel, and how satisfied you are with your neighbourhood. Your answers can be helpful in understanding how Australian suburban neighbourhoods such as yours meet the needs of those who live there, and how such neighbourhoods might be better designed to improve social interaction so that people feel more connected to their communities.

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The survey will ask you for your address so that the data can be linked to your specific neighbourhood’s design characteristics. Once coded during data entry, the address information will be detached from the questionnaire so that the information you provide is anonymous.

Your responses will be preserved confidentially. You are free to withdraw from the survey at any time before the submission of survey, after that it will not be possible to withdraw your information since the survey is anonymous. If we publish the results in any publication, information will be reported in such a way that you cannot be identified. The survey has no risk involved for participants.

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ZAINAB IBRAHIM (PhD Student)
School of Architecture and Built Environment
Deakin University / Email: zia@deakin.edu.au / Mobile: 0478849701
CONSENT FORM AND PLAIN LANGUAGE STATEMENT
TO: Dear residents

Plain Language Statement

Full Project Title: Neighbourhood Design Strategies for Increased Social Interaction in Australian Suburbs

Principal Researcher: Associate Professor Dr Richard Tucker
Student Researcher: Zainab Ibrahim Abass
Associate Researcher(s): Dr Igor Martek
Associate Researcher(s): Dr Fiona Andrews

This Plain Language Statement explains the project. This project examines how much you interact with friends and neighbours in your living area, how safe you feel, and how satisfied you are with your neighbourhood.

Your answers can be helpful in understanding how Australian suburban neighbourhoods such as yours meet the needs of those who live there, and how such neighbourhoods might be better designed to improve social interaction so that people feel more connected to their communities.

This research forms part of the PhD study for Zainab Ibrahim Abass. The research is monitored by the Principal Researcher Associate Professor Dr. Richard Tucker (Richard.tucker@deakin.edu.au Phone: 03 52278308).

With your consent, your participation in the project will involve telephone interview of approximately 20-30 minutes. We wish to voice record the interview. You may of course decide to stop the interview at any point. Example interview questions are:
1. What was it about this street that attracted you to living here?
2. Tell us about your emotional connections to this place? What is it about this street that makes you feel like you belong or not as the case may be?

Your responses will be preserved confidentially. You are free to withdraw from the interview at any time, after that it will not be possible to withdraw your information since the interview information you provide is anonymous. If we publish the results in any publication, information will be reported in such a way that you cannot be identified. The interview has no risk involved for participants.

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