THE DETERMINANTS OF PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOUR IN INNER-REGIONAL AUSTRALIA

A Thesis submitted by

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Abstract

Background: Residents of inner-regional Australia suffer poorer health than people living in Australia’s major cities and in more remote regions of Australia. Physical activity has numerous health benefits and offers an excellent preventive health strategy. Sedentary behaviour (i.e., too much sitting) is detrimental for health, particularly among those who perform low levels of physical activity. A high proportion of people living in inner-regional Australia are insufficiently active (84%), and on average, people within this population are sedentary for one third of all waking hours. To devise effective strategies to improve the health of this population by encouraging more people to lead active lifestyles, we first need to understand why so many people within inner-regional Australia are inactive and sedentary. Therefore, the overall aim of this research was to understand why high proportions of people living in inner-regional Australia lead inactive lifestyles.

Methods: A mixed-methods approach was undertaken involving two qualitative and one quantitative study. The first two studies were conducted in inner-regional southern Queensland, with qualitative methodology in the form of semi-structured interviews. The aim of the first study (N = 17) was to identify characteristics of the social and physical inner-regional environment that might impact active lifestyles. The aim of the second study (N = 8) was to identify the beliefs of people residing in inner-regional Australia in relation to physical activity and sedentary behaviour. Data from both studies were analysed by thematic analysis. The findings of these studies informed the design of the final, quantitative cross-sectional study. The aims of this study were to estimate the magnitude of the effects of characteristics of the physical and social environment on physical activity-related intentions and habit strength in inner-regional Australians, and to examine the mechanisms through which these factors affect the psychological antecedents of physical activity. An empirically-derived theoretical model was devised to guide the research. Residents of inner-regional Australia (N = 271) completed an online questionnaire, which assessed physical activity-related automaticity, intentions, attitudes, subjective norms, perceived behavioural control (PBC), and autonomous motivation, in addition to perceptions of the social and physical environment, community participation, drivers of neighbourhood selection, and demographic characteristics.
**Findings:** Neighbourhoods in inner-regional southern Queensland were described as socially cohesive, attractive, and safe. There was a strong culture of support for local sporting teams, and good pedestrian mobility infrastructure within newer housing developments. Such factors may facilitate active lifestyles and have been associated with higher levels of physical activity in previous research. Conversely, weather, poor pedestrian mobility infrastructure, dangerous traffic conditions, distance (particularly for those living outside of towns), and restricted access to destinations presented barriers to active lifestyles. Beliefs that may be conducive to active lifestyles were identified (e.g., favourable health and social outcomes were attributed to physical activity and negative health outcomes were attributed to sedentary behaviour), in addition to beliefs that may be counter to active lifestyles (e.g., features of the physical environment, such as distance to goods, services, and recreational facilities fostered beliefs about the difficulty of performing physical activity and the inevitability of transport-related sedentary behaviour). Despite the presence of some activity-supportive characteristics of inner-regional settings and beliefs that may be expected to be conducive to active lifestyles, most participants reported largely inactive lifestyles. The findings of the third study revealed that together with past physical activity and social-cognitive constructs, social cohesion, community participation, neighbourhood selection for lifestyle and community, and aesthetics accounted for substantive variation in physical activity-related intentions and automaticity. Neighbourhood selection for lifestyle and community, was associated with lower perceived difficulty to perform physical activity, and subsequently with higher physical activity-related intentions. However, contrary to predictions, the constructs representing the contextual characteristics of inner-regional Australia did not exert unique effects on the psychological constructs. Past physical activity predicted all of the psychological and motivational constructs, except for attitudes. The effects of past physical activity on intentions were mediated by subjective norms and PBC. Autonomous motivation predicted automaticity, in addition to attitudes, subjective norms, PBC, and intentions. The effects of autonomous motivation on intentions were mediated by subjective norms and PBC.

**Conclusions:** The favourable outcome expectancies attributed to active lifestyles by people in inner-regional Australia are insufficient, on their own, to generate sustained active lifestyles. Likewise, the presence of some activity supportive
features of the physical and social environment are insufficient, in isolation, to encourage active lifestyles. The need for social interaction, and normative beliefs appear to be particularly salient in inner-regional communities. Autonomous motivation is a critical component of intentional and implicit processes theorised to predict physical activity. Strategies to encourage active lifestyles in inner-regional Australia should concurrently focus on fostering autonomous motivation for physical activity and minimised sedentary behaviour, and on reducing barriers to, and enhancing opportunities for, active lifestyles within the physical environment. Such strategies may be further enhanced by highlighting and promoting opportunities for social interaction through physical activity participation.
Certification of Thesis

This Thesis is the work of Jenny Louise Olson except where otherwise acknowledged, with the majority of the authorship of the papers presented as a Thesis by Publication undertaken by the Student. The work is original and has not previously been submitted for any other award, except where acknowledged.

Principal Supervisor: Dr Michael Ireland

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Statement of Contribution

The following detail is the agreed share of contribution for candidate and co-authors in the presented publications in this thesis:


  The overall contribution of Jenny Olson was 80% to the concept development, analysis, drafting and revising the final submission; Sonja March, Charlotte Brownlow, Stuart J. H. Biddle, and Michael Ireland contributed the other 20% to concept development, analysis, editing and providing important technical inputs.


  The overall contribution of Jenny Olson was 80% to the concept development, analysis, drafting and revising the final submission; Sonja March, Bonnie Clough, Stuart J. H. Biddle, and Michael Ireland contributed the other 20% to concept development, analysis, editing and providing important technical inputs.

The overall contribution of Jenny Olson was 70% to the concept development, analysis, drafting and revising the final submission; Michael Ireland, Sonja March, Stuart J. H. Biddle, and Martin S. Hagger contributed the other 30% to concept development, analysis, editing and providing important technical inputs.
List of Conference Presentations


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The well known African proverb asserts that “it takes a village to raise a child.” This adage certainly rang true for me as I watched our children, Lauren, Erik, Harrison, and Samuel grow into fine young adults, bolstered by the love, friendship, support, and guidance of caring family, friends, teachers, and coaches. In the same way that a child benefits from the range of experiences and perspectives provided by a network of caring others, so to, does a PhD candidate. It is my firm belief that the guidance and encouragement provided by the ‘village’ emboldens the student to navigate the twists and turns of the candidature, celebrate the highs and endure the inevitable lows, and to draw deep and persist. I have been very fortunate to benefit from the guidance, mentoring, friendship, and love of wide network of generous others as I navigated this path, and I now take the opportunity to give thanks for that support.

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# Abbreviations

<table>
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<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AAQ</td>
<td>Active Australia Questionnaire</td>
</tr>
<tr>
<td>ABS</td>
<td>Australian Bureau of Statistics</td>
</tr>
<tr>
<td>ARIA</td>
<td>Accessibility/Remoteness Index of Australia</td>
</tr>
<tr>
<td>ASGS-RS</td>
<td>Australian Statistical Geography Standard – Remoteness Structure</td>
</tr>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
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<tr>
<td>CFI</td>
<td>Comparative Fit Index</td>
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<tr>
<td>COM-B</td>
<td>Competence, Opportunity, Motivation - Behaviour system</td>
</tr>
<tr>
<td>COREQ</td>
<td>The Consolidated Criteria for Reporting Qualitative Studies</td>
</tr>
<tr>
<td>FIML</td>
<td>Full-information maximum likelihood estimation procedure</td>
</tr>
<tr>
<td>INT$</td>
<td>International dollars</td>
</tr>
<tr>
<td>LGAs</td>
<td>Local government areas</td>
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<tr>
<td>METs</td>
<td>Metabolic equivalents</td>
</tr>
<tr>
<td>NEWS</td>
<td>Neighbourhood Environment Walkability Scale</td>
</tr>
<tr>
<td>NEWS-A</td>
<td>Abbreviated Neighbourhood Environment Walkability Scale</td>
</tr>
<tr>
<td>PBC</td>
<td>Perceived behavioural control</td>
</tr>
<tr>
<td>RMSEA</td>
<td>Root mean square error of approximation</td>
</tr>
<tr>
<td>SDT</td>
<td>Self-Determination Theory</td>
</tr>
<tr>
<td>SDT/TPB</td>
<td>Integration of the Theory of Planned Behaviour and Self-Determination Theory</td>
</tr>
<tr>
<td>SRBAI</td>
<td>Self-Report Behavioural Automaticity Index</td>
</tr>
<tr>
<td>SRHI</td>
<td>Self-Report Habit Index</td>
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<tr>
<td>TLI</td>
<td>Tucker-Lewis Index</td>
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<tr>
<td>TPB</td>
<td>Theory of Planned Behaviour</td>
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<td>WHO</td>
<td>World Health Organisation</td>
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Chapter One Introduction

People living in inner-regional Australia suffer poorer health and wellbeing than residents of Australia’s major cities, and some indicators of health are worse in inner-regional Australia than in more remote localities (Torrens University Australia, 2017). Almost 20% of the Australian population (more than 4.3 million people) live in inner-regional areas (Australian Bureau of Statistics, 2018b), thus the health inequalities faced by this population represent a significant public health concern. Regular physical activity is associated with numerous physical and psychological health benefits, and is an effective strategy for improving population health (Reiner, Niermann, Jekauc, & Woll, 2013; Warburton, Nicol, & Bredin, 2006). However, despite the benefits of physical activity, 70% of inner-regional Australians perform little or no physical activity (Australian Bureau of Statistics, 2015). Further, this population is also somewhat sedentary, spending on average more than 35 hours per week on sedentary activities for work and leisure (Australian Bureau of Statistics, 2013b). This represents a further public health concern, as sedentary behaviour (i.e., too much sitting) has also been associated with deleterious health outcomes, particularly among those who are also insufficiently active (Ekelund et al., 2016). Strategies designed to encourage inner-regional Australians to become more physically active and less sedentary are likely to yield significant public health benefits. It is important that such strategies take into account the context within which behaviour occurs (Ball, Timperio, & Crawford, 2006). Therefore, the current program of research sought to understand why a large number of people in inner-regional Australia are inactive and sedentary.

1.1 Problem Scope

Physical activity refers to “any activity that gets your body moving, makes your breathing become quicker and your heart beat faster” (Australian Government Department of Health, 2014, p. 2). Physical activity reduces the risk of non-communicable diseases via a range of mechanisms including lowering blood pressure and body mass index (BMI), and improving cholesterol levels (C3 Collaborating for Health, 2012). Physical activity is also beneficial for mental health. In a meta-meta-analysis of the effects of physical activity on depression and anxiety in non-clinical populations, Rebar et al. (2015) found consistent high-quality
evidence that physical activity reduced depression with a moderate effect size, and anxiety with a small effect size.

Physical inactivity (i.e., insufficient physical activity) is a leading cause of premature mortality globally (World Health Organisation, 2010). It is estimated that physical inactivity contributes to between 6-10% of major non-communicable diseases including heart disease, type-2 diabetes, breast and colon cancer, and to 9% of premature mortality worldwide (Lee et al., 2012). Together with the effects of overweight/obesity, physical inactivity contributed to 8.8% of the total burden of disease and injuries within Australia in 2011 (Australian Institute of Health and Welfare, 2017). It has been estimated that if Australians met the physical activity guidelines, by increasing their physical activity levels to at least 30 minutes per day for five days per week, more than a quarter of the disease burden attributable to physical inactivity could be avoided by 2020 (Australian Institute of Health and Welfare, 2017).

A substantial economic cost can be attributed to physical inactivity. Ding et al. (2016) estimated that the worldwide financial cost of physical inactivity in 2013 was $67.5 billion international dollars (INT$; approximately $95.7 billion AUD), including INT$53.8 billion ($76.3 billion AUD) on healthcare expenditure and INT$13.7 billion ($19.4 billion AUD) in productivity loss. In Australia, the overall cost of inactivity during 2013 was estimated to be INT$555.6 million ($787.8 million AUD), including INT$441.5 million ($626.1 million AUD) on healthcare expenditure and INT$114.1 million ($161.8 million AUD) in productivity costs.

Sedentary behaviour is distinct from physical inactivity and is defined as “any waking behavior characterized by an energy expenditure ≤1.5 metabolic equivalents (METs), while in a sitting, reclining or lying posture” (Tremblay et al., 2017, p. 9). Sedentary behaviours encompass a variety of behaviours that occur in different contexts with specific factors influencing each behaviour (Rhodes, Mark, & Temmel, 2012). Negative health outcomes have been linked to sedentary behaviour, including increased risk of ovarian, colon, and endometrial cancers, obesity, metabolic diseases, and all-cause mortality (Biddle et al., 2016; Thorp, Owen, Neuhaus, & Dunstan, 2011; Tremblay, Healy, Owen, Colley, & Saunders, 2010). However, the degree to which the negative health effects attributed to sedentary behaviour are independent from physical activity is unclear (Biddle et al., 2016). Sedentary behaviour has also been associated with increased risk of depression.
(Teychenne, Ball, & Salmon, 2010), and preliminary evidence suggests an association between sedentary behaviour and the risk of anxiety (Zhai, Zhang, & Zhang, 2015).

In an attempt to understand if the negative health effects associated with sedentary behaviour were attenuated or eliminated by physical activity, Ekelund et al. (2016) conducted a systematic review and meta-analysis of the associations between sedentary behaviour and physical activity with all-cause mortality. Thirteen prospective cohort studies (N = 1,005,791) that included data on sitting time and all-cause mortality were included in the analysis. Levels of self-reported daily sitting time were ranked in quartiles, as were levels of self-reported physical activity. Sitting was not significantly associated with mortality among those reporting the highest levels of physical activity (i.e., those in the top quartile). Conversely, mortality rates were 59% higher among those reporting the lowest levels of physical activity and more than eight hours per day of sitting time, compared to those who were most active and sitting less than four hours per day. Therefore, it appears that too much sitting has detrimental health effects among those who are physically inactive, while very high levels of physical activity can attenuate these harmful effects. Given the negative health effects of sedentary behaviour, particularly among those who perform low levels of physical activity, the term ‘active lifestyles’ will be applied throughout this thesis to refer to lifestyles that incorporate regular physical activity and minimised sedentary behaviour.

To combat the negative health effects of physical inactivity, the World Health Organisation (WHO; 2010) and the Australian Government Department of Health (2014) recommend that adults aged between 18 and 64 years perform 150-300 minutes of moderate activity or 75-150 minutes of vigorous intensity activity per week, or an equivalent combination of moderate and vigorous-intensity activity. Moderate intensity activities such as walking require effort, but it is still possible to talk whilst performing them; whereas, vigorous activities such as jogging require more effort and result in harder and faster breathing. Muscle strengthening activities on at least two days per week are also recommended. The Department of Health (2014) guidelines encourage older adults to undertake at least 30 minutes of moderate intensity activity on most, if not all days. Whereas, the WHO (2010) recommends that older adults with poor mobility perform activities to enhance balance and prevent falls, at least three times a week. Where recommendations
cannot be met due to health conditions, it is recommended that older adults perform as much physical activity as their condition allows. Whilst there are currently no specific global guidelines on sedentary behaviour, the Department of Health (2014) recommends the minimisation and interruption of prolonged sitting.

The WHO have recently released its Global Action Plan on Physical Activity 2018 – 2030, with its mission being:

To ensure that all people have access to safe and enabling environments and to diverse opportunities to be physically active in their daily lives, as a means of improving individual and community health and contributing to the social, cultural and economic development of all nations (2018a, p. 8).

A target of a 15% reduction in the prevalence of physical inactivity among adults and adolescents globally, to be achieved by 2030 has been set. Four major objectives have been outlined to achieve this goal, including the creation of active societies, environments, people, and systems. A guiding principle of the plan is to ensure equity across the life course, thus prioritising efforts to encourage participation among those who are least active through a reduction of inequities in socioeconomic determinants and opportunities for physical activity.

1.2 Prevalence of Active Lifestyle Behaviours in Australia

The Australian Health Survey: Physical Activity, 2011-12 (Australian Bureau of Statistics, 2013b) was a large-scale survey of approximately 9,500 Australian households, which collected data on health-related aspects of peoples’ lives. More than half of the Australians surveyed fell below the recommended levels of physical activity (i.e., at least 150 minutes of moderate physical activity performed in a given week), with around one-fifth performing no physical activity at all. It is important to note that physical activity levels were self-reported in this survey. Such measures often over-estimate physical activity compared to device-based measures of behaviour (e.g., accelerometer; Prince et al., 2008). Thus, the prevalence of inactivity among Australians may actually be higher than indicated here. On average, Australians were also sedentary for around one third of waking hours (Australian Bureau of Statistics, 2013b). Physical activity and sedentary behaviour levels varied by geographic remoteness. The areas of Australia classified as the most inactive were in regional and remote locations, with around a quarter of these
populations performing no physical activity, compared to less than one fifth of city dwellers. In contrast, Australians living in inner-regional areas spent less time performing sedentary activities, compared to those in rural areas and major cities. However, inner-regional Australians were still sedentary, on average, for more than 35 hours per week. This level of sedentary behaviour is concerning, particularly given the known negative influence upon health and wellbeing among those who are physically inactive. A summary of the findings of the Australian Health Survey: Physical Activity, 2011-12 (Australian Bureau of Statistics, 2013b) is presented in Table 1.1, including the proportion of the population who were found to be inactive, insufficiently active, sufficiently active, and average hours of sedentary behaviour per week, by geographic remoteness.

In summary, the prevalence of inactive lifestyles in inner-regional Australia represents a notable public health concern. Rates of physical inactivity, which is linked to negative health outcomes, are higher in inner-regional areas than in the major cities of Australia. Levels of sedentary behaviour, while lower than in other geographic regions of Australia, are likely negatively impacting the health of this population, particularly given the high prevalence of physical inactivity.

Table 1.1: Physical activity and sedentary behaviour participation by remoteness

<table>
<thead>
<tr>
<th>Remoteness classification</th>
<th>Inactive*</th>
<th>Insufficiently active*</th>
<th>Sufficiently active&quot;</th>
<th>Sedentary**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major cities</td>
<td>18.3</td>
<td>35.3</td>
<td>45.4</td>
<td>40.2</td>
</tr>
<tr>
<td><strong>Inner-regional</strong></td>
<td><strong>25.4</strong></td>
<td><strong>37.3</strong></td>
<td><strong>36.0</strong></td>
<td><strong>35.2</strong></td>
</tr>
<tr>
<td>Outer-regional &amp; remote</td>
<td>25.2</td>
<td>34.6</td>
<td>39.0</td>
<td>36.0</td>
</tr>
</tbody>
</table>

Notes: From the Australian health survey: Physical activity, 2011-12 (Australian Bureau of Statistics, 2013b); *Proportion of persons; **Average number of hours spent on sedentary behaviour for leisure and work; † At least 150 minutes of walking, moderate or vigorous physical activity.
1.3 Characteristics of Inner-Regional Australia

The term ‘inner-regional’ refers to a category of the Australian Statistical Geography Standard – Remoteness Structure (ASGS-RS), which is the formal geographical classification standard applied by the Australian Bureau of Statistics (Australian Bureau of Statistics, 2011b). Other remoteness categories include ‘major city’, ‘outer-regional’, ‘remote’ and ‘very remote’. The ASGS-RS is based upon the Accessibility/Remoteness Index of Australia (ARIA; National Centre for the Social Applications of GIS, 2015), which measures ‘remoteness’ based on road distance to the nearest service centre (defined as populated localities of greater than 1000 persons). A map of the ASGS-RS classifications throughout Australia is provided in Figure 1.1.

![Figure 1.1. Remoteness areas of Australia (Australian Bureau of Statistics, 2011b).](image)
More generally, the term ‘rural’ has typically been applied, both in academic literature and in everyday language, to describe regions outside of Australia’s major cities. However, Australia is a vast land spread over almost 7.7 million km² (Geoscience Australia, 2018). Therefore, the populations, physical and social environments, primary industries, employment prospects, and experiences of people living in areas outside of major cities varies greatly. Greater specificity is useful to understand health behaviours in the context in which they occur. Inner-regional areas are also referred to as ‘peri-urban’, particularly in international settings, and both terms will be applied interchangeably throughout this thesis. Peri-urban/inner-regional Australia is less populated than major cities, yet more urbanised than outer-regional and remote localities. According to the definition specified in the ASGS-RS, populations of inner-regional Australia face somewhat limited access to goods, services, and opportunities for social interaction (Australian Bureau of Statistics, 2011b).

1.4 Population of Inner-Regional Australia

Almost 20% of the Australian population (4.3 million people) live in inner-regional Australia, thus representing the largest population group outside of Australia’s major cities (Australian Bureau of Statistics, 2018b). Demographic characteristics of Australians by geographic remoteness, as sourced from Torrens University Australia (2017), are presented in Table 1.2. In summary, inner-regional Australians are more likely to be born in Australia compared to other Australians. Further, the people of peri-urban Australia are typically older than other Australians, with a greater proportion of the population aged 65 years or older. Inner-regional Australians are also more likely to leave school early and to be unemployed, and are less likely to participate in higher education, compared to city dwellers. Inner-regional Australian’s also experience higher levels of socioeconomic disadvantage compared to people in major cities. Just over 3.5% of inner-regional Australians identify as Indigenous.
Table 1.2: Population demographic characteristics by remoteness

<table>
<thead>
<tr>
<th>Remoteness Classification</th>
<th>Population*</th>
<th>Born in Aus**</th>
<th>Identify as Indigenous**</th>
<th>Early school leavers***</th>
<th>Higher education**</th>
<th>Unemployed**</th>
<th>Aged ≥ 65**</th>
<th>SES*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major city</td>
<td>17,671,876</td>
<td>61.7%</td>
<td>1.5%</td>
<td>27.4%</td>
<td>39.5</td>
<td>5.7%</td>
<td>14.0%</td>
<td>1017</td>
</tr>
<tr>
<td>Inner-regional</td>
<td><strong>4,386,250</strong></td>
<td><strong>80.2%</strong></td>
<td><strong>3.6%</strong></td>
<td><strong>36.8%</strong></td>
<td><strong>21.4</strong></td>
<td><strong>6.1%</strong></td>
<td><strong>19.2%</strong></td>
<td>976</td>
</tr>
<tr>
<td>Outer-regional</td>
<td>2,047,055</td>
<td>77.5%</td>
<td>6.5%</td>
<td>37.3%</td>
<td>18.3</td>
<td>6.6%</td>
<td>17.5%</td>
<td>964</td>
</tr>
<tr>
<td>Remote</td>
<td>292,272</td>
<td>75.3%</td>
<td>14.6%</td>
<td>36.8%</td>
<td>16.5</td>
<td>5.4%</td>
<td>12.5%</td>
<td>963</td>
</tr>
<tr>
<td>Very remote</td>
<td>201,480</td>
<td>79.2%</td>
<td>41.8%</td>
<td>44.0%</td>
<td>8.8</td>
<td>10.0%</td>
<td>7.7%</td>
<td>820</td>
</tr>
</tbody>
</table>

Notes: From Social Health Atlas, Torrens University Australia (2017); *Estimated resident population as at 30 June 2017; **Proportion of usual resident population 2016; ***Left school at Year 10 or below, or did not go to school; ‘School leaver participation in higher education: *Relative socio-economic disadvantage, expressed as SEIFA index score, based on Australian score = 1000.

Inner-regional Australians suffer poorer health compared to other Australians. When compared with city-dwellers, this population is more likely to report fair or poor self-rated health, to be obese, and to suffer circulatory system diseases (Torrens University Australia, 2017). Premature mortality also worsens within increasing geographic remoteness, meaning that peri-urban Australians are more likely to die prematurely from any cause, compared to people in major cities (Torrens University Australia, 2017). In addition to suffering poorer health compared to city dwellers, inner-regional Australians also suffer health disparities compared to people in more remote localities. For example, this population are more likely to report high psychological distress, and to experience high blood pressure, high blood cholesterol, respiratory system diseases, and musculoskeletal system diseases compared to people in major cities and in more remote localities (Torrens University Australia, 2017). Modelled estimates of the prevalence of selected health-risk factors and self-assessed health among adult Australian residents during 2014-15 are presented by ASGS-RS remoteness category in Table 1.3. Direct estimates of the incidence of chronic diseases and health conditions among adults during 2011-12 by remoteness category are presented in Table 1.4. Premature mortality rates of persons aged 0 – 74 years overall and by selected cause, during 2011-2015 are presented by remoteness category in Table 1.5. An overall summary of the demographic, health, and active lifestyle participation characteristics of the population of inner-regional Australia is presented in Figure 1.2.
### Table 1.3: Health-risk factors and self-assessed health by remoteness

<table>
<thead>
<tr>
<th>Remoteness classification</th>
<th>Fair or poor self-assessed health</th>
<th>High or very high psychological distress</th>
<th>High blood pressure</th>
<th>Overweight (but not obese)</th>
<th>Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major city</td>
<td>13.9</td>
<td>11.6</td>
<td>22.7</td>
<td>36.2</td>
<td>25.4</td>
</tr>
<tr>
<td><strong>Inner-regional</strong></td>
<td><strong>17.1</strong></td>
<td><strong>12.4</strong></td>
<td><strong>24.6</strong></td>
<td><strong>34.4</strong></td>
<td><strong>32.6</strong></td>
</tr>
<tr>
<td>Outer-regional &amp; remote</td>
<td>17.3</td>
<td>10.5</td>
<td>22.1</td>
<td>31.4</td>
<td>35.8</td>
</tr>
</tbody>
</table>

*Notes: From Social Health Atlas, Torrens University Australia (2017); Includes modelled estimates of the prevalence of health risk factors and self-reported health during 2014-15; Outer-regional, remote and very-remote classifications have been collapsed into one classification. All estimates are presented as age standardised rates per 100; *People aged 15 years and over*

### Table 1.4: Prevalence of chronic diseases and health conditions by remoteness

<table>
<thead>
<tr>
<th>Remoteness classification</th>
<th>Diabetes Mellitus</th>
<th>High blood cholesterol</th>
<th>Circulatory system diseases</th>
<th>Respiratory system diseases</th>
<th>Musculoskeletal system diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major city</td>
<td>5.6</td>
<td>31.7</td>
<td>16.9</td>
<td>28.1</td>
<td>26.9</td>
</tr>
<tr>
<td><strong>Inner-regional</strong></td>
<td><strong>4.7</strong></td>
<td><strong>35.8</strong></td>
<td><strong>17.7</strong></td>
<td><strong>31.4</strong></td>
<td><strong>29.8</strong></td>
</tr>
<tr>
<td>Outer-regional and remote</td>
<td>5.1</td>
<td>33.9</td>
<td>18.6</td>
<td>28.3</td>
<td>28.9</td>
</tr>
</tbody>
</table>

*Notes: From Social Health Atlas, Torrens University Australia (2017); Includes direct estimates of the prevalence of chronic diseases and health conditions during 2011-12; Outer-regional, remote and very-remote classifications have been collapsed into one classification. All estimates are presented as age standardised rates per 100; *Aged 2 and over; *Chronic Obstructive Pulmonary Disease*

### Table 1.5: Premature mortality rates by remoteness

<table>
<thead>
<tr>
<th>Remoteness classification</th>
<th>Cancer</th>
<th>Endocrine, nutritional &amp; metabolic diseases</th>
<th>Circulatory system diseases</th>
<th>Respiratory system diseases</th>
<th>Suicide &amp; self-inflicted injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major city</td>
<td>95.3</td>
<td>5.2</td>
<td>40.5</td>
<td>13.1</td>
<td>10.1</td>
</tr>
<tr>
<td><strong>Inner-regional</strong></td>
<td><strong>107.6</strong></td>
<td><strong>6.0</strong></td>
<td><strong>47.1</strong></td>
<td><strong>17.2</strong></td>
<td><strong>13.7</strong></td>
</tr>
<tr>
<td>Outer-regional</td>
<td>114.4</td>
<td>7.9</td>
<td>54.5</td>
<td>19.1</td>
<td>15.3</td>
</tr>
<tr>
<td>Remote</td>
<td>112.5</td>
<td>15.8</td>
<td>73.1</td>
<td>24.6</td>
<td>19.3</td>
</tr>
<tr>
<td>Very Remote</td>
<td>126.2</td>
<td>38.7</td>
<td>118.3</td>
<td>39.6</td>
<td>23.0</td>
</tr>
</tbody>
</table>

*Notes: From Social Health Atlas, Torrens University Australia (2017); Includes average, annual, age-standardised rates per 100,000 of premature mortality of persons aged 0-74 years, by selected cause and overall, between 2011-2015. Outer-regional, remote and very-remote classifications have been collapsed into one classification.*
Figure 1.2. Demographic, health, and active lifestyle participation characteristics of the population of inner-regional Australia.

Given the health disparities faced by the people of inner-regional Australia, who represent almost 20% of the Australian population, a specific focus on the health behaviours of inner-regional Australians is warranted. As physical activity represents an effective preventive health strategy, and consistent with the strategic priorities of the WHO Global Action Plan on Physical Activity to prioritise the populations facing inequities, this program of research focused on the active lifestyles of people residing in inner-regional Australia.

1.5 The Present Research

The overall aim of this program of research was to improve understanding of why high proportions of people living in inner-regional Australia lead inactive lifestyles. The design of the overall program of research is summarised in Figure 1.3.
An overarching social ecological approach was adopted, recognising that behaviour is the result of direct effects of, and interactions between, factors at multiple levels of influence (Sallis, Owen, & Fisher, 2015). A mixed-methods design was applied, with the first two exploratory qualitative studies informing the design of a third quantitative study. The aim of study one was to identify features of the physical and social environment that may affect active lifestyles in peri-urban settings. The aim of study two was to identify salient beliefs in relation to physical activity and sedentary behaviour among people living in peri-urban environments. Together with prevailing theoretical work, these studies informed the development of the final study, which aimed to quantitatively assess the relative influences of features of the physical and social environment upon active lifestyles, and to

*Figure 1.3. Design of PhD program of research.*
investigate how these factors might affect behaviour through established psychological processes.

For the final study, an empirically-informed theoretical model was proposed to account for motivational, intentional, and implicit psychological processes. Informed by the identification of salient behavioural, normative, and control beliefs in study two, the theory of planned behaviour (TPB; Ajzen, 1985) was adopted as a basic framework to explain physical activity-related intentions. In recognition that behaviour is influenced by implicit processes in addition to intentional processes (Evans & Stanovich, 2013; Sheeran, Gollwitzer, & Bargh, 2013; Strack & Deutsch, 2004), the framework was augmented to include habits, operationalised as behavioural automaticity (Gardner, 2012). Self-determination theory (SDT; Deci & Ryan, 1985) was adopted to describe motivational processes hypothesised to affect behaviour through both intentional and implicit processes. Hypotheses were then proposed as to how features of the physical and social environment (identified in study one) might affect behavioural intention and habit.

A review of relevant literature is provided in chapter 2 of the thesis. An overview of the design and methodology of the first two exploratory studies is presented in chapter 3. Chapter 4 describes the first study in detail. Chapter 5 presents the second study in detail. Information about the design and methodology of study three is presented in chapter 6, and the study is described in detail in Chapter 7. Finally, an overall discussion of the entire program of research is presented in chapter 8, including an overview of the findings, strengths and limitations of the research, implications, suggestions for future research and conclusions.
Chapter 2 Literature Review

2.1 Overview of the Chapter

This chapter provides an overview of the literature relevant to the current program of research. First, the importance of investigating health behaviours in the context in which they occur, and the paucity of active lifestyle research conducted specifically in inner-regional Australia is discussed, thereby building the rationale for the current research. Two theoretical frameworks that account for the influence of context on behaviour are introduced; that is, social ecological models of health behaviour (Sallis et al., 2015), and the COM-B system of behaviour (Michie, van Stralen, & West, 2011). These models provide an indication of the types of factors, across multiple levels of influence, that might influence the performance of physical activity and sedentary behaviour in inner-regional settings. Second, the correlates of active lifestyle behaviours in other adult populations, including non-metropolitan populations of Queensland, are presented. It is argued that although the research presented provides an indication of some of the factors that might influence the behaviour of inner-regional Australians, further investigation is required to assess the relevance of these factors in inner-regional settings, and whether there are additional novel factors that are influencing physical activity and sedentary behaviour in this population. Next, some additional theoretical frameworks and empirically-derived models of behaviour are described. These include the TPB (Ajzen, 1985), SDT (Deci & Ryan, 1985), dual-process theory (Evans & Stanovich, 2013; Sheeran et al., 2013; Strack & Deutsch, 2004), and habit research (Gardner, Bruijn, & Lally, 2011). These theories of behaviour provide further insight into the type of factors that might influence the adoption and maintenance of active lifestyles in inner-regional Australia; in addition to providing frameworks to guide investigation of how factors might interact to influence behaviour. The chapter concludes with a summary of how the information presented within the literature review links to other chapters of this thesis.

2.2 The Importance of Understanding Health Behaviour in the Context in Which it Occurs

According to the Ottawa Charter for Health Promotion (World Health Organisation, 1986), “Health promotion strategies and programmes should be
adapted to the local needs and possibilities of individual countries and regions to take into account differing social, cultural and economic systems” (p. 2). In order to understand how to support inner-regional Australians to lead more active lifestyles, it is important to identify the factors that affect behaviour within such settings.

Social ecological models of health behaviour provide a framework that acknowledges the influence of context on health behaviour (Sallis et al., 2015). Social ecological models contend that behaviour is the result of interactions between intrapersonal, interpersonal, community, and public policy-level factors, and that socio-cultural and physical environmental factors intersect across these levels (Sallis et al., 2015). According to Sallis et al. (2015) there are five principles of ecological perspectives on health behaviour: (a) Factors at multiple levels can influence behaviour, and the influence of these factors varies by behaviour and context; (b) Environmental contexts, including the socio-cultural and physical environments, are significant behavioural determinants; (c) Factors that influence behaviour interact across levels; (d) Ecological models are more useful when behaviour specific; and (e) Behaviour-change interventions that target multiple levels of influence should be the most effective. Thus, social ecological models of health behaviour suggest that there will be a range of factors across multiple levels that will interact to influence the performance of physical activity and sedentary behaviour among residents of inner-regional Australia. Further, it can be anticipated that the social and physical environment in inner-regional Australia will be a key determinant of active lifestyles within this population. To build understanding of the prevalence of inactive lifestyles in this setting, it is therefore, important to identify the factors across multiple levels that are supporting or hindering inner-regional Australians to perform physical activity and minimise sedentary behaviour.

Another example of a theoretical framework that acknowledges the influence of context upon behaviour is Michie, van Stralen, and West’s (2011) COM-B system of behaviour. According to the COM-B system, behaviour (B) is a product of capability (C), opportunity (O), and motivation (M). Capability refers to physical and psychological factors that affect an individual’s ability to perform the behaviour. Opportunity refers to features of the physical and social environment that facilitate or impede behaviour. Motivation refers to the conscious reasoning and implicit processes that direct behaviour. Therefore, to design strategies to encourage more people in inner-regional Australia to adopt active lifestyles, it is important to identify
factors that impede or enhance capability, opportunity, and motivation for physical activity and minimised sedentary behaviour in this environment.

Unfortunately, despite the theoretical acknowledgement of the influence of context upon health behaviour as represented in the abovementioned frameworks, little research has been conducted to understand active lifestyles, specifically in inner-regional Australian settings. Research previously conducted in inner-regional Australia has focused on a narrow range of determinants at a single level of interest and has examined physical activity without consideration of sedentary behaviour. For example, Mummery, Lauder, Schofield, and Caperchione (2008) conducted a cross-sectional study (N = 1278) investigating the relationship between social capital and physical inactivity among adults in regional Central Queensland. Social capital was defined as the interconnectedness between the individual and the community, represented by social networks, social support, and social participation. Those with social capital scores in the highest quartile were 63% less likely to be inactive compared to those reporting the lowest level of social capital, and those ranked in the second highest quartile were 58% less likely to be inactive than those in the lowest quartile. These findings provide insight into the relationship between social capital and physical activity in regional Central Queensland. However, the design of the study did not provide an opportunity to understand the mechanisms through which social capital affects behaviour, the direction of causal influence, nor does it acknowledge the influence of factors at other levels (e.g., the effect of the physical environment on behaviour). According to the COM-B system of behaviour (Michie, van Stralen, et al., 2011), in addition to understanding opportunities provided within the social environment for physical activity, it is important to understand the degree to which the physical environment facilitates or inhibits opportunities for active lifestyles, in addition to assessing the capability of inner-regional Australians to lead active lifestyles, and their motivation to do so. According to social ecological models of health behaviour (Sallis et al., 2015), there will be a variety of factors across multiple levels, in addition to social capital, that are interacting to influence active lifestyles in inner-regional Australia.

In sum, there is a dearth of active lifestyle research that has been conducted specifically in inner-regional Australian settings to date. To develop and adapt strategies designed to encourage people living in inner-regional Australia to adopt more active lifestyles, it is essential to identify factors across multiple levels of
influence that hinder and facilitate the performance of regular physical activity and the minimisation of sedentary behaviour within this setting. By identifying factors that inhibit or enhance capability, opportunity, and motivation for physical activity and sedentary behaviour in inner-regional settings, we can build understanding of why so many people within this population lead inactive lifestyles. Such knowledge can facilitate identification of factors that can be targeted in strategies designed to elicit behaviour change conducive to active lifestyles.

2.3 Active Lifestyles Research in Other Populations

A greater understanding of the factors that are leading to high levels of physical inactivity and sedentary behaviour in inner-regional Australia can be achieved through research conducted specifically in this context. However, research findings from other settings can provide a starting point for investigators when trying to identify the determinants of active lifestyles in inner-regional Australia. The following section of the literature review provides information about physical activity and sedentary behaviour research previously conducted in non-metropolitan areas of Australia, and in adult populations more generally (i.e., without a specific focus on geographical setting).

2.3.1 Active lifestyle research conducted in non-metropolitan regions of Australia

Some physical activity-related research has been conducted in areas of Australia broadly defined as rural (i.e., outside of major cities). Eley, Bush, and Brown (2014) conducted the most comprehensive study (commissioned by the Queensland State Health Department) of the opportunities and constraints to physical activity in rural Queensland. Six diverse shires were selected for inclusion in the study. These included one inner-regional, two outer-regional, two remote, and one very remote shire. The mixed-methods study included interviews with community representatives, surveys, detailed site observations and audits of facilities, amenities and resources. Participants reported many of the same barriers to physical activity experienced by city dwellers (e.g., lack of time due to work and family-related commitments and weather). Barriers that were specific to rural locations were also described, including extreme climactic conditions (i.e., hot temperatures and flooding), lack of public transport, roaming dogs, the presence of wildlife (e.g.,
snakes, crocodiles, and mosquitos), declining number of volunteers available to support local physical activity programs, and lack of support for healthy lifestyle programs within some local governments.

Eley et al. (2014) reported that the culture of exercise in rural communities contributed to the formation of beliefs about physical activity that could negatively influence participation. For example, physical activity was often conceived as merely necessary for work, rather than an opportunity to improve health and wellbeing. Participants also expressed beliefs that they were sufficiently active as a result of the physical nature of rural work, despite advances in technology that may have reduced levels of physical activity in occupations that were once quite active. The study identified a variety of physical activity beliefs held by people living in outside of Queensland’s major cities, in shires of varying geographic remoteness. Whilst many beliefs were common across locations, differences also existed between localities. Beliefs about the specific factors that presented barriers to physical activity, and degree to which the local environment was perceived to be conducive to physical activity differed between the shires. For example, in one shire the presence of sand-flies almost completely precluded participation in physical activity outdoors; and the impact of extreme climactic conditions upon physical activity was worse in inland locations, compared to more coastal regions.

The study of barriers and enablers of physical activity participation in non-metropolitan localities conducted by Eley et al. (2014) hints at factors that might affect physical activity participation in inner-regional Australia. However, given the heterogeneity of localities collectively described as rural, greater specificity is necessary to understand health behaviour of distinctive populations residing outside of Australia’s major cities. Research focussed specifically on physical activity in inner-regional settings would provide a more precise understanding of why the prevalence of physical inactivity is so high in this particular population. Further, the determinants of sedentary behaviour were not examined by Eley et al. (2014); and more generally, there has been little research of sedentary behaviour specifically focused on settings outside of Australia’s major cities. People in inner-regional Australia are likely to be susceptible to the deleterious health effects of sedentary behaviour, particularly given the high prevalence of physical inactivity in this population (Ekelund et al., 2016; Stamatakis et al., 2019). Therefore, an examination of the determinants of sedentary behaviours among inactive inner-regional
Australians is warranted. Extending research to include an investigation of the factors that affect sedentary behaviour, in addition to those that impact physical activity, would provide a more complete picture of the range of factors that contribute to the high prevalence of inactive lifestyles in inner-regional Australia.

2.3.2 Correlates and determinants of physical activity and sedentary behaviour in adult populations

Just as research conducted in broader rural Australian contexts provides an indication of factors that might influence active lifestyles in inner-regional Australia, so too does physical activity and sedentary behaviour research that has been conducted in more general adult populations (i.e., studies that have not focused specifically on geographic remoteness). An overview of the known correlates and determinants of physical activity and sedentary behaviour in adult populations is presented next.

**Correlates and determinants of physical activity.** The correlates of physical activity have been well researched. Bauman et al. (2012) conducted a review of systematic reviews of the correlates and determinants of physical activity, published between 1999 and 2012. Sixteen systematic reviews (seven with child and adolescent populations, and nine with adult populations) of demographic, psychosocial, behavioural, and social factors, and ten systematic reviews (one with child and adolescent populations, and nine with adult populations) of environmental correlates of physical activity were included in the review. Variables were coded as correlates (i.e., factor was conclusively associated with physical activity), determinants (i.e., conclusive evidence of a causal relationship), not a correlate or determinant (i.e., conclusive evidence of no relationship), or not reported (i.e., no evidence). Evidence was rated as conclusive when the factor was examined in at least three primary studies, and the finding was consistent in at least 60% of the studies in which it was examined. Individual and social factors found to be correlates, determinants, or not a correlate or determinant of physical activity in adult populations are presented in Table 2.1. In summary, of the non-environmental correlates, health status and self-efficacy were the most consistently associated with physical activity, followed by personal history of performing physical activity during adulthood, intention to exercise, and the stages of change (based on the transtheoretical model of health behaviour change; Prochaska & Velicer, 1997).
Most of the evidence in relation to environmental correlates of physical activity reported in the review of reviews by Bauman et al. (2012) was derived from cross-sectional studies, with only one of the included systematic reviews examining the findings of longitudinal studies. Associations of environmental factors were assessed by type of physical activity (i.e., transport-related, leisure-time, and total physical activity). Environmental-level determinants that were found to be correlates, determinants, or not correlates of physical activity are presented in Table 2.2. In summary, neighbourhood walkability and street connectivity were correlates of transport related physical activity; transportation environment, aesthetics, and proximity to recreation facilities and locations were correlates of leisure physical activity and total physical activity.
Table 2.1: Individual and socio-cultural-level correlates and determinants of physical activity found in review of reviews by Bauman et al. (2012).

<table>
<thead>
<tr>
<th>Category</th>
<th>Predictor</th>
<th>No. of reviews</th>
<th>Direction of association</th>
<th>Number of reviews that support the finding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Correlate</td>
</tr>
<tr>
<td>Demographic &amp; biological</td>
<td>Age</td>
<td>6</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>4</td>
<td>+</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Gender (male)</td>
<td>6</td>
<td>+</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Income/SES</td>
<td>5</td>
<td>+</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Ethnic origin (white)</td>
<td>5</td>
<td>+</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Health status/perceived fitness</td>
<td>7</td>
<td>+</td>
<td>4</td>
</tr>
<tr>
<td>Psychosocial variables</td>
<td>Intention to exercise</td>
<td>4</td>
<td>+</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Self-efficacy</td>
<td>6</td>
<td>+</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Stages of change</td>
<td>4</td>
<td>+</td>
<td>1</td>
</tr>
<tr>
<td>Behavioural variables</td>
<td>History of performing physical activity as an adult</td>
<td>4</td>
<td>+</td>
<td>1</td>
</tr>
<tr>
<td>Social and cultural variables</td>
<td>Social support from friends/peers</td>
<td>3</td>
<td>+</td>
<td>1</td>
</tr>
</tbody>
</table>

Notes: Sourced from Bauman et al. (2012). No. of reviews = the number of systematic reviews that included the predictor; Correlate = factor conclusively associated with physical activity; determinant = conclusive evidence of a causal relationship; not a correlate or determinant = conclusive evidence of no relationship. Evidence was rated as conclusive when the factor was examined in at least three primary studies included in a systematic review, and the finding was consistent in at least 60% of the studies in which it was examined. aDeterminant of physical activity maintenance, but inconclusive in relation to physical activity initiation. bDeterminant of physical activity initiation, but inconclusive in relation to physical activity maintenance. cNot a determinant of physical activity maintenance, but inconclusive in relation to physical activity initiation. dBased on transtheoretical model (Prochaska & Velicer, 1997).
Table 2.2: Environmental-level correlates of physical activity found in review of reviews by Bauman et al. (2012).

<table>
<thead>
<tr>
<th>Outcome variable</th>
<th>Predictor</th>
<th>No. of reviews</th>
<th>Direction of association</th>
<th>Correlate</th>
<th>Determinant</th>
<th>Not a correlate</th>
<th>Inconclusive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport related physical activity</td>
<td>Neighbourhood design</td>
<td>6</td>
<td>+</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Social environment</td>
<td>3</td>
<td>NA</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Aesthetics</td>
<td>5</td>
<td>NA</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Leisure-time physical activity</td>
<td>Transport environment</td>
<td>6</td>
<td>+</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Social environment</td>
<td>4</td>
<td>NA</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Aesthetics</td>
<td>4</td>
<td>+</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Total physical activity</td>
<td>Recreational facilities/locations</td>
<td>8</td>
<td>+</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Transport environment</td>
<td>8</td>
<td>+</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Social environment</td>
<td>7</td>
<td>+</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Aesthetics</td>
<td>7</td>
<td>+</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

Notes: Sourced from Bauman et al. (2012). No. of reviews = the number of systematic reviews that included the predictor; Correlate = factor conclusively associated with physical activity; determinant = conclusive evidence of a causal relationship; not a correlate = conclusive evidence of no relationship. Evidence was rated as conclusive when the factor was examined in at least three primary studies included in a systematic review, and the finding was consistent in at least 60% of the studies in which it was examined.

More recently, Choi, Lee, Lee, Kang, and Choi (2017) conducted a systematic review of reviews to update the evidence of the personal and environmental correlates of physical activity among adults. Twenty-five systematic reviews published between 1999 and January 2017, involving 980 primary studies examining 90 personal factors (i.e., demographic/biological, psychological, behavioural and social factors) and 27 environmental factors (i.e., facility, neighbourhood, safety, home environment, location of region, and climate factors) were included. Unfortunately, as in the case of the review by Bauman et al. (2012), the methodology did not allow for calculation of effect sizes. Therefore, whilst the research describes trends of associations, the strength of these relationships was not...
determined. The most commonly investigated potential correlates of physical activity (i.e., those investigated in more than 50% of the included reviews) are presented in Table 2.3. In summary, of the personal factors, self-efficacy, intention to exercise, perceived fitness, and control over exercise were positively associated with physical activity in more than half of the reviews in which these variables were included. Favourable physical activity-related outcome expectancies and perceived behavioural control (PBC) were also each positively associated with physical activity in three reviews. Unfavourable health/fitness status, lack of time, fear of symptoms, and change in family structure (e.g., having a child) were negatively associated with physical activity in more than half of the reviews in which they were included, and age was negatively associated with physical activity in three reviews. None of the environmental factors were associated with physical activity in more than half of the reviews in which they were included. The accessibility of facilities and aesthetics were positively associated with physical activity in at least three reviews.

Table 2.3: Correlates and determinants of physical activity found in review of reviews by Choi, Lee, Lee, Kang, and Choi (2017)

<table>
<thead>
<tr>
<th>Category</th>
<th>Predictor</th>
<th>Finding</th>
<th>Direction of association</th>
<th>Number of reviews that support the finding/total number of reviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal factors</td>
<td>Age</td>
<td>Correlate</td>
<td>-</td>
<td>3/8</td>
</tr>
<tr>
<td></td>
<td>Gender (male)</td>
<td>Correlate</td>
<td>+</td>
<td>2/7</td>
</tr>
<tr>
<td></td>
<td>Ethnicity (white)</td>
<td>Correlate</td>
<td>+</td>
<td>2/7</td>
</tr>
<tr>
<td></td>
<td>Marital status (married)</td>
<td>Determinant</td>
<td>-</td>
<td>1/9</td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>Correlate</td>
<td>+</td>
<td>2/7</td>
</tr>
<tr>
<td></td>
<td>Income</td>
<td>Correlate</td>
<td>+</td>
<td>2/8</td>
</tr>
<tr>
<td></td>
<td>Employment</td>
<td>Correlate</td>
<td>-</td>
<td>1/7</td>
</tr>
<tr>
<td></td>
<td>Attitude</td>
<td>Correlate</td>
<td>+</td>
<td>1/7</td>
</tr>
<tr>
<td></td>
<td>Intention to exercise</td>
<td>Correlate or Determinant</td>
<td>+</td>
<td>4/7</td>
</tr>
<tr>
<td></td>
<td>Outcome expectations</td>
<td>Correlate</td>
<td>+</td>
<td>3/7</td>
</tr>
<tr>
<td></td>
<td>Self-efficacy</td>
<td>Correlate or Determinant</td>
<td>+</td>
<td>7/9</td>
</tr>
<tr>
<td>Category</td>
<td>Predictor</td>
<td>Finding</td>
<td>Direction of association</td>
<td>Number of reviews that support the finding/total number of reviews</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------</td>
<td>----------------------------</td>
<td>--------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Personal factors</td>
<td>Stress</td>
<td>Correlate or Determinant</td>
<td>-</td>
<td>2/7</td>
</tr>
<tr>
<td></td>
<td>Smoking</td>
<td>Not correlated or inconclusive</td>
<td>NA</td>
<td>0/7</td>
</tr>
<tr>
<td>Environmental factors</td>
<td>Accessibility of facilities</td>
<td>Correlate</td>
<td>+</td>
<td>5/15</td>
</tr>
<tr>
<td></td>
<td>Aesthetics</td>
<td>Correlate</td>
<td>+</td>
<td>4/14</td>
</tr>
<tr>
<td></td>
<td>Presence of sidewalks</td>
<td>Correlate</td>
<td>+</td>
<td>3/14</td>
</tr>
<tr>
<td></td>
<td>High crime rates in the region</td>
<td>Correlate</td>
<td>+</td>
<td>1/13</td>
</tr>
<tr>
<td></td>
<td>Heavy traffic</td>
<td>Correlate</td>
<td>+</td>
<td>1/14</td>
</tr>
</tbody>
</table>

Notes: Sourced from Choi et al. (2017). Where more than 60% of primary studies reported non-significant associations factor assessed as not correlated; <60% of primary studies report associations or no associations or more than 60% of primary studies report any association factor assessed as inconclusive; 60% or more of primary studies reported significant association factor assessed as a correlate; 60% or more of primary studies reported significant association and 50% of studies that supported the association were of longitudinal design factor assessed as a determinant.

The well-developed literature-base of the correlates and determinants of physical activity summarised in the meta-reviews conducted by Bauman et al. (2012) and Choi et al. (2017) provides useful information about trends in relation to factors associated with physical activity in adult populations more generally, and thereby suggests some of the factors that might influence the physical activity of inner-regional Australians. For instance, psychological factors such as intentions, outcome expectancies, and PBC may be associated with physical activity among inner-regional Australians, as has been found in other adult populations. However, further research is required to assess the relevance of these factors to inner-regional populations, and also to determine whether there are additional factors, unique to inner-regional settings, that affect the performance of physical activity.

**Correlates and determinants of sedentary behaviour.** Compared to the physical activity literature, there is less published research investigating the correlates and determinants of sedentary behaviour in adult populations. Prince, Reed, McFetridge, Tremblay, and Reid (2017) conducted a systematic review of the correlates of sedentary behaviour among adults. A social ecological approach was undertaken to identify intrapersonal, social environmental, physical environmental and policy-level correlates. Two hundred and fifty-seven studies, published between
1978 and 2015, including data from 2,553,129 participants across 46 countries, were analysed. Intrapersonal correlates were the most frequently examined, with social and physical environmental correlates examined less frequently, and policy-level correlates studied the least. The determinants of sedentary behaviour vary by the context in which behaviour is performed. The correlates of leisure-time sedentary behaviour were investigated in 117 studies, sitting time in 69 studies, total sedentary-time in 51 studies, occupational sedentary behaviour in 21 studies, and transport-related sedentary behaviour in 12 studies. Evidence was rated as ‘consistent evidence of association’ or ‘consistently not associated’ when 60% or more of study findings concurred.

An overview of the findings of Prince, Reed, McFetridge, Tremblay and Reid’s (2017) review is presented in Table 2.1. In summary, being engaged in full-time employment was consistently associated with greater leisure-time and transport-related sedentary behaviour. Higher individual-level income/socio-economic status was associated with greater occupational and transport-related sedentary time; while area-level socioeconomic status was consistently uncorrelated with transport-related sedentary behaviour. Having an active workstation was consistently associated with lower occupational sedentary time. Marital status was consistently uncorrelated with leisure-time and transport-related sedentary behaviour. Social support was consistently uncorrelated with leisure-time and total sedentary behaviour and sitting time. Crime and safety were also consistently uncorrelated with leisure-time and total sedentary time and sitting time. Living in an urban location, compared to a rural location, was consistently associated with greater sitting time and total sedentary time.
Table 2.2: Correlates of sedentary behaviour.

<table>
<thead>
<tr>
<th>Outcome variable</th>
<th>k</th>
<th>Predictor</th>
<th>Finding</th>
<th>Direction of association</th>
<th>Findings in support of outcome/total number of studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leisure-time sedentary behaviour*</td>
<td>117</td>
<td>Full-time employment</td>
<td>Consistent significant associations</td>
<td>-</td>
<td>33/39</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Television ownership</td>
<td>Consistent significant associations</td>
<td>+</td>
<td>5/7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Marital status</td>
<td>Consistent lack of associations</td>
<td></td>
<td>14/23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social support</td>
<td>Consistent lack of associations</td>
<td></td>
<td>5/9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Crime and safety</td>
<td>Consistent lack of associations</td>
<td></td>
<td>6/8</td>
</tr>
<tr>
<td>Occupational sedentary behaviour*</td>
<td>21</td>
<td>Higher income/SES</td>
<td>Consistent significant associations</td>
<td>+</td>
<td>4/5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Having an active workstation</td>
<td>Consistent significant associations</td>
<td>-</td>
<td>5/6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social support</td>
<td>Consistent lack of associations</td>
<td></td>
<td>3/5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Crime and safety</td>
<td>Consistent lack of associations</td>
<td></td>
<td>6/10</td>
</tr>
<tr>
<td>Total sedentary time*</td>
<td>51</td>
<td>Living in more urban areas</td>
<td>Consistent significant associations</td>
<td>+</td>
<td>3/4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social support</td>
<td>Consistent lack of associations</td>
<td></td>
<td>3/5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Crime and safety</td>
<td>Consistent lack of associations</td>
<td></td>
<td>1/1</td>
</tr>
<tr>
<td>Sedentary behaviour**</td>
<td>5</td>
<td>Habit for sedentary behaviour</td>
<td>Consistent significant associations</td>
<td>+</td>
<td>5/5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intentions for sedentary behaviour</td>
<td>Consistent significant associations</td>
<td>+</td>
<td>4/4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Positive attitudes towards sedentary behaviour</td>
<td>Some evidence of associations</td>
<td>+</td>
<td>11/14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Positive attitudes towards physical activity</td>
<td>Some evidence of associations</td>
<td>-</td>
<td>4/5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Self-efficacy for/control over physical activity</td>
<td>Some evidence of associations</td>
<td>-</td>
<td>7/9</td>
</tr>
<tr>
<td>Outcome variable</td>
<td>$k$</td>
<td>Predictor</td>
<td>Finding</td>
<td>Direction of association</td>
<td>Findings in support of outcome/total number of studies</td>
</tr>
<tr>
<td>------------------</td>
<td>-----</td>
<td>-----------</td>
<td>---------</td>
<td>--------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>Sedentary behaviour**</td>
<td>10</td>
<td>Self-efficacy for/control over sedentary behaviour</td>
<td>Some evidence of associations</td>
<td>-</td>
<td>7/10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Implementation intentions/planning to reduce sedentary behaviour</td>
<td>Some evidence of associations</td>
<td>-</td>
<td>2/3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intentions for physical activity</td>
<td>Some evidence of lack of associations</td>
<td>-</td>
<td>2/3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Amotivation for physical activity</td>
<td>No association</td>
<td>-</td>
<td>1/1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Externally-regulated motivation for physical activity</td>
<td>No association</td>
<td>-</td>
<td>1/1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Introjected motivation for physical activity</td>
<td>No association</td>
<td>-</td>
<td>1/1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Identified motivation for physical activity</td>
<td>Significant association</td>
<td>-</td>
<td>1/1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intrinsically-regulated motivation for physical activity</td>
<td>Significant association</td>
<td>-</td>
<td>1/1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Externally-regulated motivation for sedentary behaviour</td>
<td>Significant association</td>
<td>-</td>
<td>1/1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Introjected regulation for sedentary behaviour</td>
<td>Significant association</td>
<td>+</td>
<td>1/1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intrinsic regulation for sedentary behaviour</td>
<td>Significant association</td>
<td>+</td>
<td>1/1</td>
</tr>
</tbody>
</table>

Notes: *Information sourced from Prince et al. (2017), with evidence was rated as ‘consistent’ when 60% or more of study findings concurred. **Information sourced from Rollo, Gaston, and Prapavessis (2016), with ‘consistent evidence’ of association concluded in cases with 100% concurrence between studies, ‘some evidence’ of association concluded when there was concurrence between more than 50% of studies, ‘no evidence’ of association concluded when more than 50% of studies found no association, and inconclusive evidence concluded where 50% of studies reported no association and 50% reported associations.

Another systematic review conducted by Rollo et al. (2016) specifically focused on identifying the cognitive and motivational factors associated with sedentary behaviour. Twenty-five studies published between 2003 and 2016 were included in the review. The review included studies of participants of all ages, and outcome variables encompassed total sedentary time, time spent undertaking specific leisure-time sedentary activities, context-specific sedentary time, screen time, and occupational sedentary behaviour. Seventeen studies applied a theoretical framework (e.g., the TPB and SDT) and eight did not specify a theoretical
orientation. ‘No evidence’ of association was concluded when more than half of the studies reported no association. ‘Some evidence’ of association were concluded when more than 50% of studies reported significant associations. ‘Consistent evidence’ of an association was concluded in cases of 100% concurrence. Evidence was described as inconsistent when 50% of studies found no association and 50% found evidence of associations. Results of this review are also included in Table 2.2.

In summary, associations were generally small to moderate. Sedentary behaviour was consistently significantly and positively associated with sedentary behaviour-related habit and intentions, and there was some evidence of associations with positive attitudes towards sedentary behaviour. Sedentary behaviour was also negatively associated (i.e., some evidence of associations) with positive physical activity-related attitudes and self-efficacy/control, sedentary behaviour-related self-efficacy/control, and implementation intentions/planning to reduce sedentary behaviour. Some evidence of a lack of association emerged between sedentary behaviour and greater physical activity-related intentions.

The reviews performed by Prince et al. (2017) and Rollo et al. (2016) provide an indication of some of the intrapersonal (including demographic, cognitive, and motivational factors), social and physical environmental, and policy-level correlates that might influence sedentary behaviour in inner-regional Australia. However, as in the case of the physical activity research, the relevance of these factors to the sedentary behaviour of inner-regional Australians has not been established. Moreover, there may be additional factors that influence sedentary behaviour among inner-regional Australians, that have not previously been identified in other populations. Further investigation is also necessary to identify the precise factors that account for some of the associations identified in these reviews. For instance, Prince et al. (2017) reported that living in an urban location was consistently associated with greater sitting time and total sedentary time; but, the specific factors that account for this trend were not identified (e.g., it could be that people living in more urban locations are more likely to have sedentary occupations or spend more time sitting due to traffic congestion, than people in more rural areas).
2.4 Additional Theories of Health Behaviour that can be Applied to Understand Active Lifestyle Participation in Inner-Regional Australia

As specified in social ecological models of health behaviour (Sallis et al., 2015), factors across multiple levels will interact to influence active lifestyle participation in inner-regional Australia. The study conducted by Eley et al. (2014) identified factors across multiple levels that were influencing physical activity in non-metropolitan regions of Queensland. Likewise, the meta-reviews conducted by Bauman et al. (2012) and Choi et al. (2017), and the systematic reviews conducted by Rollo et al. (2016) and Prince et al. (2014) identify factors across multiple levels that have been found to influence physical activity participation and sedentary behaviour, respectively, in adult populations. However, these studies do not provide any indication of how these factors might interact to influence behaviour. It would be useful to understand how factors identified as behavioural correlates and determinants interact to influence active lifestyles. For instance, if socio-cultural and physical-environmental factors influence behaviour through the formation of beliefs that are counter to physical activity, it may be possible to identify specific contextual factors within inner-regional settings that can be manipulated to foster more favourable beliefs that are conducive to physical activity participation. As stated previously, ecological models provide a valuable overview of the range of factors at multiple levels that may affect health behaviour. Ecological models also contend that factors at multiple levels interact to influence behaviour; however, the precise mechanisms through which these interactions occur is not stipulated. Other theoretical models and frameworks, such as social-cognitive theories, may be integrated within social ecological frameworks for this purpose (Sallis, Owen, & Fisher, 2008).

The following section of the literature review describes some additional theories and research that may provide insight into how factors across multiple levels might interact to influence the adoption and maintenance of active lifestyles by people living in inner-regional Australia. Together with prior research that has identified correlates and determinants of behaviour in other populations, these theories also provide additional insight into the types of factors that might influence the performance of physical activity and sedentary behaviour in inner-regional Australia.
2.4.1 Intentional processes.

One popular social-cognitive theory that has been applied to physical activity is the TPB (Ajzen, 1985). According to the TPB, intentions are the most proximal predictor of behaviour. Attitudes, subjective norms, and PBC predict behaviour indirectly by shaping intentions. PBC also predicts behaviour directly, representing external barriers and constraints that affect behavioural performance. Attitudes, subjective norms, and PBC are informed by behavioural, normative, and control beliefs respectively. Hagger, Chatzisarantis, and Biddle (2002) conducted a path analysis of meta-analytically derived correlations to test the pathways specified in the TPB, and its predecessor, the theory of reasoned action (Ajzen & Fishbein, 1980) in a physical activity context. Seventy-two studies, including 79 datasets, were included in the analysis. Medium to large positive associations were observed between intentions and behaviour, attitudes and intentions, and PBC and intentions. A small to medium association was noted between subjective norms and intentions. Significant direct effects were found for all pathways hypothesised by the TPB. Attitudes and PBC were stronger predictors of intentions, relative to subjective norms. Further, a direct effect of PBC on behaviour was noted, in addition to its effect through intentions. Direct effects of past behaviour were also observed on all TPB variables. These findings suggest that favourable beliefs about the outcomes attributable to physical activity, control over performing physical activity, and to a lesser extent, endorsement and performance of physical activity by important others, are related to the development of intentions to perform physical activity in the future. Further, the findings suggest that having intentions to perform physical activity in the future, together with the ease of performing physical activity, are related to the actual performance of physical activity. Therefore, it appears that it is important to identify the beliefs that inner-regional Australians hold in relation to physical activity and sedentary behaviour, to build understanding as to why so many people within this population lead inactive lifestyles.

Despite its ubiquity in health-behaviour research, the TPB is not without criticism. Sniehotta, Presseau, and Araújo-Soares (2014) published an editorial in Health Psychology Review, arguing that it was time to ‘retire’ the TPB. The authors contend that the theory has limited predictive validity, with substantive variance in behaviour left unexplained; and that the included constructs do not sufficiently
explain all volitional behaviour (i.e., additional constructs such as motivation, planning and implicit constructs, such as habit, predict variance in behaviour beyond the TPB constructs). Sniehotta and colleagues further presented intention-behaviour discordance as a weakness of the model (i.e., intentions to act do not always translate to action). The authors also point out that the TPB is static (i.e., does not account for the impact of past behaviour on the psychological antecedents of behaviour, and upon future behaviour), and that the theory does not predict behaviour change. Conversely, the authors acknowledge the relevance of the constructs included in the theory to predictions of volitional behaviour, further conceding that intentions and PBC are consistent predictors of behaviour. The authors also admit that interventions that induce large changes in intentions usually lead to behavioural change. The commentary of Sniehotta et al. (2014) highlights some valid limitations of the TPB.

Upon publication of Sniehotta and colleague’s (2014) editorial, Editor-in-Chief of Health Psychology Review, Professor Martin S. Hagger, asked 10 leading researchers in social and health psychology to provide comment. These commentaries were published in a subsequent issue of Health Psychology Review (Abraham, 2015; Ajzen, 2015; Armitage, 2015; Conner, 2015; Gollwitzer & Oettingen, 2015; Hall, 2015; Ogden, 2015; Rhodes, 2015; Schwarzer, 2015; Trafimow, 2015), and summarised by (Hagger, 2015). A rebuttal by Sniehotta, Pressseau, and Araújo-Soares (2015) was also published. When reporting the responses provided by these experts, Hagger (2015) described “unanimous affirmation.” The TPB was described as a seminal theory that has advanced understanding of intentional behaviour and the role of beliefs in predicting behaviour through intentions. A number of researchers, including the theories founder Icek Ajzen (2015), argued that the TPB continues to provide a useful conceptualisation of intentional processes predictive of health behaviour, and will continue to serve as a foundation for behavioural prediction by elucidating the process through which beliefs produce behaviour through the development of intentions. It was argued that the theory was never intended to provide a complete explanation of behaviour, and that additional constructs may be added to enhance predictive validity, thereby reducing unexplained variance. It was also argued that the theory does indeed account for the effects of past behaviour, through feedback loops, where positive or negative consequences attributed to performing a behaviour in the past, influence the
formation of behavioural, normative and control beliefs in relation to the behaviour. It was acknowledged that intentions do not always translate to behaviour; however, research has advanced to focus on the processes through which intentions are converted to action.

Whilst it was argued that the TPB will continue to influence thinking in relation to the intentional antecedents of health behaviour, a broader theoretical approach to health behaviour was recommended to guide future research. For example, Hagger (2015) argued that the integration of other theoretical perspectives, to build on the principals of the TPB, whilst addressing some of the theories’ shortcomings would facilitate more complete explanations of the antecedents of health behaviour. Examples include the integration of constructs such as habit and motivation to enhance behavioural predictions by accounting for implicit processes and motivational states, respectively; or the incorporation of constructs representing action planning (i.e., implementation intentions) to explain how intentions translate to behaviour (e.g., Hagger & Chatzisarantis, 2014).

In summary, although Ajzen’s TPB (1985) has been subject to some valid criticisms, it remains a useful theoretical model for explaining how attitudes, subjective norms, and PBC predict behaviour through the development of intentions, and can be augmented with other theoretical constructs, to account for additional variance in behaviour. Alongside social ecological models of health behaviour (Sallis et al., 2015), which suggest that a range of factors across multiple levels will influence behaviour, the TPB provides additional insight into some of the specific intrapersonal-level factors that might affect the physical activity and sedentary behaviours of inner-regional Australians. Additionally, the TPB provides a framework through which to understand interactions between intrapersonal factors that represent intentional psychological processes relevant to active lifestyle behaviours.

2.4.2 Autonomous motivation.

SDT (Deci & Ryan, 1985) is a popular theory of motivation that has been applied to health behaviour, including physical activity. According to SDT, behaviour is driven by qualitatively differential forms of motivation. More autonomous forms of motivation (e.g., behaviour that is regulated by enjoyment or alignment with personal values) are more likely to result in ongoing behavioural
At one end of a theoretical spectrum, intrinsic motivation is self-determined and internally-regulated, driven by innate satisfaction derived through performing an activity. At the other end of the spectrum lies amotivation, or the absence of motivation to perform a behaviour. In between are externally-regulated motivational states that vary by degree to which they are autonomously regulated. From least to most autonomous, extrinsic forms of motivation include external regulation (i.e., behaviour driven by compliance to an external source), introjected regulation (i.e., driven by guilt or anxiety), identified regulation (i.e., driven by personal value assigned to the behaviour), and internal regulation (i.e., behaviour is internally driven by perceptions that the behaviour is congruent with personal values). It is further theorised that the satisfaction of three innate psychological needs (i.e., competence, relatedness, and autonomy) will foster greater levels of autonomy, and the thwarting of such needs will lead to more external forms of behavioural regulation.

Teixeira, Carraça, Markland, Silva, and Ryan (2012) conducted a systematic review of SDT-based constructs and physical activity-related outcomes. Sixty-six studies, comprising 72 independent samples, published prior to July 2011 were included in the review. This study provides a useful summary of the relationships between the motivational states theorised by SDT and physical activity. However, effect sizes were not calculated, thus the magnitude of these effects was not identified. The review found that higher levels of autonomous motivation were positively associated with physical activity-related outcomes (8/9 studies). Studies that investigated relationships between autonomous and controlled forms of motivation with physical activity also reported consistent associations between autonomous motivation and greater levels of physical activity. Negative associations between more controlled motivation and physical activity were observed in three out of five studies that applied multivariate models; while the remaining two studies using multivariate models and those conducting bivariate analyses, found no association. Studies that examined motivation by type, found consistent evidence of positive associations between physical activity outcomes and intrinsic motivation, identified regulation, and integrated regulation, all representing more autonomous forms of motivation. The majority of studies showed no associations between physical activity and external regulation and amotivation; and mixed associations were observed for introjected regulation.
Overall, these findings suggest more autonomous forms of motivation are associated with higher levels of physical activity; while amotivation is largely unrelated to physical activity. Therefore, it appears that the active lifestyles in inner-regional Australia will be influenced by the motivation of the people within this population to perform regular physical activity and to minimise sedentary behaviour. This contention is also consistent with the COM-B system of behaviour (Michie, van Stralen, et al., 2011), which specifies the influence of motivation on health behaviour, alongside that of capability and opportunity.

2.4.3 Interactions between motivation and intentional processes.

Whilst theories such as the TPB and SDT provide useful frameworks to understand health behaviour, unexplained variance in behaviour remains. These theories focus on intrapersonal, psychological/behavioural antecedents, and do not acknowledge the effect of determinants at other levels, as theorised in social-ecological models (e.g., features of the social and physical environment). Further, of the numerous theories that provide explanations of health behaviour, conceptual overlap is evident. As previously mentioned, the integration of theories that offer complementary explanations of health behaviour can allow for more complete, yet more parsimonious explanations of behaviour (Hagger, 2009). The TPB and SDT provide examples of complementary theories, that when integrated have the potential to provide a more complete explanation.

Hagger and Chatzisarantis (2009) merged SDT and the TPB (SDT/TPB), arguing that SDT offers an explanation of motivational processes that predict behaviour, but does not explain the mechanisms through which motivational states affect behaviour; while the TPB explains intentional processes, but does not identify the origins of beliefs predictive of behavioural intention. A meta-analysis, including a path analysis of meta-analytically derived correlations, was conducted to test the SDT/TPB model in health contexts. It was hypothesised that self-determined motivation would predict attitudes and PBC. It was further hypothesised that attitudes and PBC, in addition to subjective norms, would predict behaviour through intentions. The analysis included 36 studies, 33 of which included a physical activity or sports-related outcome variable. Together with previous behaviour, the constructs included in the SDT/TPB model predicted 64.6% of variance in intentions, and 58.3% of variance in behaviour, and the results supported pathways
hypothesised in the SDT/TPB model. Unexpectedly, a small but significant, positive association between self-determined motivation and subjective norms was also found. Relationships remained significant after controlling for the effects of past behaviour.

These findings suggest that people develop behavioural beliefs that are congruent with their motivational state, and that these beliefs subsequently impact behaviour through the development of intentions. For example, a personal that is intrinsically motivated to perform physical activity will likely hold beliefs that enjoyment can be anticipated as an outcome of performing physical activity. Intentions to perform physical activity in the future will be developed accordingly, and these intentions will likely lead to the performance of the behaviour.

Collectively, the merging of these theoretical frameworks suggest that the motivational states of people living in inner-regional Australia may influence the development of beliefs that are either counter or conducive to active lifestyle participation. In turn, the beliefs in relation to physical activity and sedentary behaviour held by people living in inner-regional Australia will influence the performance of active lifestyles, through the development (or not) of intentions to perform those behaviours in the future.

2.4.4 Implicit processes.

Models such as the TPB and SDT have been applied with some success to explain the intentional processes predictive of behaviour, although, even when integrated, unexplained behavioural variance remains. This indicates the presence of additional behavioural influences. In addition to intentional processes, health behaviour has been associated with non-conscious, associative processes (i.e. implicit cognition, affect, and motivation; Sheeran et al., 2013). Dual process theories contend that behaviour is a product of two concurrently active, interacting systems, one representing reflective processes (i.e., intentional/decisional processes), and the other representing impulsive processes (i.e. where behaviour is generated through associative links and motivational orientations; Evans & Stanovich, 2013; Sheeran et al., 2013; Strack & Deutsch, 2004). These systems may concur or conflict (e.g., outcomes associated with physical activity may be consciously valued, but avoided due to implicit evaluations that performing physical activity is not enjoyable). Behaviour is generated by interactions between reflective and impulsive
determinants. Habits, defined as “a process by which a stimulus generates an impulse to act as a result of a learned stimulus-response association,” provide an example of an implicit process that can affect health behaviour, including physical activity (Gardner, 2015, p. 277).

Gardner et al. (2011) conducted a systematic review and meta-analysis of habit strength, habit-behaviour associations, and habit-intention interactions in relation to dietary, physical activity, and active travel behaviour. The review included 22 articles reporting on 21 unique datasets, all of which measured habits with the Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003). The SRHI comprises items that measure behavioural automaticity, frequency, and relevance to self-identity. Mean habit scores across behaviours, expressed as a percentage, was approximately 50%, indicating that behaviour was reported as habitual in around half of each sample. Mean habit scores in relation to physical activity (≈ 60%) and active travel (≈ 55%) were stronger than for dietary behaviours (≈ 43%). Overall, habit was significantly, positively associated with behaviour with moderate to strong effects. Habit was also significantly, positively associated with dietary, physical activity and active-travel behaviour when outcome behaviours were examined separately. Habit was also found to moderate relationships between intention and behaviour, whereby the effects of intentions on behaviour were reduced when habit was stronger (8/9 studies).

Therefore, it appears that implicit psychological processes, such as habit strength will influence the active lifestyle behaviours of people living in inner-regional Australia, in addition to the influence of intentional psychological processes.

2.4.5 Interactions between motivation and implicit processes

As well as affecting behaviour through intentions, self-determined motivation (i.e., as described in SDT) can affect behaviour through habits. Gardner and Lally (2013) conducted a study of adults aged 18-30 years (N = 192), that investigated whether positive associations between intrinsic motivation and physical activity reflected a tendency for self-determined behaviour to become more strongly habitual. It was hypothesised that habit would predict physical activity, beyond the effects of past behaviour; and that self-determined regulation, operationalised as level of relative autonomy, would interact with past behaviour to predict habit
strength (i.e., the relationship between past physical activity and physical activity-related habit strength would be stronger among those demonstrating more self-determined behavioural regulation). The findings indicated that habit predicted behaviour (i.e., together with demographics, 40% of variance in physical activity was explained), and as hypothesised, this effect remained significant when past physical activity was accounted for. Further, the relationship between past physical activity and physical activity-related habit strengthened as relative autonomy increased. Self-determined motivation also independently predicted habit strength.

Radel, Pelletier, Pjevac, and Cheval (2017) also examined relationships between motivation and automaticity for 12 lifestyle behaviours (e.g., alcohol consumption, smoking, toothbrushing, running, and going to the gym), in a cross-sectional, online survey study of 315 young adults. Data were analysed using Linear Mixed Models. Consistent with the findings of Gardner and Lally (2013), this study also found stronger relationships between automaticity and more self-determined forms of motivation, relative to more externally-regulated motivation. When controlling for behavioural frequency (i.e., past behaviour), behavioural automaticity was positively associated with more intrinsic forms of motivation (i.e., intrinsic motivation $\beta = 0.13, p < .001$, and identified regulation $\beta = 0.13, p < .001$). A smaller, positive association was also observed between behavioural automaticity and external regulation ($\beta = 0.08, p < .001$), and no significant association was found between automaticity and amotivation ($\beta = 0.02, p < .433$). Further, and consistent with the findings of Gardner and Lally (2013), autonomous motivation moderated relationships between past behaviour and automaticity, with the relationship between past behaviour and automaticity stronger among those who were more autonomously motivated. Whilst this study was cross-sectional, when considered together with the findings of Gardner and Lally (2013), it appears that self-determined motivation is related to perceptions of behaviour as automatic, and that behavioural frequency is more strongly associated with habit strength for those who are more autonomously motivated. Therefore, it is possible that, together with behavioural repetition, the motivational states of inner-regional Australians in relation to active lifestyle behaviours, will influence physical activity and sedentary behaviour-related habit strength; and the relationship between behavioural repetition and habit strength will be stronger among inner-regional Australians who are more autonomously motivated to lead active lifestyles.
2.4.6 Contextual variables.

Features of the environment are also likely to affect behaviour through implicit and intentional processes. Kremers et al. (2006) posited a dual-process conceptualisation of the impact of environmental influences upon health behaviours associated with overweight and obesity (i.e., dietary behaviours and physical activity), whereby features of the environment affect behaviour both directly and indirectly. The direct pathway represents automatic processes where behaviour is elicited in response to environmental cues (e.g., the presence of a chair may elicit sitting without conscious reasoning processes); and the indirect pathway represents a process where the environment affects behaviour through cognitions (e.g., an absence of footpaths and pedestrian crossings could lead to beliefs that walking in the local neighbourhood is difficult, leading to behavioural avoidance). One specific conceptualisation of how environmental factors affect behaviour through cognitions/intentional processes is indicated within the ‘sufficiency assumption’ of the TPB. According to this assumption, the TPB mediates the effects of all other variables on behaviour (Ajzen, 1985; Sutton, 2003). Therefore, it appears that features of the social and physical environment in inner-regional Australia will impact the behavioural, normative, and control beliefs held by residents, in relation to active lifestyle behaviours. In turn, these beliefs will inform attitudes, subjective norms, and PBC, which influence behaviour through the development of intentions to perform (or not perform) physical activity or sedentary behaviour in the future.

2.5 Chapter Summary

The importance of understanding contextual influences on health behaviour was highlighted in this chapter. Both social ecological models of health behaviour (Sallis et al., 2015) and the COM-B system of behaviour (Michie, van Stralen, et al., 2011) recognise the influence of environmental context on behaviour. To ensure a comprehensive understanding of why such high proportions of inner-regional Australians lead inactive lifestyles, it is essential to identify the range of factors across multiple levels that may influence physical activity and sedentary behaviour in this setting. It is also important to understand whether people in inner-regional Australia are capable and motivated to perform physical activity and minimise sedentary behaviour, and the degree to which the social and physical environment facilitate opportunities for active lifestyles.
Despite calls to recognise the effect of differing social, cultural, and economic systems on health behaviour, as articulated by the Ottawa Charter for Health Promotion (World Health Organisation, 1986), little research has been undertaken to understand inactive lifestyles, particularly in vulnerable populations such as inner-regional Australia, where health outcomes and physical activity participation rates are poor (Australian Bureau of Statistics, 2013b; Torrens University Australia, 2017). Research specifically focusing on identifying the factors that affect physical activity and sedentary behaviour in inner-regional contexts is required to build understanding why such high proportions of this population lead inactive lifestyles. In turn, such information can inform the development of strategies to encourage more people in inner-regional Australia to adopt active lifestyles.

Research previously conducted outside of Australia’s major cities, and in other general adult populations (i.e., without specific consideration of geographic remoteness) provides an indication of some of the factors that might affect the active lifestyles of people living in inner-regional Australia (e.g., Bauman et al., 2012; Choi et al., 2017; Eley et al., 2014; Prince et al., 2017; Rollo et al., 2016). For example, it is possible that factors such as age, employment status, and level of education will be related to the conduct of physical activity and/or sedentary behaviour among inner-regional Australians, as has been found in other adult populations. It is also possible that people in inner-regional Australia do not perceive physical activity as important for health, as was the case in some rural Australian contexts (Eley et al., 2014). However, research is required to determine if such factors are relevant in inner-regional settings, and whether there are additional factors, that have not previously been identified in other populations, that are affecting the active lifestyle behaviours of inner-regional Australians.

A number of theoretical frameworks and models were described in this chapter. The TPB was presented as an explanation of the intentional processes that influence behaviour (Ajzen, 1985). SDT was presented to explain the effect of motivation on behaviour (Deci & Ryan, 1985). Dual-process theory was presented to demonstrate that behaviour is influenced by implicit psychological processes, in addition to intentional processes (Evans & Stanovich, 2013; Sheeran et al., 2013; Strack & Deutsch, 2004). Finally, habit research was described, providing an example of an implicit psychological process theorised to influence behaviour.
(Gardner & Lally, 2013). Together with active lifestyle research conducted in other populations, and multi-level frameworks such as social ecological models (Sallis et al., 2015) and the COM-B system of behaviour (Michie, van Stralen, et al., 2011), these frameworks provide additional insight into some of the specific factors that might be affecting the performance of physical activity and sedentary behaviour in inner-regional Australia. Further, these theoretical frameworks can also guide understanding of how such factors interact to influence behaviour.

2.6 Links to Other Chapters

The physical activity and sedentary behaviour research conducted in other populations, and the theoretical frameworks and models described in this chapter were applied to guide the present research. For example, the design of study one was guided by the premise of social ecological models that environmental context is a significant determinant of behaviour (Sallis et al., 2015); and by the premise of the COM-B system of behaviour, that opportunities for health behaviour will be facilitated through the physical and social environment (Michie, van Stralen, et al., 2011). Likewise, the preliminary exploratory work to identify active lifestyle beliefs among inner-regional Australians, conducted in study two, was guided by social-ecological theory and the TPB (i.e., it was anticipated that contextual factors could impact the formation of behavioural, normative, and social beliefs, which are theorised to impact behaviour through the formation of belief-congruent intentions; Ajzen, 1985; Sallis et al., 2015). The design of the final study of this program of research was informed by all of the theoretical frameworks and models described throughout this chapter (i.e., social ecological theory, TPB, SDT, and dual-process models and habit theory). Previously identified correlates of physical activity among adults were also tested in the final study (e.g., items representing demographic variables such as age, gender, education, and income were included in the online questionnaire, and correlations between those constructs and the outcome variables were tested in the preliminary analyses). Further examples of how the literature, and the assumptions attributable to the theoretical frameworks described in this chapter influenced the design of the PhD are depicted in Figure 2.1. Further information about the design of studies one and two is presented in Chapter 3. Study one is described in detail in Chapter 4, and study two is presented in Chapter 5.
Information about the design of study three is presented in Chapter 6, and the study is reported in detail in Chapter 7.

*Figure 2.1.* How theories of health behaviour and previous research influenced the design of the PhD.
Chapter 3 Research Design Studies One and Two

3.1 Overview of the Chapter

This chapter presents information relating to the design of the first two exploratory studies of this PhD. Both studies are described in detail in subsequent chapters, however, additional information about the shared methodology and design features of the studies is presented here. Notes about the supplementary material available for each of the studies is also summarised within this chapter.

3.2 Common Methodology and Design Features

The first two studies of this program of research were exploratory, driven by the need to understand behaviour in the context in which it occurs (World Health Organisation, 1986), and the paucity of research identifying the factors that are leading to the high prevalence of inactive lifestyles within inner-regional Australia (Australian Bureau of Statistics, 2013b, 2015). The aim of the first study was to identify contextual features of the physical and social environment in inner-regional Australia that might impact active lifestyles. The aim of the second, was to identify salient physical activity and sedentary behaviour-related beliefs of people residing in inner-regional Australia. Both studies employed qualitative methods, involving semi-structured interviews.

3.2.1 Setting and participants.

Both studies were conducted in inner-regional southern Queensland. The area comprised five local government areas (LGAs) classified as inner-regional in accordance with the ASGS-RS (Australian Bureau of Statistics, 2011b), including Toowoomba, Scenic Rim, Southern Downs, Somerset, and Lockyer Valley. The Somerset LGA is located adjacent to the Queensland state capital city of Brisbane. The region is also located adjacent to other major city LGAs, including Logan, Ipswich, and the Gold Coast. The regional centre of Toowoomba is located 130 kilometres from Brisbane. A map of the study region is presented in figure 3.1. This region was selected partially due to its proximity to the University of Southern Queensland and the population that is served by the university. More importantly, the region was selected because the population is representative of the national population of inner-regional Australia, in terms of health inequality and physical activity participation rates.
Despite being located proximally to the capital city of Brisbane, it is estimated the population of the study region have a greater prevalence of health risk factors than their city-dwelling neighbours. Modelled estimates calculated by Torrens University Australia (2017) indicate that people within the study region are more likely to report fair or poor self-assessed health, high psychological distress, and to be obese compared to people living in Brisbane. People living within the study region are also less active than their city-dwelling neighbours, being more likely to report ‘no’ or ‘low’ (i.e., less than 150 minutes of moderate intensity) physical activity in a given week. Residents of Toowoomba are more likely to suffer from high blood pressure compared to those residing in Brisbane. Estimated rates (i.e., age standardised rates per 100) of fair or poor self-assessed health and health-risk factors by LGA during 2014-15, are presented in Figure 3.2. Participation rates

Figure 3.1. Map of the five LGAs included in studies one and two.
for the state capital, Brisbane, have been included for comparative purposes. At the
time of writing, modelled estimates of levels of sedentary behaviour by LGA were
not available.


Modelled estimates provided by Torrens University Australia (2017) also
indicate that people in the study region are more likely to suffer a range of chronic
diseases when compared to their city dwelling neighbours. Specifically, residents of
the study region are more likely to suffer musculoskeletal, circulatory, and
respiratory system diseases compared to people living in Brisbane. Residents of
Somerset are more likely than residents of Brisbane to suffer diabetes mellitus.
Rates of high cholesterol are similar in the study region and Brisbane. Estimated
rates (i.e., age standardised rates per 100) of common chronic diseases and health
conditions, by LGA, are presented in Figure 3.3. Once again, Brisbane has been
included for comparative purposes.
Some demographic characterises of the populations within the study region are consistent with factors identified as correlates of inactive lifestyle behaviours in previous research, such as older age, lower levels of education and income, unemployment, and socioeconomic disadvantage (e.g., Choi et al., 2017; Prince et al., 2017). According to the Queensland Government Statistician’s Office (2017), when compared to people living in Brisbane, people residing in the study region are older (i.e., median age of the population is greater, and a higher proportion of the population are aged 65 or older), have lower levels of education and income, are more likely to be unemployed (except for those living in the Scenic Rim and Toowoomba), and are more likely to be among the most socio-economically disadvantaged (i.e., are included in the lowest quintile of the index of relative socio-economic disadvantage). A summary of population-level demographic characteristics, by LGA, and including Brisbane for comparative purposes is presented in Table 3.1.
Table 3.1 Population characteristics of study region

<table>
<thead>
<tr>
<th></th>
<th>Lockyer Valley</th>
<th>Scenic Rim</th>
<th>Somerset</th>
<th>Southern Downs</th>
<th>Toowoomba</th>
<th>Brisbane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>40,229</td>
<td>41,753</td>
<td>25,533</td>
<td>35,570</td>
<td>166,045</td>
<td>1,209,322</td>
</tr>
<tr>
<td>Median age</td>
<td>37.9</td>
<td>44.3</td>
<td>42.3</td>
<td>45.3</td>
<td>38.0</td>
<td>34.6</td>
</tr>
<tr>
<td>Aged ≥ 65</td>
<td>16%</td>
<td>20.2%</td>
<td>18.8%</td>
<td>23.0%</td>
<td>17.5%</td>
<td>12.2%</td>
</tr>
<tr>
<td>Completed secondary</td>
<td>44.4%</td>
<td>49.5%</td>
<td>49.5%</td>
<td>42.3%</td>
<td>43.8%</td>
<td>73.2%</td>
</tr>
<tr>
<td>Completed secondary</td>
<td>9.5%</td>
<td>12.3%</td>
<td>8.3%</td>
<td>10.2%</td>
<td>16.1%</td>
<td>32.6%</td>
</tr>
<tr>
<td>Bachelor Degree</td>
<td>33.0%</td>
<td>23.4%</td>
<td>46.1%</td>
<td>38.4%</td>
<td>23.8%</td>
<td>5.6%</td>
</tr>
<tr>
<td>Median total personal</td>
<td>$27,820</td>
<td>$29,588</td>
<td>$26,624</td>
<td>$26,312</td>
<td>$33,384</td>
<td>$40,040</td>
</tr>
<tr>
<td>annual income (AUD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployment</td>
<td>6.9%</td>
<td>5.3%</td>
<td>8.6%</td>
<td>6.2%</td>
<td>5.4%</td>
<td>5.3%</td>
</tr>
</tbody>
</table>

Notes: Information sourced from the Queensland Government Statistician’s Office (2017). Includes population characteristics during 2017; "Proportion in the lowest quintile by index of relative socio-economic disadvantage. "The proportion of the population aged 15 years and over who were not employed during the reference week, but had actively looked for work in the 4 week period preceding the reference week; or were waiting to start a new job in the following 4 weeks, and could have started the job during the reference week, had the job been available.

3.2.2 Analyses.

For both study one and two, thematic analysis informed by the procedures outlined by Braun and Clarke (2006) was conducted. Thus, the analyses incorporated six phases. An essentialist/realist epistemological position was adopted for both analyses. The first phase involved familiarisation with the data. Approximately half of the transcription of the recorded interviews was conducted by the PhD candidate researcher (with the remainder performed by a professional transcription service), providing an excellent opportunity for initial familiarisation with the data. All transcripts were read repeatedly by the researcher to facilitate understanding of the content, and to allow for preliminary identification of potential patterns in the data. Phase two involved generating initial codes; that is, organising the data into meaningful groups. NVivo software was utilised to code the entire datasets at this point. An inductive approach to the analyses was undertaken in both studies at this stage. This allowed for the identification of novel behavioural influences unique to inner-regional Australia that was not constrained by existing research or theoretical approaches. The third phase involved searching for themes.
This phase was conducted manually, by listing all codes on separate pieces of paper and organising them into common ‘theme-piles.’ Then, the relationship between the potential themes was considered, with some themes identified as possible sub-themes of overarching themes. In both studies, this phase of the analyses was more deductive. In study one, potential themes were compared with previously identified behavioural correlates, to try to determine what themes might be unique to the inner-regional southern Queensland setting, versus those that were more universal. In study two, the codes were grouped into themes representing different levels of influence, as specified in social ecological models of behaviour (Sallis et al., 2015). The fourth phase involved reviewing the preliminary themes identified during the previous phase. All coded extracts were re-read in the context of the proposed theme. Each theme was then considered in the context of the entire dataset. All coding was reviewed at this point, with some data re-coded in light of the thematic map that had been generated. Phase five involved defining and naming the themes. A narrative ‘story’ was generated for each of the themes, and relationships between the themes clarified, with overarching and sub-themes identified. Themes were named to concisely convey the content of each theme at a glance. Phase six involved producing the final manuscript for each analysis. Data extracts that best conveyed the content of each theme were selected for inclusion in the manuscript. Co-authors of each manuscript contributed to the analysis by reviewing the coding (by reading sections of the transcribed interviews and the associated coding to determine their level of agreement) and through discussions and feedback in relation to the development and finalisation of themes and sub-themes. These discussions continued until the manuscripts were accepted for publication.

3.3 Study One

Inactive lifestyles in Peri-Urban Australia: A qualitative examination of social and physical environmental determinants (Olson, March, Brownlow, Biddle, & Ireland, 2018) was the first study conducted as part of the PhD program of research. Human research ethics approval (H16REA105) was attained from the USQ Human Research Ethics Committee. A copy of the ethics approval document is included in Appendix A. The participant information sheet and consent form for this study are presented in Appendix B. Participants were requested to complete a brief, online demographics questionnaire prior to taking part in the semi-structured
The items included in this questionnaire are presented in Appendix C. The semi-structured interview guide is presented in Appendix D. The consolidated criteria for reporting qualitative studies (COREQ) was used as a guide when reporting the findings of this study. A copy of the completed COREQ checklist for this study is included in Appendix E. The manuscript was accepted for publication in the Health Promotion Journal of Australia on the 24th August 2018. The accepted version of the manuscript is presented in Chapter 4.

3.4 Study Two

Not Quite City and Not Quite Rural: Active Lifestyle Beliefs in Peri-Urban Australians (Olson, March, Clough, Biddle, & Ireland, 2019) was the second study conducted as part of the PhD program of research. Human research ethics approval (H16REA117) was attained from the USQ Human Research Ethics Committee. A copy of the ethics approval document is included in Appendix F. The participant information sheet and consent form for this study are presented in Appendix G. Participants were requested to complete a brief, online demographics questionnaire prior to taking part in the semi-structured interviews. The demographics questionnaire for this study was largely the same as that used in the first study. Given the findings of study one in relation to the different experiences of people living within townships and those residing outside of towns, one additional question was included to assess whether participants lived within or outside of towns. The mean age of participants was 58.89 years (SD = 10.49), with a mean BMI of 27.46 (SD = 3.89). Seventy-five percent had been educated to Bachelor degree level or higher. Sixty percent of participants lived within a town, and all had a car available for their personal use. The items included in this questionnaire are presented in Appendix H. The semi-structured interview guide is presented in Appendix I. The COREQ checklist was applied as a guide for reporting the findings of this study. A copy of the completed COREQ checklist for this study is provided in Appendix J. The manuscript was accepted for publication by the Health Promotion Journal of Australia on the 5th of February 2019. The accepted version of this manuscript is presented in Chapter 5.
3.5 Chapter Summary

The current chapter included information relating to shared design features of the first two exploratory, qualitative studies of this PhD. Characteristics of the study setting and population within the study region were described. Like the overall population of inner-regional Australia, people within the study region are insufficiently active, and suffer health inequalities compared to people in major cities (despite the close proximity of the study region with the Brisbane capital city). Details of the process of thematic analysis conducted in both studies is provided in greater detail than what was covered in the manuscripts that were accepted for publication (due to limits on manuscript lengths). Finally, the supporting information available for each of the studies was described, including information pertaining to human research ethics approvals, participant information sheets, items included in preliminary demographics questionnaires, interview guides, and COREQ checklists used as a guide for presenting the findings of each study.

3.6 Links to Other Chapters

The methodology of the first two studies of this program of research was described in this chapter. A full description of study one is provided in Chapter 4, and a full description of study two is presented in Chapter 5. The empirically developed theoretical frameworks that informed the design and analysis of these studies (i.e., social ecological theory and the TPB) are explained in detail in the literature review presented in Chapter 2.
Chapter 4 Inactive lifestyles in Peri-Urban Australia: A qualitative examination of social and physical environmental determinants

4.1 Abstract

**Issue addressed:** Australians living in peri-urban areas are insufficiently active, sedentary, and experience poorer health than people in major cities. There are health benefits attributable to active lifestyles that could contribute to the improved health and wellbeing of this population. To support the adoption of active lifestyles it is important to understand the unique context in which behaviour occurs. **Methods:** The aim of this study was to identify characteristics of the social and physical peri-urban environment that may impact active lifestyles. Semi-structured interviews were conducted in peri-urban southern Queensland. Data were analysed by thematic analysis. **Results:** The natural environment, weather, distance, accessibility and walkability were features of the physical environment relevant to active lifestyles. Social factors included social capital and crime. Activity-supportive characteristics (e.g., community spirit) were identified, in addition to active lifestyle barriers (e.g., lack of public transport). **Conclusions:** Despite activity-supportive social and environmental characteristics, most participants reported inactive lifestyles. The barriers to active lifestyles in peri-urban environments may negate these activity-supportive features. Some barriers are difficult to modify (e.g., distance and accessibility). However, some may be alleviated through the adoption of activity-supportive policy and urban design (e.g., pedestrian mobility infrastructure). **So what?** Strategies to support active lifestyles in peri-urban environments must take into account unmodifiable contextual barriers, whilst encouraging utilisation of existing activity-supportive infrastructure and resources. The enhancement of activity-supportive environments through improved neighbourhood walkability and the usability of public transport may encourage some peri-urban residents to undertake more active forms of transport and recreational physical activity.

4.2 Summary

People in peri-urban Australia are insufficiently active, sedentary and suffer poorer health than city dwellers. Supporting active lifestyles represents an opportunity to improve the health of this population. This qualitative study identified
characteristics of the peri-urban social and physical environment that may act barriers or facilitators to active lifestyles.

Key words: physical activity; sedentary behaviour; health behaviour; non-metropolitan; qualitative methods

4.3 Introduction

Physical inactivity is estimated to cause between 6-10% of major non-communicable diseases and 9% of premature mortality worldwide (Lee et al., 2012). Sedentary behaviour has also been associated with increased risk of all-cause mortality, particularly among those who perform low levels of physical activity (Biddle et al., 2016; Ekelund et al., 2016). Although leisure-time physical activity levels among Australians increased slightly in the decade between 2002 and 2012, many remain inactive (i.e., not physically active) and sedentary (high amounts of sitting; Devonshire-Gill & Norton, 2018). Moreover, Australians residing in peri-urban areas (i.e., areas classified as inner-regional in accordance with the ASGS-RS) and in more geographically remote locations (i.e., those classified as outer-regional and remote) have been shown to be less active than people living in major cities (Australian Bureau of Statistics, 2011b, 2013b). Estimates of the proportions of each population classified as sufficiently active are lowest in peri-urban areas (36%), compared to 39% in remote areas and 45% in major cities (Australian Bureau of Statistics, 2013b). In contrast, Australians living in peri-urban areas spend similar time performing sedentary behaviours (35.2 hours per week) compared to those in remote areas (36 hours per week), but less than those in major cities (40.2 hours per week; Australian Bureau of Statistics, 2013b). These characteristics of peri-urban populations suggest that there may be unique features of peri-urban environments distinct from those in metropolitan and more remote locations that impact active lifestyle participation. Therefore, a close examination of the factors that influence physical activity and sedentary behaviour is warranted.

Almost one-fifth of Australian residents live in peri-urban locations, which may be conceptualised as areas outside of major cities characterised by some restricted access to goods, services and opportunities for social interaction (Australian Bureau of Statistics, 2018b). Indeed, peri-urban populations represent a significant proportion of the global population, with almost half of the worlds’ urban
dwellers residing in settlements of less than 500,000 inhabitants (United Nations Department of Economic and Social Affairs, 2014). Residents of peri-urban Australia are more likely to be overweight or obese, have high blood pressure, high cholesterol, and are more likely to die prematurely from cardiovascular disease, cancers, respiratory diseases, and suicide compared to those in major cities (Australian Health Policy Collaboration, 2017). Thus, the inactive lifestyles of this population are particularly concerning given the known health risks of physical inactivity and sedentary behaviour. Improving active lifestyle participation could provide tremendous benefit to the health of people of peri-urban Australia.

Understanding the context in which health behaviour takes place is of critical importance for health promotion (Sallis et al., 2008). The Ottawa Charter for Health Promotion states that health promotion strategies should be crafted to suit local needs and should aim to reduce health inequities, ensuring supportive environments and access to information, while providing individuals with life skills and opportunities for healthy choices (World Health Organisation, 1986). As physical activity participation does not simply decline in a linear manner with increasing remoteness, contextual factors beyond road distances to populated localities are likely impacting the degree to which peri-urban environments support active lifestyles. Despite differences in participation and the relative health disadvantages faced by peri-urban populations, limited research has been specifically directed towards identifying the range of contextually-relevant determinants of physical activity and sedentary behaviour within this population. Whilst research has been conducted in rural settings in Australia and around the world, the term ‘rural’ has often been applied to reference any geographic setting outside of major cities, and thus lacks contextual specificity. Of the studies that have been conducted specifically in peri-urban environments, research has focused on discrete ranges of behavioural determinants, sub-sections of populations, or solely on physical activity without consideration of sedentary behaviour. For example, Mummery et al. (2008) investigated associations between social capital and physical activity among adults in inner-regional Rockhampton, Australia ($N = 1278$). Participants reporting the highest levels of social capital were 67% less likely to be inactive compared to those reporting the lowest levels of social capital. Whilst such studies provide insight into specific predictors of behaviour, a broader investigation of peri-urban settings would facilitate a more complete understanding of inactive lifestyles within this population.
Further, given the association of sedentary behaviour with negative health outcomes, especially for those with low levels of physical activity, it is important to build an understanding of the determinants of sedentary activity in addition to those of physical activity.

More generally, reviews of the correlates of physical activity without consideration of geographic remoteness have found consistent evidence of positive associations between physical activity and the accessibility of facilities, the existence of sidewalks/footpaths, population density and neighbourhood aesthetics (Choi et al., 2017). Although studies of social and physical environmental correlates of sedentary behaviour were limited, Prince and colleagues (Prince et al., 2017) found preliminary evidence of negative associations between transport-related sedentary behaviour and neighbourhood walkability, and with residential density and road intersection density. The relevance of these factors upon active lifestyle behaviours, specifically within peri-urban environments, and whether there are additional unique characteristics of influence, is largely unknown.

The aim of the present research, therefore, was to identify social and physical-environmental characteristics of peri-urban settings that might influence physical activity and sedentary behaviour. The study was conducted in southern Queensland, Australia. Qualitative methodology in the form of semi-structure interviews was utilised to allow for an in-depth investigation of the social and physical environmental characteristics that may contribute to inactive lifestyles that was not restricted by pre-determined theories of behavioural determinants.

4.4 Methods

4.4.1 Setting and participants.

The study was conducted in the Lockyer Valley, Scenic Rim, Somerset, Southern Downs and Toowoomba LGAs. These are primarily classified as inner-regional, in accordance with the ASGS-RS (2011b). Spread over 32,000 km2, more than 305,000 people live in the region, which includes the large regional centre of Toowoomba with a population of 164,595 (Queensland Government Statistician’s Office, 2017). The remaining LGAs are less populous ranging between 25,173 in Somerset and 40,975 in the Scenic Rim (Queensland Government Statistician’s Office, 2017). Toowoomba is situated approximately 130 kilometres from the nearest major city (Brisbane), whilst Somerset is adjacent to Brisbane. A map of the
region is presented in Figure 4.1. Consistent with the overall peri-urban population, people within the study region are more likely to be obese, suffer mental health problems, report high or very high psychological distress, and to die prematurely from suicide compared to the overall Australian population (Torrens University Australia, 2017).

![Map of five LGAs included in the study](image)

**Figure 4.1.** Map of the five LGAs included in the study.

Recruitment was conducted in mid 2016. The study was advertised via unpaid distribution on Facebook and was targeted to groups located within the selected regions (e.g., ‘Toowoomba Facebookers’). English-speaking adults of at least 18 years of age, who resided in inner-regional southern Queensland at the time of the study and for at least one year prior, were eligible to participate. Ethical approval for human research was attained through the host institution. Study information was provided to participants prior to completion of an online eligibility
questionnaire. Consent was attained upon completion of an online demographics questionnaire, which participants were automatically directed to upon confirmation of eligibility. Participation was voluntary, and a prize draw for two $50 gift cards was conducted as an incentive for interview participation. The Consolidated criteria for Reporting Qualitative research (COREQ) guidelines were consulted when reporting this research (Tong, Sainsbury, & Craig, 2007).

Twenty-two participants aged between 23 and 74 years ($M = 46.41$) completed the demographics questionnaire. Ten were classified as obese (46%), five overweight (23%), and seven within the healthy weight range (32%; World Health Organisation, 2017). Participants were then invited to participate in an interview. One person declined to participate, one did not respond, and two did not provide contact details. In total, 17 people from Toowoomba ($n = 4$), Somerset ($n = 4$), Southern Downs ($n = 5$), Lockyer Valley ($n = 5$), and Scenic Rim ($n = 2$) participated in the interviews. Thirteen were female (77%). Seven reported living within a town area (41%), while 10 reported living outside of a town (59%). Each participant was allocated a unique identifier (e.g., P01), and personal identifying information was removed from the findings to ensure participant confidentiality and anonymity.

4.4.2 Data collection and analysis.

Semi-structured interviews took place in June 2016. The interviews were facilitated by the first author, a female PhD candidate with a Bachelor of Science (Honours) in Psychology and considerable experience ($> 10$ years) conducting non-research related interviews. No relationship between the interviewer and participants existed prior to the scheduling of interviews. Participants were advised that the study formed part of the interviewers PhD-related program of research. Due to the graphical dispersion of the sample, interviews were conducted using Skype. Only the interviewer and participant were present during the interviews. A questioning route was drafted to act as a broad roadmap of topics to be included. However, the approach was purposely flexible, to allow for exploration of issues raised by participants. A summary of the questioning route is provided in Table 4.1. The questions were reviewed and agreed by JO, SM, CB, and MI. The first interview served as a pilot to field test the questioning route, with no adjustments required.
upon review. Interviews ranged between 25 and 71 minutes in duration, and were conducted until the point of data saturation.

Table 4.1: Summary of the questioning route

<table>
<thead>
<tr>
<th>Topic</th>
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<tbody>
<tr>
<td>Descriptions of the natural and built environment (positive and negative aspects)</td>
</tr>
<tr>
<td>Descriptions of the social environment</td>
</tr>
<tr>
<td>Neighbourhood safety (crime and any other safety concerns)</td>
</tr>
<tr>
<td>Local traffic conditions</td>
</tr>
<tr>
<td>Usual method of transport</td>
</tr>
<tr>
<td>Accessibility of goods, services and facilities</td>
</tr>
<tr>
<td>Contextual factors that may impact sedentary behaviour*</td>
</tr>
<tr>
<td>Self-reported description of the type and location of activities performed whilst sitting</td>
</tr>
<tr>
<td>Contextual factors that may impact physical activity**</td>
</tr>
<tr>
<td>Self-reported description of the type and location of physical activities performed</td>
</tr>
</tbody>
</table>

Notes: *Sedentary behaviour was described as any waking activity performed whilst sitting or reclining resulting in low energy expenditure. **Physical activity was described as any activity that gets you moving and increases your breathing and heart rate.

All interviews were audio-recorded and transcribed verbatim. Participants were provided an opportunity to review and correct the transcript prior to analysis. Data were evaluated using thematic analysis, informed by Braun and Clarke (2006). An essentialist/realist epistemological position was adopted. NVivo software was used to develop a codebook of major themes and common patterns. First, an inductive approach to analysis was undertaken to allow for detection of ideas not restricted by known correlates of behaviour. Through this phase, factors explicitly reported by participants as impacting physical activity or sedentary behaviour were identified. Next, themes and ideas were analysed to identify known behavioural correlates. The first author conducted the initial coding, with three of the other authors independently reviewing the coding. Data were then summarised into meaningful categories by consensus, and statements selected to support specific themes.

4.5 Results

The findings include characteristics of peri-urban localities that impacted the physical activity and sedentary behaviour of participants, and attributes described by
participants that have previously been identified as behavioural correlates in the literature, even if behavioural impact was not explicitly stated. The findings are presented in two themes. The first encapsulates social environmental factors relevant to the conduct of active lifestyle behaviours, including social capital and crime. The second encapsulating physical environmental factors, including the natural environment and weather, distance and accessibility, and walkability.

4.5.1 Social environment.

The first theme represents characteristics of the social environment that impacted the active lifestyle behaviours of participants or are known behavioural correlates. Subthemes include social capital and crime.

**Social capital.** Participants portrayed a strong sense of neighbourliness, community spirit, cohesion, and trust. Formal social clubs, volunteer organisations, theatre companies, art galleries, school communities, church groups, and informal groups provided opportunities for social participation:

> It’s an area of lovely people and it’s a wonderful community. Everyone knows each other and if you’re not meeting the neighbours at the Rural Fire when you do fire training, you’re meeting them at the local hall when there’s a sing along. (P08, Male)

Strong community support of local sporting teams was also expressed. One participant described sporting clubs as a social hub for families:

> [Sports clubs are] sort of a central hub for families during the winter season, like your sports such as soccer, hockey and netball. (P16, Female)

However, only three participants reported personal sport participation. Some explained that they did not identify as a ‘sporting person,’ whilst others reported lack of time as a barrier to participation. Another participant described interest in health behaviours within the local community, however, did not participate herself, although did not explain why:

> We've just got a massive gym put in ... It's like a craze at the moment and I think people are trying to ... attend these health places as well. Whether it's just a sign of the times, people realise we do need to be healthy. I myself don't do any of that but a lot of people do. (P17, Female)

Participants also reported that social interaction facilitated sedentary behaviour:
In a leisure aspect though, [a reason for sitting] would be catching up with friends. So, you are sitting around, or standing around talking” (P04, Male)

Overall, participants described positive indicators of social capital, which are known correlates of physical activity (Ball, Cleland, et al., 2010; Mummery et al., 2008). However, participants also reported sitting whilst socialising. Strong sporting cultures and engagement in healthy lifestyle behaviours by others did not necessarily result in personal engagement in sport or exercise.

Crime. Thirteen participants described their local neighbourhood as safe, reporting only low-level crime. All stated that crime generally did not preclude physical activity. For example, when asked if crime prevented day or night time activity, one participant said:

No, I wouldn’t say so … you see [local residents] all the time, walking into town. It is like a village. (P02, Female)

However, five participants reported that they would avoid activity in certain locations at night due to crime. Others avoided some activities at night, despite appraisals of low-levels of risk:

I would quite happily walk with my roommate for example into town and back of a night time … but I wouldn’t do it by myself, but I think that is more so because I grew up in Brisbane [state capital] and as soon as the sun goes down, whether you have lights or not, you do not go walking. (P10; Female)

Overall, participants perceived local neighbourhoods to be safe. Whilst crime generally did not preclude physical activity, walking in specific areas at night was avoided by some.

4.5.2 Physical environment.

The second theme represents features of the physical environment that were reported as influencing the active lifestyle behaviours of participants or are known behavioural correlates.

Natural environment and weather. Participants described the aesthetic characteristics of their neighbourhoods, in addition to the impact of weather upon active lifestyle behaviours. Seven described the natural beauty of the local environment:

There is a lot of natural beauty around here … visually it just captures you. (P02, Female)
However, participants reported that the climate presented barriers to active lifestyles. Very warm and very cold temperatures negatively impacted outdoor physical activities:

[It’s] very cold in winter and very hot in summer … in winter we often get frost, and in summer it’s not unusual to get up to 40 degrees [Celsius] … if it is 40 degrees, you are not going to get out and go for a walk. (P05, Female)

Unfavourable weather also led to more sedentary behaviours:

People don’t want to get out and about because it's too cold for them. They stay home and they watch TV. (P14, Female)

Being physically active was perceived as essential to manage large properties in peri-urban environments:

Without being active you wouldn’t be able to live here … 40 acres of lawn and garden takes a fair bit of mowing and maintaining. (P08, Male)

However, weather dictated the scheduling of property maintenance, leading to irregular physical activity:

I took a month off work so I could do some fencing and get some hard work into the place … while the weather and everything else is ideal … it can’t be blowing and it can’t be too hot. It can’t be wet. You have got to have the ideal conditions to get out and do it. (P03, Female)

Taken together, these responses indicate that local peri-urban environments are considered aesthetically pleasing, which is likely to facilitate active lifestyles, however, weather presented barriers to physical activity and encouraged sedentary behaviour (Kerr et al., 2016; Van Dyck et al., 2012). Physical activity was also associated with the work required to maintain a large property, although weather impacted the regularity of physical labour.

**Distance and accessibility.** Participants reported that distance and accessibility negatively influenced active lifestyle behaviours. Poorer access to goods, services, and facilities influenced sedentary driving time, the ability to undertake active forms of transport, and the time available for recreational physical activity:

To go to the movies or something like that, you have got to drive for an hour pretty much … we have to drive to get to anything. (P11, Female)
Participants also reported a lack of access to intra-city public transport in all locations except for the larger regional town of Toowoomba, leading to a reliance on sedentary travel by private vehicles:

Well I get around by car. Everyone else that I know of gets around by car. (P10, Female)

Despite the availability of public transport in Toowoomba, it was not utilised due to a lack of route options and electronic timetabling, and longer journey times. Regular, extended commuting for work or school was also often necessary in peri-urban communities, due to a lack of local employment and educational opportunities leading to further prolonged sitting and reduced recreational time:

We were commuting for 3 years to Brisbane and back … doing 80 kilometres each way, each day … until we could find local jobs. (P03, Female)

More promisingly, most participants reported proximal access to sporting and recreational facilities. Five also reported that proximity to national parks and dams provided opportunities for recreational physical activity:

A lot of people love living here for the access to some of, probably the best bush walking in Australia … I do a lot of bush walking in the national parks and things. There is also fishing. There is also a lot of bike riders. (P04, Male)

However, consistent with the failure to participate in sport despite strong sporting cultures, several participants reported that they did not personally utilise sports and recreation services or facilities. Lack of time and not being interested in sports were cited as reasons for not utilising these facilities.

More generally, the accessibility of goods, services and facilities varied between localities, with access to aged-care facilities, health professionals, and entertainment facilities poorer in smaller towns than in larger towns. For example, a participant living in a small town said:

I think we have, maybe 5 streets in Rifle Range … there is nothing, just streets, and … a water station. (P07, Female)

Whereas, a resident of a larger town said:

You could certainly buy anything that you needed in Beaudesert without leaving town. (P04, Male)
Accessibility also differed for people living within towns and those living outside of towns. Walking for transport was typically viable for participants living within town precincts, but not for those outside of towns:

When I first moved here I lived in town, two blocks away from where I work, so of course I just walked to and from work every day. Which was fantastic … I really loved it … but the 5 kilometres is a little bit far. (P04, Male)

However, despite the practicability of walking, all participants residing within townships reported driving at least some of the time. Reasons included a lack of time and motivation, the town being spread over a large area, and other impracticalities like having too many items to carry home from the store:

I should walk a bit more and I don’t … and that is through laziness … and really, really bad time management. (P09, Female)

People living outside of towns were completely reliant on driving and travelled longer distances to access good, services, employment or education:

You drive everywhere. You drive to work. You drive to the shop. You drive to, every bloody thing … it would be completely impractical for me to walk anywhere. (P01, Female)

Access to sports and recreational facilities was also more limited for peri-urban residents living outside of town areas, which negatively impacted recreational physical activity.

Distance and accessibility influenced the amount of sedentary driving time, opportunities to walk for transport, time available for recreational activities, and the use of recreational facilities. The impact of accessibility in peri-urban environments differed as a function of the size of the local town, and when living within or outside of a town. Even when walking for transport was viable, or recreational facilities were near, some participants still avoided active lifestyle behaviours.

Walkability. Participants described features of the environment that impacted the walkability of local neighbourhoods. Poor pedestrian-mobility infrastructure was reported, particularly by participants residing outside of towns. The absence of footpaths, pedestrian crossings, street lighting, and poor road conditions restricted physical activity:

It is [a] dirt road … We would like to do more walking … and we really can’t because the only place to walk is down the middle of the road. (P01, Female)
High speed traffic and heavy vehicles also presented significant barriers to physical activity. When asked if traffic influenced physical activity, one participant said:

Yeah it does. Especially with the heavy transports, because they can’t stop really quickly and that has been some real concerns. (P04, Male)

However, footpaths, street lighting, parks, and cycling paths were features of newer housing estates emerging in several of the study localities:

We are lucky to have a lot of new estates going in … they always make sure that they get a certain number of kilometres of bike paths when they approve a new estate … one of the big new estates, they are going to have a big lake there as well as grassed areas and BBQs and all sorts of things. (P04, Male)

In summary, poor pedestrian-mobility infrastructure and dangerous traffic conditions presented barriers to active lifestyles. However, the inclusion of footpaths, street lighting, and green spaces in newly developed areas provides environments more conducive to physical activity.

4.6 Discussion

Health promotion strategies should take into account local context, aiming to reduce health inequalities by ensuring supportive environments that provide opportunities for healthy choices (World Health Organisation, 1986). Peri-urban localities are unique environments, characterised by smaller populations, fewer opportunities for social interaction, employment and education, and more restricted access to goods, services, and facilities than in major cities, but are not as isolated as more remote (or rural) populations (Australian Bureau of Statistics, 2011b). There is a need to improve our understanding of the context of peri-urban environments and how features of these environments impact population health and wellbeing. This study identified physical and social environmental characteristics of peri-urban Australia that potentially impact active lifestyle participation.

Participants reported features of the environment that supported active lifestyle behaviours. Communities were portrayed as socially cohesive. This is consistent with the findings of Eley et al. (2014) who reported neighbourliness and community spirit enhanced by the interaction of people in multiple environments (e.g., school, work, church and social) in a study conducted in six rural shires of Queensland (including one classified as inner-regional). Social capital has previously been associated with physical activity. Ball, Cleland, et al. (2010)
identified indicators of social capital associated with physical activity among women living in urban Melbourne, Australia. Individuals reporting the highest levels of social participation were 230% more likely to report any leisure-time physical activity than those reporting the lowest levels of participation. Further, where neighbourhood levels of interpersonal trust were highest, individuals were 73% more likely to report leisure-time physical activity; and where neighbourhood cohesiveness was highest, individuals were 71% more likely to report leisure-time physical activity, compared to neighbourhoods where trust and cohesion were lowest. The broader impact of social capital upon sedentary behaviour is unclear. For example, in a systematic review of the correlates of sedentary behaviour among adults without consideration of geographic remoteness, O'Donoghue et al. (2016) found no evidence of overall associations between sedentary behaviour and interactions between friends, peers and colleagues. However, limited evidence of a negative association between sense of community and total sitting time was noted.

Neighbourhoods were also described as attractive and safe. This is consistent with the findings of Cleland, Hughes, Thornton, Squibb, et al. (2015), whereby participants in outer-regional and remote Tasmania consistently described neighbourhoods as aesthetically pleasing. Favourable neighbourhood aesthetics have been positively associated with physical activity. For example, a study conducted in 17 cities across 12 countries found that favourable neighbourhood aesthetics increased the likelihood of cycling for transport by 15% and of walking for transport by 19% (Kerr et al., 2016). The impact of neighbourhood aesthetics upon physical activity may vary by geographic remoteness. A study examining the moderating influence of urban-rural status upon relationships between the perceived environment and physical activity among mid-older aged adults in Victoria, Australia found neighbourhood aesthetics was associated with physical activity among rural but not urban dwellers (Cleland, Sodergren, et al., 2015). Neighbourhood aesthetics have also been negatively associated with sedentary behaviour. In a study conducted in urban areas of Australia, the USA and Belgium, Van Dyck et al. (2012) found that for every increase in aesthetics (i.e., one level on a 4-point scale) daily sitting decreased by 3%. Associations between physical activity and crime in previous research have been mixed (Silva et al., 2016). A longitudinal study conducted in metropolitan Perth found that increased safety from crime (i.e., by one level on a 5-point Likert scale) was associated with an 18 minute per week
increase in walking (Foster et al., 2016). However, safety from crime may impact physical activity differently in urban and rural settings. Cleland and colleagues Cleland, Hughes, Thornton, Venn, et al. (2015) found that perceived crime generally did not impact physical activity in outer-regional and remote Tasmania; whilst personal safety was associated with physical activity among mid-older adults living in rural, but not urban, Victoria in another study (Cleland, Sodergren, et al., 2015). The impact of perceived crime upon sedentary behaviour also appears to vary by population. Van Dyck et al. (2012) found that increased crime safety (i.e., one level increase on a 4-point scale) was associated with 3% less daily sitting among women, but not associated among the overall sample of men. However, among Australian participants (male and female) increased crime safety was associated with 3% less daily sitting. In the present study, the presence of sports and recreational facilities also provided opportunities for physical activity, and sparked community interest in healthy lifestyles, while proximity to national parks facilitated recreational physical activity. This is consistent with the findings of a qualitative study conducted in rural Tasmania, whereby 60% of participants ($N = 49$) reported opportunities for physical activity afforded in natural settings (Cleland, Hughes, Thornton, Squibb, et al., 2015).

However, despite descriptions of ‘activity supportive’ features of peri-urban environments, participants self-reported largely inactive lifestyles. Driving was prevalent, even when walking was viable, and most participants did not engage in sport despite the accessibility of sporting and recreational facilities, strong community sporting cultures, and modelling of healthy lifestyle behaviours by fellow residents. Whilst potentially beneficial, these features are insufficient in isolation to encourage widespread engagement in active lifestyles. It is possible that environmental barriers outweigh the activity-supportive characteristics of peri-urban environments. No matter how attractive or safe from crime the environment is perceived to be, or how cohesive the local community, if distance, accessibility, traffic conditions, pedestrian-mobility infrastructure and weather are unfavourable, inactive lifestyles may be difficult to change. Proximal access to destinations has been associated with increased physical activity and reduced sitting. Choi and colleagues Choi et al. (2017) reported consistent positive associations between the accessibility of facilities and physical activity among adults of unspecified geographic remoteness. However, this relationship is unclear in rural settings. A
systematic review of the effects of the built environment of physical activity among adults living in rural settings found associations between walkable destinations in only two out of five studies (Frost et al., 2010). Associations between access to destinations and sedentary behaviour are also unclear. For example, Van Dyck et al. Van Dyck et al. (2012) unexpectedly found that decreased access to services (i.e., one point on a 5-point scale) was associated with 2% less daily sitting. In addition to increasing sedentary travel, the lack of usable public transport may negatively impact physical activity. In an umbrella review of environmental determinants of physical activity across the life course, Carlin et al. (2017) found some evidence of positive associations between the availability, accessibility and proximity of public transport with walking and cycling.

Poor pedestrian mobility infrastructure creates neighbourhoods that are less ‘walkable.’ Built environments that are supportive of residents walking have been positively associated with walking among urban Australians, with adults from the most walkable neighbourhoods twice as likely to report 30 minutes of home-based walking, compared to those living in very car dependent areas (Cole, Dunn, Hunter, Owen, & Sugiyama, 2015). Associations between neighbourhood walkability and sedentary behaviour have been mixed (Owen, Healy, Matthews, & Dunstan, 2010). However, one study found that women living in the most walkable neighbourhoods of urban Adelaide spent 17 minutes less watching television per day compared to those in the least walkable neighbourhoods (Sugiyama, Salmon, Dunstan, Bauman, & Owen, 2007). The overall impact of traffic safety upon active lifestyle behaviours is also unclear. Choi et al. (2017) found negative associations between physical activity and heavy traffic in only one of 14 reviews published between 2002 and 2016 (among adult populations without consideration of remoteness), with one review finding no correlation, and the remainder reporting inconclusive findings. It is possible that factors beyond traffic volume contribute to perceptions of dangerous traffic conditions that impact physical activity. Consistent with the present study, Cleland, Hughes, Thornton, Venn, et al. (2015) found that high numbers of trucks on the road and high speed limits, in addition to poor visibility at night and tourist traffic negatively impacted physical activity in outer-regional and remote Tasmania. It also appears that the impact of traffic safety upon physical activity differs between settings. In contrast with the findings of the present study and those of Cleland, Hughes, Thornton, Venn, et al. (2015), Eley et al. (2014) noted low traffic volume in
six rural shires of Queensland and suggested that wide roads with low traffic still afforded opportunities for walking. The impact of traffic safety upon sedentary behaviour also appears to vary by population. Van Dyck et al. (2012) found negative associations between traffic safety and sitting among women but not men; and among both men and women in urban areas of Australia, but not in Belgium or the USA. Research investigating associations between weather and overall physical activity has produced mixed findings, however, there is some indication of positive associations between favourable weather and leisure-time physical activity (Carlin et al., 2017). Whereas, consistent associations have been noted between unfavourable weather and total sitting (O'Donoghue et al., 2016).

The failure of individuals to adopt active lifestyles regardless of activity-supportive environmental features also suggests that disparities in active lifestyle participation are not exclusively attributable to environmental factors. Ecological models of physical activity and sedentary behaviour posit that behaviour is influenced by a range of variables at the individual, social, community, environmental, and policy levels, and that correlates on multiple levels interact to predict behaviour (Owen et al., 2011; Sallis et al., 2006). Accordingly, factors at other levels are likely interacting with those identified within this study, resulting in inactive lifestyles. According to Michie, van Stralen, et al. (2011), behaviour is generated through interactions between capability, motivation, and opportunity (provided through the social and physical environment; Michie, van Stralen, et al., 2011). The present study focused on physical and social environmental characteristics of peri-urban environments that create or impede opportunities to undertake active lifestyles. An examination of factors such as capability and motivation was beyond the scope of the study, however, these are necessary conditions to support physically active lifestyles even in the context of ideal environmental conditions. Specifically, it is possible that those who are not active despite supportive environmental features are not motivated to be active or are not capable. Indeed, lack of motivation was cited as a reason for driving despite the viability of walking. Further research focusing on factors such as motivation and capability may be useful to understand why peri-urban people are failing to be active, despite the presence of some activity-supportive environmental features, in addition to identifying factors that aid people to overcome unsupportive characteristics of peri-urban settings and lead active lifestyles.
Opportunities to build more activity-supportive environments in peri-urban localities were identified through this research. The inclusion of footpaths and street lighting in more areas, and urban design features that protect pedestrians from dangerous traffic conditions could improve neighbourhood walkability (Choi et al., 2017; Cole et al., 2015; Sugiyama et al., 2007; Van Dyck et al., 2012). Further, the creation of physical activity spaces that minimise the impact of unfavourable weather may further support active lifestyles by encouraging recreational physical activity and limiting sedentary behaviour. However, the feasibility of major changes to the built environment in peri-urban areas that are less densely populated than major cities must be acknowledged. Local government agencies are bound by limited budgets to serve smaller populations spread over greater geographic areas. The financial viability of commercial service provision in peri-urban communities is another factor which may hamper the development of activity supportive environments. For example, while enhancing the usability of existing public transport services with user-friendly journey planning, efficient timetabling and minimised journey times may encourage the use of public transport (Carlin et al., 2017), service providers are unlikely to expand operations to sparsely-populated, non-profitable areas. Resources should be prioritised to ensure maximum benefit across the population, without further widening health disparities (e.g., among those who live outside of townships in the least populated areas). Planners and policymakers must also consider creative ways to address unmodifiable factors that impact active lifestyles in peri-urban environments, such as distance and accessibility.

Despite these obvious challenges, this study has identified several characteristics of peri-urban communities which represent assets for the development of strategies to encourage active living. The strong sense of social cohesion represents a psychological resource for communities and potential avenue to supporting active lifestyle participation. Support for local sporting teams and community interest in health behaviours also represent opportunities to craft strategies to encourage increased participation. While, aesthetically pleasing and safe environments provide locations that are ideal for the conduct of physical activity.

Recruitment through social media and the conduct of interviews via Skype represent a limitation of this research, as individuals without internet access were effectively excluded. It is possible that patterns and determinants of sedentary behaviour (and physical activity) differ between internet users and non-users, which
should be taken into account when interpreting the findings. Additionally, 14 out of the 17 participants were female and as such it was difficult to detect any possible variation in the impact of contextual factors upon active lifestyles by gender.

Finally, the sample was specific to peri-urban southern Queensland and provided an understanding of the contextual factors likely to impact active lifestyles within this region. Research in other localities will provide a more complete understanding of the range of contextual factors that contribute to inactive lifestyles across wider peri-urban contexts.

4.7 Conclusion

The social and physical environmental characteristics of peri-urban environments present unique barriers to and opportunities for active lifestyles. Barriers to active lifestyles included unfavourable weather, distance and poor accessibility, low residential density, poor pedestrian-mobility infrastructure, and dangerous traffic conditions. Activity-supportive characteristics included social cohesion, safety from crime, and favourable neighbourhood aesthetics. However, these features were insufficient to generate broad uptake of active lifestyles. Further research is recommended to understand the relative influence of each of the identified characteristics and to determine why peri-urban populations remain inactive despite activity-supportive environmental attributes, and to identify factors that may encourage active lifestyles in the face of contextual barriers, such as accessibility. Peri-urban environments may be enhanced with improvements to the built environment that improve neighbourhood walkability, especially those that focus on minimising the impact of dangerous traffic conditions and unfavourable weather. Social cohesion, strong sporting interest, and safe and attractive physical environments represent resources that may be drawn upon when drafting policy or planning strategies designed to encourage active lifestyles in peri-urban regions.

4.8 Acknowledgements

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4.9 How the Publication Contributes to the Advancement of the Research Area

Both the COM-B and social ecological models of health behaviour posit that health behaviour results through multi-level interactions between a range of factors, with both frameworks acknowledging the important influence of the physical and social environment on behaviour (Michie, van Stralen, et al., 2011; Sallis et al., 2015). Formative research that identifies contextual factors that support or inhibit active lifestyles is critical for the development of effective behaviour-change interventions to support more active lifestyles (Sallis et al., 2006). The present study has identified contextual factors that facilitate and constrain active lifestyles in inner-regional Australia.

This study is the first to examine and identify a wide range of features of the physical and social environmental context in inner-regional Australia that may influence physical activity and sedentary behaviour within this population. The findings build on previous research that has identified determinants of physical activity in non-metropolitan regions of Australia (e.g., Eley et al., 2014), and in adult populations more generally (e.g., Choi et al., 2017), by identifying factors that are specifically relevant to physical activity in the inner-regional Australian context.

Sedentary behaviour is detrimental to health, particularly for those who are physically inactive, as is the case for a large proportion of people who live in inner-regional Australia (Australian Bureau of Statistics, 2015; Ekelund et al., 2016). Therefore, it is important to identify opportunities for inactive inner-regional Australians to reduce their sedentary time, in addition to increasing physical activity. The present study further builds on the existing research by identifying previously unidentified contextual factors that may impact the performance of sedentary behaviour, in addition to those that may impact physical activity. The findings from this research can be used to inform the development of contextually-relevant strategies (i.e., policies and interventions) to support increased physical activity and reduced sedentary behaviour in inner-regional Australia.

4.10 Links to Other Chapters

Further description of the design and methodology applied in this study is presented in Chapter 3. The design of the study was informed by social-ecological theory, recognising that health behaviour is a product of multiple influences, at multiple levels. Social ecological theory is described in detail in Chapter 2
(Literature Review). One of the findings of the current study was that features of the physical and social environment that may impact active lifestyles differed amongst those who lived within towns and those who lived outside of towns. This distinction was taken into account in the subsequent studies (e.g., items related to living in town and out of town were included in studies two and three). A full description of study two follows in Chapter 5. The findings of the present study also informed the design of the third and final study of the program of research. Information pertaining to the design and methodology of the final study is presented in Chapter 6. A full description of study three is presented in Chapter 7.
Chapter 5 Not quite city and not quite rural: Active lifestyle beliefs in peri-urban Australians

5.1 Abstract

**Issue addressed:** Residents of peri-urban Australia face health inequalities compared to city dwellers. Active lifestyles provide many benefits that could improve the health of this population; however, peri-urban Australians are more likely to be inactive and sedentary. The aim of this study was to identify the physical activity and sedentary behaviour-related beliefs of peri-urban Australians.

**Methods:** Semi-structured interviews were undertaken with adult residents of peri-urban, southern Queensland. Participants (N = 8) were recruited from a related study, purposefully selected to ensure diversity. Data were analysed by thematic analysis. Interviews were conducted until data and inductive-thematic saturation were reached. **Results:** Three themes were identified, representing beliefs about intrapersonal, interpersonal/socio-cultural, and physical environmental factors relevant to active lifestyles among peri-urban Australians. Active lifestyle behaviours were perceived as beneficial for health. Social interaction was described as an important outcome of physical activity. Features of the physical environment negatively impacted the perceived difficulty of performing physical activity and avoiding sedentary behaviour. **Conclusions:** Active lifestyle strategies that support social interaction through physical activity and sports participation may be particularly useful in peri-urban environments where opportunities for social interaction are limited. Such strategies should also take into account contextual factors that negatively impact active lifestyle control beliefs (e.g., distance). **So what?** This study provides insight into factors that may influence the active lifestyles of peri-urban Australians. This information can be used to develop contextually-relevant strategies designed to encourage physical activity, discourage sedentary behaviour, and assist to relieve health disparities faced by this population.

5.2 Summary

Peri-urban Australians are inactive, sedentary, and suffer poorer health than other Australians. This qualitative study identified physical activity and sedentary behaviour-related beliefs among peri-urban Australians. Some regarded social interaction as an important outcome of physical activity, which was otherwise
limited in peri-urban settings. Environmental context (e.g., distance) impacted beliefs about the difficulty of performing physical activity and the necessity of sedentary driving activity.

Key words: physical activity; rural and regional health; behavioural theory; qualitative methods

5.3 Introduction

Australia is spread over an area of 7.7 million km², with more than 6.9 million people living outside of its major cities in regions of differing geographic remoteness (Australian Bureau of Statistics, 2018b; Geoscience Australia, 2018). The residential settings of non-city dwelling Australians vary greatly (e.g., population density, climate). Around 65% of those living outside of Australia’s major cities live in inner-regional areas (4.3 million people), henceforth referred to as ‘peri-urban’ (Australian Bureau of Statistics, 2018b). Peri-urban regions are more urbanised and densely populated than outer-regional and remote localities, while access to goods, services and opportunities for social interaction is more restricted than in major cities (Australian Bureau of Statistics, 2011b). Despite often being located in relative proximity to major cities, peri-urban Australians experience poorer health and wellbeing than their city-dwelling neighbours. It is estimated that peri-urban Australians are more likely to report poor self-assessed health, high psychological distress, high blood pressure, high blood cholesterol, mental or behavioural problems, circulatory system diseases, respiratory system diseases, musculoskeletal system diseases, obesity, and to die prematurely from all causes than people living in major cities (Torrens University Australia, 2017). Some indicators of public health are also worse in peri-urban Australia than in more remote areas (Torrens University Australia, 2017). Modelled estimates of health disparities by geographic remoteness are presented in Table 5.1.
### Table 5.1: Health disparities faced by inner-regional southern Queenslanders

| LGA                  | Population as at 30 June 2016 | Low or no exercise in the previous week *‖↑ | Obese *‖↑ | High blood pressure | High blood cholesterol | Circulatory system diseases †↑ | Respiratory system diseases * | Musculoskeletal system diseases * | Mental or behavioural problems * | High/very high psychological distress † | Fair/poor self-assessed health ||||| |
|----------------------|-------------------------------|-------------------------------------------|-----------|---------------------|------------------------|-------------------------------|-------------------------------|---------------------------------|---------------------------------|--------------------------------|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| Lockyer Valley       | 39,486                        | 78.3                                      | 35.7      | 22.4                | 30.3                   | 17.5                          | 29.4                          | 28.7                            | 15.7                            | 14.3                          | 16.4                          | 257.9            |                 |
| Scenic Rim           | 40,975                        | 71.6                                      | 33.4      | 20.3                | 31.3                   | 17.6                          | 29.0                          | 28.2                            | 14.5                            | 12.2                          | 14.4                          | 230.7            |                 |
| Somerset             | 25,173                        | 75.8                                      | 32.3      | 23.5                | 29.8                   | 18.1                          | 29.8                          | 29.1                            | 16.0                            | 14.9                          | 16.6                          | 286.5            |                 |
| Southern Downs       | 35,622                        | 75.8                                      | 35.3      | 20.4                | 30.6                   | 17.6                          | 27.7                          | 28.5                            | 15.6                            | 12.3                          | 16.7                          | 258.0            |                 |
| Toowoomba            | 164,595                       | 72.8                                      | 36.3      | 25.9                | 29.9                   | 17.8                          | 30.7                          | 28.2                            | 14.8                            | 13.1                          | 16.9                          | 245.9            |                 |
| Brisbane             | 1,184,215                     | 63.5                                      | 23.8      | 24.8                | 30.8                   | 16.6                          | 26.2                          | 25.6                            | 13.9                            | 10.8                          | 13.3                          | 212.8            |                 |
| Major Cities/Inner-regional | 17,671,876          | 53.6                                      | 25.4      | 22.7                | 31.7                   | 16.9                          | 28.1                          | 26.9                            | 16.8                            | 11.6                          | 13.9                          | 218.0            |                 |
| Outer-regional & remote | 4,380,230           | 62.7                                      | 32.0      | 24.6                | 35.8                   | 17.7                          | 31.4                          | 29.8                            | 18.8                            | 12.4                          | 17.1                          | 258.5            |                 |
|                      | 2,330,327                     | 59.8                                      | 35.8      | 22.1                | 33.9                   | 18.6                          | 28.3                          | 28.9                            | 19.3*                           | 10.5                          | 17.3                          | 285.0*           |                 |

**Notes:** Adapted from (Australian Bureau of Statistics, 2013b; Queensland Government Statistician’s Office, 2017; Torrens University Australia, 2017); Includes Modelled estimates of health disparities faced by adult populations of inner-regional southern Queensland by LGA in 2014-2015; *Age standardised rates per 100; †Age standardised rates per 100,000; ‡performed no exercise or did not meet the requirement of at least 150 minutes of physical activity during the week specified; ^BMI 30 or greater; †People aged 18 years and over; ††People aged 2 years and over; †††People aged 15 years and over; ††††People aged 0 – 74 years; ‘Outer Regional only; ’National
Physical activity provides an effective prevention strategy for chronic diseases including obesity, hypertension, cardiovascular disease, cancer, and depression (Warburton et al., 2006). Unfortunately, most peri-urban Australians do not reap the substantial health benefits attributable to physical activity, with only 36% being sufficiently active (i.e., participated in at least 150 minutes of physical activity over a given week, including moderate and vigorous intensity activity, and walking for transport and fitness; Australian Bureau of Statistics, 2013b). Even fewer meet recommendations regarding activities specifically for muscle strengthening (Bennie et al., 2016). Peri-urban Australians are also sedentary for an average of 35.2 hours per week (Australian Bureau of Statistics, 2013b). This is likely contributing to the poorer health of this population, as sedentary behaviour (i.e., too much sitting) has been associated with deleterious health effects and all-cause mortality, particularly among those who are physically inactive (Biswas et al., 2015; Ekelund et al., 2016). Supporting peri-urban Australians to lead more active lifestyles that incorporate regular physical activity and minimised sedentary behaviour will help to improve health and wellbeing within these communities.

To develop effective strategies to support active lifestyles it is important to understand behaviour in the context in which it occurs. Social-ecological approaches posit that health behaviour is a product of interactions between intrapersonal, interpersonal, organisational, community and policy level factors (Sallis et al., 2008). The socio-cultural and physical environment may impact these factors at multiple levels. Other theoretical frameworks (e.g., social-cognitive models) may compliment ecological models by providing explanations of how multi-level factors interact to predict behaviour. The TPB is a well-known framework that has been applied to understand the cognitive determinants of behaviour, whereby attitudes, social norms and PBC influence behaviour through intentions (Ajzen, 1985). When applying the TPB to represent the cognitive processes that mediate the relationships between environmental factors and behaviour, it is theorised that environmental features impact behaviour through their influence upon attitudes, social norms and PBC, which in turn influence behaviour through intentions (Kremers et al., 2006). These factors reflect the individual’s underlying behavioural, control and normative beliefs. Identification of these beliefs as they relate to physical activity and sedentary behaviour is important to build understanding of the inactive lifestyles of peri-urban Australians. Such knowledge can provide insight into modifiable
behavioural determinants and inform the development of strategies to support active living.

Despite the health inequalities faced by peri-urban Australians and the health benefits attributable to active lifestyles, little research has been conducted to identify the contextually-relevant determinants of active lifestyles specifically within this population. Some research has been conducted in rural areas of Australia (e.g., Cleland and colleagues, Cleland, Hughes, Thornton, Squibb, et al., 2015; Cleland, Hughes, Thornton, Venn, et al., 2015; Cleland, Sodergren, et al., 2015; Cleland, Ball, King, & Crawford, 2012; Eley et al., 2014). However, the term ‘rural’ has often been applied to reference any geographic setting outside of major cities and thus lacks contextual specificity. Eley et al. (2014) conducted a study of the opportunities and constraints to physical activity in rural Queensland. The study was conducted in one inner-regional, two outer-regional, two remote, and one very remote shire, as classified by the ASGS-RS (Australian Bureau of Statistics, 2011b). The importance of rural context was clearly highlighted in the findings. For instance, the culture of exercise in some communities shaped beliefs about physical activity that negatively influenced participation levels (e.g., physical activity was viewed as necessary for work rather than as important for the maintenance of good health). Such studies provide valuable insight into the behavioural determinants of active lifestyles among those who live outside of Australia’s major cities. However, the unique behavioural influences specific to peri-urban regions as distinct from more remote localities were not differentiated. Given the heterogeneity of non-metropolitan settings, investigation is warranted to identify the specific characteristics of peri-urban populations that are impacting physical activity participation. Further, this study focused on physical activity and did not include sedentary behaviour. Given the deleterious health effects of sedentary behaviour, particularly among those who are inactive, an examination of the contextually relevant determinants of prolonged sitting is warranted.

The aim of this study was to identify the salient beliefs of peri-urban Australians in relation to physical activity and sedentary behaviour. Qualitative methodology was adopted to allow for responses that were not restricted to known determinants of behaviour identified in other populations.
5.4 Methods

5.4.1 Setting and participants.

The study (N = 8) was conducted in LGAs of southern Queensland primarily classified as inner-regional in accordance with the ASGS-RS, including the Lockyer Valley (n = 1), Scenic Rim (n = 1), Somerset (n = 1), Southern Downs (n = 3), and Toowoomba (n = 2; Australian Bureau of Statistics, 2011b). A map of the region is presented in Figure 5.1. The overall area of this region is greater than 32,000 km² with a population of 305,851 (Queensland Government Statistician’s Office, 2017). Population levels vary between LGAs, with the largest population in the regional centre of Toowoomba and the smallest in the Scenic Rim (Queensland Government Statistician’s Office, 2017). Toowoomba is situated approximately 130 kilometres from Brisbane, the state capital, and Somerset is located adjacent to Brisbane. Despite the relative proximity of the selected LGAs to Brisbane, people within the region suffer health disparities consistent with the overall population of peri-urban Australia (Torrens University Australia, 2017). People within the study region are also less active than their Brisbane neighbours. Population, physical activity participation and health related statistics for each included LGA and Brisbane are displayed in Table 5.1.

Figure 5.1. Map of the five LGAs included in the study.
Ethical approval was obtained from the host institution’s Human Research Ethics Committee. Participants were recruited from the participant pool of a related study which has been described elsewhere (Olson et al., 2018). In summary, participants of the parent study took part in semi-structured interviews 3 months prior to taking part in the present study and were asked to describe the physical and social environment in their local neighbourhood. Specific individuals were purposefully targeted for the present study to maximise diversity between the participants, informed by the analysis of the first study (e.g., the range of views expressed, inclusion of those living within townships and those living in more rural areas, by gender, approximate age and descriptions of active lifestyle participation). Half of the participants lived in a town and half were female. Recruitment for the original study was conducted via unpaid distribution on Facebook, with posts targeted to groups and pages located within the study region (e.g., ‘Toowoomba Facebookers’). Participation was voluntary and a prize draw for two $50 prepaid Visa cards was conducted as an incentive for participation. English speaking adults (≥ 18 years), presently living in the region (and for at least one year prior) were eligible to participate. Study information was provided to participants prior to completion of an online eligibility and demographics questionnaire. Participants provided written informed consent when submitting the questionnaire and were then contacted to schedule the interview.

5.4.2 Data collection and analysis.

Semi-structured interviews were conducted by the first author, a female PhD candidate with a Bachelor of Science (Honours) majoring in Psychology and considerable experience facilitating non-research related interviews. The interviewer was known to participants, through the original study. Participants were aware that the study formed part of the researcher’s PhD project. Interviews were conducted during Spring, 2016, via Skype voice call due to the geographical dispersion of the sample. Only the interviewer and participant were present. A questioning route was developed to provide a broad framework of issues to be covered. A flexible approach to facilitation was undertaken to allow for exploration of ideas introduced by participants. A summary of the topics covered is provided in Table 5.2. The questioning route was reviewed and agreed by JO, BC and MI. The first interview
served as a pilot test of the questioning route, with no adjustments required. The duration of interviews ranged between 41 and 103 minutes.

Table 5.2: Overview of the questioning route

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Activity</td>
<td>The type of activities performed by the participant</td>
</tr>
<tr>
<td></td>
<td>Where activities were performed</td>
</tr>
<tr>
<td></td>
<td>Why each activity was performed</td>
</tr>
<tr>
<td></td>
<td>Behavioural beliefs</td>
</tr>
<tr>
<td></td>
<td>Barriers to physical activity</td>
</tr>
<tr>
<td></td>
<td>Facilitators of physical activity</td>
</tr>
<tr>
<td>Sedentary Behaviour</td>
<td>The type of activities performed by the participant</td>
</tr>
<tr>
<td></td>
<td>Where activities were performed</td>
</tr>
<tr>
<td></td>
<td>Why each activity was performed</td>
</tr>
<tr>
<td></td>
<td>Behavioural beliefs</td>
</tr>
<tr>
<td></td>
<td>Barriers to reducing prolonged sitting</td>
</tr>
<tr>
<td></td>
<td>Facilitators of the reduction of prolonged sitting</td>
</tr>
</tbody>
</table>

Data were analysed by thematic analysis informed by Braun and Clarke (2006). An essentialist/realist epistemological position was adopted. NVivo software was used to develop a codebook of themes. Initially, an inductive approach was undertaken to code the data. The organisation of codes into overarching themes was guided by social-ecological theory (Sallis et al., 2015). Coding was conducted by the first author and independently reviewed by SM, BC and MI. Next, behavioural influences were sorted into themes, and statements were selected to represent each of the themes. ‘Data saturation’ and ‘inductive thematic saturation’ were determined after analysis of the interviews of the initial eight participants recruited to take part, and no further recruitment was required. Data saturation was assessed based on the high degree of repetition in the data obtained, and inductive thematic saturation was determined when no new codes or themes were identified (Saunders et al., 2018). The interviews were voice recorded and transcribed verbatim. A copy of the transcript was provided to each participant to confirm accuracy. The COREQ checklist guided the reporting of this study (Tong et al., 2007).
5.5 Results

Three major themes were identified, representing beliefs (including behavioural, normative, and control beliefs) about intrapersonal, interpersonal/socio-cultural, and physical environmental factors relevant to active lifestyle behaviours. An overview of the themes and subthemes (where applicable) are presented in Table 5.3, and a detailed description is presented next.

Table 5.3: Themes and subthemes identified through thematic analysis

<table>
<thead>
<tr>
<th>Major theme</th>
<th>Subthemes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intrapersonal factors</td>
<td>Health</td>
</tr>
<tr>
<td></td>
<td>Psychological factors</td>
</tr>
<tr>
<td></td>
<td>Time constraints and competing demands</td>
</tr>
<tr>
<td>Interpersonal/Socio-Cultural factors</td>
<td>Social interaction</td>
</tr>
<tr>
<td></td>
<td>Active lifestyle behaviours performed by others</td>
</tr>
<tr>
<td></td>
<td>Social support and social approval of active lifestyles</td>
</tr>
<tr>
<td>Physical environmental factors</td>
<td>Presented as a single, all-encompassing theme</td>
</tr>
</tbody>
</table>

5.5.1 Intrapersonal factors.

This theme includes factors that impacted physical activity and sedentary behaviour at the intrapersonal (i.e., biological and psychological) level. Participants described beliefs about health outcomes attributable to active lifestyle behaviours; psychological factors that impacted active lifestyle behaviours, including enjoyment and self-efficacy; and the impact of lack of time and competing demands on active lifestyles.

Health. All participants expressed beliefs that physical activity was beneficial for health. The perceived benefits included improved fitness, sleep, mental health, weight loss/maintenance, and healthy aging. One participant noted a unique positive impact of peri-urban lifestyles upon healthy ageing, which he attributed to the physical work required to maintain a large property:
... when my wife tells me that we've really got to sell up and go somewhere where it's not as tough on the body, I keep reminding her that this is actually what's keeping me supple. If I went into suburbia … I would start going backwards fairly quickly. (Male)

Most participants reported initiating physical activity because of the perceived health benefits. Weight control, increased fitness and healthy ageing were the most commonly cited motivators. Although health benefits motivated the initiation of physical activity, behaviour was not always maintained.

I did go to an exercise lady at the beginning of the year, to try and get some fitness. She taught me some exercises which I still try and do, but I'm afraid I don't do them on a regular basis … because I either forget or I - yeah, just don't have the time. (Female)

Beliefs about the health benefits of physical activity were informed by mass-media campaigns. One participant reported that mass-media campaigns designed to encourage physical activity also fostered the minimisation of sedentary behaviour.

There's this constant background thought, of this is not healthy. I need to stop [sitting]. I need to move around and do things. So that constant health message … through society, through media, through media identities and news articles and things, I think it overall has a facilitating effect, a positive one, to get people moving. (Male)

Participants also expressed beliefs that prolonged sitting could lead to spine, joint and circulatory problems, discomfort, weight gain, and had detrimental effects on mental health and cognition. For example, one participant said:

[Sitting] makes me feel really lethargic … I think it has a huge effect of you mentally … it probably makes you feel like you're … a bit worthless … I think if you relax too much by sitting, it's very hard to get yourself moving and motivated. (Male)

The interruption of sedentary behaviour was also described as beneficial for health.

So, there are health benefits and probably social benefits [of interrupting sitting], you know, just talking, seeing other people as you move around and physical benefits, probably less weight gain and less pressure on your body. (Male)

The negative health outcomes attributed to sedentary behaviour motivated the minimisation and interruption of prolonged sitting, in addition to physical activity participation.
So, I tend to alternate [between sitting and physically active tasks] … because of … the fusion of C2, 3, 4 vertebrae. I've got to keep moving or I freeze up. (Male)

Because I have a fairly sedentary job now and to try and get some exercise in. (Female)

In summary, participants expressed beliefs that physical activity and the interruption of prolonged sitting were beneficial for health, while sedentary behaviour was perceived as detrimental. These beliefs motivated the initiation of physical activity, and the minimisation and interruption of prolonged sitting; however, the initiation of physical activity motivated by health benefits was not necessarily sustained over time.

**Psychological factors.** Participants described beliefs about psychological factors relevant to active lifestyle behaviours. Some described physical activity as enjoyable.

I actually enjoy the physical [activity], especially the bushwalking, because you're getting back to nature and keeping that connection as well. (Male)

In contrast, physical activity was described as exhausting by two participants, and specific activities (e.g., running) were described as unenjoyable by three participants, leading to behavioural avoidance.

If my husband said to me, let's go for a walk every night … I'd probably go with him. But for me, the running thing, like if he wants me to go running with him, we don't have the same pace. He's gone. I think I'm still out here on my own, just hitting the pavement. I hate this. (Female)

Others described low self-efficacy for physical activity.

Last summer, when we went on holidays, we all went, okay, let's use this as a kicker to try and get into some regular exercise. We just ran around the block. It would have been a kilometre, and the whole family went … each day we went that actually wasn't too bad. I feel good for having done that … But I think my problem is, I then go … let's see if I could make it up to five kilometres … then don't know how to look after myself well enough, have I fuelled my body well enough to do five K? Have I done all the other things that it then just doesn't make you feel fatigued for having done it … when I keep trying to do more, I end up - it gets too hard. (Female)

Low self-efficacy to perform certain tasks in a non-seated position was also expressed by some participants.
I've tried standing and using the computer, and that just doesn't work for me. To me, it's something that you have to sit and do ... I've never, ever set it up on my phone to have internet access. So that's one thing I find that I do have to sit and do ... probably the other thing would be I would hate to stand up and watch a movie. (Male)

Activities performed whilst sitting were described as relaxing, enjoyable, and as a means of relieving stress by some participants. Also, there's the benefit of relaxing, of enjoying that time of sitting there and just focusing on something that I want to do, that I'm enjoying doing that I want to find out about whether it's reading a book, studying. (Male)

In summary, physical activities were described as enjoyable by some participants. In contrast, some described beliefs that specific physical activities were not enjoyable, while others described low self-efficacy for physical activity and for performing specific tasks in a non-seated position. Some participants also described activities performed whilst sitting as enjoyable.

**Time constraints and competing demands.** Lack of time and competing demands were commonly described as barriers to physical activity. Specifically, participants reported a lack of time for physical activity due to the demands of family life.

But [physical activity] is kind of a selfish pursuit, like it is very much an individual goal ... but for me, you've got to put so many people out to do it. Like I am not spending time with my family on the weekend. I'm not with the kids, or I've got to leave them all with my husband. (Female)

Work demands were also described as a barrier to physical activity. For example, when asked if there were any barriers to performing physical activity, one participant described work demands that restricted time available for physical activity:

I start [work] at 7:30. I have to leave just before seven so there's not a lot of time to do things in the morning and then I don't get home until about five o'clock. Then by the time you sort of - making dinner, washing whatever, it's harder to fit things in and you're tired at the end of the day. (Female)

Participants also described beliefs that activities performed whilst sedentary facilitated the achievement of work and personal goals.

I do get work done ... I'm achieving personal or professional goals as I'm doing those activities [working on the computer/making telephone calls]. (Male)
Five participants reported that taking breaks could disrupt concentration and negatively impact productivity.

The kind of disadvantages which would come from having to take a break [from sitting], are disruption of the flow of thought. When you're in control of it, if that flow of thought is running, there's no reason to take the break. (Male)

Some participants expressed beliefs about time and competing demands that were more conducive to active lifestyles. One (who lived within a town) expressed that peri-urban lifestyles afforded more time for recreational physical activity:

People have different lifestyles. I think because they're not so busy they've got a little bit of extra time, so they can just spend a bit more time on recreation. (Male)

Another participant expressed beliefs that the demands of family life facilitated the minimisation and interruption of sedentary behaviour. When asked if anything helped him to reduce sitting time, he said:

Just having other things to do, like goals, deadlines, things I need to do, things I want to do … having children and other people around that want to do something. (Male)

Another stated that the interruption of prolonged sitting at the computer provided an opportunity her to refocus and prioritise work:

When you get up and you go and do something different, you refocus and … make decisions about whether what you're doing is important or not. (Female)

In summary, lack of time and competing demands due to family and work negatively impacted beliefs about the difficulty of performing physical activity. Work demands also fostered sedentary behaviour and negatively impacted beliefs about the difficulty of interrupting prolonged sitting. In contrast, one participant perceived more time available for physical activity due to ‘less busy’ peri-urban lifestyles. Another perceived the interruption of sedentary behaviour as an opportunity to re-focus and re-prioritise work goals, whilst another participant described family demands as facilitating the minimisation and interruption of prolonged sitting.

5.5.2 Interpersonal/socio-cultural factors.

Participants expressed beliefs about interpersonal/socio-cultural factors relevant to active lifestyle behaviours. These included social interaction, the active
lifestyle behaviours of others, and social support and social approval of active lifestyles.

**Social interaction.** Two Participants specifically reported that sports participation provided an opportunity for social interaction that was not otherwise catered for in peri-urban communities.

I think one thing that probably does influence [physical activity] very much in the country, more than the city, is the need for social interaction. Because that's quite often where you're going to get involved in some sort of sporting organisation, to get social interaction, because you don't have the huge access to social events that you have in big cities. (Male)

Participants who expressed this belief also described regular sports participation, which they may not have undertaken in different settings.

I find [sport is] part of the social fabric of town, like people do sports to socialise … whereas if I was living in a city … I don't think I really would have gone and joined a social hockey team. (Female)

Social interaction also facilitated sedentary activity. For example, when asked what, if anything, impacted prolonged sitting in regional environments, one participant said:

I think there's more … social time … We have quite an active social life … There's a lot of time spent sitting and talking to people having glasses of wine on evenings and whatever. (Male)

In summary, social interaction was perceived as a favourable outcome of physical activity by some, and this belief fostered sustained sports participation. Social interaction also led to sedentary behaviour.

**Active lifestyle behaviours performed by others.** Participants described the active lifestyle behaviours of significant others, community members, and work colleagues. Perceptions of the behaviour of others varied between groups in these peri-urban communities. For example, younger people were perceived to be more conscious of the importance of being active. It was also suggested that those living on rural properties were, by nature, more active:

I think … a lot of people who choose the rural lifestyle … are doing it because they are people that are active anyway … So, I think there's a sense in which the people who move to the rural area are predisposed - they're that sort of people … (Male)

Another participant reported that farmers were more active than others, however, they also needed to sit more whilst driving:
Anybody who is on a property or in the farming community would have a lot more active opportunities than anyone who's just living in town … They have to do more things around their property or farm that is active … … but they would spend a lot more time sitting, too, because they would have to drive tractors and they would have to drive to places …

(Female)

Physical activity performed by others prompted behavioural reflection.

I often drive past other people who are walking, and I think, oh, I should be doing that … There's a lady at the end of our street, and honestly, it's like having someone knock at your conscience. Every time I get in my car to drive somewhere, she's either coming back from town or leaving, on foot … I think, oh, gee, I should have been walking. (Female)

Observing the active lifestyle behaviours of others had a mixed impact on active lifestyle beliefs. Two participants specifically attributed regular involvement in sport to the participation of significant others.

My daughter was playing the social hockey at night, so I went down one day and played one with her. Then someone at the hockey club told me that they were running a summer series … So, I convinced my husband to play again and another friend of ours who hadn't played since school. (Female)

In contrast, physical activity performed by important others was also described as dissuading physical activity by one participant:

I've got a few good friends who are runners … I think well if they can do it, why can't I do it? But the reality is I hate it … Friends who are marathon training have to take at least three or four hours out of their weekend to just run, and … I don't have that in me to do that. (Female)

Participants also described beliefs about sedentary behaviour and the interruption of prolonged sitting performed by work colleagues, which encouraged prolonged sitting.

There can be times where we are very busy, and we do tend to take less breaks … after lunch we tend to just work through right until the end of the day. We don't have any time for a break. (Male)

In summary, active lifestyle behaviours were perceived to vary between population sub-groups. Seeing others perform physical activity prompted reflection about personal physical activity participation. Some reported that the physical activity performed by important others encouraged participation. However, one participant described becoming discouraged when observing others performing
physical activity. Participants also described normative beliefs about sedentary behaviour in the workplace which encouraged prolonged sitting.

**Social support and social approval of active lifestyles.** Participants described perceived social approval and social support for physical activity and sedentary behaviour. Some beliefs were not conducive to active lifestyles. Social approval of sedentary behaviour by significant others encouraged sedentary behaviour. For example, one participant said:

[My wife] says I don't do enough time sitting. I'll sit for 20 minutes and I'll think, oh I just might duck out and get - she goes, no, no … So, I probably should spend a little bit more time … sitting. (Male)

Another participant interpreted the inactivity of a significant other as a lack of support for physical activity. When asked if she received encouragement from those around her to do physical activity, one participant said:

No, not really. My husband keeps saying we need to lose weight, we need to do this, we need to do that but then he doesn't follow through with things. (Female)

In contrast, some beliefs about social approval or disapproval of physical activity and sedentary behaviour were conducive to active lifestyles. Some participants expressed beliefs that significant others discouraged specific activities performed whilst sedentary. For example, when asked if there was anything there were any factors that facilitated a reduction in sedentary time, one participant said:

I've been caught a number of times by [my partner] on eBay because there's an auction on Saturday afternoon and boy do I cop it then. What are you doing? (Male)

Another participant described social support for the interruption of prolonged sitting in the workplace:

I think what has helped [me to interrupt prolonged sitting] is having positive colleagues that you can go and talk to ... You know, if someone seems like they want to talk as you are moving past then just stopping and engaging with them. (Male)

One participant described not succumbing to social pressures to sit in certain circumstances:

I'll be talking to someone … and they go, oh do you want to sit down? I go, no, no, I'm fine here standing up … If it's informal like that it's fine. If it's a formal interview, yeah, I would more likely sit with the person, but not if it's just a chat or catching up with somebody. (Male)
In summary, some participants described perceptions of social approval of sedentary behaviour and lack of support for physical activity by significant others. In contrast, others perceived that immediate family members discouraged activities performed whilst sitting, and that work colleagues supported the interruption of sitting in the workplace. One participant described not succumbing to social pressure for sedentary behaviour.

5.5.3 Physical environmental factors.

Participants described features of the physical environment that negatively impacted beliefs about the difficulty of performing behaviours conducive to active lifestyles. Distances to goods and services negatively impacted beliefs about the feasibility of active transport (i.e., walking or cycling as a means of transportation). For example, one participant said:

I can't exactly walk anywhere because, well I'm not in the position. Oh you could walk down to the shops, 10-mile hike up the hill. No, because you've got to drive everywhere. (Female)

Distance to sporting and recreational facilities was described as a barrier to recreational physical activity by participants living outside of towns.

When I was [living outside of a town] … it would have been harder to have gone to do things like hockey and stuff like that, because you're adding the travel time on and … you're not just going down for an hour-long game. It's become a two-hour thing. (Female)

Distance to goods and services also negatively impacted beliefs about the viability of avoiding sedentary behaviour. Extended sedentary driving activity was perceived as unavoidable due to the distance to destinations. Having children in the home exacerbated the need for extended car travel within peri-urban settings.

When my kids were younger … I'd have to drive to Ipswich three times a day because if they'd have things before school and then after school - and then if I had an appointment … I'd drive in there three times a day. That would be half an hour each way so that would be like three hours I'd just be sitting driving in a day. (Female)

Five participants also expressed beliefs that poor pedestrian mobility infrastructure made physical activity difficult.

I'd love to walk to walk [to work] … but the road's too dangerous and there's no walking track … You've really got to walk right on the edge of the road. We had a bike rider killed here just the other day … It just highlights it again about some of the roads just aren't made to have cyclists on, or walkers for that matter. (Male)
In contrast, participants who described proximal access to destinations (typically those living within town precincts) also reported walking for transport. I have shops close by … I usually walk to the supermarket … I try to walk to the post office which is about … 500, 600 metres … and I try to walk to exercise class. (Male)

Others described beliefs that the accessibility of recreational facilities and parks within the region (e.g., the Brisbane Valley Rail Trail) encouraged recreational physical activity. Additionally, the design of buildings/venues enhanced perceptions of the ease of avoiding sedentary behaviour. For example, one participant said:

We've got a very modern [workplace] which is … [a] very open, inviting environment. All our desks are … high enough that you can just lean on them … which is fantastic … So, I'm always on the move when I can be. (Male)

In summary, poor pedestrian mobility infrastructure and distance to goods, services, and recreational facilities negatively impacted perceptions of the difficulty of performing physical activity and avoiding sedentary behaviour; whereas proximal access to destinations and design features of the built environment enhanced perceptions of the ease of performing physical activity and avoiding sedentary behaviour.

5.6 Discussion

The health inequities faced by peri-urban Australians present a serious public health challenge. To understand how to encourage active lifestyles within this population, the aim of this study was to identify active lifestyle-related beliefs among residents of peri-urban Australia. The findings revealed beliefs about intrapersonal, interpersonal/socio-cultural, and physical environmental factors relevant to active lifestyles among residents of peri-urban southern Queensland. These factors informed behavioural, normative, and control beliefs in relation to physical activity and sedentary behaviour. According to the TPB, such beliefs inform attitudes, subjective norms, and PBC, respectively, which, in turn facilitate behaviour through the development of behavioural intentions (Ajzen, 1991).

Participants described outcome expectancies in relation to physical activity and sedentary behaviour. ‘Outcome expectancy’ refers to the “expectation that an outcome will follow a given behaviour” (Williams, Anderson, & Winett, 2005, p. 70). Outcome expectancies represent behavioural beliefs which impact behaviour
through the development of attitudes and subsequently, intentions (Ajzen, 1991). Some outcome expectancies described by participants were conducive to active lifestyles. For instance, among the intrapersonal factors that affected active lifestyle beliefs, all participants recognised the health benefits of physical activity. This is in contrast to the findings of Eley et al. (2014) who described cultural beliefs within some rural settings whereby physical activity was viewed as essential for work, but not imperative for health. (Eley et al., 2014) investigated physical activity beliefs among rural populations including people living in peri-urban and more remote localities. The difference in findings between the studies may indicate differences in behavioural beliefs between people residing in peri-urban settings and those in more remote areas and highlights the importance of understanding behaviour in the context in which it occurs. Participants in the present study reported awareness of public-health campaigns that communicated the benefits of physical activity, and also described examples of important others performing and supporting physical activity. It is possible that people in more remote localities are not benefiting from these influences. It is also possible that levels of awareness of the health benefits of physical activity have increased across the board in rural Queensland since Eley and colleagues collected their data, due to the influence of recent public health campaigns (e.g., 10,000 steps; Queensland Department of Health, 2019). Physical activity was also described as enjoyable by some in this study. Prolonged sitting was linked to pain, discomfort, and ineffective cognition, leading to attempts to minimise or interrupt sedentary behaviour. Social interaction was an interpersonal factor that influenced outcome expectancies in relation to physical activity and was described as providing an opportunity for social interaction that was otherwise limited in peri-urban settings.

Participants also described outcome expectancies that were not conducive to active lifestyles. Intrapersonal factors that contributed to less favourable outcome expectancies included beliefs that sedentary behaviour was enjoyable, relaxing, and facilitated the attainment of professional and personal goals; that the interruption of sitting negatively impacted concentration and productivity; and that physical activity was exhausting, or specific physical activities were not enjoyable. Although physical activity initiation was motivated by health benefits, behaviour was not necessarily maintained; whereas affective and social benefits appeared to be more conducive to sustained activity. One theory that explains differences in the
determinants of physical activity initiation in comparison to the determinants of sustained physical activity is SDT (Deci & Ryan, 1985). According to SDT, behaviour is driven by qualitatively distinct motivational states. Behaviour that is internally regulated (e.g., physical activity is performed because the activity is perceived to be enjoyable) is more likely to be sustained than behaviour that is externally regulated (e.g., physical activity is performed because of social pressure or to avoid guilt). Congruent with this theory, participants who experienced physical activity as enjoyable, or who personally valued physical activity-related social interaction maintained participation, whereas the initiation of physical activity driven by motives that one ‘should’ do physical activity for improved health was not sustained.

Socio-cultural and interpersonal factors that affected active lifestyles included normative beliefs. Normative beliefs are beliefs about the typical actions of others and the approval/disapproval of significant others in relation to a specific behaviour (Hagger & Chatzisarantis, 2005). Normative beliefs inform subjective norms, which impact behaviour through the development of intentions (Ajzen, 1991). Some normative beliefs described by participants were conducive to active lifestyles. Observations of other community members undertaking physical activity prompted behavioural reflection. In some cases, physical activity modelled by others encouraged physical activity participation, although the opposite was true for one participant. Social disapproval of activities performed whilst sedentary, social approval for the interruption of sedentary behaviour in the workplace, and efforts not to succumb to social pressures for sedentary behaviour were further conducive to active lifestyles. Other normative beliefs less conducive to active lifestyle were described, with behaviour modelled by work colleagues encouraging prolonged sitting. Previous research examining the influence of subjective norms upon physical activity have produced mixed findings. Reviews examining the behavioural correlates have found no association between norms and physical activity (Bauman et al., 2012; Trost, Owen, Bauman, Sallis, & Brown, 2002). However, a meta-analysis examining the construct and predictive validity of the TPB in physical activity research reported significant, small effects of norms upon behaviour, mediated through intentions (Hagger et al., 2002). It has been argued that the mixed findings in relation to associations between norms and physical activity may be attributed to inconsistencies in the conceptualisation and measurement of social
norms (Ball, Jeffery, Abbott, McNaughton, & Crawford, 2010). The importance of norms in predicting behaviour through intentions varies by behaviour (McEachan, Conner, Taylor, & Lawton, 2011). In a study examining the factor structure and composition of constructs of the TPB in relation to sedentary behaviour Prapavessis, Gaston, and DeJesus (2015) found that norms were a strong and consistent predictor of sedentary behaviour, mediated through intentions. Positive associations between greater social support/norms and higher levels of sedentary behaviour were also found in a review of associations between cognitive and motivational factors and sedentary behaviour (Rollo et al., 2016). It is possible that norms are more influential upon sedentary behaviour than physical activity, driving sedentary behaviour as an alternative to physical activity.

Participants also described control beliefs in relation to physical activity and sedentary behaviour. Beliefs about available resources, behavioural opportunities and barriers inform perceived behavioural control, which in turn impacts behaviour through the development (or not) of intentions (Ajzen, 1991). Control beliefs have been found to predict physical activity intentions with medium to large effects, and also to directly influence physical activity behaviour (Hagger et al., 2002). Greater control over/self-efficacy for sedentary behaviour has been associated with lower levels of sedentary behaviour (Rollo et al., 2016). Participants described factors that facilitated favourable beliefs about the ease of performing active lifestyle behaviours. Intrapersonal factors included perceptions that more time was available for physical activity because peri-urban lifestyles were less busy, which enhanced beliefs about the ease of performing physical activity. Family demands also facilitated the cessation or interruption of sedentary behaviour. Physical environmental factors included proximal access to destinations (among those living within towns), which favourably impacted beliefs about the feasibility of active transport, and features of the built environment, which facilitated opportunities to avoid sedentary behaviour. Other factors negatively influenced control beliefs in relation to active lifestyle behaviours. Intrapersonal factors included low self-efficacy for physical activity, and low self-efficacy to perform some activities when not in a seated position. Lack of time and competing demands also negatively impacted control beliefs about physical activity, and the reduction and interruption of sedentary behaviour. Environmental factors included poor pedestrian mobility infrastructure and distance to destinations, which facilitated beliefs about the
difficulty of performing physical activity, and the necessity of sedentary driving activity.

Beliefs representing barriers and facilitators of active lifestyles varied between participants. For example, some described enjoying physical activity, while others reported that they did not enjoy specific activities. Many reported that the interruption of work performed whilst sedentary negatively impacted concentration and productivity, however, one described interruption to activities performed whilst sedentary as an opportunity to refocus and prioritise work. Some reported a lack of time for physical activity, whilst another reported that peri-urban lifestyles afforded more time for recreational physical activity. These differences serve as a reminder that in addition to being contextually relevant, strategies to promote active lifestyles need to account for individual differences (e.g., strategies to foster enjoyment of physical activity may encourage sustained participation among those who have more externalised motives for participation, but may not be effective among those who enjoy physical activity but face time constraints).

Whilst the relatively small sample should be acknowledged, the purposeful sampling of participants of diverse characteristics and the attainment of ‘data’ and ‘inductive-thematic saturation’ indicate that the findings provide a reasonable account of the beliefs that may impact the active lifestyles of peri-urban, southern Queenslanders. Further study in other regions could enhance understanding of behavioural beliefs that impact active lifestyles among broader peri-urban populations. It is also worth noting the differences highlighted between participants residing within town areas and those living outside of towns. Those living outside of towns perceived less time available for recreational physical activity, active transport was described as unfeasible, and sedentary driving activity as unavoidable. Conversely, it was suggested that those living on larger properties, were necessarily active, while participants living within towns were able to utilise active transport and perceived less time constraints as barriers to recreational physical activity.

Investigation of the differential impact of living within and outside of towns may be useful to build more specific understanding of the inactive lifestyles of these sub-populations. It is possible that participation in the parent study (Olson et al., 2018) raised participant awareness of contextual influences upon active lifestyles in peri-urban environments. However, the 3-month delay between the studies, and the
differing focus of the studies (i.e., environmental factors versus beliefs about
behaviours) should minimise any potential risk of bias.

The identification of physical activity and sedentary behaviour-related beliefs
in peri-urban southern Queensland contributes to improved understanding of why
many in these environments lead inactive lifestyles. This knowledge may inform the
development of contextually-relevant strategies to encourage increased physical
activity and reduced sedentary behaviour. Unlike some people in some rural
communities (Eley et al., 2014), participants were aware of the health benefits of
physical activity. Educational strategies focusing solely on the health benefits of
physical activity may not realise significant benefit. However, fostering internalised
motives for physical activity (e.g., providing enjoyable physical activity experiences
that include opportunities for social interaction, may represent a useful strategy to
encourage physical activity participation in environments where opportunities for
social interaction are limited. Finally, active living strategies should take into
account the differential impact of features of the environment (e.g., distance) upon
active lifestyle beliefs among those who live within peri-urban towns, and those who
live outside of towns.

5.7 Conclusion

Intrapersonal, interpersonal/socio-cultural, and physical environmental
factors impacted active lifestyle beliefs (including outcome expectancies, and
normative and control beliefs) among people residing in peri-urban, southern
Queensland. Control beliefs that negatively impacted active lifestyles were shaped
by environmental factors such as distance and poor pedestrian mobility
infrastructure; although additional recreational time afforded by peri-urban lifestyles
fostered favourable control beliefs in some instances. The need for social interaction
appears to be highly salient in peri-urban environments, and those who considered
sports participation as an opportunity for social interaction reported sustained
physical activity. Active lifestyle strategies that focus on social interaction may be
particularly useful in peri-urban environments.
5.8 Acknowledgements

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5.9 How the Publication Contributes to the Advancement of the Research Area

The WHO Global Action Plan on Physical Activity 2018-2030 calls for the prioritisation of physical activity programs for populations who are the least active (World Health Organisation, 2018a). Preliminary research identifying behavioural determinants is essential to inform such programs. Despite a high prevalence of physical inactivity in inner-regional Australia (Australian Bureau of Statistics, 2013b, 2015), there has been a paucity of physical activity research conducted specifically within this population. High levels of sedentary behaviour among inactive inner-regional Australians is also concerning, given that sedentary behaviour is associated with detrimental health effects, particularly among those who are inactive (Ekelund et al., 2016). As in the case of physical activity, little research has previously been conducted to understand the factors that influence sedentary behaviour within this population. The present study redressed these gaps within the literature by building understanding of some of the factors that may affect physical activity and sedentary behaviour (i.e., behavioural, normative, and control beliefs that are influenced by individual, social and environmental-level factors) in the previously understudied and inactive population of inner-regional Australia.

Understanding the beliefs of inner-regional Australians in relation to physical activity and sedentary behaviour is important to inform the development of strategies that encourage more active lifestyles. In line with the TPB, such beliefs influence behaviour through the development of intentions (or not) to perform physical activity or sedentary behaviour in the future (Ajzen, 1985). Identification of salient beliefs can highlight opportunities to encourage active lifestyles by targeting changes in beliefs to encourage the development of intentions to perform physical activity or avoid sedentary behaviour. For example, reframing beliefs that the interruption of prolonged sitting at work leads to disrupted concentration, by suggesting that such breaks provide an opportunity to reorder one’s thoughts and therefore can actually enhance productivity, may encourage some to develop intentions to interrupt prolonged sitting at work. The present study fills a gap in the extant literature, by
identifying the salient physical activity and sedentary behaviour-related beliefs, specifically among inner-regional Australians, that are likely influencing active lifestyle behaviours.

Together with the findings of the first study of this program of research (i.e., characteristics of the physical and social environment that may impact physical activity and sedentary behaviour), the findings of the present study are providing a more complete picture of the range of factors operating at multiple levels that are likely contributing to the alarmingly high prevalence of inactive lifestyles in inner-regional Australia. Consistent with the WHO’s call to prioritise physical activity programs for populations that are the least active (2018a), these studies can inform the design of strategies that target a range of determinants across multiple levels of influence, to encourage more people within inner-regional Australia to adopt active lifestyles.

5.10 Links to Other Chapters

The aim of this study was to identify beliefs in relation to active lifestyle behaviours among people living in inner-regional southern Queensland. Additional information regarding the design and methodology of the present study is presented in Chapter 3. The design of the study and discussion of the results was guided by the TPB (Ajzen, 1985). The TPB is described in detail in the literature review in Chapter 2 of this thesis. An overarching social-ecological approach was also applied to guide the study, and to inform the development of themes during the analysis (Sallis et al., 2015). Social ecological models of health behaviour are also described in Chapter 2. Participants of this study were purposefully recruited from the participant pool of the preceding study. The first study is described in detail in Chapter 4. The findings of the present study informed the design of the third and final study of the PhD. A discussion of the design and methodology of the final study is presented in Chapter 6. A full description of the study is presented in Chapter 7.
Chapter 6 Study Three Design and Methodology

6.1 Chapter Overview

This chapter provides information pertaining to the design and methodology of the third and final study of this PhD. A manuscript, entitled ‘Physical Activity in Peri-Urban Australia: Testing Intentional and Implicit Processes within an Ecological Framework’ (Olson, Ireland, March, Biddle, & Hagger, under review) was submitted to Applied Psychology: Health and Well-Being on the 15th of January 2019, and was revised and resubmitted on the 5th of July 2019. The manuscript is presented in Chapter 7. Additional information that was not included in the manuscript, due to manuscript length restrictions, is presented here. First, the rationale for limiting the focus of this examination to concentrate exclusively on physical activity, and not on sedentary behaviour, is described. Second, the selection of measures to assess past physical activity and perceived characteristics of the physical environment is discussed.

Human research ethics approval (H17REA077) was attained from the USQ Human Research Ethics Committee for this study. A copy of the ethics approval document is included in Appendix K. The participant information sheet and consent form for the study are presented in Appendix L. Recruitment was conducted via social media (i.e., Twitter, Facebook, and Instagram). The primary method was by paid advertising on Facebook, targeted specifically to users living within LGA’s classified as inner-regional in accordance with the ASGS – RS (Australian Bureau of Statistics, 2011b). A sample of the post promoted on Facebook for the purpose of participant recruitment is included in Appendix M. The candidate also promoted the study through her own personal and professional social media and email networks, resulting in the campaign being visible to people residing outside of the targeted area. These individuals were not precluded from participating; however, their data were excluded from the main analysis (major city \( n = 173 \); outer-regional, remote, and very remote \( n = 278 \)). Sample size justification was based on the number of paths in the proposed model, with at least 10 participants for each estimated pathway. Given the final peri-urban sample size \( (n = 271) \) and the 26 pathways included in the hypothesised model, the sample size was adequately powered for the analysis undertaken (10.42 participants/pathway).
6.2 Focus on Physical Activity Rather than Sedentary Behaviour

The design of the final study focused on the physical activity of residents of inner-regional Australia and did not examine sedentary behaviour as the previous investigations had done. The rationale behind this decision was pragmatic. To understand the mechanisms that predict and explain behaviour, a complex theoretically-inductive and empirically-derived theoretical model was proposed. This framework included variables representing intentional and implicit psychological processes, motivational state, past physical activity, perceptions of the physical and social environment, and drivers of neighbourhood selection predicted to influence behaviour. A preliminary correlational analysis, conducted to justify inclusion of variables in the final model, assessed 22 constructs (seven demographic or health-related variables, six social or physical environmental variables, six psychological, social-cognitive or motivational variables, two neighbourhood selection variables, and one behavioural variable). The assessment of these variables involved a final questionnaire pack containing 116 items. This represented considerable participant response burden just to assess these physical activity-related constructs. Had sedentary behaviour also been assessed, a large number of additional items would have been needed to assess sedentary behaviour, in addition to the motivational and social-cognitive constructs related to sedentary behaviour (i.e., items assessing attitudes, subjective norms, PBC, intentions, autonomous motivation, and automaticity would need to be worded to assess beliefs in relation to sedentary behaviour). It was determined that this would have resulted in a very long and potentially confusing questionnaire, that could have discouraged participation, or resulted in poor quality data, or a large number of incomplete responses. Further, the inclusion of additional variables would have required a larger sample size to adequately power the required analyses. It was determined that the sample size required to conduct such an analysis was impractical within the constraints of the available resources (i.e., budget and time).

Given these factors, a pragmatic choice was made to focus on physical activity and exclude an analysis of sedentary behaviour. Physical activity is known to benefit health (Reiner et al., 2013; Warburton et al., 2006), and sedentary behaviour has been associated with negative health effects (Biddle et al., 2016; Thorp et al., 2011; Tremblay et al., 2010). However, evidence suggesting that the
deleterious effects of sedentary behaviour may be attenuated through physical activity (Ekelund et al., 2016; Stamatakis et al., 2019) emerged during the period in which this program of research was conducted. Thus, it is possible that efforts to support increased physical activity participation may not only realise health benefits attributable to physical activity but may produce additional benefits to health through the minimisation of the negative effects of sedentary behaviour.

6.3 Measurement

6.3.1 Physical activity by self-report.

Past physical activity was included in the theoretical model that was developed for this research. Recollections of past experiences of performing behaviour are theorised to influence cognitions about performing behaviour in the future (e.g., if pain or physical discomfort is experienced when performing physical activity, this will likely lead to beliefs that similar outcomes can be expected when undertaking physical activity in the future, which in turn may negatively influence intentions for future physical activity). This phenomenon has been referred to as ‘feedback loops’ (Ajzen, 2015; Fishbein & Ajzen, 2010), and has been empirically supported in previous research (e.g., Hagger et al., 2002). Pathways were included in the theoretical model formulated for this research to demonstrate the influence of past physical activity on the belief-based constructs theorised to predict physical activity intentions. Past physical activity was also included to represent and account for behavioural repetition, which is a key component of habit, whereby behavioural repetition is a precursor of perceptions of behaviour as automatic (i.e., automaticity; Gardner, 2012). Therefore, a suitable measure of past physical activity needed to be sourced.

There are a variety of methods for measuring physical activity. These include doubly labelled water (i.e., a method of assessing energy expenditure through changes in carbon dioxide production in urine or saliva after consumption of isotopes; Schoeller & Santen, 1982), device-based measures (e.g., accelerometer), direct behavioural observations, and self-report instruments (e.g., questionnaires and diaries). Kelly, Fitzsimons, and Baker (2016) urge researchers to consider ‘context validity’ (i.e., whether the measure will provide useful information in the proposed context), when selecting instruments to measure physical activity. No measure of physical activity is without limitation. Doubly labelled water captures energy
expenditure, and device-based measures capture total movement within a specified time period. Both measures are expensive to administer, and neither provide information about the type of movement/physical activity that was undertaken, nor the context in which the behaviour occurred. Self-report questionnaires typically capture recollections of specific types of physical activity performed during a specified time period and can capture information about the context in which the behaviour was performed (e.g., the amount of moderate or vigorous leisure-time physical activity performed in the previous week). However, measures of physical activity by self-report can be subject to social desirability bias, leading to over-reporting of physical activity; and are further limited by the complexity of cognitive demands required to accurately recall behaviour (Sallis & Saelens, 2000).

In line with Kelly et al. (2016), context validity was considered, in addition to practical considerations when deciding upon an appropriate measure of physical activity for inclusion in this study. As already discussed, past physical activity was incorporated in the proposed theoretical model in line with the proposition that past behaviour can influence cognitions in relation to future performance of behaviour (Ajzen, 2015; Fishbein & Ajzen, 2010). Therefore, it was reasoned that subjective recollections of behaviour were more relevant to the prediction of the belief-based constructs included in the model (i.e., attitudes, subjective norms, and PBC) and perceptions of physical activity as automatic (i.e., automaticity), than total energy expenditure or movement. It could be further argued that subjective personal recollections of past physical activity are more relevant to the formation of beliefs, as predicted in this theoretical model, than a more ‘objective’ measure of physical activity through direct observation. Further, measurement of physical activity by self-report provides a cost effective method of collecting data from a large sample (Sallis & Saelens, 2000). Even if it were reasoned that an alternative measure of physical activity, such as device-measured physical activity, was appropriate, this would have been impractical (financially and logistically) given the large sample size required to adequately power the study. Therefore, a validated self-report measure of physical activity, namely, the Active Australia Questionnaire (AAQ; Australian Institute of Health and Welfare, 2003) was selected. The AAQ has been applied to measure self-reported physical activity of Australians in the National Nutrition and Physical Activity Survey (Australian Bureau of Statistics, 2013a), and is described in greater detail in chapter 7.
6.3.2 Features of the physical environment.

A variety of features of the physical environment were identified as potential factors that might influence physical activity in inner-regional Australia (e.g., distance, accessibility of goods and services, weather, and poor pedestrian mobility infrastructure) in the first study of this program of research. The influence of these characteristics of the physical environment upon beliefs related to physical activity was noted in the second exploratory study (e.g., distance, restricted accessibility, and poor pedestrian infrastructure negatively impacted beliefs about the difficulty of performing physical activity). Therefore, it was theorised that such characteristics of the physical environment would influence the psychological antecedents of physical activity in the present study. As such, a contextually-relevant measure of characteristics of the perceived environment was sought.

The abbreviated Neighbourhood Environment Walkability Scale (NEWS-A) measures perceptions of aesthetics, traffic hazards, crime and safety, and infrastructure for safety and walking within the neighbourhood environment (Cerin, Saelens, Sallis, & Frank, 2006). As suggested by the name of the instrument, the NEWS-A is an abbreviated version of the full Neighbourhood Environment Walkability Scale (NEWS), which was originally developed for use in the USA (Saelens, Sallis, Black, & Chen, 2003). The NEWS was adapted to suit the environmental context and language in the Australian context (Leslie et al., 2005), and was subsequently validated for use in Australia (Cerin, Leslie, Owen, & Bauman, 2008). Burton et al. (2009) further adapted items from the NEWS-A in a study conducted in Brisbane Australia, and it was this version of the instrument that was considered most contextually relevant for use in the present study. Based on the descriptions of the physical environment provided in the first exploratory study of this PhD, additional items relevant to inner-regional settings in Australia were added to the instrument for use in this study. A full description of the instrument including additional items added in to specific subscales and analyses conducted to examine reliability of the adapted scales is provided in Chapter 7.

6.4 Chapter Summary

Information relevant to the design and methodology of the final study of this PhD was presented in this chapter. Specifically, the chapter contains information supplementary to that provided in the full description of the study included in the
following chapter. For practical reasons, this study focused exclusively on physical activity and did not include an examination of the correlates of sedentary behaviour. After considerable deliberation, a self-report measure of physical activity was selected (i.e., the AAQ), as subjective recollections of physical activity were considered the most relevant to the development of physical activity-related beliefs and perceptions of physical activity as automatic. Finally, the selection and modification of a contextually-relevant instrument to measure characteristics of the perceived environment (i.e., the NEWS-A) was discussed.

6.5 Links to Other Chapters

This chapter provided an overview of the design and some methodological considerations relevant to the third and final study of this PhD. The study is described in detail in Chapter 7. The theoretical frameworks, models, and physical activity literature that informed the design of the model developed for this study is described in detail in the literature review presented in Chapter 2. The first two exploratory studies of this program of research informed the development of the model to be examined as part of this final study. Specifically, study one identified features of the physical and social environment that might impact physical activity in inner-regional Australia, and these constructs were included in the final study. The first study was described in detail in Chapter 4. Study two of this program of research identified the influence of intrapersonal, interpersonal/social, and physical environmental factors on beliefs related to physical activity. Pathways were included in the model that was the subject of study three, to represent the influence of features of the physical and social environment on the psychological antecedents (including physical activity-related beliefs) of physical activity. The second study was described in detail in Chapter 5.
Chapter 7 Physical Activity in Peri-Urban Australia: Testing Intentional and Implicit Processes within an Ecological Framework

7.1 Abstract

**Background:** Given the substantive health inequalities in peri-urban communities and the potential for physical activity to promote health in these communities, identifying modifiable physical activity determinants in this population is important. This study explored effects of the peri-urban environment and psychological constructs on physical activity intentions and behavioural automaticity guided by an integrated theoretical framework. **Methods:** Peri-urban Australians (N=271) completed self-report measures of environmental (i.e., physical/social-environment, and neighbourhood selection), motivational (i.e., autonomous motivation), and social cognition (i.e., attitudes, norms, and perceived behavioural control [PBC]) constructs, past behaviour, intentions, and automaticity. **Results:** A well-fitting path analytic model revealed that: autonomous motivation predicted all social cognition constructs; subjective norms and PBC, but not attitudes; autonomous motivation predicted intentions and automaticity; and subjective norms and PBC mediated effects of autonomous motivation on intentions. Of the environmental constructs, only neighbourhood selection was related to intentions, mediated by PBC. **Conclusions:** Autonomous motivation is an important correlate of physical activity intentions and automaticity, and subjective norms and PBC also related to intentions. Individuals perceiving a supportive environment were more likely to report positive PBC and intentions. Targeting change in autonomous motivation, and normative and control beliefs may help enhance physical activity intentions and automaticity in peri-urban communities. **Keywords:** physical activity; intentions; automaticity; autonomous motivation; beliefs; integrated model

7.2 Introduction

The mission of the WHO Global Action Plan on Physical Activity 2018-2030 is “to ensure that all people have access to safe and enabling environments, and to diverse opportunities to be physically active in their daily lives, as a means of improving individual and community health and contributing to the social, cultural and economic development of all nations” (2018b, p. 8). The plan aims to reduce
physical inactivity globally by 15% by 2030 through the creation of active societies, environments, people, and systems. One strategy to achieve this goal is the introduction of programs for those who are least active. This necessitates identifying and targeting those who are at the greatest risk of inactivity.

In Australia, a population that is highly likely to be inactive are people living in inner-regional\(^1\) or peri-urban communities. Peri-urban dwellers experience notable health inequalities compared to other Australians. Peri-urban Australians are more likely to suffer higher levels of psychological distress, blood pressure, and cholesterol, and to be diagnosed with respiratory and musculoskeletal diseases compared to city dwellers and people in more geographically remote areas (Torrens University Australia, 2017). In addition, 70% of people living in peri-urban communities participate in little or no physical activity (Australian Bureau of Statistics, 2015). More than 4.3 million people (18% of the total Australian population) live in peri-urban Australia (Australian Bureau of Statistics, 2018b), thus the health inequities experienced by this population represent a significant public health concern, which may be addressed through preventive health strategies aimed at increasing physical activity.

Research has demonstrated the importance of formative research and a theoretical basis for the development of effective behaviour-change interventions (Glanz & Bishop, 2010; Sheeran, Klein, & Rothman, 2017; Webb, Joseph, Yardley, & Michie, 2010). Consistent with this evidence, developing means to increase physical activity participation among people living in peri-urban communities necessitates formative research identifying the determinants of inactivity in this population. Behavioural theories offer a systematic means to identify these determinants. A prominent approach to identify the determinants of physical activity has been to apply ecological theories. These theories posit that behaviour is a function of intrapersonal and interpersonal factors, the perceived environment, the characteristics of settings in which behaviour occurs, and policy-level factors (Sallis et al., 2006). Strategies designed to promote physical activity are likely to be most impactful if they account for these factors, and the processes by which they relate to behaviour (Bull, Eakin, Reeves, & Kimberly, 2006; Sallis et al., 2015).

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\(^1\)Inner-regional Australia refers to a classification according to geographic remoteness specified within the Australian Statistical Geography Standard Remoteness Classification (ASGS-RS).
Research aimed at identifying contextual characteristics that relate to physical activity from an ecological perspective has revealed that peri-urban dwellers perceive their neighbourhoods to be socially cohesive, aesthetically pleasing and safe, with good access to sports and recreational facilities, strong community support of local sporting teams, and activity-supportive social norms (Olson et al., 2018). Such constructs have been also shown to be positively associated with physical activity in prior research (e.g., Ball, Cleland, et al., 2010; Foster et al., 2016; Kerr et al., 2016). In addition, distance from goods, services and facilities; poor pedestrian-mobility infrastructure; dangerous traffic conditions; and unfavourable weather have been identified as substantive as barriers to physical activity in peri-urban settings (Olson et al., 2018).

Beyond ecological correlates of physical activity in peri-urban communities, research has also aimed to identify the intrapersonal factors that determine physical activity participation from social-cognition theories. For example, research has provided some insight into the salient behavioural beliefs that relate to physical activity participation among people living in a peri-urban community (Olson et al., 2019). Favourable outcome expectancies, varying normative beliefs among population sub-groups (e.g., people living on larger properties were perceived to be more active), and negative control beliefs (e.g., distance precluding walking as a means of transport and limited time available for recreational physical activity) were described as impacting physical activity participation. Notably, in environments that are defined by limited opportunities for social interaction, social interaction was reported as a favourable outcome of physical activity. However, it remains unclear whether these contextual characteristics and social-cognition factors are typical of the broader population of peri-urban Australians, and how intrapersonal factors, such as beliefs, relate to behaviour alongside other interpersonal and contextual factors.

More broadly, although some studies have simultaneously examined effects of ecological and interpersonal constructs on physical activity intentions and behaviour (e.g., Lemieux & Godin, 2009; Panter, Griffin, Jones, Mackett, & Ogilvie, 2011; Thomas & Upton, 2014), such approaches are far from the norm and, bar a few notable exceptions (e.g., Shores, Moore, & Yin, 2010), there are virtually none in peri-urban and remote communities.

Whilst useful in providing an overview of the range of factors that contribute to health behaviour, ecological models do not specify the mechanisms by which
these factors impact behaviour (Sallis et al., 2008). Researchers have called for the integration of ecological and social-cognition theories because they may offer enhanced, more comprehensive explanations of behaviour (e.g., Orbell, Szczepura, Weller, Gumber, & Hagger, 2017; Schüz, Li, Hardinge, McEachan, & Conner, 2017). Such calls are based on evidence that psychological factors from these theories mediate effects of social-demographic factors on behaviour (Orbell et al., 2017; Von Wagner, Good, Whitaker, & Wardle, 2011). This suggests that such constructs contribute to psychological states and beliefs which determine behaviour. In addition, recent advances in theories applied to predict and explain health behaviours like physical activity have sought to integrate components from multiple theories to facilitate more comprehensive explanations of behaviour, and the motivational and intentional processes involved.

One version of these integrated approaches was proposed by Hagger and Chatzisarantis (2009). The model integrates Ajzen’s (1985) theory of planned behaviour (TPB) and Deci and Ryan’s (1985) self-determination theory (SDT). The TPB identifies intentions as the most proximal predictor of participation in a given target behaviour, such as physical activity. Intentions, in turn, are predicted by beliefs relating to participating in that behaviour in future: attitudes, subjective norms, and perceived behavioural control (PBC). Consistent with the TPB, previous research has found that intentions explain a large proportion of variance in physical activity behaviour (e.g., Godin & Kok, 1996; Hagger et al., 2002). In addition, interventions targeting change in the antecedents of intentions have demonstrated effective changes in in both intentions and behaviour (Sheeran et al., 2016; Steinmetz, Knappstein, Ajzen, Schmidt, & Kabst, 2016). According to SDT, qualitatively distinct forms of behavioural motivation drive behaviour. More autonomous forms of motivation reflect performing behaviours for self-endorsed reasons; and are positively associated with sustained participation in behaviours like physical activity (Teixeira et al., 2012). In the integrated model, autonomous motivation is proposed to serve as a distal influence on intentions and behaviour mediated by the belief-based constructs from the TPB. Applying this process to physical activity, the model suggests that individuals with autonomous motives toward physical activity seek out future opportunities to participate in physical activity, and strategically form positive beliefs and intentions to do so.
While the integrated SDT and TPB model (Hagger & Chatzisarantis, 2009) demonstrates the importance of constructs representing motivational states and social cognition constructs in determining intentions, it does not incorporate effects of contextual factors. However, other integrated theoretical frameworks have simultaneously incorporated contextual factors alongside social-cognition determinants of physical activity participation, and specified the mechanisms by which these factors may relate to intentions and behaviour, consistent with calls to integrate ecological and social-cognition models (Orbell et al., 2017; Schüz et al., 2017). For example, Rhodes, Courneya, Blanchard, and Plotnikoff (2007) integrated personality, perceived environment, and planning, alongside constructs from the TPB to predict leisure-time walking. Results revealed that social-cognition constructs and ecological model constructs (i.e., aesthetics, infrastructure quality, and proximity to shops) explained 25% of the variance in physical activity behaviour. Consistent with previous finding (e.g., Orbell et al., 2017), statistically significant effects of both aesthetics and walking infrastructure on behaviour were observed, mediated by attitudes and intentions. Similarly, Maddison et al.’s (2009) integrated model of the perceived and built environment and TPB constructs on adolescent physical activity found that intentions had the strongest direct effects on physical activity, with direct effects of perceived environment and ownership of recreational equipment on self-reported physical activity. Taken together, these studies provide examples of how ecological and social-cognition models can be integrated to provide comprehensive explanations of the determinants of physical activity intentions and behaviour, and the processes involved.

Many of the studies integrating ecological and social-cognition determinants focus on intentions alone as the proximal determinant of behaviour. However, dual-process theories contend that behaviour is also driven by implicit processes, represented by the effects of constructs such as habit (Evans & Stanovich, 2013; Sheeran et al., 2013; Strack & Deutsch, 2004). Habits have been defined as “automatic responses to everyday contexts, learned through repeated performance in those contexts,” and have been operationalised as ‘automaticity,’ that is, the experience of behaviours as automatically initiated on presentation of associated cues or contexts (Gardner, 2012, p. 32). For example, in the case of physical activity, repeated attendance at the gym after work may be ‘triggered’ (i.e., instigation of a learned behavioural response) by driving towards the gym when leaving work each
day (i.e., repeated exposure to a behavioural cue in an everyday context). The construct of behavioural automaticity has typically been measured using self-report reflections of behaviours as controlled and experienced as ‘automatically’ initiated or enacted (Verplanken & Orbell, 2003).

Research has, therefore, expanded social-cognition theories that exclusively focus on intentional processes to integrate psychological constructs that represent implicit processes such as habit, as well as constructs from the environment. For example, Lemieux and Godin (2009) assessed the predictors of active commuting with a theoretical framework that incorporated constructs from the TPB, habit, environmental characteristics, and social-demographic factors. Collectively, past behaviour, PBC, attitudes, time to get to school/work, car accessibility, work status, social deprivation and habit explained substantive variance in active commuting. Thomas and Upton (2014) also adopted a model that incorporated constructs from the TPB, habit, and the environment to examine the predictors of physical activity in children. Gender, environmental variables, the TPB variables and habit strength predicted physical activity behaviour. Taken together, these studies suggest considerable promise for theories that integrate constructs representing contextual factors, intentional and implicit processes, such as habit, in accounting for substantive variance in physical activity intentions and behaviour.

7.2.1 The present study.

Based on previous research integrating SDT and TPB constructs (Hagger & Chatzisarantis, 2009), and research integrating constructs representing reasoned (e.g., social-cognition constructs), ecological, and automatic (e.g., behavioural automaticity), the present research aims to test the effectiveness of an integrated model incorporating these constructs to predict physical activity intentions and habits among people living in peri-urban communities in Australia. The proposed model adopts constructs from theories of motivation (i.e., autonomous motivation from SDT) and social cognition (i.e., belief-based constructs and intentions from the TPB), dual-process models (i.e., behavioural automaticity), and ecological models (i.e., perceived features of the physical and social environment). The model proposes that physical activity-related intentions and the experience of physical activity as ‘automatic’ or habitual are a function of motivational constructs and characteristics of the physical and social environment. Next, we outline hypothesised relations
among constructs of the proposed integrated model that relate to the environmental, intentional and implicit components. The relations are illustrated in Figure 7.1.²

Figure 7.1. Hypothesised framework for the prediction of physical activity-related automaticity and intentions.

Features of the social environment comprised social cohesion and community participation, features of the physical environment included aesthetics, crime, infrastructure for safety and walking, and traffic hazards. Drivers of neighbourhood selection were selected by factor analysis and comprised lifestyle and community, and proximity. Only variables from these factors that were significantly correlated with social cognition and motivational constructs were included in the final model. PBC = Perceived behavioural control.

Consistent with research that has integrated SDT with TPB (Hagger & Chatzisarantis, 2009), it was hypothesised that autonomous motivation would predict physical activity intentions mediated by attitudes, subjective norms, and PBC. Furthermore, consistent with research integrating ecological models with social cognition and motivational theories (e.g., Lemieux & Godin, 2009; Orbell et al., 2017; Thomas & Upton, 2014), features of the social and physical environment and drivers of neighbourhood selection were hypothesised to positively predict physical activity intentions mediated by attitudes, subjective norms, and PBC.

Consistent with research integrating constructs representing implicit determinants of behaviour (e.g., Hamilton, Kirkpatrick, Rebar, & Hagger, 2017),

²A detailed list of hypotheses is presented in Appendix O.
such as behavioural automaticity, alongside motivational and social cognition constructs, it was hypothesised that past physical activity participation would be a direct predictor of autonomous motivation. In addition, it was also hypothesised that autonomous motivation would predict automaticity. This is based on research suggesting that individuals with autonomous motivation are likely to persist on tasks that are personally meaningful and, therefore, develop adaptive habits to do so, which obviate the need for intentional processing (Gardner & Lally, 2013). It was also expected that autonomous motivation would moderate the relationship between past physical activity and automaticity, such that individuals with autonomous motivation are more likely to persist with the behaviour over time. The relationship between past physical activity and automaticity was, therefore, expected to be stronger with higher levels of autonomous motivation.

Finally, as environmental behavioural constructs are likely to represent important stable determinants of activity and maintain the development of healthy habits (Wood & Rünger, 2016), it was hypothesised that these constructs would also predict automaticity. Finally, it was further hypothesised that past physical activity participation would predict all modelled psychological constructs, consistent with previous research, but that model predictions would remain (e.g., Albarracin, Johnson, Fishbein, & Muellerleile, 2001; Hagger, Polet, & Lintunen, 2018).

7.3 Method

7.3.1 Participants, design, and procedure.

The present study adopted a cross-sectional correlational design. Participants were recruited via social media platforms (Facebook, Instagram, LinkedIn and Twitter). The ‘audience-selection’ tool for publication of paid advertisements on Facebook and Instagram was utilised to specifically target adults (> 18 years) residing in peri-urban communities in Australia. Australians living outside these target regions were not excluded from participating, however, their data were not used in the current analysis. Status as a resident of peri-urban Australia was assessed by matching residential postcodes to AGSG-RS categories, using AGSG correspondences (Australian Bureau of Statistics, 2011a). A total of 722 participants completed the online questionnaire, 271 of which were classified as living in peri-urban localities. Participants were aged between 18 and 76 years ($M = 46.47, SD = 13.78$), and the majority were female (79.3%). According to BMI, two thirds of
participants were obese (33.6%) or overweight (33.2%), with the remainder classified within the normal (30.6%) and underweight (1.5%) weight ranges. On average, participants reported 325.95 minutes of moderate and vigorous physical activity (MVPA) in the previous week (SD = 318.91), with 59% reporting ‘sufficient’ physical activity, in accordance with the Australian Government guidelines for physical activity (2014). Over half of the sample (51.3%) held a Bachelor degree or higher, and 36% reported an annual income of over AUD$93,600. Conversely, 9.2% did not complete the final year of high school, and 18.7% reported earning less than AUD$36,400 per annum. Participation was voluntary, and a prize draw to win one of two $50 prepaid Visa cards was conducted as an incentive for participation. Approval was attained from the host institutions’ human research ethics committee, and participants provided informed consent prior to completing the online questionnaire.

7.3.2 Measures.

The online questionnaire included measures to assess constructs representing intentional and implicit processes, past physical activity participation, characteristics of the physical and social environment, drivers of neighbourhood selection, and health-related and demographic characteristics of participants. The measures are summarised below, and a complete list of items is available in Appendix N.

**Autonomous motivation.** Autonomous motivation towards physical activity was measured using the 24-item Behavioural Regulation in Exercise Questionnaire – 3 (Markland & Tobin, 2004; Wilson, Rodgers, Loitz, & Scime, 2006). Items are statements reflecting thoughts and feelings about performing physical exercise (e.g., “I think it is important to make the effort to exercise regularly.”) Responses were recorded on 5-point scales (0 = not true for me to 4 = very true for me). A relative autonomy index was computed for each participant, as recommended by Markland (2014), with weights assigned to each subscale (i.e., Amotivation * -3, External Regulation * -2, Introjected Regulation * -1, Identified Regulation * 1, Integrated Regulation * 2, and Intrinsic Regulation * 3), and then the sum of the weighted subscales was calculated. Higher scores reflect higher levels of autonomous motivation.

**Theory of Planned Behaviour.** Development of items relevant to the TPB constructs, including intentions, attitudes, subjective norms, and PBC were guided
by procedures outlined by Ajzen (2006). Intentions were measured on three items (e.g., “I will try to be physically active for at least 30 minutes on most days in the forthcoming week”). Responses were measured on 10-point scales (1 = definitely true to 10 = definitely false). Attitudes were measured on five items sharing a common stem: “For me, being physically active for at least 30 minutes on most days …” Responses were provided on 10-point scales (e.g., 1 = harmful to 10 = beneficial). Subjective norms were measured with six items (e.g., “Most people who are important to me are physically active on most days each week”). Responses were provided on 10-point scales (e.g., 1 = completely true to 10 = completely false). PBC was measured on four items (e.g., “For me to be physically active for at least 30 minutes on most days in the forthcoming week would be…”). Responses were provided on 10-point scales (1 = impossible to 10 = possible).

**Automaticity.** Habitual instigation of physical activity was assessed on the four item Self-Report Behavioural Automaticity Index (SRBAI), which has been assessed as a reliable and valid measure of behavioural automaticity (Gardner, Abraham, Lally, & de Bruijn, 2012). Items were preceded with the common stem: “Deciding to do physical activity is something I do,” concluding with actions such as “without thinking” and “automatically”. Responses were given on a 7-point scales (1 = strongly disagree to 7 = strongly agree).

**Past physical activity.** Self-reported physical activity over the past week was measured on the AAQ (Australian Institute of Health and Welfare, 2003). The questionnaire comprises nine items assessing minutes and instances of walking, moderate, and vigorous leisure-time physical activity (e.g., “In the last week, how many times have you walked continuously, for at least 10 minutes, for recreation, exercise or to get to or from places?”). Reported minutes walking and performing moderate and vigorous physical activity were summed, with vigorous activity weighted by two, to determine MVPA. In accordance with the survey manual for implementation, analysis and reporting, to avoid over-reporting responses greater than 840 minutes for any specific activity were truncated to 840 minutes and total times greater than 1680 minutes were truncated to 1680 (Australian Institute of Health and Welfare, 2003).

**Physical environment.** Characteristics of the physical environment were measured on items adapted from four subscales of the (NEWS-A), including aesthetics, traffic hazards, crime and safety, and infrastructure and safety for walking.
(Cerin et al., 2006). Burton et al. (2009) adapted the instrument for use in metropolitan Brisbane, Australia. These adaptations were further revised for the present study, to ensure items were contextually appropriate for peri-urban Australia, based on our preliminary work (Olson et al., 2018). Aesthetics was measured with seven items relating to the attractiveness of the built and natural environment in the local neighbourhood (e.g., “There are many interesting things to look at in my neighbourhood”). Higher scores indicated perceptions of more aesthetically pleasing neighbourhood environments. Crime and safety was assessed with eight items (e.g., “There is a lot of crime in my neighbourhood”). Two items were reverse scored, and higher scores indicated greater levels of perceived crime. Traffic hazards were assessed with six items (e.g., “In my neighbourhood, there is usually a lot of traffic on the local streets”). Two items were reverse scored, and higher scores indicated perceptions of more dangerous traffic conditions. Infrastructure and safety for walking was assessed on nine items (e.g., “There are footpaths on most of the streets in my neighbourhood”). Two items were reverse scored, with higher scores indicating more walkable neighbourhoods. Responses for all items were recorded on five-point Likert scales (1 = strongly disagree to 7 = strongly agree).

**Social environment.** Social cohesion was measured on five items developed by Buckner (1988). For example, “I am good friends with many people in my neighbourhood.” Responses were recorded on five-point scales (1 = strongly disagree to 5 = strongly agree). Two items were reverse scored. Higher scores indicate greater levels of social cohesion.

Community participation was measured on a single item asking, “In what ways do you get involved with your local community?” Participants were able to select an option reporting no community participation (scored as 0). Alternatively, participants could indicate community participation through volunteer work, formal clubs, informal interest groups, and ‘other,’ that were provided as multiple-choice options allowing multiple responses to be selected. For those who reported some community participation, the number of options indicating active community participation was summed. Thus, overall scores ranged from 0, indicating no community participation to 4, indicating the greatest level of self-reported participation.

**Neighbourhood selection.** Eighteen items assessing drivers of neighbourhood selection were included. Participants were asked: “How important
were each of the following in your decision to move to your current neighbourhood.” Seventeen items based on those used by Burton et al. (2009) were included (e.g., “ease of walking to places”). An additional item, (“country lifestyle”) was added based on our prior research (Olson et al., 2018). Responses were collected on 5-point scales (1 = not important at all to 5 = very important).

**Self-rated health.** Self-rated health was assessed on a single item: “In general, would you say your health is …” Responses were provided on a 5-point scale (1 = poor to 5 = excellent). In order to assess BMI, participants were asked to provide their height in centimetres or feet and inches, and their weight in kilograms, stones or pounds. BMI was calculated as weight in kilograms divided by height in metres, squared.

**Demographic and remoteness variables.** Items were included to assess known demographic correlates of physical activity including age, gender, education, and income. A single item assessing whether participants lived within a town or outside of a town was also included. Responses for this item were collected on a 10-point scale (1 = I live in town to 10 = I live out of town).

**7.3.3 Data analysis.**

Preliminary analyses to assess the internal consistency of the proposed measures and zero-order correlations among the mean average scores of the scales were computed using SPSS Statistics v.24. Alpha reliability coefficients used to assess the internal consistency of measures, with alphas greater than .70 considered acceptable (Ponterotto & Ruckdeschel, 2007). A principal components analysis with oblique rotation was conducted on the items from the neighbourhood selection scale to determine drivers of neighbourhood selection among peri-urban dwellers. Correlations between demographic and health correlates of physical activity and model constructs were examined to determine which demographic variables should be included in the model. A path analysis was conducted to test the hypothesised model using Mplus v.6.12 with the robust maximum likelihood estimator, which provides robust estimates for data with distributions that deviate moderately from a normal distribution (Asparouhov & Muthen, 2006). Sample size justification was based on the number of paths in the proposed model, with at least 10 participants for each estimated pathway. Missing data were handled using the full-information maximum likelihood estimation procedure (FIML). Model goodness-of-fit indices
included the model chi-square value (with a conservative $\alpha$ level set at < .01), root mean square error of approximation (RMSEA), the comparative fit index (CFI), and the Tucker-Lewis Index (TLI). A non-significant chi-square test and values < .06 for the RMSEA and $\geq .95$ for the CFI and TLI indicate ‘good fit;’ CFI and TLI values > .90 will be taken to represent ‘adequate fit’ (Hu & Bentler, 1999). In addition to the direct and indirect pathways specified in the hypothesised model, attitudes, subjective norms and PBC were allowed to co-vary in the path analysis, as were the modelled contextual variables. Automaticity and intentions were also set to co-vary$^3$.

**7.4 Results**

**7.4.1 Preliminary analyses.**

Alpha coefficients indicated acceptable internal consistency for the TPB, autonomous motivation, automaticity, social cohesion, and neighbourhood aesthetics variables. Adjustments were made to the crime and safety, infrastructure for safety and walking, and traffic hazards variables to improve internal consistency. The results and scale adjustments to maximise alpha are reported in Appendix P. Principal components analysis of neighbourhood selection variables resulted in the extraction of two factors, accounting for 41.16% of the variance in the 16 included items. The first factor included six items representing neighbourhood selection driven by a desire for close access to shops, work, city, transport, main roads, and destinations within walking distance. This factor was named ‘proximity,’ and explained 26.87% of the variance in the items, with all factor loadings greater than .466. The second factor included four items representing neighbourhood selection driven by the appeal of a ‘country lifestyle’ and sense of community. This factor was named ‘lifestyle and community,’ and explained 14.29% of the variance in the items, with all factor loadings greater than .661. Descriptive statistics and zero-order correlations among study variables are presented in Appendix Q. Correlations between the psychological variables and past physical activity variables were statistically significant. Small-to-medium significant associations were found for intentions with community participation, aesthetics, and neighbourhood selection for

$^3$Data files and analysis output for the Mplus analyses are available online: https://osf.io/8kf37/?view_only=800c2e93694f4e7f86c2d519e328eec5
lifestyle and community, and for automaticity with social cohesion and
neighbourhood selection. The remaining contextual variables were not significantly
correlated with intentions or automaticity and were excluded from further analysis.
Education, self-rated health, and BMI were significantly correlated with intentions
and automaticity. In order to control for effects of these socio-demographic and
health-related variables in the proposed model, and to reduce model
parameterisation, we computed unstandardised residual scores for the variables to be
used in the model by regressing each variable on the set of demographic variables.
Finally, a preliminary check using the Hayes Process macro in SPSS (Hayes, 2012)
revealed no moderation effect of autonomous motivation on the relationship between
past physical activity and automaticity, so this pathway was omitted from the final
model.

7.4.2 Model effects.

Overall model fit was acceptable according to the multiple criteria adopted
($\chi^2 (15) = 28.87, p = .017$; RMSEA = .058, CFI = .968, TLI = .905). The model
explained 46.2% of the variance in intentions, and 24.9% of the variance in
behavioural automaticity. Standardised parameter estimates of the modelled direct
and indirect pathways are presented in Table 7.1. Direct effects are also illustrated in
Figure 7.2. $^4$ $^5$

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$^4$Error covariances are presented in Appendix R and a figure depicting the significant indirect effects
is presented in Appendix S.

$^5$ Although not a specific aim of the research, an additional multi-group analysis was conducted to
compare model effects in inner-regional and major city populations of Australia. The results of this
analysis and a brief discussion related to its findings are presented in Appendix G. The corresponding
data files and analysis output are available online:
https://osf.io/8kf37/?view_only=800c2e93694f4e7f86e2d519c328ce5c5
Table 7.1: Standardised direct, indirect, and total effects of modelled pathways

<table>
<thead>
<tr>
<th>Effect</th>
<th>$\beta$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direct effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autonomous motivation→attitudes</td>
<td>.403</td>
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<tr>
<td>Autonomous motivation→subjective norms</td>
<td>.201</td>
<td>.001</td>
</tr>
<tr>
<td>Autonomous motivation→PBC</td>
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<tr>
<td>Autonomous motivation→intentions</td>
<td>.258</td>
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<tr>
<td>Attitudes→intentions</td>
<td>.102</td>
<td>.090</td>
</tr>
<tr>
<td>Subjective norms→intentions</td>
<td>.241</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>PBC→intentions</td>
<td>.167</td>
<td>.001</td>
</tr>
<tr>
<td>Past physical activity→autonomous motivation</td>
<td>.322</td>
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</tr>
<tr>
<td>Past physical activity→attitudes</td>
<td>.050</td>
<td>.427</td>
</tr>
<tr>
<td>Past physical activity→subjective norms</td>
<td>.214</td>
<td>.001</td>
</tr>
<tr>
<td>Past physical activity→PBC</td>
<td>.160</td>
<td>.007</td>
</tr>
<tr>
<td>Past physical activity→intentions</td>
<td>.249</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Autonomous motivation→automaticity</td>
<td>.391</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Past physical activity→automaticity</td>
<td>.190</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Aesthetics→automaticity</td>
<td>-.074</td>
<td>.144</td>
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<tr>
<td>Aesthetics→attitudes</td>
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<td>Aesthetics→subjective norms</td>
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<td>Aesthetics→PBC</td>
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<tr>
<td>Social cohesion→automaticity</td>
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<td>.167</td>
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<td>Social cohesion→attitudes</td>
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<tr>
<td>Social cohesion→subjective norms</td>
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<td>.354</td>
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<td>Social cohesion→PBC</td>
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<tr>
<td>Community participation→automaticity</td>
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<tr>
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<td>Community participation→subjective norms</td>
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<td><strong>Indirect effects</strong></td>
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<tr>
<td>Autonomous motivation→PBC→intentions</td>
<td>.038</td>
<td>.010</td>
</tr>
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<td>Autonomous motivation→attitudes/subjective norms/PBC→intentions</td>
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<td>.083</td>
<td>&lt;.001</td>
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<td>Past physical activity→autonomous motivation→attitudes</td>
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<td>Past physical activity→autonomous motivation→subjective norms</td>
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<td>.003</td>
</tr>
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<td>.477</td>
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<tr>
<td>Aesthetics→attitudes/subjective norms/PBC→intentions</td>
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<td>.881</td>
</tr>
<tr>
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<td>.243</td>
</tr>
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Social cohesion→subjective norms→intentions
Social cohesion→PBC→intentions
Social cohesion→attitudes/subjective norms/PBC→intentions\(^a\)
Community participation→attitudes→intentions
Community participation→subjective norms→intentions
Community participation→PBC→intentions
Community participation→attitudes/subjective norms/PBC→intentions\(^a\)
Neighbourhood selection→attitudes→intentions
Neighbourhood selection→subjective norms→intentions
Neighbourhood selection→PBC→intentions
Neighbourhood selection→attitudes/subjective norms/PBC→intentions\(^a\)

Total effects
Autonomous motivation→automaticity
Past physical activity→automaticity
Aesthetics→automaticity
Community participation→automaticity
Neighbourhood selection→automaticity
Social cohesion→automaticity
Autonomous motivation→intentions
Past physical activity→intentions
Attitude→intentions
Subjective norms→intentions
PBC→intentions
Aesthetics→intentions
Community participation→intentions
Neighbourhood selection→intentions
Social cohesion→intentions

Note. PBC = Perceived behavioural control; \(^a\)Total indirect effects.

**Figure 7.2.** Parameter estimates for statistically significant paths in the proposed model with explained variance in dependent variables.

Feint lines represent paths with non-significant parameter estimates. PBC = Perceived behavioural control.
Based on the integrated model, it was hypothesised that autonomous motivation would predict physical activity intentions mediated by the social cognition constructs from the TPB variables. As predicted, autonomous motivation had statistically significant and positive direct effects on attitudes, subjective norms, PBC, and intentions. Further, subjective norms and PBC had significant and positive direct effects on intentions. However, contrary to hypotheses, there was no effect of attitudes on intentions. As predicted, there were significant indirect effects of autonomous motivation on intentions, mediated by subjective norms and PBC, but not by attitudes. In addition, past physical activity had significant and positive direct effects on autonomous motivation, attitudes, subjective norms, PBC, and intentions, as expected. However, there were no indirect effects of past physical activity on intentions through autonomous motivation, attitudes, subjective norms, or PBC.

As hypothesised, autonomous motivation and past physical activity had statistically significant and positive direct effects on behavioural automaticity. Although not predicted, there was also a significant indirect effect of past physical activity on automaticity, mediated by autonomous motivation.

As hypothesised, neighbourhood selection for lifestyle and community had a statistically significant direct effect on PBC. However, there was no effect of neighbourhood selection for lifestyle and community on attitudes, subjective norms, or automaticity, resulting in the rejection of these hypotheses. As predicted, significant indirect effects were observed between neighbourhood selection for lifestyle and community on intentions mediated by PBC. However, attitudes and subjective norms did not mediate this relationship. Contrary to predictions, there were no significant direct or indirect effects of any of the other constructs from the ecological model on intentions, or its determinants from the TPB.

7.5 Discussion

In the present study, we used an integrated model comprising constructs from motivational and social cognition-theories of behaviour, dual-process theories, and ecological frameworks to identify the predictors of physical activity intentions and behavioural automaticity in a sample of peri-urban dwelling Australians. Results indicated that autonomous motivation, subjective norms, PBC, and past behaviour were significant predictors of intentions to participate in physical activity in the future, and autonomous motivation and past behaviour were significant predictors of
behavioural automaticity. Of the ecological constructs, only neighbourhood selection for lifestyle and community predicted intentions, mediated by perceived behavioural control. There were no effects of aesthetics, social cohesion, and community participation on intentions and behavioural automaticity. Together, constructs from the proposed model explained substantive variance in physical activity intentions and automaticity in this sample, although the effects of the social cognition and motivational variables were most pervasive.

The rationale for applying psychological and motivational models within an overarching ecological framework was based on the assumption that features of the physical and social environment would shape psychological beliefs that relate to physical activity participation (Orbell et al., 2017; Von Wagner et al., 2011). Consistent with predictions, there was a significant indirect effect of neighbourhood selection on intentions, mediated by PBC. This indicates that the selection of residential location for lifestyle and community (i.e., a desire to be near to greenspace/bushland, open spaces, a country lifestyle and strong sense of community) was linked to favourable perceptions over the ease of performing physical activity, which was in turn, linked to intentions to perform physical activity.

Conversely, although aesthetics, social cohesion, and community participation were correlated with physical activity-related intentions and automaticity, they did not have unique effects in the model. This finding contrasts with previous studies that have found that constructs from the TPB mediated relationships between environmental constructs and physical activity behaviour (e.g., Fleig et al., 2016; Rhodes, Brown, & McIntyre, 2006; van der Horst, Oenema, te Velde, & Brug, 2010). However, these studies were conducted in heavily-populated and highly-walkable metropolitan areas, with highly active participants. Rhodes et al. (2006) concluded that environmental constructs may be antecedents of physical activity-related motivation and may not exert direct effects on behaviour independent of motivation. This may be the case in highly walkable environments that do not present actual barriers to physical activity. It may not be the case, however, in environments with low walkability and considerable barriers to physical activity, as have been described in peri-urban regions of Australia (Olson et al., 2018). In such cases, features of the environment may have a direct influence on health behaviours bypassing intentions, although this hypothesis could not be tested in the current study (Fishbein, 2000). To speculate, given the significant effects of neighbourhood
selection on PBC in the current study, it is possible that this construct may influence behaviour via PBC, in cases where PBC serves as a proxy for actual control, consistent with the TPB (Ajzen, 1985). For example, distance to shops may preclude walking as a viable means of transport, regardless of intentions to be active, and would be beyond the control of the individual.

Another potential pathway through which the environment may impact health behaviour is by moderating the intention-behaviour relationship, consistent with research that has demonstrated moderating effects of socio-demographic factors on relations in the TPB, such as the intention-behaviour relationship (Schüz et al., 2017). For example, land-use mix has been found to moderate the relationship between intentions and walking behaviour; with the relationship being stronger among those who perceived more proximal access to recreational facilities (Rhodes et al., 2006; Rhodes et al., 2007). Thus, it is possible that features of the environment in peri-urban settings are moderating the relationship between intentions and behaviour (e.g., the intention-behaviour relationship could be stronger among peri-urban Australians who live in more walkable environments, suggesting that higher walkability fosters the conversion of intentions into action). However, the present research design precludes investigation of this possibility.

In the present study the correlations of the contextual constructs with intentions and automaticity were small in size. Therefore, it is possible that their effects on intentions were rendered relatively trivial alongside the belief-based predictors. These smaller correlations are consistent with previous research that has shown that individual and social factors exert a stronger influence upon physical activity, relative to environmental factors (Giles-Corti & Donovan, 2002; Lemieux & Godin, 2009). Maddison et al. (2009) also noted that social cognition variables were better predictors of physical activity compared to characteristics of the perceived and built environment. However, the smaller effect of contextual variables relative to social cognition constructs does not mean that the influence of the environment on physical activity behaviour is not of practical significance. Ecological models indicate that efforts to effect behaviour change will be most successful when targeting multiple levels of influence on behaviour (Sallis et al., 2015), and health behaviour may be viewed as a product of motivation, capability, and supportive environments (Michie, van Stralen, et al., 2011).
It is also possible that measures of the ecological constructs included in the study were too general and did not adequately represent the specific nature of environmental cues that drive physical activity in this community. Moreover, correspondence between measures of the social cognition constructs and the measure of intentions was high (e.g., in terms of action, target, context and time, consistent with Ajzen’s recommendations), while the correspondence between the intention measure and the measures of the social environmental variables was low. The weaker effects observed for the ecological constructs relative to the psychological constructs may, therefore, be an artefact of measurement. Future research should seek to measure the ecological variables using objective means. It would also be important to include a measure of physical activity participation, preferably by objective rather than self-report means, in order to examine the unique effects of the psychological and ecological constructs on behaviour.

Focusing on effects of motivational and social-cognition constructs in the integrated model, we found that participants with autonomous motives were more likely to report positive beliefs with respect to future participation in physical activity. The findings also suggest that the relationship between autonomous motivation and the development of intentions to undertake physical activity is facilitated by beliefs that significant others endorse physical activity participation, and the perceived ease of performing physical activity. This is consistent with the integrated model (Hagger & Chatzisarantis, 2009, 2016), as well as the predictions of self-determination theory (Deci & Ryan, 1985), suggesting that autonomously motivated individuals will tend to align their beliefs with their motives in order to initiate future behaviours that are likely to be experienced as autonomous.

Contrary to predictions, however, we found no effect of attitudes on intentions. This finding is inconsistent with previous research that typically shows small-to-medium sizes effects of attitudes on physical activity intentions (Hagger et al., 2002). This finding, however, seems congruent with research in which peri-urban participants reported largely inactive lifestyles despite describing positive physical activity-related outcome expectancies (Olson et al., 2019). However, the most likely reason for the small, trivial effect of attitudes on intentions is the large zero-order correlations of attitudes with both autonomous motivation and subjective norms (r > .50). As attitudes and these variables were significantly correlated with intention as well, it is possible that any effect of attitudes on intentions in the context of the path
model may have been subsumed by the effects of these variables. This likely illustrates substantive overlap these constructs in this context for this population – for example, the distinction between attitudes, which reflect positive appraisal of physical activity, and subjective norms, which reflect perceived approval of significant others may not have been readily apparent. This may be the case when the beliefs underpinning the two constructs are identical (e.g., participants may have viewed social approval as a salient outcome of participating in physical activity in itself).

The small, non-significant effect of attitudes meant that subjective norms and PBC were the dominant predictors of intentions. This is somewhat inconsistent with previous research applying social-cognition theories (Hagger et al., 2002), and integrated models (Hagger & Chatzisarantis, 2009) in health behaviour which found larger effects for attitudes and PBC, and modest effects for subjective norms. To speculate, the effect of normative beliefs may be more salient in peri-urban communities because people living in smaller communities experience a strong sense of neighbourliness and community spirit (Eley et al., 2014; Olson et al., 2018). Further, it is also possible that individuals’ estimates of perceived control over the behaviour in the current sample may have been an accurate reflection of actual control over the behaviour, in which case it should directly predict behaviour consistent with Ajzen (1991) predictions. The absence of a follow-up measure of physical activity in the present study, however, precluded analysis of direct effects of PBC on physical activity.

We also found that both past physical activity and autonomous motivation predicted automaticity. This is consistent with other research that has found that self-determined motives are more strongly associated with behavioural automaticity (Gardner & Lally, 2013; Radel et al., 2017). Together, these findings indicate that experiencing physical activity as automatic is a function of previous experience and motivation style. These findings are unsurprising. Past behaviour was measured using frequency of past participation in physical activity, so likely captures the repetition of the behaviour in stable contexts, a primary determinant of habit formation, of which automaticity is a key component. In addition, individuals with autonomous motivation are likely to seek out regular participation in behaviours that provide opportunities to experience autonomy – such behaviours are, therefore, likely to become highly automated.
We found no evidence that autonomous motivation moderated the relationship between past behaviour and automaticity. Instead it seems that autonomous motivation may be partly responsible for the development of automaticity. Given that individuals holding autonomous motives toward physical activity tend to persist with physical activities over time, they are more likely to experience repeated bouts of physical activities in stable contexts and, as a consequence, develop adaptive habits and experience the activities as automatically, rather than intentionally, controlled.

7.5.4 Strengths, limitations, and recommendations for future research and practice.

The current study is unique in that it applied an integrated model comprising factors from multiple theoretical perspectives (motivation and social cognition, dual process, and ecological models) to predict physical activity in peri-urban contexts, a seldom studied population. Given that ecological models are not explicit on the process by which environmental determinants relate to health behaviour, the integration of these constructs alongside theoretical frameworks that focus on the intentional and implicit psychological processes that relate to physical activity participation enabled us to test some potential mechanisms. However, there are a number of limitations which should be taken into account. First, the direction of the relationships among model constructs were based on established theoretical frameworks, but the correlational design precluded causal inferences. Future research may consider longitudinal or panel designs, which may enable modelling of stability and reciprocal effects. Importantly, adoption of experimental designs, in which key constructs are manipulated and their effects on outcomes tested, would provide stronger evidence to infer causal links. Second, a prospective measure of physical activity participation was not included. Therefore, the degree to which intentions and automaticity predict subsequent physical activity participation has yet to be determined. This limitation also precluded further exploratory investigation of additional mechanisms through which contextual features of peri-urban settings might impact physical activity (i.e., whether such features impact behaviour via PBC, rather than intentional processes; or whether such factors moderate the intention-behaviour relationship). Third, the use of self-report data represents a further limitation of the study design. Self-report measures are subject to response
bias but may also introduce common method variance into the data, which may affect relations among constructs. Future research should include prospective measures of behaviour, to enable behavioural prediction, and consider the adoption of objective measures of physical activity using devices such as accelerometers. Finally, we used convenience sampling, and participant education and income levels were higher than Australian national averages (Australian Bureau of Statistics, 2018a; Torrens University Australia, 2017). The current sample should, therefore, not be considered representative of the general peri-urban population and should impose limits on the extent to which current findings can be generalized. We look to future studies to explore the effects of the gamut of determinants from our integrated model on physical activity in a representative sample of peri-urban dwellers, recruited using random, stratified methods.

Current findings may assist in providing preliminary evidence of potential targets for behaviour-change interventions. Strategies that target change in subjective norms and perceived control to foster positive intentions toward physical activity may, for example, be appropriate for this sample. Intervention strategies might include persuasive communications highlighting the importance of social support and negating barriers, as well as providing experiences of success with activities. In addition, fostering autonomous motives for physical activity by enhancing enjoyment and providing experiences of mastery of activities may encourage the development of intentions to perform physical activity and promote physical activity habits. Further, broader community-based strategies such as enhancing the ‘sense of community’ and ‘country lifestyle’ within peri-urban communities may be effective in influencing intentions to participate in future physical activity in the current sample. However, tangible means to do this remain elusive. Affecting change in the motivational and social-cognition constructs may be more viable. However, it is important to note that given the preliminary nature of the findings, and the limitations outlined previously, the current evidence should not form the basis of definitive advice on intervention strategy.

7.6 Conclusion

The aims of this research were to estimate effects of features of the physical and social neighbourhood environment, and motivational and social-cognition constructs, on physical activity-related intentions and automaticity among peri-urban
Australians. Only neighbourhood selection for lifestyle and community, together with autonomous motivation and social cognition constructs, explained substantive variance in intentions. Autonomous motivation and past behaviour were the only correlates of automaticity. Overall, current results suggest that contextual features of peri-urban settings may not play a substantive role in determining physical activity intentions. Based on this preliminary evidence, fostering autonomous motivation (e.g., by enhancing enjoyment) and favourable normative and control beliefs (e.g., by encouraging social support and reducing barriers to physical activity) may be possible strategies interventionists could adopt to encourage physical activity among inactive peri-urban Australians.

7.7 How the Publication Contributes to the Advancement of the Research Area

This publication contributes to the advancement of research in two main ways. Firstly, by adding to the limited literature base investigating physical activity in the inactive population of inner-regional Australia. Prior to this program of research, there was a paucity of research conducted to understand the range of factors, at multiple levels of influence, that were contributing to the high prevalence of inactive lifestyles among inner-regional Australians. This study builds on the preliminary work conducted in the first two studies that identified features of the physical and social environment, and physical activity-related beliefs of people living in inner-regional southern Queensland, by testing the relevance of these factors to the broader population of inner-regional Australian. Together, these studies provide an indication of the range of factors that affect physical activity among inner-regional Australians, and how these factors interact to influence behaviour. This information can be used to devise multi-level strategies to encourage and support more people in inner-regional Australia to perform sufficient physical activity for health benefit, consistent with the call articulated in the WHO’s Global Action Plan on Physical Activity (2018a) to prioritise programs for those who are the least active.

Secondly, the publication makes a contribution to the literature of physical activity theory, with the conceptualisation and testing of a comprehensive, empirically-derived theoretical model to explain physical activity. The model devised for this study builds on social ecological theories, by explicitly predicting how multi-level factors will interact to influence behaviour (Sallis et al., 2006; Sallis
et al., 2015). In line with dual-process theories of behaviour (Evans & Stanovich, 2013; Sheeran et al., 2013; Strack & Deutsch, 2004), the inclusion of a pathway representing an implicit psychological process (i.e., habit strength) builds on social cognitive theories that focuses solely on intentional processes, thereby providing a more comprehensive account of the psychological antecedents of physical activity. The inclusion of a construct representing autonomous motivation (Deci & Ryan, 1985) provides an indication of how the belief-based constructs of the TPB (Ajzen, 1985) are formed (Hagger & Chatzisarantis, 2009); and how motivation predicts perceptions of physical activity as automatic (Gardner & Lally, 2013). Together with the inclusion of constructs representing characteristics of the social and physical environment in inner-regional Australia (Olson et al., 2018), the framework provides a comprehensive representation of intrapersonal, interpersonal, and environmental factors that impact physical activity in inner-regional Australia.

7.8 Links to Other Chapters

Additional information pertaining to the design and methodology of the current study is presented in Chapter 6. The overall design of the study was underpinned by social-ecological theory, recognising that health behaviour is a product of multiple influences, at multiple levels (Sallis et al., 2015). Constructs from other theoretical frameworks and models were integrated to create the hypothesised model that guided the study. These included intentions and the belief-based constructs from the TPB (Ajzen, 1991), autonomous motivation from SDT (Deci & Ryan, 1985), and habit/automaticity (Gardner et al., 2011), as a representation of an implicit psychological process posited to influence behaviour, as elucidated in dual process theories (Evans & Stanovich, 2013; Sheeran et al., 2013; Strack & Deutsch, 2004). An explanation of each of these theoretical frameworks/models, and the constructs represented within each, is provided in the literature review presented in Chapter 2.

The exploratory work conducted in the first two studies informed the design of the present study. Study one identified features of the physical and social environment in inner-regional Australia that may influence the performance of physical activity. These features were examined in the present study, to determine their relationship with physical activity-related intentions and automaticity. Study one is presented in detail in Chapter 4. Study two identified salient physical activity-
related beliefs among inner-regional Australians. The findings informed the assessment of constructs representing attitudes, subjective norms, and perceived behavioural control, and the inclusion of pathways representing the influence of features of the physical and social environment on these belief-based constructs in the present study. Study two is described in detail in Chapter 5.
Chapter 8 General Discussion

8.1 Overview of the Chapter

The purpose of this chapter is to provide an overall discussion and interpretation of the findings of the PhD. First, to orient the reader, a brief summary of the research aims and specific findings, followed by a concise overview of the theoretical frameworks that influenced the research is provided. Thereafter, overall interpretations of the research findings are presented. The strengths and limitations of the research are then discussed, followed by implications, and recommendations for future research and practice. Finally, the overall conclusion of the thesis is presented.

8.2 A Summary of the Aims and Main Findings

The overall aim of this research was to understand why high proportions of people living in inner-regional Australia lead inactive lifestyles. There were four specific aims. The first was to identify characteristics of inner-regional settings that might influence active lifestyles. Factors that were conducive to active lifestyles were identified, in addition to those that serve as barriers to active lifestyles. The second aim was to identify salient beliefs of people residing in inner-regional Australia in relation to physical activity and sedentary behaviour. Further aims were to estimate the magnitude of effects of characteristics of the physical and social environment on the psychological antecedents of active lifestyles; and to examine how features of the physical and social environment affects the psychological antecedents of active lifestyles. The findings of each of these research aims have been synthesised and are depicted in Figure 8.1.
8.3 A Summary of the Theories that Guided the PhD.

The current research was informed by several theoretical perspectives, which are summarised in Table 8.1. Consistent with social ecological conceptualisations of health behaviour (Sallis et al., 2015), the role of the physical and socio-cultural environment as a key determinant of health behaviour was central. This premise prompted the initial inductive investigation of contextual factors that might impact active lifestyle behaviours. Social ecological frameworks also content that factors across multiple levels interact to influence behaviour (Sallis et al., 2015). Therefore, the research was designed to identify factors at multiple levels of influence, and subsequently to investigate how those factors might interact to produce behaviour. As social ecological frameworks do not specify the mechanisms of such interactions, other theories were applied for this purpose.

Consistent with Ajzen’s (1985) TPB, intentions were conceptualised as a proximal predictor of behaviour, and therefore specified as a key outcome variable in the theoretical framework developed for the final study. Another contention of the TPB is that intentions are predicted by attitudes, subjective norms, and PBC, and that these constructs are informed by behavioural, normative, and control beliefs,
respectively. Therefore, it was deemed important to identify salient physical activity and sedentary behaviour-related behavioural, normative, and control beliefs of people living in inner-regional Australia, giving rise the second study of this PhD. Pathways demonstrating these relationships were also included in the theoretical model developed for the final study. Consistent with dual process theories of behaviour (Evans & Stanovich, 2013; Sheeran et al., 2013; Strack & Deutsch, 2004), it was presumed that implicit psychological processes influence behaviour in addition to intentional processes. In the final study of the current research, habit strength, operationalised as automaticity (as per Gardner, 2012), was included as a key outcome variable representing a proximal implicit psychological antecedent of behaviour, alongside intentions.

The contention of Deci and Ryan’s SDT (1985), that autonomous motivation is conducive to the maintenance of health behaviour, also influenced the design of the current research, and interpretations of its findings. The design of the theoretical framework developed for the final study drew on previous research that has separately identified relationships between autonomous motivation and intentions, mediated by attitudes, subjective norms, and PBC (Hagger & Chatzisarantis, 2009), and between autonomous motivation and automaticity (Gardner & Lally, 2013). Finally, the findings of this research have been interpreted through the lens of the COM-B system of behaviour (Michie, van Stralen, et al., 2011), with factors that support or hinder capability, opportunity, and motivation for active lifestyles in inner-regional Australia identified.
Table 8.1: Theories that guided this research

<table>
<thead>
<tr>
<th>Theory (source)</th>
<th>Central Proposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social ecological theory (Sallis et al., 2015)</td>
<td>A range of factors across multiple levels interact to influence health behaviour. Environmental contexts, including the physical &amp; social environment, intersect across multiple levels of influence, and are significant determinants of health behaviour.</td>
</tr>
<tr>
<td>COM-B (Michie, van Stralen, et al., 2011)</td>
<td>Health behaviour is a product of motivation, including reflective &amp; automatic brain processes that direct behaviour; capability, referring to the individual’s physical &amp; psychological capability to perform the behaviour; &amp; opportunity, afforded through supportive physical &amp; social environments.</td>
</tr>
<tr>
<td>TPB (Ajzen, 1985, 1991)</td>
<td>Intentions are the most proximal predictor of behaviour. Intentions are informed by attitudes, subjective norms &amp; PBC, which are informed by behavioural, normative, &amp; control beliefs, respectively.</td>
</tr>
<tr>
<td>SDT (Deci &amp; Ryan, 1985)</td>
<td>Behaviour is driven by qualitatively distinct forms of motivation, with more autonomous forms of motivation conducive to sustained health behaviour maintenance.</td>
</tr>
<tr>
<td>Dual process theories (Evans &amp; Stanovich, 2013; Sheeran et al., 2013; Strack &amp; Deutsch, 2004)</td>
<td>Implicit psychological processes, such as habit, drive behaviour in concert with intentional processes.</td>
</tr>
<tr>
<td>Habit (Gardner, 2012; Gardner &amp; Lally, 2013)</td>
<td>Automaticity is the active ingredient of habit. Behavioural repetition and autonomous motivation predict automaticity.</td>
</tr>
</tbody>
</table>

Notes. COM-B = capability, opportunity, motivation, and behaviour; TPB = theory of planned behaviour; PBC = perceived behavioural control; SDT = self-determination theory.

8.4 Overall Interpretation of the Findings

Consistent with social ecological theories of health behaviour (Sallis et al., 2015), factors at multiple levels of influence affected the active lifestyles of inner-regional Australians. At the intrapersonal level, beliefs that physical activity was enjoyable fostered active lifestyles, while low self-efficacy beliefs or beliefs that physical activity was exhausting or unenjoyable led to behavioural avoidance. At the interpersonal level, people were aware of the active lifestyle behaviours performed by others, and of social approval for active lifestyles, and consistent with Ajzen’s (1985) TPB, more favourable normative beliefs were linked to greater intentions to be active in the future. Whilst some factors at the physical-environmental level were conducive to physical activity, many factors constrained active lifestyles. At the community level, opportunities for social interaction are limited; however, for some participants, sports participation fulfilled an important
need for social interaction, which in turn, was linked to sustained participation. Ultimately, interactions between these factors across multiple levels will influence the adoption of active lifestyles in inner-regional Australia.

8.4.1 Opportunities for active lifestyles through the physical and social environment.

The findings of this research show that the socio-cultural and environmental context in inner-regional Australia influences active lifestyle participation. This is consistent with one of the key principles of social ecological theory, which recognises environmental context as a significant determinant of health behaviour (Sallis et al., 2015); and reinforces the need to understand behaviour in the context in which it is performed (World Health Organisation, 1986). To develop effective strategies to encourage more people in inner-regional Australia to lead active lifestyles, it was of critical importance to identify the factors that were contributing to the high prevalence of physical inactivity and sedentary behaviour within this population. The current research achieved that aim.

Contextual characteristics that may influence active lifestyles within inner-regional settings are presented in Table 8.1. Some activity-supportive social and physical-environmental characteristics were identified. For example, inner-regional neighbourhoods were perceived to be safe, cohesive, and aesthetically appealing. However, a variety of barriers to active lifestyles were also identified, particularly within the physical environment. For instance, geographic isolation restricted accessibility to goods, services, and facilities, thereby precluding active forms of transport and necessitating sedentary forms of transport. These features of the physical environment limited opportunities for people in inner-regional Australia to lead active lifestyles. In line with Michie, van Stralen, and West’s (2011) COM-B system of behaviour, supportive social and physical environments that provide opportunities for physical activity and also minimise sedentary behaviour are essential to support people in inner-regional Australia to lead active lifestyles. In the presence of substantive contextual barriers within the physical environment, inner-regional Australians may be unlikely to undertake regular physical activity or minimise sedentary behaviour, despite holding beliefs that they will benefit from doing so.
Social factors appear to be particularly relevant to active lifestyles in inner-regional Australia. Together with past physical activity, neighbourhood aesthetics, and psychological constructs, the social constructs included in the final study (i.e., social cohesion, community participation, and neighbourhood selection driven by an attraction to the ‘country lifestyle’ and sense of community) accounted for substantive variance in physical activity-related intentions and automaticity. Inner-regional areas of southern Queensland were described as neighbourly and socially cohesive; people knew their neighbours and kept an eye out for one another. People were aware of the physical activity and sedentary behaviour performed by those around them, and the degree to which active lifestyles were endorsed by important others. In contrast with previous research that has indicated attitudes and PBC are stronger predictors of physical activity intentions than subjective norms (e.g., Hagger et al., 2002); the findings of the current research indicated that social norms may be more critical to the development of intentions than attitudes in inner-regional settings, where populations are small and cohesive. Beliefs that physical activity participation provided an important opportunity for social interaction, which was otherwise limited in inner-regional environments, also appeared to drive sustained physical activity participation. Thus, while some features of the physical environment may present substantial barriers to active lifestyles, there are characteristics of the socio-cultural environment in inner-regional Australia that may provide opportunities for active lifestyles.

8.4.2 Capability for active lifestyles.

In addition to supportive physical and social environments, the COM-B system of behaviour stipulates that capability and motivation are necessary for the performance of health behaviours (Michie, van Stralen, et al., 2011). Perceptions of low self-efficacy for physical activity and for avoiding specific sedentary behaviours inhibited active lifestyles among inner-regional Australians. This is a clear example of limited capability negatively affecting active lifestyles. According to the TPB, control beliefs, such as low self-efficacy (in addition to beliefs about environmental barriers, such as those described above), negatively influence PBC over health behaviours, which in turn inhibits the development of intentions to perform the behaviours in the future (Ajzen, 1985, 1991). Consistent with this contention, the
findings of this PhD indicated that more favourable physical activity-related PBC was linked to greater intentions to perform physical activity in the future.

**8.4.3 Motivation for active lifestyles.**

Motivation was identified as an important construct in the current research. People living in inner-regional Australia who found physical activity to be enjoyable or socially beneficial, also described sustained physical activity participation. However, those who initiated physical activity for health reasons did not necessarily continue that behaviour over time. This is consistent with SDT, according to which, behaviour that is more autonomously motivated (e.g., regulated by enjoyment) is more likely to be maintained than behaviour that is externally regulated (e.g., undertaken for health benefits; Deci & Ryan, 1985).

Moreover, autonomous motivation was related to both implicit and intentional psychological processes contended to be predictive of physical activity according to dual-process theories of behaviour (Evans & Stanovich, 2013; Sheeran et al., 2013; Strack & Deutsch, 2004). This finding not only builds understanding of the psychological antecedents of physical activity among inner-regional Australians but makes an important theoretical contribution to the evidence supporting dual-process theories of behaviour and motivational research more generally. It appears that autonomous motivation for physical activity (e.g. behaviour is driven by enjoyment) is linked to higher levels of physical activity-related automaticity, and greater intentions to perform physical activity in the future. It is possible that autonomous motivation for physical activity facilitates the development of congruent and favourable physical activity-related beliefs. In turn, and consistent with the TPB (Ajzen, 1985), favourable normative beliefs (i.e., beliefs of others performing physical activity, and beliefs that important others endorse physical activity) and control beliefs (i.e., the relative ease of performing physical activity) may foster the development of intentions to take part in physical activity in the future.

**8.4.4 Capability, opportunity, and motivation are all essential for active lifestyles.**

This research revealed that, among inner-regional Australians, neither opportunities provided through activity-supportive socio-cultural or physical environments, nor motivation driven by favourable behavioural beliefs were
sufficient, in isolation, to support sustained active lifestyle participation. For example, despite people living within towns describing destinations within easy walking distance, and a strong culture of support for local sporting teams, people still drove rather than undertaking active forms of transport and did not personally participate in sport. Notwithstanding beliefs that physical activity was beneficial for health; and that pain, discomfort, and psychological ill-being could result from prolonged sitting, people described inactive and sedentary behaviours.

According to Michie et al.’s (2011) COM-B system of behaviour, capability, opportunity, and motivation are all necessary for health behaviour to occur. However, as demonstrated by the findings of this research, individually, each of these components is insufficient to generate health behaviour. Active lifestyles will not be supported in inner-regional Australia, unless people feel capable of performing regular physical activity and minimising sedentary behaviour, have access to opportunities for active lifestyles through supportive social and physical environments, and are motivated to perform physical activity and minimise sedentary behaviour. If a person living in inner-regional Australia is not motivated to lead an active lifestyle, that person is unlikely to take advantage of opportunities within the environment to perform physical activity or minimise sedentary behaviour. Likewise, even when an individual is highly motivated to lead an active lifestyle, if substantial barriers within the physical environment limit opportunities to undertake physical activity or minimise sedentary behaviour, that individual is unlikely to lead an active lifestyle.

8.5 Strengths and Limitations of the Research

This program of research was the first to systematically investigate the range of factors across multiple levels of influence that may affect the active lifestyles of people living in inner-regional Australia. The focus on people residing in inner-regional Australia, where a high proportion of the population is insufficiently active (Australian Bureau of Statistics, 2015) and substantial health inequalities are evident (Torrens University Australia, 2017), is consistent with the prioritisation of physical activity programs for those at greatest risk of physical inactivity, as promulgated by the WHO in the Global Action Plan on Physical Activity (2018a). Health promotion programs, such as those designed to support physical activity participation, should be adapted to suit local needs (World Health Organisation, 1986). The development of
contextually relevant strategies to foster active lifestyles in inner-regional Australia is dependent upon first understanding of why so many people within this population are inactive and sedentary. The current program of research has advanced this understanding, by identifying a range of contextually-relevant factors that may affect the performance of physical activity and sedentary behaviour.

The current studies were guided by established social-cognitive, motivational, and social ecological theoretical frameworks that have been empirically developed and corroborated. The adoption of an over-arching social ecological approach allowed for the identification of a wide range of potential behavioural influencers, across multiple levels, providing a more complete understanding of behaviour than would have been achieved by focusing on any single level of influence. The merging of complementary elements from social ecological theory, social-cognitive theories (i.e., TPB and SDT), dual process theories, and habit research provided a comprehensive framework through which to test interactions between features of the physical and social environment, drivers of neighbourhood selection, and intentional and implicit psychological processes predictive of physical activity. Not only did this research improve understanding of the factors that are likely contributing to the high prevalence of inactive lifestyles in inner-regional Australia; the research also makes a contribution to the science of predicting health behaviour by validating the application of these theoretical frameworks, and the compatibility of the constructs included within them.

The mixed-methods design of this research facilitated an investigation of active lifestyles in inner-regional Australia that was both inductive and deductive, thus providing a full and rich picture of the factors that are contributing to the high prevalence of inactive lifestyle in inner-regional Australia. The application of qualitative methods in the initial exploratory studies provided an opportunity to identify novel contextual characteristics and beliefs that had not been associated with physical activity or sedentary behaviour in previous research. The application of quantitative methods in the final study allowed for quantification of the relationships between contextual factors and the psychological antecedents of physical activity, providing an avenue through which to investigate how these factors interact to influence behaviour.

There were also limitations of this research that should be acknowledged. The research design facilitated identification of factors that may influence physical
activity and sedentary behaviour in inner-regional Australia. However, the research wholly comprised studies of observational design, including two qualitative and one quantitative, cross-sectional study. Therefore, the factors that cause inactivity and sedentary behaviour in inner-regional Australia could not be conclusively determined. Moreover, whilst the research allowed for preliminary identification of factors that could be targeted in interventions to encourage more people in inner-regional Australia to adopt active lifestyles, the research design did not extend to testing the feasibility and effectiveness of manipulating such variables to enact behaviour change. Thus, it remains unknown whether such strategies would be successful in reducing the prevalence of inactive lifestyles in inner-regional Australia.

The design of the initial exploratory studies of this PhD allowed for identification of contextual characteristics and beliefs that might influence physical activity and sedentary behaviour in inner-regional southern Queensland. However, further exploration of the factors that influence sedentary behaviour across the wider population of inner-regional Australia, and how these factors interact to produce behaviour was precluded by practical constraints. Active lifestyles are a product of regular physical activity and minimised sedentary behaviour, and sedentary behaviour may be particularly harmful to those who are the least active (Ekelund et al., 2016; Stamatakis et al., 2019). As such, further investigation of the factors that influence sedentary behaviour among inner-regional Australians would be useful. Health behaviours do not occur in isolation, and factors that affect physical activity may also affect sedentary behaviour. For example, distance and accessibility of goods and services precluded opportunities to walk as a means of transport and necessitated regular sedentary driving behaviour. Cross-behavioural cognitions and intentions were also evident. For example, negative outcome expectancies attributed to sedentary behaviour encouraged physical activity intentions. Unfortunately, the current research design did not allow for further investigation of how the correlates of physical activity and sedentary behaviour might interact to produce inactive lifestyles among inner-regional Australians. Such research could provide a more comprehensive understanding of why such high proportions of people in inner-regional Australia lead inactive lifestyles.

Finally, some of the design features of this program of research represent potential sources of bias. Non-random convenience samples were used in all three
studies. Thus, the samples may not be representative of inner-regional residents more generally. For instance, males were under-represented in studies one and three. It is possible that males perceive the physical and social environment differently than females (e.g., may not perceive walking at certain times of the day to be dangerous), and that the relationships between multi-level behavioural determinants of physical activity may differ among men and women. Further, recruitment for all studies was primarily via social media, and participation required internet/telephone access. It is widely reported that internet access outside of Australia’s major cities can be problematic. It is possible that study participants differed systematically from those who were unable to take part or were unaware of the study as they do not use social media. For example, those in areas with very limited internet access may also face other barriers in the physical environment that preclude active lifestyles. Given these potential sources of bias, caution should be exercised when interpreting the findings of this research.

Additionally, the findings of study one included participant descriptions of features of the physical and social environment in inner-regional settings that have been associated with active lifestyles in previous research, even where participants did not describe these factors as having an influence over behaviour. The findings of research conducted in other populations can provide an indication of factors that might influence the physical activity and sedentary behaviour of inner-regional Australians; however, further research is required to confirm these relationships. It is possible that factors that are relevant to active lifestyles in metropolitan environments are not relevant in inner-regional settings, or that the direction of effects is different. For example, access to public transport has been associated with increased physical activity in previous research (Carlin et al., 2017). However, in more remote settings where people may have to drive to their nearest transit stop, this effect may be negated.

8.6 Implications, and Recommendations for Future Research and Practice

In line with the prioritisation of programs for populations at the greatest risk of physical inactivity (World Health Organisation, 2018a), it is of critical importance to prioritise the development of strategies to encourage and support more people living in inner-regional Australia to adopt active lifestyles. The present research improved understanding of why so many people within this population lead inactive
lifestyles. This provides researchers and practitioners with an opportunity to apply this knowledge to the development and testing of interventional strategies to encourage active lifestyles within this population. A range of factors at multiple levels of influence were associated with physical activity and sedentary behaviour among people living in inner-regional Australia. This indicates that multi-level strategies to reduce the prevalence of inactive lifestyles within this population are likely to be the most beneficial. Such strategies should be designed to foster capability among inner-regional Australians to perform regular physical activity and minimise sedentary behaviour, enhance physical environments to provide more opportunities for people to lead active lifestyles, promote the benefits of social interaction that can be attained through physical activity participation, and foster autonomous motivation for active lifestyle behaviours.

Capability for active lifestyles could be enhanced by building the self-efficacy of people in inner-regional Australia to perform physical activity and minimise sedentary behaviour. Behavioural practice or rehearsal may be an appropriate behaviour change technique to build self-efficacy (Michie, Ashford, et al., 2011). Opportunities for inner-regional Australians to lead active lifestyles could be enhanced by building physical environments that are more supportive of physical activity. Restructuring the physical environment to facilitate physical activity or minimise sedentary behaviour may be an appropriate behaviour change technique to build opportunities for active lifestyles (Michie, Ashford, et al., 2011). Supporting the development of autonomous motivation for active lifestyle behaviours may also encourage more people in inner-regional Australia to adopt active lifestyles. Reframing of physical activity-related beliefs about enjoyment, or alignment of physical activity with personal values may offer an effective behaviour change technique to foster more autonomous motivation (Michie, Ashford, et al., 2011). In summary, a multi-level approach to reducing the prevalence of inactive lifestyles in inner-regional Australia, that addresses shortfalls in capability and opportunity, while fostering autonomous motivation for active lifestyle behaviours is indicated. One possible example of such an approach is presented in Figure 8.2.
There are also several recommendations for future research that could address the limitations of the current research, whilst building on its findings. The current research identified factors associated with active lifestyle behaviours, and physical activity-related intentions and habits in inner-regional Australia; and provided an indication of how environmental, social, and individual-level factors might interact to produce physical activity in inner-regional Australia. Future research of prospective, longitudinal, and experimental design could enhance these findings by specifically identifying factors that cause physical activity and/or sedentary behaviour in this population. For example, researchers could assess the effect of enhancing opportunities for physical activity in the physical environment in inner-regional Australia on PBC, and whether these changes alter physical activity-related-intentions or behaviour. Research examining whether manipulation of autonomous motivation leads to changes in physical activity-related habit strength, or to changes in intentions, via altered behavioural, normative, or control beliefs, offers another such example.

Figure 8.2. An example of a multi-level approach to reducing the prevalence of inactive lifestyles in inner-regional Australia
Notable differences between participants residing within and outside of town areas were identified in the first two studies of this research. The barriers and facilitators of active lifestyle behaviours within the physical environment differed between the groups. For example, distance was more likely to present a barrier to active lifestyles among those who lived outside of towns. Beliefs about physical activity and sedentary behaviour also differed between the groups. For example, those living outside of town were more likely to describe lower levels of perceived control over active lifestyle behaviours than their city-dwelling neighbours. Future research further investigating these differences could improve understanding of active lifestyles in inner-regional Australia, with a greater degree of contextual specificity in relation to behavioural determinants.

Additional research to better understand the determinants of sedentary behaviour, and the mechanisms through which these factors interact to produce behaviour would also be beneficial. For example, a model similar to that applied to examine physical activity-related intentions and habit strength in the final study of this PhD could be adopted to examine the psychological antecedents of sedentary behaviour. Such knowledge would be especially valuable given people within this population are likely to be particularly susceptible to the negative health outcomes of sedentary behaviour due to the high prevalence of physical inactivity. Future research that examines how the factors that affect physical activity and sedentary behaviour interact to produce lifestyles that are more or less active (or inactive) overall could also further build a more complete picture of why so many people in inner-regional Australia lead inactive lifestyles.

8.8 Conclusions

This research has improved understanding of why such high proportions of inner-regional Australians are physically inactive and sedentary. As expected, active lifestyle participation is complex and multifaceted with a range of characteristics of the physical and social environment, and beliefs about physical activity and sedentary behaviour servicing to promote and/or hinder active lifestyles in inner-regional Australia. It appears that neither opportunities for active lifestyles provided through supportive social and physical environments, nor favourable outcome expectancies in relation to physical activity and sedentary behaviour, are sufficient on their own to produce active lifestyles. Intuitively, where opportunities to
undertake active lifestyles are restricted by barriers in the physical environment, people may not lead active lifestyles, even if they are motivated to do so. Likewise, environments that provide opportunities to for people to undertake physical activity and/or minimise sedentary behaviour, are unlikely to produce active lifestyles among those who are not motivated or capable of performing physical activity or minimising sedentary behaviour. It is therefore important to ensure strategies designed to support more people in inner-regional Australia to adopt active lifestyles focus on fostering autonomous motivation for active lifestyles, in addition to enhancing opportunities for active lifestyles within the physical environment, and fostering capability for physical activity and the avoidance of sedentary behaviour among inner-regional Australians. The need for social interaction and the influence of normative beliefs appear to be particularly important in inner-regional settings. Therefore, strategies to encourage active lifestyles in inner-regional Australia may further benefit by promoting social interaction as a benefit of physical activity participation, in addition to highlighting social approval of active lifestyle behaviours.
References


Appendix A: Study One Ethics Approval

11 April 2016

Ms Jenny Olson

Dear Jenny

The USQ Human Research Ethics Committee has recently reviewed your responses to the conditions placed upon the ethical approval for the project outlined below. Your proposal is now deemed to meet the requirements of the National Statement on Ethical Conduct in Human Research (2007) and full ethical approval has been granted.

<table>
<thead>
<tr>
<th>Approval No.</th>
<th>H16REA105</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Title</td>
<td>What are the factors that influence sitting and physical activity in inner-regional Australia?</td>
</tr>
<tr>
<td>Approval date</td>
<td>12 April 2016</td>
</tr>
<tr>
<td>Expiry date</td>
<td>12 April 2019</td>
</tr>
<tr>
<td>HREC Decision</td>
<td>Approved</td>
</tr>
</tbody>
</table>

The standard conditions of this approval are:

(a) conduct the project strictly in accordance with the proposal submitted and granted ethics approval, including any amendments made to the proposal required by the HREC
(b) advise (email: ethics@usq.edu.au) immediately of any complaints or other issues in relation to the project which may warrant review of the ethical approval of the project
(c) make submission for approval of amendments to the approved project before implementing such changes
(d) provide a ‘progress report’ for every year of approval
(e) provide a ‘final report’ when the project is complete
(f) advise in writing if the project has been discontinued, using a ‘final report’

For (c) to (f) forms are available on the USQ ethics website:
http://www.usq.edu.au/research/support-development/research-services/research-integrity-ethics/human/forms
Appendix B: Study One Participant Information Sheet and Informed Consent

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**Participant Information for USQ Research Project Questionnaire and Interview**

**Project Details**

<table>
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<tr>
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<th>What are the factors that influence sitting and physical activity in inner-regional Australia?</th>
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<td>Human Research Ethics Approval Number:</td>
<td>H16REA105</td>
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</table>

**Research Team Contact Details**

<table>
<thead>
<tr>
<th>Principal Investigator Details</th>
<th>Supervisor Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mrs Jenny Olson</td>
<td>Dr Michael Ireland</td>
</tr>
<tr>
<td>Email: <a href="mailto:Jenny.Olson@usq.edu.au">Jenny.Olson@usq.edu.au</a></td>
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<td>Telephone: +81 80 4292 9129</td>
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<tr>
<td>(Japan)</td>
<td></td>
</tr>
<tr>
<td>Mobile: +81 80 4292 9129 (Japan)</td>
<td></td>
</tr>
</tbody>
</table>

**Description**

This project is being undertaken as part of a PhD program.

The purpose of this project is to identify aspects of 'regionality' (relating to the setting where you live) that influence participation in physical activity (any activity that gets your body moving, and makes your breathing quicker and your heart beat faster) and sedentary behaviour (activities undertaken whilst sitting that result in low energy expenditure). How these aspects vary in different settings and their influence upon active lifestyle behaviours will be investigated.

The research team requests your assistance because we are seeking to understand what it is about place of residence that influences both physical activity and sedentary behaviour.

**Participation**

Initially you will be asked to complete a brief eligibility checklist to confirm your eligibility to participate in the study. Questions will include whether you are over 18 years of age, what your residential postcode is, and how long you have lived in the region?

Next, your participation will involve completion of an anonymous questionnaire that will take approximately 10 minutes of your time. The questionnaire will ask for general information such as...
your gender, age, and employment status. Finally, your participation will involve an interview that will take approximately 40-60 minutes of your time.

The interview will be undertaken by teleconference (either on the telephone, or online with Skype or Zoom) at a date and time that is convenient to you.

Questions will be about environmental and social factors relevant to where your live that may or may not influence the performance of physical activity and common sedentary activities. For example:

- What kind of activities do you perform while sitting and where do you do them?
- What kind of physical activity do you perform?
- What sport and recreation activities and facilities are available in your region?
- How safe do you feel your residential area is?

A copy of your anonymous questionnaire responses will be retained by the researcher and by the University of Southern Queensland.

The interview will be audio recorded and transcribed. A copy of the audio recording and transcription will be retained by the researchers and by the University of Southern Queensland.

Non-identifiable research data may be made available for use by other researchers in accordance with the Australian Code for the Responsible Conduct of Research (2.5.2).

Your participation in this project is entirely voluntary. If you do not wish to take part you are not obliged to. If you decide to take part and later change your mind, you are free to withdraw from the project at any stage. You are able to withdraw your data from the online questionnaire at any time prior to clicking the submit button. As the questionnaire is anonymous, you will be unable to withdraw your data after submitting the survey. You may also request that any interview data collected about you be destroyed. If you do wish to withdraw from this project or withdraw data collected about you, please contact the Research Team (contact details at the top of this form).

Your decision whether you take part, do not take part, or to take part and then withdraw, will in no way impact your current or future relationship with the University of Southern Queensland.

To thank you for your participation a you will be entered into a prize draw to win one of two $50 pre-paid visa cards.

A brief summary of the overall results of the study will be made available by request only. Individual feedback will not be provided. Please contact the Research Team (contact details at the top of this form) for further information.

### Expected Benefits

It is expected that this project will not directly benefit you. However, it is hoped that the results of this study might help the researchers to understand factors that predict physical activity and sedentary behaviour. Such information will help inform clinicians and researchers in how to encourage people to undertake regular physical activity and to minimize sedentary behaviour for health benefit.

### Risks
• There are minimal risks associated with your participation in this project. Sometimes thinking about the sorts of issues raised in the interview can create some uncomfortable or distressing feelings. If you need to talk to someone about this immediately please contact Beyond Blue telephone counselling services on 1300 22 4636. You may also wish to consider consulting your General Practitioner (GP) for additional support.

Privacy and Confidentiality

All comments and responses will be treated confidentially unless required by law.

The interview will be audio recorded and then transcribed by a professional transcription service. It is not possible to participate in this project without being recorded. You will be provided a copy of the transcript of the interview and given an opportunity to verify your comments and responses prior to final inclusion. The audio recording will not be used for any purpose other than what has been described in this study.

The audio recording and any other data collected as a part of this project will be retained by the researchers and stored securely as per University of Southern Queensland’s Research Data Management policy.

Consent to Participate

Clicking on the ‘Submit’ button at the conclusion of the online questionnaire is accepted as an indication of your consent to participate in both the online questionnaire and the interview components of this study.

Questions or Further Information about the Project

Please refer to the Research Team Contact Details at the top of the form to have any questions answered or to request further information about this project.

Please include your email address at the end of your signed consent form if you would like us to send you a copy of the results of this study.

Concerns or Complaints Regarding the Conduct of the Project

If you have any concerns or complaints about the ethical conduct of the project you may contact the University of Southern Queensland Ethics Coordinator on (07) 4631 2690 or email ethics@usq.edu.au. The Ethics Coordinator is not connected with the research project and can facilitate a resolution to your concern in an unbiased manner.

Thank you for taking the time to help with this research project. Please keep this sheet for your information.
Consent Form for USQ Research Project
Focus Group

Project Details

Title of Project: What are the factors that influence sitting and physical activity in inner-regional Australia?
Human Research Ethics Approval Number: H16REA105

Research Team Contact Details

Principal Investigator Details
Mrs Jenny Olson
Email: Jenny.Olson@usq.edu.au
Telephone: +61 80 4292 9129
Mobile: +61 80 4292 9129

Supervisor Details
Dr Michael Ireland
Email: Michael.Ireland@usq.edu.au
Telephone: +61 7 3470 4497

Statement of Consent

By clicking the ‘submit’ button at the conclusion of this survey, you are indicating that you:

- Have read and understood the information document regarding this project.
- Have had any questions answered to your satisfaction.
- Understand that if you have any additional questions you can contact the research team.
- Understand that the researcher will retain a copy of your responses to the anonymous questionnaire.
- Understand that the interview will be audio / video recorded.
- Understand that I will be provided with a copy of the transcript of the interview for my perusal and endorsement prior to inclusion of this data in the project.
- Understand that the researcher will retain a copy of the audio recording and transcript of the interview.
- Understand that non-identifiable research data may be made available for use by other researchers in accordance with the Australian Code for the Responsible Conduct of Research (2.5.2).
- Understand that participation is voluntary and there will be no negative consequences arising from non-participation.
• Understand that you are free to withdraw at any time or decline to respond to any particular question or discussion, without comment or penalty.

• Understand that if you wish to withdraw from the project after you have submitted the questionnaire, it will not be possible to withdraw your data, as all responses will be anonymous.

• Understand that if you wish to withdraw from the project, it will be possible to withdraw your interview data.

• Understand that you can contact the University of Southern Queensland Ethics Coordinator on (07) 4631 2690 or email ethics@usq.edu.au if you do have any concern or complaint about the ethical conduct of this project.

• Are over 18 years of age.

• Agree to participate in the project.
Appendix C: Study One Online Questionnaire

Eligibility Questions

Please answer the following question(s) to find out if you are eligible to participate in the study:

- **Q1** Are you 18 years of age or older?
  - Yes (1)
  - No (2)

- **Q2** Which region do you live in?
  - Toowoomba (1)
  - The Lockyer Valley (2)
  - Somerset (3)
  - The Scenic Rim (4)
  - The Southern Downs (5)
  - None of these (6)

- **Q3** Have you lived in Toowoomba/Lockyer Valley/Somerset/Scenic Rim/Southern Downs for at least one year?
  - Yes (1)
  - No (2)

- **Q4** What is your postcode?

Demographics

This brief, anonymous questionnaire asks a few questions about you. We need to ask these questions as it is important to understand the characteristics of the people participating in the study.

- **Q1** Are you
  - Male (1)
  - Female (2)

- **Q2** Please indicate your age in years

- **Q3** What is the highest educational qualification you have completed?
  - Year 9 or less (1)
  - Year 10 (Junior/4th form) (2)
  - Year 11 (Senior/5th form) (3)
  - Year 12 (Senior/6th form) (4)
  - Certificate (trade or business) (5)
  - Diploma or Associate Degree (6)
  - Bachelor Degree (Pass or Honours) (7)
  - Graduate Diploma or Graduate Certificate (8)
  - Postgraduate degree (Masters degree or Doctorate) (9)
  - Other (please specify) (10)

- **Q4** Which ONE of the following best describes your current employment situation?
  - Full time paid work in a job, business or profession (1)
  - Part time paid work in a job, business or profession (2)
  - Casual paid work in a job, business or profession (3)
  - Work without pay in a family or other business (4)
  - Home duties - not looking for work (5)
  - Unemployed - looking for work (6)
• Q5 What is your current occupation? (If you have more than one job, we are interested in your main job)
  o Retired (7)
  o Permanently unable to work (8)
  o Student (9)
  o Other (please specify) (10)
• Q6 Do you have a motor vehicle available for your personal use?
  o Yes, always (1)
  o Yes, sometimes (2)
  o No (3)
  o Do not drive (4)
  o Definitely not (5)
• Q7 Which one best describes your cigarette smoking?
  o I smoke daily (1)
  o I smoke occasionally (2)
  o I don't smoke now, but I used to (3)
  o I have never smoked (4)
• Q8 How tall are you without shoes on? Please tell us in centimetres.
• Q9 How much do you weigh without your clothes and shoes on? Please tell us in kilograms.

Thank you for completing this questionnaire. Upon clicking the submit button, you will be directed to a page to submit your details for participation in the interview. Please note that all contact details will be submitted separately from your responses to the questions you have just answered, to ensure that all responses remain completely anonymous.

Contact Details

Please provide your contact details, so that the researchers can contact you to arrange a suitable time to conduct the interview.

• Q1 What is your first name?
• Q2 What is your surname?
• Q3 What is your email address?
• Q4 Please confirm your email address:
• Q5 What is your phone number?
• Q6 Do you wish to receive a copy of the study results?
  o Yes (1)
  o No (2)
Appendix D: Study One Interview Guide

- Thank you for agreeing to participate in this study.
- Audio check
- Self-introduction
- So, I will ask a few questions, and would like you to answer with as much detail as you can. I will try not to interrupt you, so that you have the opportunity to share as much information as possible. If I need to know more info I will ask you.
- Reminder that the interview will be taped.
  - Start taping now.
- Which town/suburb/region do you live in?
  - How long have you lived there?
- Tell me about what it is like living in [NAME OF TOWN]? (Think about both the natural environment and the built environment)
  - What do you like best living in [NAME OF TOWN]?
  - What do you dislike about living in [NAME OF TOWN]?
- How do people in [NAME OF TOWN] get along/relate to each other?
  - Do you experience a sense of neighbourliness or community spirit in [NAME OF TOWN]? Why/Why not?
- Is [NAME OF TOWN] a safe place to live? Why/why not?
  - Would the level of crime/safety influence whether people walked during the day and at night time in XXX? (Or activities other than walking?) Why/why not?
- What is the traffic like in [NAME OF TOWN]?
  - Would the traffic in [NAME OF TOWN] influence whether people walked during the day and at night time in [NAME OF TOWN]? (Or activities other than walking?) Why/why not?
  - What is the main means of transport for yourself and other people you know in [NAME OF TOWN]? Why?
  - Is walking a viable means of transport for many people living in [NAME OF TOWN]? Why/why not?
- How good/bad is the access to business, services and facilities in [NAME OF TOWN]? What is and is not available?
  - What about access to sporting and recreational facilities/organisations in [NAME OF TOWN]?
  - Are there popular recreational activities that are not specifically sport or fitness based?
- What do you think it is about living in [NAME OF TOWN] that might influence the amount of time people spend sitting (and the type of activities they perform whilst sitting)?
  - What type of activities do you perform while sitting, and where do you do them?
- What do you think it is about living in [NAME OF TOWN] that might influence the type of physical activity people do, and the time they spend doing it?
  - What type of physical activities do you perform, and where do you do them?
- Is there anything else that you can think of that I should have asked you, or that you would like to tell me about life in [NAME OF TOWN]?
- Where did you hear about/see this study?
- Describe prize draw – to be conducted at the conclusion of all interviews.
- This study forms part of a larger research project involving 2 more studies (one more interview style study, and a questionnaire).
  - Would you be interested in participating in future studies?
  - Do you know others who might be willing to participate? Would you provide them with my contact details?

Thank you so much for your participation. If you requested a copy of the results of the study, this will be provided by email at the conclusion of the study, after the data collected has been analysed.
Appendix E: Study One COREQ Checklist

Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

Developed from:


<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Guide questions/description</th>
<th>Reported on Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Domain 1: Research team and reflexivity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Interviewer/facilitator</td>
<td>Which author/s conducted the interview or focus group?</td>
<td>6</td>
</tr>
<tr>
<td>2.</td>
<td>Credentials</td>
<td>What were the researcher’s credentials? E.g. PhD, MD</td>
<td>6</td>
</tr>
<tr>
<td>3.</td>
<td>Occupation</td>
<td>What was their occupation at the time of the study?</td>
<td>6</td>
</tr>
<tr>
<td>4.</td>
<td>Gender</td>
<td>Was the researcher male or female?</td>
<td>6</td>
</tr>
<tr>
<td>5.</td>
<td>Experience and training</td>
<td>What experience or training did the researcher have?</td>
<td>6</td>
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<tr>
<td></td>
<td><strong>Relationship with participants</strong></td>
<td></td>
<td></td>
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<tr>
<td>6.</td>
<td>Relationship established</td>
<td>Was a relationship established prior to study commencement?</td>
<td>6</td>
</tr>
<tr>
<td>7.</td>
<td>Participant knowledge of the interviewer</td>
<td>What did the participants know about the researcher? e.g. personal goals, reasons for doing the research</td>
<td>6</td>
</tr>
<tr>
<td>8.</td>
<td>Interviewer characteristics</td>
<td>What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic</td>
<td>6</td>
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<tr>
<td></td>
<td><strong>Domain 2: study design</strong></td>
<td></td>
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<tr>
<td>9.</td>
<td>Theoretical framework</td>
<td>What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td><strong>Participant selection</strong></td>
<td></td>
<td></td>
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<tr>
<td>10.</td>
<td>Sampling</td>
<td>How were participants selected? e.g. purposive, convenience, consecutive, snowball</td>
<td>5</td>
</tr>
<tr>
<td>11.</td>
<td>Method of approach</td>
<td>How were participants approached? e.g. face-to-face, telephone, mail, email</td>
<td>5</td>
</tr>
<tr>
<td>12.</td>
<td>Sample size</td>
<td>How many participants were in the study?</td>
<td>6</td>
</tr>
<tr>
<td>13.</td>
<td>Non-participation</td>
<td>How many people refused to participate or dropped out? Reasons?</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td><strong>Setting</strong></td>
<td></td>
<td></td>
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<tr>
<td>14.</td>
<td>Setting of data collection</td>
<td>Where was the data collected? e.g. home, clinic, workplace</td>
<td>6</td>
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<tr>
<td>15.</td>
<td>Presence of non-participants</td>
<td>Was anyone else present besides the participants and researchers?</td>
<td>6</td>
</tr>
<tr>
<td>16.</td>
<td>Description of sample</td>
<td>What are the important characteristics of the</td>
<td>6</td>
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</tbody>
</table>
### Data collection

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Were questions, prompts, guides provided by the authors? Was it pilot tested?</td>
<td>6</td>
</tr>
<tr>
<td>Were repeat interviews carried out? If yes, how many?</td>
<td>NA</td>
</tr>
<tr>
<td>Did the research use audio or visual recording to collect the data?</td>
<td>6</td>
</tr>
<tr>
<td>Were field notes made during and/or after the interview or focus group?</td>
<td>No</td>
</tr>
<tr>
<td>What was the duration of the interview or focus group?</td>
<td>6</td>
</tr>
<tr>
<td>Was data saturation discussed?</td>
<td>6</td>
</tr>
<tr>
<td>Were transcripts returned to participants for comment and/or correction?</td>
<td>6</td>
</tr>
</tbody>
</table>

### Domain 3: analysis and findings

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>How many data coders coded the data?</td>
<td>7</td>
</tr>
<tr>
<td>Did authors provide a description of the coding tree?</td>
<td>No</td>
</tr>
<tr>
<td>Were themes identified in advance or derived from the data?</td>
<td>6 &amp; 7</td>
</tr>
<tr>
<td>What software, if applicable, was used to manage the data?</td>
<td>6</td>
</tr>
<tr>
<td>Did participants provide feedback on the findings?</td>
<td>No</td>
</tr>
</tbody>
</table>

### Reporting

<table>
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<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Were participant quotations presented to illustrate the themes/findings?</td>
<td>Yes, throughout results 7-12</td>
</tr>
<tr>
<td>Was there consistency between the data presented and the findings?</td>
<td>Yes 7-12</td>
</tr>
<tr>
<td>Were major themes clearly presented in the findings?</td>
<td>Yes 7-12</td>
</tr>
<tr>
<td>Is there a description of diverse cases or discussion of minor themes?</td>
<td>Yes 7-12</td>
</tr>
</tbody>
</table>
Appendix F: Study Two Ethics Approval

26 April 2016

Ms Jenny Olson

Dear Jenny

The USQ Human Research Ethics Committee has recently reviewed your responses to the conditions placed upon the ethical approval for the project outlined below. Your proposal is now deemed to meet the requirements of the National Statement on Ethical Conduct in Human Research (2007) and full ethical approval has been granted.

<table>
<thead>
<tr>
<th>Approval No.</th>
<th>H16REA117</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Title</td>
<td>Beliefs, barriers and facilitators of time spent sitting and undertaking physical activity in regional Australia</td>
</tr>
<tr>
<td>Approval date</td>
<td>26 April 2016</td>
</tr>
<tr>
<td>Expiry date</td>
<td>26 April 2019</td>
</tr>
<tr>
<td>HREC Decision</td>
<td>Approved</td>
</tr>
</tbody>
</table>

The standard conditions of this approval are:

(a) conduct the project strictly in accordance with the proposal submitted and granted ethics approval, including any amendments made to the proposal required by the HREC

(b) advise (email: ethics@usq.edu.au) immediately of any complaints or other issues in relation to the project which may warrant review of the ethical approval of the project

(c) make submission for approval of amendments to the approved project before implementing such changes

(d) provide a ‘progress report’ for every year of approval

(e) provide a ‘final report’ when the project is complete

(f) advise in writing if the project has been discontinued, using a ‘final report’

For (c) to (f) forms are available on the USQ ethics website:
http://www.usq.edu.au/research/support-development/research-services/research-integrity-ethics/human/forms
Participant Information for USQ Research Project Interview

Project Details

Title of Project: Beliefs, barriers and facilitators of time spent sitting and undertaking physical activity in regional Australia.
Human Research Ethics Approval Number: H16REA117

Research Team Contact Details

Principal Investigator Details
Mrs Jenny Olson
Email: Jenny.Olson@usq.edu.au
Telephone: +61 80 4292 9129 (Japan)
Mobile: +61 80 4292 9129 (Japan)

Supervisor Details
Dr Michael Ireland
Email: Michael.Ireland@usq.edu.au
Telephone: (07) 3470 4497

Description

This project is being undertaken as part of a PhD program.

The purpose of this project is to identify beliefs, facilitators and barriers of active lifestyle behaviours in regional Australia. The study will explore the range of viewpoints that influence common activities undertaken whilst sitting in addition to common physical activities.

The research team requests your assistance because we are seeking to understand beliefs in relation to physical activity and sedentary behaviour of people residing in regional Australia.

Participation

Initially you will be asked to complete a brief eligibility checklist to confirm your eligibility to participate in the study. Questions will include whether you are over 18 years of age, what your residential postcode is, and how long you have lived in the region.

Next, your participation will involve completion of an anonymous questionnaire that will take approximately 10 minutes of your time. The questionnaire will ask for general information such as your gender, age, and employment status. Finally, your participation will involve an interview that will take approximately 40-60 minutes of your time.

The interview will be undertaken by teleconference (either on the telephone, or online with Skype or Zoom) at a date and time that is convenient to you.
Questions will explore beliefs in relation to active living that may or may not influence the performance of physical activity and common sedentary activities. For example:

- What do you believe are the advantages of performing regular physical activity?
- What do you believe are the disadvantages of performing regular physical activity?
- Is there anything else you associate with performing regular physical activity?
- What do you believe are the advantages of spending time sitting and watching television?
- What do you believe are the disadvantages of spending time sitting and watching television?
- Is there anything else you associate with spending time sitting and watching television?

A copy of your anonymous questionnaire responses will be retained by the researcher and by the University of Southern Queensland.

Non-identifiable research data may be made available for use by other researchers in accordance with the Australian Code for the Responsible Conduct of Research (2.5.2).

The interview will be audio recorded and transcribed. A copy of the audio recording and transcription will be retained by the researchers and by the University of Southern Queensland.

Your participation in this project is entirely voluntary. If you do not wish to take part you are not obliged to. If you decide to take part and later change your mind, you are free to withdraw from the project at any stage. You are able to withdraw your data from the online questionnaire at any time prior to clicking the submit button. As the questionnaire is anonymous, you will be unable to withdraw your data after submitting the survey. You may also request that any interview data collected about you be destroyed. If you do wish to withdraw from this project or withdraw data collected about you, please contact the Research Team (contact details at the top of this form).

Your decision whether you take part, do not take part, or to take part and then withdraw, will in no way impact your current or future relationship with the University of Southern Queensland.

To thank you for your participation a you will be entered into a prize draw to win one of two $50 pre-paid visa cards.

A brief summary of the overall results of the study will be made available by request only. Individual feedback will not be provided. Please contact the Research Team (contact details at the top of this form) for further information.

**Expected Benefits**

It is expected that this project will not directly benefit you. However, it is hoped that the results of this study might help the researchers to understand factors that predict physical activity and sedentary behaviour. Such information will help inform clinicians and researchers in how to encourage people to undertake regular physical activity and to minimize sedentary behaviour for health benefit.

**Risks**

There are minimal risks associated with your participation in this project. These include:

- Sometimes thinking about the sorts of issues raised in the interview can create some uncomfortable or distressing feelings. If you need to talk to someone about this immediately please contact Beyond Blue telephone counselling services on 1300 22 4636.
You may also wish to consider consulting your General Practitioner (GP) for additional support.

**Privacy and Confidentiality**

All comments and responses will be treated confidentially unless required by law.

The interview will be audio recorded and then transcribed by a professional transcription service. It is not possible to participate in this project without being recorded. You will be provided a copy of the transcript of the interview and given an opportunity to verify your comments and responses prior to final inclusion. The audio recording will not be used for any purpose other than what has been described in this study.

The audio recording and any other data collected as a part of this project will be retained by the researchers and stored securely as per University of Southern Queensland’s Research Data Management policy.

**Consent to Participate**

Clicking on the ‘Submit’ button at the conclusion of the online questionnaire is accepted as an indication of your consent to participate in both the online questionnaire and the interview components of this study.

**Questions or Further Information about the Project**

Please refer to the Research Team Contact Details at the top of the form to have any questions answered or to request further information about this project.

Please include your email address at the end of your signed consent form if you would like us to send you a copy of the results of this study.

**Concerns or Complaints Regarding the Conduct of the Project**

If you have any concerns or complaints about the ethical conduct of the project you may contact the University of Southern Queensland Ethics Coordinator on (07) 4631 2690 or email ethics@usq.edu.au. The Ethics Coordinator is not connected with the research project and can facilitate a resolution to your concern in an unbiased manner.

Thank you for taking the time to help with this research project. Please keep this sheet for your information.
# Consent Form for USQ Research Project Interview

## Project Details

- **Title of Project:** Beliefs, barriers and facilitators of time spent sitting and undertaking physical activity in regional Australia.
- **Human Research Ethics Approval Number:** H16REA117

## Research Team Contact Details

- **Principal Investigator Details**
  - Mrs Jenny Olson
  - Email: Jenny.Olson@usq.edu.au
  - Telephone: +61 80 4292 9129
  - Mobile: +61 80 4292 9129

- **Supervisor Details**
  - Dr Michael Ireland
  - Email: Michael.Ireland@usq.edu.au
  - Telephone: +61 7 3470 4497

## Statement of Consent

By clicking the 'submit' button at the conclusion of this survey, you are indicating that you:

- Have read and understood the information document regarding this project.
- Have had any questions answered to your satisfaction.
- Understand that if you have any additional questions you can contact the research team.
- Understand that the researcher will retain a copy of your responses to the anonymous demographic questionnaire.
- Understand that the interview will be audio recorded.
- Understand that you will be provided with a copy of the transcript of the interview for perusal and endorsement prior to inclusion of this data in the project.
- Understand that the researcher will retain a copy of the audio recording and transcript of the interview.
- Understand that non-identifiable research data may be made available for use by other researchers in accordance with the Australian Code for the Responsible Conduct of Research (2.5.2).
- Understand that participation is voluntary and there will be no negative consequences arising from non-participation.
- Understand that you are free to withdraw at any time or decline to respond to any particular question or discussion, without comment or penalty.
- Understand that if you wish to withdraw from the project after you have submitted the questionnaire, it will not be possible to withdraw your data, as all responses will be anonymous.

- Understand that if you wish to withdraw from the project, it will be possible to withdraw your interview data.

- Understand that you can contact the University of Southern Queensland Ethics Coordinator on (07) 4631 2690 or email ethics@usq.edu.au if you do have any concern or complaint about the ethical conduct of this project.

- Are over 18 years of age.

- Agree to participate in the project.
Appendix H: Study Two Online Questionnaire

Eligibility Questions

Please answer the following question(s) to find out if you are eligible to participate in the study:

- **Q1 Are you 18 years of age or older?**
  - Yes (1)
  - No (2)
- **Q2 Which region do you live in?**
  - Toowoomba (1)
  - The Lockyer Valley (2)
  - Somerset (3)
  - The Scenic Rim (4)
  - The Southern Downs (5)
  - None of these (6)
- **Q3 Have you lived in Toowoomba/Lockyer Valley/Somerset/Scenic Rim/Southern Downs for at least one year?**
  - Yes (1)
  - No (2)
- **Q4 What is your postcode?**

Demographics

This brief, anonymous questionnaire asks a few questions about you. We need to ask these questions as it is important to understand the characteristics of the people participating in the study.

- **Q1 Are you**
  - Male (1)
  - Female (2)
- **Q2 Please indicate your age in years**
- **Q3 What is the highest educational qualification you have completed?**
  - Year 9 or less (1)
  - Year 10 (Junior/4th form) (2)
  - Year 11 (Senior/5th form) (3)
  - Year 12 (Senior/6th form) (4)
  - Certificate (trade or business) (5)
  - Diploma or Associate Degree (6)
  - Bachelor Degree (Pass or Honours) (7)
  - Graduate Diploma or Graduate Certificate (8)
  - Postgraduate degree (Masters degree or Doctorate) (9)
  - Other (please specify) (10)
- **Q4 Which ONE of the following best describes your current employment situation?**
  - Full time paid work in a job, business or profession (1)
  - Part time paid work in a job, business or profession (2)
  - Casual paid work in a job, business or profession (3)
  - Work without pay in a family or other business (4)
  - Home duties - not looking for work (5)
  - Unemployed - looking for work (6)
• Q5 What is your current occupation? (If you have more than one job, we are interested in your main job)
  o Retired (7)
  o Permanently unable to work (8)
  o Student (9)
  o Other (please specify) (10)
• Q6 Do you have a motor vehicle available for your personal use?
  o Yes, always (1)
  o Yes, sometimes (2)
  o No (3)
  o Do not drive (4)
  o Definitely not (5)
• Q7 Which one best describes your cigarette smoking?
  o I smoke daily (1)
  o I smoke occasionally (2)
  o I don't smoke now, but I used to (3)
  o I have never smoked (4)
• Q8 How tall are you without shoes on? Please tell us in centimetres.
• Q9 How much do you weigh without your clothes and shoes on? Please tell us in kilograms.
• Q10 Do you perceive the place where you live to be 'in town' or 'out of town'?
  o In town (1)
  o Out of town (2)

Thank you for completing this questionnaire. Upon clicking the submit button, you will be directed to a page to submit your details for participation in the interview. Please note that all contact details will be submitted separately from your responses to the questions you have just answered, to ensure that all responses remain completely anonymous.

Contact Details

Please provide your contact details, so that the researchers can contact you to arrange a suitable time to conduct the interview.

• Q1 What is your first name?
• Q2 What is your surname?
• Q3 What is your email address?
• Q4 Please confirm your email address:
• Q5 What is your phone number?
• Q6 Do you wish to receive a copy of the study results?
  o Yes (1)
  o No (2)
Appendix I: Study Two Interview Guide

Preliminary Questions

- Audio check
- Warm-up chat
- Encourage open discussion
- Reminder that interview will be recorded
- Start recording
- Can I please confirm which local government area you live in?
- Which town do you live in?
- Do you live in town, or outside of town?
- How many years have you live there?

Physical Activity

Think about doing any activity physical activity you do. (Anything that increases your heart rate and speeds up your breathing) This could be done at work, at home, for travel, for sport, leisure, or health and fitness.

- What kinds of activities do you do?
  - Why do you do these particular activities?
  - How long do you spend doing them?
  - Where do you do them?
- What do you believe are the benefits of performing regular physical activity?
- What do you believe are the disadvantages of performing regular physical activity?
- What kind of things get in the way of you performing regular physical activity?
- What sort of things help/encourage you to perform physical activity?
- Do you believe that living in a regional area influences the amount of PA that you do?
  - If so, in what ways?

Sedentary Behaviour

Think about all of the activities that you might do while sitting. These activities could be done at home, at work, for transport, for leisure, or while socialising.

- What kind of activities do you do while sitting?
  - Why do you perform these particular activities?
  - Where do you do them?
  - How long do you spend doing them?
  - How frequently would you get up and move around for at least 5 minutes when you are doing these activities?
- What are the advantages of performing these activities?
- What are the disadvantages of performing these activities?
- What are the advantages and disadvantages of taking regular breaks from sitting activities?
- What sort of things help you to minimise the amount of time you spend sitting?
- What sort of things hinder you from minimising the amount of time you spend sitting?
- What factors help or hinder you to take regular breaks when spending long periods sitting?
- Do you believe that living in a regional area influences the amount of sitting that you do?
  - If so, in what ways?
- Is there anything that I haven’t asked you, that I should have, in order to better understand active lifestyles in regional Australia?
Appendix J: Study Two COREQ Checklist

Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

Developed from:


<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Guide questions/description</th>
<th>Reported on Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Domain 1: Research team and reflexivity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Interviewer/facilitator</td>
<td>Which author/s conducted the interview or focus group?</td>
<td>7</td>
</tr>
<tr>
<td>2.</td>
<td>Credentials</td>
<td>What were the researcher’s credentials? E.g. PhD, MD</td>
<td>7</td>
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<tr>
<td>3.</td>
<td>Occupation</td>
<td>What was their occupation at the time of the study?</td>
<td>7</td>
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<tr>
<td>4.</td>
<td>Gender</td>
<td>Was the researcher male or female?</td>
<td>7</td>
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<tr>
<td>5.</td>
<td>Experience and training</td>
<td>What experience or training did the researcher have?</td>
<td>7</td>
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<tr>
<td></td>
<td><strong>Relationship with participants</strong></td>
<td></td>
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<tr>
<td>6.</td>
<td>Relationship established</td>
<td>Was a relationship established prior to study commencement?</td>
<td>7</td>
</tr>
<tr>
<td>7.</td>
<td>Participant knowledge of the interviewer</td>
<td>What did the participants know about the researcher? e.g. personal goals, reasons for doing the research</td>
<td>7</td>
</tr>
<tr>
<td>8.</td>
<td>Interviewer characteristics</td>
<td>What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic</td>
<td>7</td>
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<tr>
<td></td>
<td><strong>Domain 2: study design</strong></td>
<td></td>
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<td></td>
<td><strong>Theoretical framework</strong></td>
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<tr>
<td>9.</td>
<td>Methodological orientation and Theory</td>
<td>What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td><strong>Participant selection</strong></td>
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<tr>
<td>10.</td>
<td>Sampling</td>
<td>How were participants selected? e.g. purposive, convenience, consecutive, snowball</td>
<td>7</td>
</tr>
<tr>
<td>11.</td>
<td>Method of approach</td>
<td>How were participants approached? e.g. face-to-face, telephone, mail, email</td>
<td>7</td>
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<tr>
<td>12.</td>
<td>Sample size</td>
<td>How many participants were in the study?</td>
<td>7</td>
</tr>
<tr>
<td>13.</td>
<td>Non-participation</td>
<td>How many people refused to participate or dropped out? Reasons?</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td><strong>Setting</strong></td>
<td></td>
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<td>14.</td>
<td>Setting of data collection</td>
<td>Where was the data collected? e.g. home, clinic, workplace</td>
<td>8</td>
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<tr>
<td>15.</td>
<td>Presence of non-participants</td>
<td>Was anyone else present besides the participants and researchers?</td>
<td>8</td>
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<tr>
<td>16.</td>
<td>Description of sample</td>
<td>What are the important characteristics of the</td>
<td>7</td>
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<tr>
<td>Domain 3: analysis and findings</td>
<td>Data collection</td>
<td>Reporting</td>
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<tr>
<td>Data collection</td>
<td></td>
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<tr>
<td>17. Interview guide</td>
<td>Were questions, prompts, guides provided by the authors? Was it pilot tested?</td>
<td>8</td>
<td></td>
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<tr>
<td>18. Repeat interviews</td>
<td>Were repeat interviews carried out? If yes, how many?</td>
<td>NA</td>
<td></td>
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<tr>
<td>19. Audio/visual recording</td>
<td>Did the research use audio or visual recording to collect the data?</td>
<td>8</td>
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<tr>
<td>20. Field notes</td>
<td>Were field notes made during and/or after the interview or focus group?</td>
<td>NA</td>
<td></td>
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<tr>
<td>21. Duration</td>
<td>What was the duration of the interviews or focus group?</td>
<td>8</td>
<td></td>
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<tr>
<td>22. Data saturation</td>
<td>Was data saturation discussed?</td>
<td>8</td>
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<tr>
<td>23. Transcripts returned</td>
<td>Were transcripts returned to participants for comment and/or correction?</td>
<td>8</td>
<td></td>
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<tr>
<td>Domain 3: analysis and findings</td>
<td></td>
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<tr>
<td>Data analysis</td>
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<tr>
<td>24. Number of data coders</td>
<td>How many data coders coded the data?</td>
<td>8</td>
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<tr>
<td>25. Description of the coding tree</td>
<td>Did authors provide a description of the coding tree?</td>
<td>NA</td>
<td></td>
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<tr>
<td>26. Derivation of themes</td>
<td>Were themes identified in advance or derived from the data?</td>
<td>8</td>
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<tr>
<td>27. Software</td>
<td>What software, if applicable, was used to manage the data?</td>
<td>8</td>
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<tr>
<td>28. Participant checking</td>
<td>Did participants provide feedback on the findings?</td>
<td>NA</td>
<td></td>
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<tr>
<td>Reporting</td>
<td></td>
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<tr>
<td>29. Quotations presented</td>
<td>Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number</td>
<td>9-21 Not identified per journal requirements</td>
<td></td>
</tr>
<tr>
<td>30. Data and findings consistent</td>
<td>Was there consistency between the data presented and the findings?</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>31. Clarity of major themes</td>
<td>Were major themes clearly presented in the findings?</td>
<td>9-21</td>
<td></td>
</tr>
<tr>
<td>32. Clarity of minor themes</td>
<td>Is there a description of diverse cases or discussion of minor themes?</td>
<td>9-21</td>
<td></td>
</tr>
</tbody>
</table>
Appendix K: Study Three Ethics Approval

Saturday, January 5, 2019 at 5:36:29 PM Australian Western Standard Time

Subject: USQ HREC H17REA077 Application Approval Notice - Jenny Olson
Date: Wednesday, 3 May 2017 at 9:15:13 am Australian Western Standard Time
From: Human Ethics
To: Jenny Olson
CC: Michael Ireland, Human Ethics

Dear Jenny,

I am pleased to confirm your human research ethics application has been granted full ethical approval as your research proposal has been deemed to meet the requirements of the National Statement on Ethical Conduct in Human Research (2007).

Project Title: H17REA077 - How do the characteristics of residential setting influence active lifestyles throughout Australia?
Approval date: 3 May 2017
Expiry date: 3 May 2020
HREC status: Approved

The standard conditions of this approval are:

- a) conduct the project strictly in accordance with the proposal submitted and ethics approval, including any amendments made to the proposal required by the HREC.
- b) advise human.ethics@usq.edu.au, immediately of any complaints or other issues in relation to the project which may warrant review of the ethical approval of the project.
- c) make submission for approval of any amendments to the approved project prior to implementing changes.
- d) provide a ‘milestone report’ for every year of approval.
- e) Provide a ‘milestone report’ when the project is completed.

The additional conditionals of this approval are:

- Nil.

Please note that failure to comply with the conditions of approval and the National Statement (2007), may result in withdrawal of approval for the project.

If you have any questions or concerns, please don't hesitate to make contact with an Ethics Officer.

Congratulations on your ethical approval! Wishing you all the best for success!

Kindest regards,

The Human Research Ethics Team

University of Southern Queensland
Toowoomba – Queensland – 4350 – Australia
Ph: 07 4687 5703 – Ph: 07 4631 2690
Email: human.ethics@usq.edu.au
Appendix L: Study Three Participant Information Sheet and Informed Consent

Participant Information for USQ Research Project Questionnaire

Project Details

Title of Project: How do the characteristics of residential setting influence active lifestyles throughout Australia?

Human Research Ethics Approval Number: H17REA077

Research Team Contact Details

Principal Investigator Details
Mrs Jenny Olson
Email: Jenny.Olson@usq.edu.au
Telephone: 0431 071 031

Supervisor Details
Dr Michael Ireland
Email: Michael.Ireland@usq.edu.au
Telephone: (07) 3470 4497

Description

This project is being undertaken as part of a PhD program. The purpose of the study is to examine how the setting where people live and the beliefs that people hold influence commonly performed lifestyle behaviours. Specifically, the study aims to understand how the characteristics of different geographic settings (in major city, regional, rural and remote areas) affect activities that get your body moving, and make your breathing quicker and your heart beat faster. Activities done whilst sitting that result in low energy expenditure will also be included.

The research team requests your assistance to share information about the characteristics of the area where you live, in addition to your beliefs in relation to physical activity and sedentary behaviour. It is hoped that people from a range of geographic settings (from the most remote rural environments to major cities) will take part in this study.

Participation

Your participation will involve the completion of a questionnaire that includes questions about you, the area where you live, your beliefs in relation to physical activity, and the physical activities that you do. This part of the survey will take approximately 20 minutes of your time. You will then be asked if you wish complete additional questions asking about your beliefs about sedentary behaviour and the sedentary activities that you do. These additional questions will take approximately 25 minutes of your time. (Note: If you complete both sets of questions, it is anticipated that it will take a total of approximately 45 minutes of your time.)

Questions will include:

- Do you or someone else in your household own a dog(s)?
• Overall, how would you rate your suburb/town as a place to live?
• Is public transport available to get around your local area?
• During the last 7 days, on how many days did you walk for at least 10 minutes at a time as part of your work?
• How much control do you have over the amount of time you spend sitting?

A copy of your anonymous questionnaire responses will be retained by the researcher and by the University of Southern Queensland.

Non-identifiable research data may be made available for use by other researchers in accordance with the Australian Code for the Responsible Conduct of Research (2.5.2).

Your participation in this project is entirely voluntary. If you do not wish to take part, you are not obliged to. If you decide to take part and later change your mind, you are free to withdraw from the project at any stage. Please note, that if you wish to withdraw from the project after you have submitted your responses, the Research Team are unable to remove your data from the project. If you do wish to withdraw from this project, please contact the Research Team (contact details at the top of this form).

Your decision whether you take part, do not take part, or to take part and then withdraw, will in no way impact your current or future relationship with the University of Southern Queensland.

To thank you for your participation you have the option to enter into a prize draw to win one of four $50 pre-paid visa cards. You will be provided an opportunity to submit your email address at the conclusion of the survey if you wish to enter the draw.

A brief summary of the overall results of the study will be made available by request only. Individual feedback will not be provided. You will be provided an opportunity to submit your email address at the conclusion of the survey if you wish to receive the summary of results. Please contact the Research Team (contact details at the top of this form) for further information.

All contact details collected for the purpose of entry into the prize draw or for provision of study results will be collected separately from questionnaire responses to ensure all responses remain anonymous.

### Expected Benefits

It is expected that this project will not directly benefit you. However, it is hoped that the results of this study might help the researchers to understand factors that predict physical activity and sedentary behaviour. Such information will help inform clinicians and researchers in how to support people to undertake active lifestyles for health benefit.

### Risks

There is no risk anticipated as a result of participation in this research.

### Privacy and Confidentiality

All responses will be treated confidentially unless required by law.

The names of individual persons are not required in any of the responses.

Any data collected as a part of this project will be stored securely as per University of Southern Queensland’s Research Data Management policy.
Consent to Participate

Clicking on the ‘Submit’ button at the conclusion of the questionnaire is accepted as an indication of your consent to participate in this project.

Questions or Further Information about the Project

Please refer to the Research Team Contact Details at the top of the form to have any questions answered or to request further information about this project.

Concerns or Complaints Regarding the Conduct of the Project

If you have any concerns or complaints about the ethical conduct of the project you may contact the University of Southern Queensland Ethics Coordinator on (07) 4631 2690 or email ethics@ussq.edu.au. The Ethics Coordinator is not connected with the research project and can facilitate a resolution to your concern in an unbiased manner.

Thank you for taking the time to help with this research project. Please keep this sheet for your information.
Consent Form for USQ Research Project Questionnaire

Project Details

Title of Project: How do the characteristics of residential setting influence active lifestyles throughout Australia
Human Research Ethics Approval Number: H17REA077

Research Team Contact Details

Principal Investigator Details
Mrs Jenny Olson
Email: Jenny.Olson@usq.edu.au
Telephone: +81 80 4292 9129 (Japan)
Mobile: +81 80 4292 9129 (Japan)

Supervisor Details
Dr Michael Ireland
Email: Michael.Ireland@usq.edu.au
Telephone: (07) 3470 4497

Statement of Consent

By clicking the ‘submit’ button at the conclusion of this survey, you are indicating that you:

- Have read and understood the information document regarding this project.
- Have had any questions answered to your satisfaction.
- Understand that if you have any additional questions you can contact the research team.
- Understand that you are free to withdraw at any time, without comment or penalty.
- Understand that you can contact the University of Southern Queensland Ethics Coordinator on (07) 4631 2690 or email ethics@usq.edu.au if you do have any concern or complaint about the ethical conduct of this project.
- Are over 18 years of age.
- Agree to participate in the project.
Appendix M: Study Three Sample of Recruitment Advertising

Regional Australia: Lifestyle Related Research

Participate in an online questionnaire for a chance to win one of 4 $50 prepaid Visa cards. If you are an adult living in Australia, researchers at USQ would like to hear from you for a study investigating how the setting where you live impacts common lifestyle behaviours. Participation is voluntary, and involves answering questions in an online questionnaire (takes approximately 30 minutes). To find out more, please click below:

USQIRRDEPLICENSE.AU1.QUALTRICS.COM

bit.ly
Appendix N: Study Three Questionnaire Items

Eligibility and Remoteness Classification

- What is your age in years?
- Do you currently live in Australia? yes/no
- Have you lived in Australia for at least one year? yes/no
- What is the postcode for your home address?

Social Cohesion

The following statements are about your neighbourhood and the people living around you. How much do you agree or disagree with each statement? 1 (strongly disagree) to 5 (strongly agree)

- I have a lot in common with many people in my neighbourhood
- If I no longer lived here, hardly anyone around here would notice
- I am good friends with many people in my neighbourhood
- I generally trust my neighbours to look out for my property
- I have little to do with most people in my neighbourhood

Traffic Hazards

The following statements are about traffic in your neighbourhood. How much do you agree or disagree with each statement? 1 (strongly disagree) to 5 (strongly agree)

- In my neighbourhood, there is usually a lot of traffic on the local streets
- The speed of traffic on most nearby streets is usually slow (50kph or less)
- There are many traffic slowing devices in my neighbourhood such as speed humps, roundabouts, traffic islands
- I live on or near a main road or busy through-way for motor vehicles
- In my neighbourhood there are a lot of exhaust fumes from motor vehicles
- There are a lot of heavy vehicles (trucks) on the roads in my neighbourhood

Aesthetics

The following statements are about your neighbourhood's surroundings. How much do you agree or disagree with each statement? 1 (strongly disagree) to 5 (strongly agree)

- There is a lot of greenery around my neighbourhood (trees, bushes, household gardens)
- There are many interesting things to look at in my neighbourhood
- There is tree cover along many of the footpaths in my neighbourhood
- My neighbourhood is generally free from litter or rubbish
- There are attractive buildings and homes in my neighbourhood
- There are pleasant natural features in my neighbourhood (e.g., nature reserves, beach, riverfront, bushland)
- My neighbourhood is generally free from graffiti
Infrastructure for Safety and Walking

The following statements are about streets and footpaths in your neighbourhood. How much do you agree or disagree with each statement? 1 (strongly disagree) to 5 (strongly agree)

- The streets around my neighbourhood are sealed (bitumen)
- The streets around my neighbourhood are in good condition
- Many streets in my neighbourhood have cul-de-sacs (dead-end streets)
- There are footpaths on most of the streets in my neighbourhood
- There are many four-way intersections in my neighbourhood
- Many streets in my neighbourhood are hilly
- Many roads and streets in my neighbourhood have pedestrian crossings and traffic signals
- Most footpaths in my neighbourhood are well lit at night
- Most footpaths in my neighbourhood are well maintained (flat and even, not broken or cracked)

Crime

The following statements are about crime and safety in your neighbourhood. How much do you agree or disagree with each statement? 1 (strongly disagree) to 5 (strongly agree)

- There is a lot of crime in my neighbourhood
- There are unsecured dogs in my neighbourhood
- There are a lot of snakes around my neighbourhood
- Children are safe walking around the neighbourhood during the day
- The level of crime in my neighbourhood makes it unsafe to walk on the streets at night
- There are rowdy youth on the streets or hanging around in parks in my neighbourhood
- The level of crime in my neighbourhood makes it unsafe to walk on the streets during the day
- In my neighbourhood, I would feel safe walking home at night

Neighbourhood Selection

How important were each of the following in your decision to move to your current neighbourhood? 1 (not important at all) to 5 (very important)

- Affordability of land, housing or rent
- Closeness to open space (e.g., parks)
- Ease of walking to places
- Sense of community
- Country/town lifestyle
- Closeness to schools
- Safety from crime
- Closeness to public transport
• Wanted to live close to shops
• Access to freeways or main roads
• Closeness to work
• Closeness to recreational facilities
• Closeness to childcare
• Closeness to relatives
• Closeness to city
• Near to green space/bushland
• Moved in with my spouse/partner
• Investment potential
• Other

Past Physical Activity

• In the LAST WEEK, how many times have you walked continuously, for at least 10 minutes, for recreation, exercise or to get to or from places? (number of times)
• What do you estimate was the total time that you spent walking continuously, for at least 10 minutes, for recreation, exercise or to get to or from places in the LAST WEEK? (minutes/hours)
• In the LAST WEEK, how many times did you do any vigorous household chores, gardening or heavy work around the yard, which made you breathe harder or puff and pant? (number of times)
• What do you estimate was the total time that you spent doing vigorous household chores, gardening or heavy work around the yard in the LAST WEEK? (minutes/hours)

The next questions EXCLUDE household chores, gardening or yard work.

• In the LAST WEEK, how many times did you do any VIGOROUS physical activity which made you breathe harder or puff and pant (e.g., jogging, cycling, aerobics, competitive tennis, or similar activity)? (number of times)
• What do you estimate was the total time that you spent doing any VIGOROUS physical activity which made you breathe harder or puff and pant in the LAST WEEK (e.g., jogging, cycling, aerobics, competitive tennis, or similar activity)? (minutes/hours)
• In the LAST WEEK, how many times did you do any other more MODERATE physical activities that you have not already mentioned (e.g., gentle swimming, social tennis, golf or similar activity)? (number of times)
• What do you estimate was the total time that you spent doing these more moderate activities in the LAST WEEK (e.g., gentle swimming, social tennis, golf or similar activity)? (minutes/hours)

Autonomous Motivation

Why do you do PHYSICAL ACTIVITY? We are interested in the reasons underlying peoples’ decisions whether or not to do physical activity. Using the scale below, please indicate to what extent each of the following items is true for you. Please note that there are
no right or wrong answers and no trick questions. We simply want to know how you personally feel about exercise. Your responses will be held in confidence and only used for our research purposes. 0 (not true for me) to 4 (very true for me)

- It’s important to me to do regular physical activity
- I don’t see why I should have do physical activities
- I do physical activity because it’s fun
- I feel guilty when I am not physically active
- I am physically active because it is consistent with my life goals
- I do physical activity because other people say I should
- I value the benefits of physical activity
- I can’t see why I should bother with physical activity
- I enjoy my physical activities
- I feel ashamed when I miss physical activities
- I consider physical activity part of my identity
- I take part in physical activities because my friends/family/partner say I should
- I think it is important to make the effort to do regular physical activity
- I don’t see the point in physical activity
- I find physical activity to be pleasurable
- I feel like a failure when I haven’t been physically active in a while
- I consider physical activity a fundamental part of who I am
- I do physical activities because others will not be pleased with me if I don’t
- I get restless if I don’t do regular physical activity
- I think doing physical activity is a waste of time
- I get pleasure and satisfaction from participating in physical activities
- I would feel bad about myself if I was not making time to be physically active
- I consider physical activity consistent with my values
- I feel under pressure from my friends/family to do physical activities

**Intentions**

- I intend to be physically active for at least 30 minutes on most days in the forthcoming week: 1 (extremely unlikely) to 10 (extremely likely)
- I will try to be physically active for at least 30 minutes on most days in the forthcoming week: 1 (definitely false) to 10 (definitely true)
- I plan to be physically active for at least 30 minutes on most days in the forthcoming week: 1 (strongly disagree) to 10 (strongly agree)

**Attitudes**

- For me, being physically active for at least 30 minutes on most days is:
  - 1 (harmful) to 10 (beneficial)
  - 1 (pleasant) to 10 (unpleasant)
  - 1 (good) to 10 (bad)
  - 1 (worthless) to 10 (valuable)
  - 1 (enjoyable) to 10 (unenjoyable)
Subjective Norms

- Most people who are important to me think that I: 1 (should not be physically active for at least 30 minutes on most days in the forthcoming week) to 10 (I should be physically active for at least 30 minutes on most days in the forthcoming week)
- It is expected of me that I be physically active for at least 30 minutes on most days in the forthcoming week: 1 (extremely unlikely) to 10 (extremely likely)
- The people in my life whose opinions I value would: 1 (disapprove of me being physically active for at least 30 minutes on most days in the forthcoming week) to 10 (approve of me being physically active for at least 30 minutes on most days in the forthcoming week)
- Most people who are important to me are physically active for at least 30 minutes on most days: 1 (completely false) to 10 (completely true)
- The people in my life whose opinions I value: 1 (are not physically active for at least 30 minutes on most days) to 10 (are physically active for at least 30 minutes on most days)
- Many people like me are physically active for at least 30 minutes on most days: 1 (extremely unlikely) to 10 (extremely likely)

Perceived Behavioural Control

- For me to be physically active for at least 30 minutes on most days in the forthcoming week would be: 1 (impossible) to 10 (possible)
- If I wanted to I could be physically active for at least 30 minutes on most days in the forthcoming week: 1 (definitely true) to 10 (definitely false)
- How much control do you believe you have over being physically active for at least 30 minutes on most days in the forthcoming week: 1 (no control) to 10 (complete control)
- It is mostly up to me whether or not I am physically active for at least 30 minutes on most days in the forthcoming week: 1 (strongly agree) to 10 (strongly disagree)

Automaticity

We are interested in the decisions people make to do physical activity. Using the scale below, please indicate to what extent you agree or disagree. Please note that there are no right or wrong answers. 1 (strongly disagree) to 7 (strongly agree)

- Deciding to do physical activity is something I do automatically
- Deciding to do physical activity is something I do without having to consciously remember
- Deciding to do physical activity is something I do without thinking
- Deciding to do physical activity is something I start doing before I realize I'm doing it
**Demographics**

- **Are you? (male/female)**
- **What is the highest educational qualification you have completed? 1 (year 9 or less) to 9 (postgraduate degree)**
- **Which ONE of the following best describes your current employment situation?**
  - Full-time paid work in a job, business or profession
  - Part-time paid work in a job, business or profession
  - Casual paid work in a job, business or profession
  - Work without pay in a family or other business
  - Home duties – not looking for work
  - Unemployed – looking for work
  - Retired
  - Permanently unable to work
  - Student/Other (Please specify)
- **Please add up the amount of BEFORE-TAX income received by ALL members of your household and tick the box that comes closest to this number. Please indicate income either per year, per fortnight, or per week.**

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<td>Less than 300</td>
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<td>20,800 – 25,999</td>
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<td>31,200 – 36,399</td>
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## Appendix O: Study Three Hypothesised Direct and Indirect Effects

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<td>H1d</td>
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<td>Attitudes</td>
<td>Subjective norms</td>
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<tr>
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<td></td>
<td></td>
<td>Subjective norms</td>
<td></td>
</tr>
<tr>
<td>H1g</td>
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<td>PBC</td>
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<td>H1h</td>
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<tr>
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<td>H1j</td>
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<td>Subjective norms</td>
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<td></td>
<td>Intentions</td>
<td>Attitudes</td>
</tr>
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<tr>
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<td>----------------------</td>
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<td>PBC</td>
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<td>Intention</td>
<td>PBC</td>
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Note: All associations are hypothesised to be positive. PBC = perceived behavioural control; Neighbourhood selection = neighbourhood selection for lifestyle and community. It was hypothesised that the relationship between past behaviour and automaticity would also be moderated by autonomous motivation.
Appendix P: Study Three Alpha Reliability Coefficients and Adjustments to Enhance Internal Consistency

Alpha reliability coefficients indicated acceptable internal consistency for the TPB constructs, autonomous motivation, automaticity, social cohesion, and neighbourhood aesthetics with alphas greater than .70 ((Ponterotto & Ruckdeschel, 2007)). However, the crime and safety scale exhibited low internal consistency (alpha = .58). Two items referring to the presence of snakes and unsecured dogs were removed resulting in a six-item scale with acceptable internal consistency (alpha = .68) reflecting perceived safety from crime and incivilities. Four items relating to the presence of cul-de-sacs, hills, street-lighting and the condition of footpaths were also removed from the infrastructure for safety and walking scale to improve internal consistency (initial alpha .42). The resulting five-item scale included items reflecting the condition of streets and footpaths, and the presence of pedestrian crossings and intersections and exhibited acceptable internal consistency (alpha = .72). Due to the poor internal consistency of the traffic hazards scale, a principal component analysis with oblique rotation was conducted in order to determine distinct factors within the items. One factor including four items representing volume of traffic in the local neighbourhood was identified and included in subsequent analyses (presence of exhaust fumes, heavy vehicles, traffic on local streets, and live near a main or busy road). This factor represented 28.19% of variance in the items, with all factor loadings greater than .557. Alpha reliability coefficients and amendments to maximise alpha are presented in the table below:
<table>
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<th>Variable</th>
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<th>Initial $\alpha$</th>
<th>Amendments to maximise $\alpha$</th>
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<td>7</td>
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<td>7</td>
<td>.77</td>
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<tr>
<td>Crime and Safety</td>
<td>8</td>
<td>.58</td>
<td>Two items removed (there are unsecured dogs in my neighbourhood; there are a lot of snakes around my neighbourhood).</td>
<td>6</td>
<td>.68</td>
</tr>
<tr>
<td>Infrastructure for safety and walking</td>
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<td>.42</td>
<td>Four items removed (many streets in my neighbourhood have cul-de-sacs; many streets in my neighbourhood are hilly; most footpaths in my neighbourhood are well lit at night; most footpaths in my neighbourhood are well maintained).</td>
<td>5</td>
<td>.72</td>
</tr>
<tr>
<td>Traffic hazards</td>
<td>6</td>
<td>.39</td>
<td>A new scale representing traffic volume in local neighbourhood was identified through factor analysis. Two items removed (the speed of traffic on most nearby streets is usually slow; there are many traffic slowing devices in my neighbourhood).</td>
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</tr>
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<td>Variable</td>
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<td>2</td>
<td>3</td>
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<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
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<td>.18**</td>
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<td>9. Aesthetics</td>
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<td>.16**</td>
<td>.03**</td>
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<td>.03**</td>
<td>.11**</td>
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<td>12. NS lifestyle &amp; community</td>
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<td>.29**</td>
<td>.48**</td>
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<td>.03**</td>
<td>.00**</td>
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**Note.** PBC = Perceived behavioural control; NS proximity = neighbourhood selection for proximal access to destinations; NS lifestyle & community = neighbourhood selection driven by the appeal of a country lifestyle and sense of community; BMI = body mass index.
## Appendix R: Study Three Error Covariances

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<th>Estimate/SE</th>
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Appendix S: Study Three Model Indirect Effects
Appendix T: Study Three Supplementary Multi-Group Analysis

Although not a specific aim of the research, we conducted an additional multi-group path analysis to test for differences in the pattern of relationships in the hypothesised model across the peri-urban sample \((n = 271)\) and across a sample of adults living in major cities of Australia \((n = 173)\). Descriptive statistics and zero-order correlations of the included variables for the major city group are presented Table T.1 below. The descriptive statistics and zero-order correlations of the included variables for the peri-urban group have been presented previously (Appendix P).

The multi-group analysis was conducted using Mplus v.6.12 with the robust maximum likelihood estimator. The same procedures for handling missing data and assessing goodness-of-fit of the hypothesised model used in main study analysis were applied. The evaluation of the goodness-of-fit indices for testing measurement invariance was evaluated by changes in the goodness-of-fit chi-square consistent with (Byrne, Shavelson, & Muthén, 1989) recommendations.

First, the multi-group analysis was a baseline model in which all free parameters were set to be non-invariant across the peri-urban and city groups. This resulted in a model with reasonable fit according to most criteria adopted, although the low TLI value indicated a lack of parsimony \((\chi^2 (30) = 66.534, p <.001; \text{RMSEA} = .074, \text{CFI} = .953, \text{TLI} = .859)\). The standardised effects of the unconstrained modelled pathways for the major city and peri-urban groups are presented in Table T.2.

Next, the analysis was conducted with all parameters (path coefficients and covariances) constrained to be invariant across the groups. This analysis resulted in an acceptable overall model fit according to the multiple criteria adopted \((\chi^2 (70) = 105.779, p =.004; \text{RMSEA} = .048, \text{CFI} = .954, \text{TLI} = .941)\). When compared, there was no significant difference between the baseline model and the fully constrained model \((\Delta \chi^2 = 39.245, p = .504)\). As we were mainly interested in differences in the path coefficients alone, the model was re-estimated with constraints on covariance parameters removed while constraining all remaining free parameters to be invariant. Once again, this analysis resulted in adequate model fit according to most of the adopted indicators \((\chi^2 (60) = 98.301, p = .001; \text{RMSEA} = .054, \text{CFI} = .951, \text{TLI} = .926)\), although, again, the TLI fell short of recommended cut-off values lower
indicating lack of parsimony. Importantly, there were no differences between the baseline model and the partially constrained model ($\Delta \chi^2 = 31.767, p = .378$). These analyses suggest that there was, overall, congruence in the pattern of relationships of the proposed model between the samples from peri-urban and major city communities.

Table T.1 Descriptive statistics for major city group

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Note. PBC = Perceived behavioural control; NS proximity = Neighbourhood selection for proximal access to destinations; NS lifestyle & community = Neighbourhood selection driven by the appeal of a country lifestyle and sense of community; BMI = Body mass index. * p < .05 ** p < .01
Table T.2 Standardised effects of the unconstrained modelled pathways for the major city and peri-urban groups

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