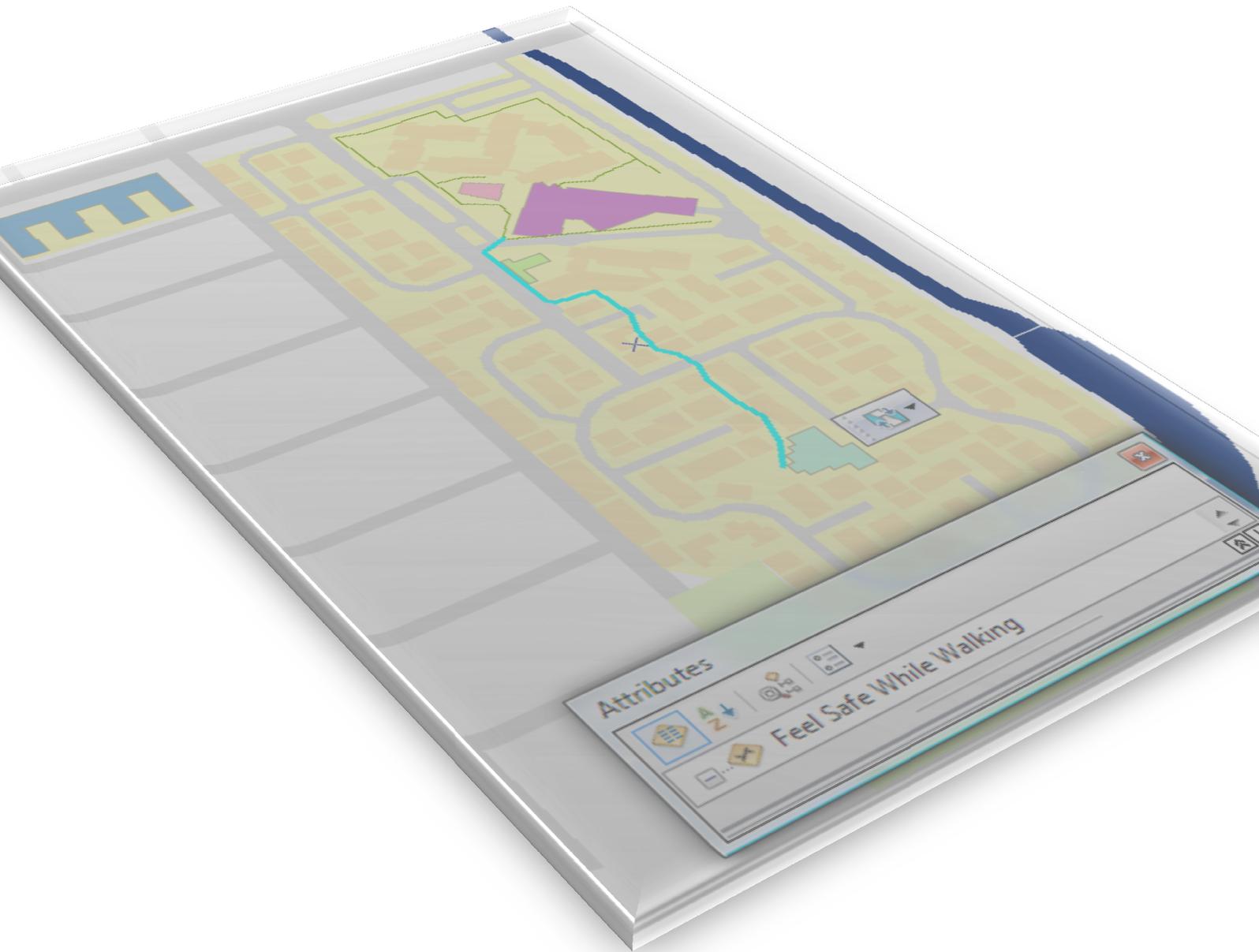# The built environment as 'shaper' of older adults' physical activity behavior. A softGIS based case study in a retirement community in Tempe, Arizona USA.

Master thesis Nienke Boneschansker, November 2012

SCHOOL OF
Geographical Sciences
& Urban Planning
ARIZONA STATE UNIVERSITY

university of
groningen

faculty of spatial sciences

"We ought to plan the ideal of our city with an eye to four considerations.

The first, as being the most indispensable, is health".

Aristotle, in Politics ca 350 B.C. (Frank et al, 2003).

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November, 2012

Prelude

This master thesis is the end product of a four month stay in Tempe, Arizona (USA), where I stayed as a participant of the NEURUS-ICURD program. Living (in a gated community) in a city so different from my hometown Groningen was a very interesting experience and enabled me to study a phenomenon that is non-existent in the Netherlands. The concept of the 'retirement community,' that provides maintenance-free living for older adults, was completely new to me.

The name of the community where I conducted my research has been well chosen, as I was warmly welcomed and received all the help I needed in 'Friendship Village,' Tempe. I would like to thank all the seventeen residents of Friendship Village that participated in the study. The positive attitude and inspiring answers to my questions made me even more enthusiastic about my project. I would also like to express my gratitude towards Mary Lockhart, the health and fitness director of Friendship Village. Your help with gathering research participants and organizing the interview schedule worked out perfectly.

Also from Arizona State University (ASU) I received great support for my research. I especially appreciate that NEURUS coordinator Kathy Crewe gave me my own little office, that I shared with other master- and PhD students. This surrounding brought me in the right atmosphere for working on my thesis, instead of going outside to enjoy the Arizona sun (although the idea remained tempting at times).

After setting up the research and collecting all the necessary data in Tempe, the research writing process started when I was back in the Netherlands. I would like to thank my supervisor Johan Woltjer for keeping me on track but also for letting me choose my own path in the process.

It is a bittersweet feeling that with the presentation of this master thesis, also five years of studying in Groningen will come to an end. I can look back on an amazing time with many great experiences. Now, the time has come that I have to prepare myself for the future and find a job, hopefully somewhere in the Randstad. This will be a new adventure in a new environment and I am ready for it.

Nienke Boneschansker.

Summary

The body of research emphasizing the relation between the **BU**ilt **EN**vironment and **P**hysical **A**ctivity (acronym: BUENPA research) with a focus on older adults, is limited. However, this inactive and rapidly expanding age group may be particularly vulnerable to environmental influences in comparison to younger generations (King et al, 2011). This qualitative case study addresses this research gap by analyzing how built environment characteristics of a retirement community shape the older adult residents' physical activity behavior. To do so, a comprehensive softGIS based methodology is used for the analysis in GIS. This methodology combines 'hard' objective spatial data, gathered through audit observations, with 'soft' perceived data by residents of the retirement community, conducted through interviews. Audit, interview and GIS are commonly used measurement tools in BUENPA research, but have so far not been used together in one analysis. Therefore, in this research the softGIS based methodology will be used for the analysis and will be evaluated for its potential in BUENPA research on older adults.

The qualitative case study is set in Friendship Village, a relatively large CCRC (Continuing Care Retirement Community) that has been developed as an initiative of local residents in 1980 in Tempe, Arizona USA (Keane, 1995). A CCRC can be described as an age-restricted community that provides maintenance free living and life care to its older adult residents. Seventeen residents (9♂/8♀) of Friendship Village participate in the study. Their age ranges between 72 and 92 (average: 83), they have good to excellent perceived health and they are fairly physically active.
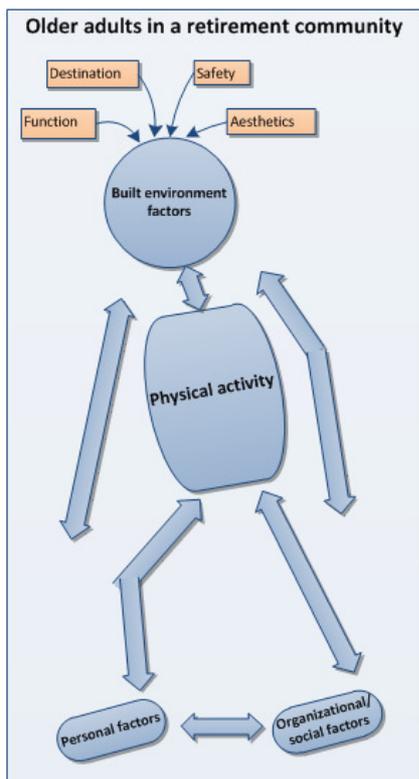
Figure 1: The BUENPA model (Author, 2012)

Researching the relation between the built environment and physical activity is a complicated task, due to the complex nature of factors influencing physical activity behavior (Owen et al, 2000). To make sense of these complex relations, a conceptual framework in the form of an ecological model is created (figure 1). This so-called BUENPA model forms a central element in the research. It provides input for the softGIS analysis and is used for the interpretation of the research findings (output). The BUENPA model shows the different interrelated factors that are believed to influence physical activity behavior like personal, organizational/social and built environment factors. The model also shows subcategory features for the factor built environment (function, destination, safety and aesthetics) to enable the analysis of the relative importance of these specific environmental factors.

The features function, destination, safety and aesthetics are used as input for the audit and interview tool analyses. The audit tool helps to determine how the built environment features are present in Friendship Village (e.g. the presence of sidewalks, safety features and facilities in the community). The interview tool enables the data gathering from the seventeen FV participants in the form of drawn maps. These maps show how the residents use and evaluate the built environment of their retirement community for physical activity. The GIS tool is used to create maps and analyze the data provided by the audit and interview tool. The research findings of the analysis are added to the BUENPA model.

Built environment characteristics in Friendship Village that shape the older adults residents' physical activity behavior are: (the feeling of) path material, maintenance, safety features that provide security and slow down traffic, close access to different (PA) facilities and transportation modes and green landscaping including plants and trees with different flowering stages. The research findings indicate that beside tangible also intangible characteristics of the retirement community are important for creating a safe environment for physical activity behavior. Examples include the feeling of courtesy among the residents and taking notice of each other while driving in a vehicle on the FV property. The intangible characteristics can be seen as a combination of similar personal factors (age/health condition) and shared social/ organizational factors (social engagement/life care/amenities) that prevail in Friendship Village. Together, the personal and social/organizational factors shape the feeling of 'being a community' in which the people feel safe. This enables walking on the street instead of the sidewalk during the day and during the night, within the community. Outside Friendship Village, the residents are much more cautious and they spend much less time over there for physical activity. Because the intangible characteristics have a distinct border in the shape of the walls of Friendship Village, they can be seen as elements of the 'intangible environment' of the community.

The main conclusion of this research is that the built environment and the intangible environment together shape opportunities, reduce barriers and influence the attractiveness for older adults to be physically active at a location. This conclusion also indicates the importance of including personal and social/organizational factors in BUENPA research in order to get a comprehensive understanding of the shapers of physical activity of older adults in retirement communities.

An ecological model can be used to make sense of the complex relations between factors that shape physical activity behavior. For BUENPA research focusing on older adults, also the softGIS based methodology has potential. The combined usage of the three measurement tools: audit, interview and GIS tool analyses help the researcher to look at the research area/question in three different ways. Overall, the softGIS based methodology enables a comprehensive analysis of how built environment characteristics of a retirement community shape the older adult residents' physical activity behavior, which is exactly the aim of this research.

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Content

Chapter 1: Introduction

1.1 Background

The origins of modern land use planning lie in the 19th century, when the unhealthy living conditions of factory workers in burgeoning industrial cities led to the recognition that there is a connection between environmental conditions and human health (Barton, 2009). Improvements in clear water supply and sanitation infrastructure contributed to the dramatic reduction of mortality from infectious disease, which was the main cause of death in US cities in the early 20th century (Cutler and Miller, 2004). Today, the former industrial cities suffer from health related problems of a different kind. In the USA, physical inactivity is a major public health issue (Brownson et al, 2009). It contributes to about one in ten deaths, making it the fourth leading cause of death in the country (Danaei et al, 2009). The design of the modern American city with its suburbs is seen as an important contributor to this problem (Frank et al, 2003). Originally conceived as promoters of public health, safety, and welfare (Kerr et al, 2012), the USA land development practices are now viewed as inhibiting many forms of physical activity such as walking (Frank et al, 2003). One inactive and rapidly expanding population group that may be particular vulnerable to environmental influences are the older adults (King et al, 2011). As body functions progressively decline with age and the risk of problems with mobility and physical activity increase (Johnston, 2012), long distances, slopes and obstacles may increasingly become physical barriers to being physically active (Kerr et al, 2012; van Cauwenberg et al, 2011). Many older adults spend a vast majority of their time at home and in and around buildings in their own neighborhood (Joseph et al, 2006; Kerr et al, 2012). Therefore, an important question that land use planners are facing today is how to design and (re)develop communities to create healthy and safe places that enable physical activity and mobility of older adults (Kerr et al, 2012).

To date, just a few studies have been focusing on the impact of design features at the spatial scale of the site, campus or building where older adults live (Joseph et al, 2006). In general, there is little focus on older adults in research that emphasizes the relation between the **BU**ilt **EN**vironment and **P**hysical **A**ctivity (acronym: **BUENPA** research), despite the expanding body of literature on this topic in the last decade (King et al, 2011).

An increasingly popular type of residence for older adults in the USA is the Continuing Care Retirement Community (CCRC). A CCRC is an age-restricted community providing maintenance-free living and life care for its older adult residents. The development of retirement communities started in the 1950s in Florida and Arizona and included a big emphasis on marketing an 'active adult' image and lifestyle (Trolander, 2011). In the last decade the number of older adults living in retirement communities has more than doubled (Shippee, 2012). An addition of ten to twenty CCRCs per year has been characteristic for the period 1990 – mid 2000s in the USA (CCRC Task Force, 2010). Today, about 2000 retirement

communities exist throughout the country (Groger and Kinney, 2007; Shippee, 2012). They exist in 48 states and the District of Colombia (CCRC Task Force, 2010) and house about twelve per cent of the older adult population (Bernard et al, 2011). The emphasis on leisure and promoted 'active lifestyle' in retirement communities make them an interesting topic of research, especially because of their increasing popularity among older adults and the relative growth of this population group.

Measuring BUENPA relations is a complicated task, which is partly due to the complex relations of factors that are believed to influence physical activity behavior (Owen et al, 2000). Examples include personal, social/organizational and physical environment factors (Joseph et al, 2006). Up to date, it is still not clear which specific built environment attributes are important and how they influence physical activity (Pikora et al, 2003). Another issue in BUENPA research is that although multiple studies suggest that there is a connection between the built environment and physical activity, the evidence is inconsistent due to differences in populations, theories, measurements, definitions and variables used in analysis (Giles-Corti et al, 2009; Bauman et al, 2002). Consequently, the ability of BUENPA research to build on previous findings is limited (Bauman et al, 2002). To better this situation, many researchers emphasize on quality improvement suggestions for further research in their own studies (TRB, 2005; Van Cauwenberg, 2011; Giles-Corti, 2009; Bauman et al, 2002). Brownson et al (2009) argue that especially the development of high-quality measures, to analyze the relative impact of built environment characteristics on physical activity, is essential. Currently, three types of built environment measures are often used in BUENPA research:

1. Observation with the help of <u>audit</u> tools;
2. Environment perception of individuals obtained through <u>questionnaires/interviews</u>;
3. <u>GIS</u> analysis based on archival data sets.

Although considerable progress has been made in the last decades, Brownson et al (2009) emphasize that further research is necessary to improve the technical quality of these measures. A new type of methodology that potentially could contribute to this is the softGIS approach. SoftGIS is a relatively new tool developed by a Finnish research team that combines 'hard' objective spatial data with 'soft' spatial data based on residents' perceived quality of the environment (Kahila and Kyttä, 2006). In BUENPA research, softGIS could be used to jointly analyze observational data about the built environment (gathered with an audit tool) and data about the environmental perception of individuals (derived from interviews) in GIS. The softGIS methodology may be particularly useful in this research, because it enables a detailed analysis of how older adults use and evaluate their own living environment in a retirement community for physical activity. A softGIS approach that combines audit, interview and GIS measurement tools hasn't been used in BUENPA research before and may contribute to the technical quality improvements of these measures.

1.2 Problem statement, research goal and question

The body of research focusing on the relation between the built environment and physical activity behavior is increasing, but the focus on the rapidly expanding and inactive older adult age group stays limited (King et al, 2011). Older adults may be especially vulnerable to built environment characteristics due to increasing physical obstacles that are fostered by functional impairments that come with age (Kerr et al, 2012; van Cauwenberg et al, 2011). Older adults spend much of their time in and around buildings in their home and community. However, just a few studies have focused on design features at the spatial scale of where the older adults live (Joseph et al, 2006). The increasing popularity of continuing care retirement communities in the USA, that have a special emphasis on active lifestyle and leisure, make them an important topic of research. Because BUENPA relations are very complex and different research designs in studies have led to inconsistent research findings, there is a clear need for methodologies that help to clarify how people use their built environment and specific physical attributes for physical activity (Giles-Corti et al, 2009). The softGIS based methodology may be very useful for this as it enables a detailed analysis of how older adults use and evaluate their direct living environment in a retirement community for physical activity.

The goal of this research is to analyze how built environment characteristics of a retirement community shape the older adult residents' physical activity behavior by using (and evaluating the potential of) a comprehensive softGIS based methodology that combines three types of built-environment measures commonly used in BUENPA research: audit, interview and GIS. The main research question is:

How do the built environment characteristics of a retirement community shape the older adult residents' physical activity behavior and what potential has a softGIS based methodology for this (type of) analysis?

Three sub questions are used to answer the main question:

1. Which built environment features can be related to (moderate) physical activity behavior and how are they present in Friendship Village?

2. How are the built environment features evaluated and used by the older adults in the retirement community?

3. How can a softGIS based methodology be used to analyze how built environment characteristics shape the physical activity behavior of older adults in the retirement community?

1.3 Research design

A softGIS based methodology forms the core of the research design in which the collection and analysis of 'hard' data based on audit observation is combined with 'soft' data based on residents' perceived quality of the environment (Kahila and Kyttä, 2006). Three types of built environment measurements are used to both collect and analyze the data:

1. Audit: systematic observations (for answering sub question two)
2. Survey: indebt interviews (for answering sub question two)
3. GIS: adding and analyzing data on maps (for answering sub question three)

Before the softGIS analysis, the first sub research question will be answered through a literature review in which a conceptual framework, the BUENPA model, will be created. This model is a central element of the study as it both functions as input to the analysis and as a framework for the interpretation of the output of the analysis (figure 1.1). The BUENPA model is based on existing studies that are part of the literature review. The literature is required through searches in both 'Scopus' and 'Google Scholar' with the keywords: older adults, elderly, sedentary, physical activity, physical inactivity, active aging, wellbeing, retirement community and built environment. The literature review and the BUENPA model are both part of the theoretical framework in chapter two. The usage of the measurement tools: audit, interview and GIS will be further explained in chapter three about the methodology and operation of the research. The complete research design is visualized in figure 1.1 and should be read starting with the heading 'literature'.
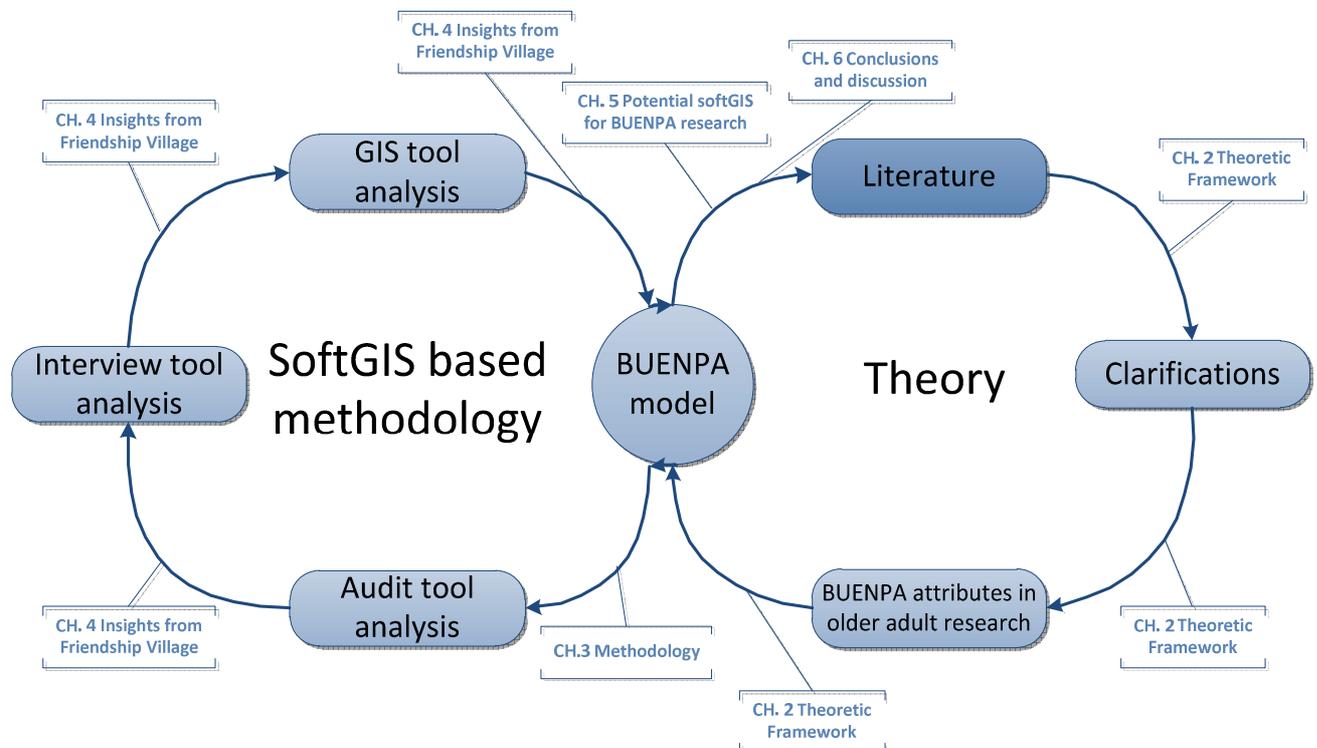
Figure 1.1: Research design thesis (author, 2012)

Before continuing with the theoretical framework in the next chapter, this chapter will finish with a clarification of the research method, the research area, ethical issues concerning the study and its relevance.

1.3.1 Research method

In BUENPA research, the usage of quantitative analysis is very common. Statistical methods are used to examine associations between theoretically derived variables and physical activity behavior to help 'understand and predict' behavior (Bauman et al, 2002). This case study research is not focused on the quantitative testing and predicting of behavior. Instead, through a qualitative analysis this research aims to identify how physical environment characteristics shape physical activity behavior in older adults, by using them as experts of their own environment. The research findings of this study may be used as input for quantitative analysis in further research. This type of research method, based on non-quantitative, non-mathematical methods to identify currently important issues that may require further scientific analysis can be seen as an example of the regional studies approach as defined by McCann (2007).

Acknowledging for the complex nature of BUENPA relations, a qualitative approach enables the detailed analysis of one case study. The emphasis is on understanding how older adults use their living environment and interpret how their community encourages or discourages their participation in physical activity. The need for more qualitative based studies in BUENPA research with an emphasis on how residents experience their living environment is also emphasized by the Transportation Research Board (TRB, 2005, p123):

"A more rigorous understanding of the extent to which the built environment is a factor in individuals' choices about physical activity is important in designing effective policies and interventions to address the decline in such activity"

1.3.3 Research area: Friendship Village

This research focuses on the American context as contemporary USA community design has been affected by decades of land development practices based on facilitating automobile travel. This has led to an urban landscape that can be characterized by a separation of land uses (e.g. residential, employment and retail), low residential densities and a hierarchical network of roads consisting of wide high-speed arterial roads bordering residential enclaves. It is this particular USA urban structure that is blamed for declining levels of active transportation (Kerr et al, 2012). In the growing USA cities, also planned residential enclaves for people who share specific characteristics like age, interests, values, or aspirations have become increasingly important (Forsyth and Crewe, 2011). This study focuses on a residential enclave specifically designed for older adults, the Continuing Care Retirement Community. A CCRC can defined as *"an organization that offers a full range of housing, residential services, and health care in order to serve its residents as their health needs change over time"* (Young et al, 2010 p257).

Figure 1.2 Tempe Arizona, USA (Eachtown, 2012)
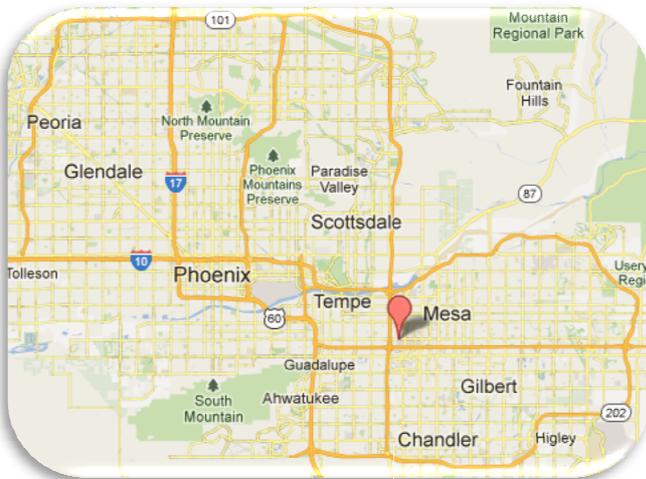
Figure 1.3: Location Friendship Village (googlemaps, 2012)

The case study of this research is situated in the CCRC Friendship Village (abbreviation FV) in Tempe, Arizona USA (figure 1.2 and 1.3). This retirement community is developed in 1980 by local residents (Keane, 1995) and consists of independent living apartments and cottages and assisted living apartments on a surface of approximately 0,18km² (600m by 300m) (figure 1.4).

Around 850 residents live in Friendship Village and there are 475 employees working in the community (Lockhart, 2012). With 573 housing units, Friendship Village is a relatively large CCRC (AZcentral, 2012). According to the whitepaper of the CCRC Task Force (2010) only eight per cent of the CCRCs have more than 500 housing units. About one-third of the CCRCs consist of more than 300 units, but a typical CCRC has less than 300 units in total.

Friendship Village provides life care to its residents. The concept of life care implies that the older adult residents can stay in the same community when their healthcare needs change. The website of Friendship Village (2012) indicates that after paying an entrance fee, the residents get guaranteed access to 24-hour nursing care for low additional costs. Besides continuing health care, other amenities and services are available in CCRCs to enable an active lifestyle like dining and transportation services, leisure facilities, and coordinated activities (Friendship Village, 2012).

Friendship Village is a not-for-profit retirement community which corresponds to 82 percent of the CCRCs (CCRC Task Force, 2010). However,

Figure 1.4: Total research area (ESRI, 2010)

living in a CCRC does come at a certain price. In general, the entry fee ranges from 20.000 dollar to more than four million dollar. The monthly fees range from 200 dollar for one person to more than 10.000 dollar for two people, all depending on the type of CCRC (Young et al, 2010). In Friendship Village, the entry fee ranges from 90.000 dollar to 383.000 dollar and the monthly fee for the first person ranges between 1930 dollar and 3770 dollar (Lockhart, 2012). The housing fees show that living in a CCRC is not available to everybody. Still, retirement communities like Friendship Village are increasingly popular in the USA. This means that CCRCs will become an increasingly important setting for interventions to improve good health for older adults (Rosenberg et al, 2009). A better insight of the design features that influence Friendship Village residents' physical activity behavior, may be beneficial for future housing development for older adults in the USA. Also, existing CCRCs may benefit from the research, as many of them are governed by a single organizational owner which makes it relatively easy to make changes to the existing built environment (Josheph and Zimring, 2007).

Because of its relative small area size, Friendship Village is very suitable for performing a detailed study of the design features of the site and an evaluation of the softGIS based methodology. Figure 1.4 on the previous page shows the total research area of about 540m by 840m. This area is larger than the actual border of Friendship Village, as the living environment of the older adult residents does not have to stop directly at the community gate.

1.3.3 Ethics

Ethical considerations play an important role in this research, as interviews with 'human subjects' are included in the study. Babbie (2010) identifies four broadly agreed-on ethical considerations that prevail in social science and are taken into account in the research. They are: voluntary participation, no harm to the participants, anonymity and confidentiality. The agreements voluntary participation and no harm for the participants can be formalized in the concept of 'informed consent'. This concept can be defined as a norm in which *'Subjects must base their voluntary participation in research projects on a full understanding of the possible risks involved'* (Babbie, 2012 p66). In this research, informed consent was realized through the availability of recruitment flyers in the community that exactly stated what the research included, what was expected from the participants and where they could subscribe to participate in the study. Before the start of each interview, the participants were informed again about the interview procedure. A recruitment announcement was presented that stressed that participants could skip any question they didn't wish to answer and that they could withdrawal participation in the study at any time. Furthermore, the announcement stated that the responses to the voluntary interview would be kept completely confidential and in case the subjects had the feeling that they had been placed at risk, the contact information of the chair of the human subjects institutional review board of Arizona State University was included. A complete version of the recruitment/ announcement letter can be found in appendix 1. Anonymity in social research is achieved

when *'neither the researchers nor the readers of the findings can identify a given response with a given respondent'* (Babbie, 2010 p67). In this research it was not possible to reach absolute anonymity, because audio recordings were made of the interviews after permission of the interviewees and used for the analysis. Nevertheless, this research does promise complete confidentiality which means that *'the researcher can identify a given person's responses but promises not to do so publicly'* (Babbie, 2010 p67). Numbers instead of names are used in the analysis and whenever the research participants are quoted in the thesis it is indicated as 'FV interviews' (2012).

Before the interviews took place in March 2012, the study had been determined to be exempt after review by the Institutional Review Board pursuant to Federal regulations of Arizona State University (Office of Research Integrity and Assurance, 2012).

1.3.4 Relevance

Although this research focuses specifically on the USA context, the need to accommodate for the changing demographics in cities due to the worldwide aging phenomenon is a global issue and emphasized by the World Health Organization in their 'Age-friendly Environments Programme'. This international program addresses the social and environmental factors that contribute to active and healthy aging with the goal to make cities and communities age-friendly (WHO, 2012). Through the program, WHO tries to provide guidance and promotes research that focuses on questions like: *"how to assess the age-friendliness of cities and communities, how to integrate an ageing perspective in urban planning and how to create age-friendly urban environments"* (WHO, 2012). These are all points to which this thesis hopes to contribute. The objectives of this study are fivefold:

Firstly, this study performs a comprehensive qualitative analysis to identify built environment characteristics of a retirement community that shape the physical activity behavior of older adult residents with the aim to build new hypotheses (that may function as input for quantitative analysis in further research).

Secondly, this study evaluates the potential of a new softGIS based methodology that incorporates audit, survey and GIS measurement tools, to contribute to the need for technical quality improvements of measures in the BUENPA study field.

Thirdly, this study addresses the research gap that although older adults spend the majority of their time in their direct living environment, just a few studies have been focusing on the impact of design features at the spatial scale of the site, campus of building where the older adults live. A comprehensive analysis of Friendship Villages contributes to enlarge this body of research.

Fourthly, this study views residents as experts of their own living environment. By showing how a softGIS approach can be used to collect data from older adults, this study may function as an example of how to involve residents in the planning process for the (re)development of their own community.

Fifthly, this BUENPA study focuses specifically on older adults in a retirement community. With the increasing popularity of retirement communities in the USA, results of this study may benefit future housing developments for the older adult population.

To finalize, Frank et al (2003) describe how active design of communities may eventually lead to improvements in the quality of life of people, which should be the ultimate goal of all housing developments with the 'healthy an active ageing' principles in mind. It also indicates the importance of continuing research in the BUENPA field of study:

"Communities can be designed to make physical activity possible or even desirable. Environments that encourage moderate physical activity may also have features that make them more liveable in other ways, by improving one's quality of life – they may generate more social interaction, foster less dependence on the automobile, be safer for their inhabitants, and give people more choices with respect to how they get around and spend their time" (Frank et al., 2003 p8).

This chapter was an introduction on the topic of BUENPA research and presented a background, the research goals and questions and the approach for answering the research questions. In the second chapter, a theoretical framework will be presented based on the existing literature on the topic of built environment and physical activity with a special focus on older adults, retirement communities and wellbeing. Besides clarifying definitions and concepts used in this research, the theoretical framework helps to develop a conceptual framework in the form of an ecological model. This so-called BUENPA model will be used in chapter four for both the input and the interpretation of the output of the analysis. The softGIS based methodology and operation of the analysis are explained in chapter three. In the fifth chapter the usage of the SoftGIS based methodology will be evaluated after which in chapter six the conclusion and implications of the research will be presented.

Chapter 2: Theoretical Framework

2.1 Introduction

Around the year 2000, direct assessments of the links between the built environment and personal physical activity were still rare in urban planning (Handy et al, 2002). In the last decade the topic has quickly gained attention and in 2005 Giles-Corti et al (2005) predicted an enormous increase in the understandings of environmental correlates of physical activity in the next five to ten years. Today in 2012, indeed the body of BUENPA research is growing but an agreed-upon theoretical framework is still lacking (Handy et al, 2002). Also, the amount of BUENPA research focusing on older adults is specifically limited (King et al, 2011). The aim of this research is to get a better understanding of how built environment attributes shape the physical activity behavior of older adults in a retirement community. In this chapter, a literature review of current BUENPA research is conducted. Because clearly defined concepts are crucial for the interpretation of research findings, the chapter starts with definitions and clarifications of the concepts: built environment, physical activity, older adults and retirement communities, as used in this thesis. Then, the focus shifts to current BUENPA research on older adults and the usage of models. In this section, current limitations for theory building and suggestions for quality improvements in this field of study will be discussed to find a suitable conceptual framework in the form of an ecological model. The features in this 'BUENPA model' are used as input for the softGIS analysis, but the model also functions as a framework for the interpretation of the output of the analysis. The empirical findings of the study will be added to the model in the fourth chapter of this thesis.

2.2 Built environment, physical activity and older adults

As stated in the introduction of this thesis, older adults are the most rapidly growing population group in the USA, but they are also inactive. Only five per cent of USA adults above age 65 meet physical activity recommendations (King et al, 2011). Today, about twenty percent of the USA population is aged 65 or over and between the years 2005 and 2030 the amount of people in this age category is expected to almost double, indicating a dramatic increase of the older adult population in the upcoming years (Allen and Klein, 2011). The aging population will put new demands on society in the next decennia of which one is the quest for living environments in which older adults can long remain healthy, independent and autonomous (WHO, 2012). This section will start with definitions of the concepts 'physical activity', 'built environment' and 'older adults' as they are used throughout this thesis. Then, research focusing on physical activity in older adults will be explored after which the research area of the retirement community will be discussed in terms of wellbeing.

2.2.1 Physical activity

Physical activity can be defined as: *"Any bodily movement produced by contraction of skeletal muscle that substantially increases energy expenditure, although the intensity and duration can vary substantially"* (Singh, 2002, p. 262). As this definition indicates, there are many different forms of physical activity that may vary in type and intensity. Different types of physical activity may include household, transportation and leisure physical activity (Brownson et al, 2009; Giles Corti et al, 2005). A distinction that is commonly made in research to indicate PA intensity is between moderate physical activity (e.g. walking and cycling) and vigorous physical activity that is associated with heavier breathing and an increasing hart beat (e.g. running or fitness exercises) (Giles Corti et al, 2005; Sallis et al, 2004; Singh, 2002). Increasingly, the focus of physical activity intervention research has moved from vigorous to moderate-intensity exercise, because epidemiological evidence suggests that the latter provides similar health benefits when it is regular participated (Pikora et al, 2003). An example of this is the increasing popularity of walkability research (Hutabarat Lo, 2009; Pivo and Fisher, 2011). In this thesis there are both distinctions made in type of physical activity (transportation and leisure) and intensity (moderate and vigorous). The term physical activity is interchangeably used with its abbreviation PA. The causal relation between physical activity levels and health has been well established and will not be discussed in this study. Instead, the focus is on the connection between the built environment and levels of physical activity, a topic that is far less understood in research (TRB, 2005).

2.2.2 Built environment

In this thesis the words physical environment and built environment will be used interchangeably, both implicating the physical form of communities. This includes land-use patterns, built and natural features, and transportation systems (including facilities and services) that link locations to each other (Brownson et al, 2009). A problem with the concept of the 'built environment' is the different geographic scales in which research can take place. Physical attributes on the city level may have very different effects on an individual's propensity to be physically active than are physical attributes in someone's local community or neighborhood. Even at the neighborhood level physical attributes put different demands as suggested by a study of Boone-Heinonen et al (2010) that shows relevance for physical activity facilities within a three km buffer of a respondent's home and a street connectivity (to encourage street-based activities like jogging/walking) within a one km buffer of a respondent's home. According to the TRB (2005) issues of geographic scale have been under examined in studies that link physical activity behavior to the built environment. The TRB (2005) also suggests that due to time, budget and physical limitations, the physical activity behavior of people is spatially constrained. Therefore, research focusing on smaller geographic scales (e.g. the neighborhood level) is likely to give more information about BUENPA relations. In this thesis a specific focus is on the geographical scale of the retirement community in which older adults live, which will be further explained later in this section.

2.2.3 Older adults

In this thesis 'older adult' refers to people over the age of 65, since this has historically been set as the legitimate age to collect full retirement benefits under Social Security (Old Age Survivors Disability Insurance) in the United States (Allen and Klein, 2011). Subsequently, the term older adult will be used interchangeably with the term retiree. Though, it must be noted that the terms older adult and retiree don't necessarily mean that a person has completely stopped working. Rather, the terms mark the gradually phasing out of full-time or part-time employment. In the United States about 80 percent of the baby boomers anticipate to remain in the labor market in some form after retirement for a variety of reasons like the need for continued income, maintaining health benefits supported by the employer, or for personal satisfaction (Allen and Klein, 2011).

Older adults cannot be seen as one homogeneous group as there are various stages in older age that occur differently to every individual. Heisler et al (2004) have analyzed demographic patterns of migration in the USA and found three distinct moving phases in late adulthood that can be attributed to different stages in life. The first move occurs at retirement between the ages of 60 and 70 when lifestyle amenities are sought-after. The second move occurs when minor disabilities arise and living in the current residence becomes difficult. The third move is typically made at the end of life when major disabilities require intensive care. In this research the main focus is on older adults that have moved to a retirement community and who are still physically able to be physically active, even when minor disabilities have arisen. This corresponds to the first two moving phases as described by Heisler et al (2004) within one retirement community.

2.2.4 Older adults and physical activity

Physical activity patterns could be seen as quantitatively and qualitatively related to age, as both the amount and type of physical activity preferred by age categories seems to diver. Usually, the amount of physical activity is believed to decrease with older age (Joseph et al, 2006), but retirement may also have a positive effect on physical activity as there is more time available to be physically active. On the other hand, according to the habit discontinuity hypothesis, good old habits can be disrupted when the environment changes (Beck et al, 2010). This means that people may become less physically active after retirement. According to Joseph and Zimring (2007) the most popular form of physical activity in older adults is walking, but there are also other types of physical activity that can be associated with older age. Washburn et al (1993) have developed PASE (Physical Activity Scale for the Elderly), based on a physical activity survey specific to older people. Their main motive for making the scale was that there were no established assessment methods for measuring physical activity in the older adults in the early 1990s (Siorida, 2012). The physical activity variables for measuring PASE include: walking, light/moderate/strenuous sports, muscle strength, outdoor gardening, caring for another person, housework (heavy/light) and house repairs etc (Washburn et al, 1993). PASE is a popular instrument, a quick search on Scopus results in hundreds of studies that use the instrument in subject areas of: medicine, health

professions, biochemistry, genetics and molecular biology, nursing etc. Chad et al (2005) used PASE to measure physical activity levels in community-dwelling older adults. They found higher PASE scores, indicating higher levels of physical activity, for individuals in the following categories: male, married or common-law, not living alone, not living in senior's housing, higher levels of education and higher incomes. When looking at the built environment, higher PASE scores were positively related to the presence of hills, biking and walking trails, street lights, various recreation facilities, seeing others and unattended dogs. High crime and heavy traffic were not associated with physical activity status. PASE does not come without critique, Siordia (2012) warns studies that asses physical functioning with PASE that the instrument may be age and culture insensitive. After citing various studies that critique the PASE instrument for its disability to recognize and fairly weight the diverse activities, he proposes a new set of "weights" to score PASE items to better accommodate for the sample of aged Mexican origin Latinos in his project. The circumstances in this research deviate slightly from studies incorporating the PASE score, as it is situated in a CCRC in which care/housework/house repairs/outdoor gardening is provided for by the community staff.

2.2.5 Retirement communities and wellbeing

Previously in this chapter, the importance of BUENPA research on a specific geographic scale has been emphasized. In current research, especially the design of the neighborhood in which older adults live, is associated with physical activity and therefore part of the analysis. Detailed studies on design features at the scale of a site, campus or building are less apparent (Joseph et al, 2006). A potential important geographic scale for BUENPA research focusing on older adults is the scale at which their 'community' exists. Communities can be defined as 'social networks of mutual support' (Barton, 2009 p119). Especially for locally based groups like older adults these social networks are often on the neighborhood level (Barton, 2009). Robust communities are beneficial for social engagement, life satisfaction and wellbeing, which may be particularly important for older adults because this age group faces extra challenges to wellbeing and social engagement due to age related events like declining health and mobility, role and partner losses (Shippee, 2012). A potential mechanism to prevent declines in social engagement and personal activity when people age, are age-segregated housing with attractive amenities for older adults. An example of this is the CCRC as explained in the introduction of this thesis. This type of retirement community is *"meant to provide a setting that allows 'aging in place' and helps to create a community environment which benefits older adults' social engagement"* (Shippee, 2012 pp12). There are different types of CCRCs that range from all-inclusive CCRCs (providing unlimited home and nursing care services without extra charges), to fee-for-service CCRCs (providing home and nursing care service after a fee payment) (Young et al, 2010).

Although CCRCs are very positively promoted, for example as a place where *'fun meets peace of mind'* (Friendship Village, 2012), Forsyth and Crewe (2012) indicate specific concerns about urban enclaves of like-minded people. They note that retirement

communities may disrupt overall urban diversity and minimize interactions with people different from themselves by excluding others. Retirement communities may also undermine regional authorities and limit urban planning by forming voting blocks and by disrupting the flow of mainstream functions, such as traffic, distribution of institutions, services, and land uses (Forsyth and Crewe, 2011). Nevertheless, retirements are only gaining popularity among the elderly in the USA. The reason why older adults chose to move to CCRCs has been topic of research of Groger and Kinney (2007). They found that push factors for older adults to move to a CCRC include the desire to plan while they still can, fear of burdening family, burden of house/yard maintenance, declining health, being ready for a change and optimal timing. Pull factors include community attachment, nearness to family, prospect of long-term care and amenities of the CCRC, joining friends/family who are also moving there.

As quoted in the introduction chapter of this thesis, Frank et al (2003) argue that communities can be designed to promote physical activity. This can lead to environments that become more livable in many ways including increasing social interaction, safety and choice for people with respect to how and where they spend their time. These are all factors that retirement communities try to provide for their residents, which makes them an interesting geographic scale to perform BUENPA research focusing on older adults. In their study, Wert et al (2010) compare characteristics of walking, physical activity, fear of falling and actual reported falling of older adults in two different types of senior residences. These two residence types are senior living residences (SLR) like CCRCs and individual community residences (ICR) which are more traditional home/apartment living. The researchers found that the older adults living in SLR were older, more likely to live alone and had a greater disease burden. Nevertheless, they had similar physical function (gait speed and physical activity), reported less fair of falling and had lower actual reported falling in the past year than older adults living in ICR. As an explanation the researchers note that that SLR may be designed to reduce barriers to walking and may provide a sense of security that enable residents to be more physically active in their environment. This finding led to the researchers' conclusion that physical function and psychosocial aspects may be affected by differences in residential environments (Wert et al, 2010).

For this research, the hypothesis that retirement communities may be designed to reduce barriers for walking and that they provide a sense of security that enables physical activity in older adults is interesting. In the conclusion chapter of this thesis, the research findings of this case study will therefore be compared with the insights of Wert et al (2010). First, this chapter will continue with a discussion about different ecological models that can be used to make sense of the complex nature of relations in BUENPA research.

2.3 BUENPA research and the usage of models

As stated in the introduction of this thesis, researching the relation between physical activity and the built environment is a complicated task. In this section ideas of researchers for the quality improvement of BUENPA research will be discussed and the usage of ecological models will be evaluated to find a suitable base for the BUENPA model. This BUENPA model functions as a central element of the analysis. It visualizes personal, social/organizational and built environment factors that are believed to influence physical activity behavior. The section starts with presenting built environment attributes that are commonly researched in BUENPA studies focusing on older adults.

2.3.1 Built environment attributes in BUENPA research on older adults

BUENPA research usually focuses on four general domains in which people can be physically active: at home, at school or work, during recreation and while moving between destinations (FNB, 2012). For older adults, physical activity at school or work is less relevant, therefore the focus mostly is on the other three domains: at home, during recreation and while moving between destinations. In the previous section of this chapter, the importance of BUENPA research on the neighborhood level was stressed by the TRB (2005). An example of older adult BUENPA research on the neighborhood level is the study of Berke et al (2007). They found evidence for increased walking of older adults (both men and women) living in walkable neighborhoods consisting of a denser street network and street connectivity, in comparison to older adults living in areas less conductive to walking. Another study focusing on the neighborhood level is from Patterson and Chapman (2004). They found that good pedestrian access to mixed local facilities in urban neighborhoods is associated with increased walking among older adults (Patterson and Chapman, 2004).

As stated in the introduction chapter of this thesis, the total amount of BUENPA studies focusing on older adults is limited. Nevertheless, van Cauwenberg et al (2011) have made a systematic literature review including 31 articles about the relation between the physical environment and physical activity in older adults. Figure 2.1. shows the main built environment attributes that are included in these studies. Access to recreational facilities and crime-related safety appear to be popular themes, while access to shops and access to services are less researched. The main conclusion in the study of van Cauwenberg et al (2011) after evaluating the 31 studies is that the articles' research findings are inconsistent. According to the researchers, this may be caused by methodological issues like variability in operational definitions and measurements. An example of an inconsistent research finding is the attribute 'access to services'. A study of Nagel et al (2008) found a positive relation between objectively measured access to services and total walking in the US. But in two other studies, one of Li et al (2005) in an USA urban region and one of Sugiyama et al (2009) in British urban and rural regions, there was no relation found between distance to recreational facilities and total walking. Van Cauwenberg et al (2011) conclude their paper with the remark that *"knowledge about the relationship between the physical environment and PA in older adults is limited"* (p468). Because of the inconsistencies, this study does not

directly copy and analyze the built environment attributes that are researched in these previous BUENPA studies on older adults. Instead, an ecological model that includes built environment features will function as a framework to identify built environment characteristics in Friendship Village. The usage of this model and suggested improvements for BUENPA research including ecological models will now be discussed.
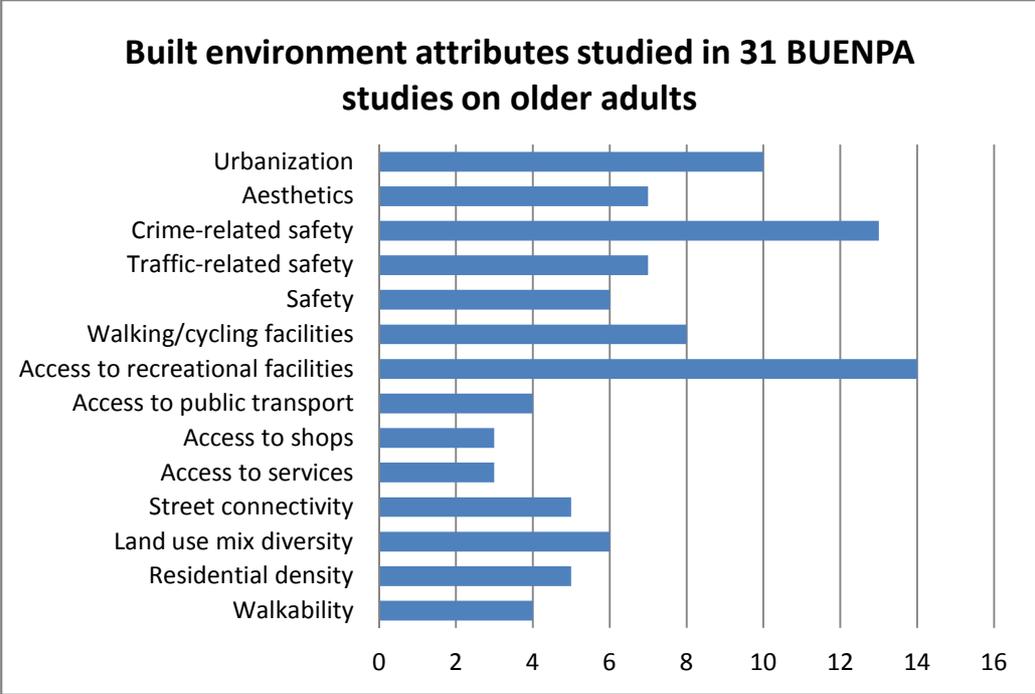
Figure 2.1: Built environment attributes in 31 older adult BUENPA studies based on Van Cauwenberg (2011) (author, 2012).

2.3.2 Improvements in BUENPA research and the usage of ecological models

The research of van Cauwenberg et al (2011) is one of many BUENPA studies that indicate that research findings in this study field are inconsistent. In order to increase the ability of BUENPA research to build on previous findings, researchers put a lot of emphasis in their studies on quality improvement suggestions for further research. The suggestions range from emphasizing differences in scale (TRB, 2005; Van Cauwenberg, 2011), PA domains (van Cauwenberg et al, 2011) age, sex and cultures in research (Giles-Corti, 2009) to the consistent and standardized use of terminology (Bauman et al, 2002), the usage of a combination of objective and self-report (perceived) PA measures (Van Cauwenberg et al, 2009) and improvements of the technical quality of the measures (Brownson et al, 2009) as described in the introduction of this thesis. An important argument for the suggested improvements is that *"the predictive capacity of models appear to improve when environmental measures more closely match the behavior of interest and the setting in which the behavior takes place."* (Giles-Corti et al, 2005, pp 179).

The mentioned models by Giles-Corti et al (2005) are increasingly used in BUENPA research and function to simplify and make sense of the complex nature of relations between factors that are believed to influence physical activity (Owen et al, 2000). Sallis (2012) notes that

many models of health behavior in the past were specifically focused on the individual (e.g. biological, sociological, skills) and possible the social and cultural environment. This meant that interventions were also focused on these levels. Today, more ecological models are used in which alongside the individual and social environment, also the physical environment and policy context are seen as important. The idea behind these models is that health behavior interventions are most effective when they change influences at different levels (Rosenberg et al, 2009). Sallis (2012) explains that when physical environments and policies are changed, they reach almost everybody in a relative permanent way instead of targeting small groups of individuals that participate for example in PA classes. Subsequently, when the physical environment and policies are changed, then individual programs are believed to be more affective. Therefore, the strength of ecological models is that options for interventions are broadened because of their focus on multiple levels of influence on physical activity (Sallis et al, 2002).

Ecological models have emerged from developments in various disciplines as psychology, sociology, public health etc (Richard et al, 2011) and can be used to emphasize the expected interplay of different variables (environmental, social, demographic etc.) in influencing physical activity patterns (King et al, 2000). Joseph et al (2006, p143) give the following definition *"Social ecology models seek to understand complex patterns of causation where individual and group behaviors are influenced by, and influence, social and physical structures"*. In this definition, there is an emphasis on the reciprocal nature of the factors, meaning that the causal relations work in both directions (Bauman et al, 2002). Sallis et al (2002) identify four core principles of ecological models of health behavior:

1. *There are multiple influences on specific health behaviors, including factors at the intrapersonal, interpersonal, organizational, community, and public policy levels.*
2. *Influences on behaviors interact across these different levels.*
3. *Ecological models should be behavior-specific, identifying the most relevant potential influences at each level.*
4. *Multi-level interventions should be most effective in changing behavior* (Sallis et al, 2002 p466).

In their research Joseph et al (2006) use an ecological model to study the relationships between the built environment (the presence and visibility of outdoor and indoor physical activity resources) and physical activity behavior of elderly residents in senior housing communities. The model they use distinguishes between three different interacting factors that can be related to physical activity levels, as described in table 2.2 and illustrated in a model in figure 2.3. The factors are: personal, social/organizational and built environment. The emphasis on different geographical scales is also emphasized in this model, as Joseph et al (2006) acknowledge potential differences in influence on several spatial scales for the factor 'physical environment'.

FACTOR	DESCRIPTION	EXAMPLE
Personal	An individual's personal attitude and beliefs related to physical activity which can be influenced among others by demographics, health, and psychology variables	Age
Social/ Organizational	the culture and goals of social structures, support and organizations, that may facilitate or hinder efforts to participate in physical activity	PA programs
Physical environment	Four different levels of spatial scale: 1. Urban design. 2 Site selection and design. 3. Building design. 4. Building element design	Traffic safety, Interesting views

Table 2.2: Factors related to physical activity as described by Joseph et al (2007)
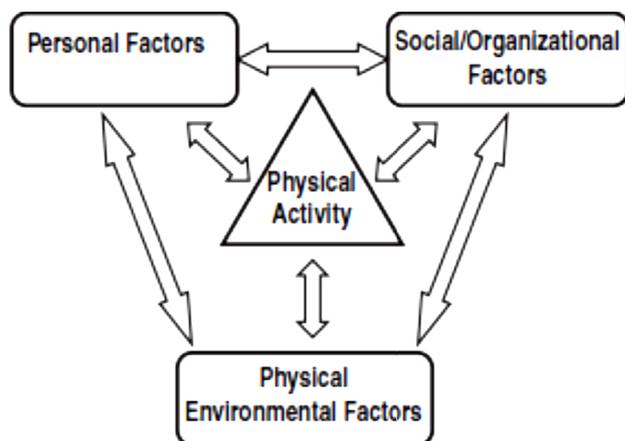

Figure 2.3: Ecological model by Joseph et al (2006)

The distinction by Joseph et al (2006) in these three different factors is very similar to the distinction made by Giles Corti et al (2005) that focuses on individual factors (e.g. physiological and demographic), social environmental factors (e.g. social support and norms) and physical environmental factors (e.g. built and natural environment). Pikora et al (2003) use the same ecological model in their research, but put extra emphasis on the physical environmental factors that may influence walking/cycling for recreation in the local neighborhood. They suggest the usage of four features in the framework to enable the analysis of the relative importance of specific environmental factors. These features include: **function** (walking surface, streets, traffic, and permeability), **safety** (personal and traffic), **aesthetics** (streetscape, views) and **destination** (access to facilities). The different built environment attributes as identified by Van Cauwenberg (2011) in 31 BUENPA studies on older adults, could be subdivided to one or more features as shown in table 2.4.

Function	Safety	Aesthetics	Destination
Urbanization	Crime-related safety	Aesthetics	Access to recreational facilities
Walking/cycling facilities	Traffic-related safety	Land use mix diversity	Access to public transport
Street connectivity	Safety	Walkability	Access to shops
Land use mix diversity	Street connectivity		Access to services
Residential density	Walkability		Walkability
Walkability			

Table 2.4: Built environment attributes identified by van Cauwenberg (2011) subdivided to environmental features identified by Pikora et al (2003)

2.3.3 The BUENPA model

The 'BUENPA' model (figure 2.5) that is used in this research, is based on the ecological model as created by Joseph et al (2006) but includes the extra features as identified by Pikora et al (2003). The environmental features function as categories to which different types of built environment characteristics related to (moderate) physical can be subdivided. The BUENPA model also includes some of the research quality indicators as suggested by

other researchers, like a focus on a specific age category (older adults) and geographical scale (retirement community). Other suggested quality improvements in the literature will not be included in the model but are part of the analysis, like the combination of objective and self-report PA measures and the evaluation of a softGIS based methodology which will be further explained in the next chapter. Also, clear distinctions between PA domains in type (transportation, leisure) and intensity (moderate, vigorous) are taken into account during the analysis.
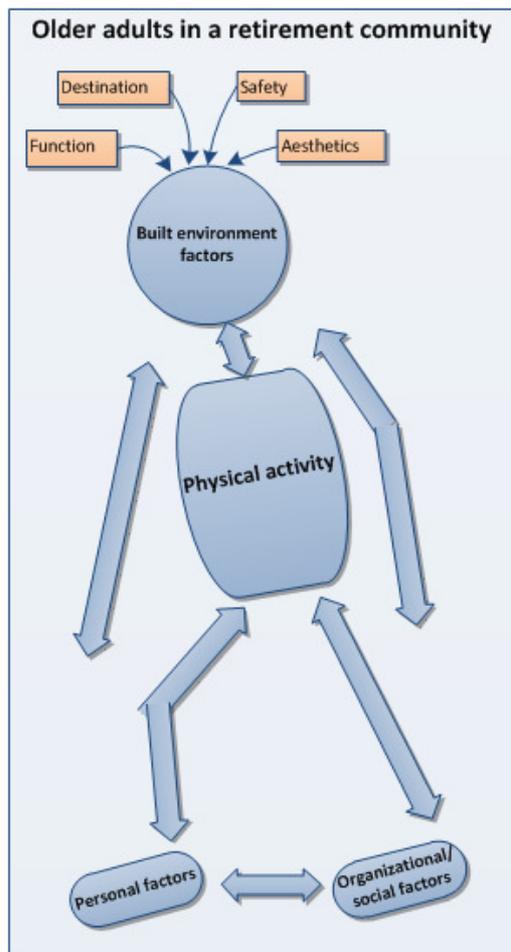
Figure 2.5: The BUENPA model (author, 2012)

The BUENPA model is used in two different parts of the research. First, the features of the model: function, safety, aesthetics and destination are used as input for the audit and interview tool analysis. In the audit tool analysis, the different environmental features function as a checklist to identify built environment characteristics related to BUENPA research in Friendship Village. During the interview the built environment features provide structure in the form of discussion topics for the evaluation of the living environment by the FV participants. By discussing the environmental features during the map drawing exercise, there is room for the participant to mention specific built environment characteristics that they value for physical activity. In the final part of the softGIS analysis, the empirical findings of the study will be added to the BUENPA model and subdivided to the factors personal, organizational/social or built environment. The softGIS analysis and presentation of the research findings in the BUENPA model will be part of chapter four.

This chapter provided a literature review of current BUENPA research to clarify concepts, to identify common built environment attributes in BUENPA research focusing on older adults and to build an ecological model that will be used as a conceptual framework for this thesis. In the next chapter the research methodology and operation will be explained in more detail. The methodology plays an important role in this study, as one of the research goals is to evaluate the potential of a softGIS based methodology for BUENPA research on older adults.

Chapter 3: Methodology and operation

3.1 Introduction

The used methodologies for collecting, processing and analyzing the data in this research are a crucial element of study, as part of the research is aimed at evaluating a new softGIS based methodology that has not been used in BUENPA research before. As described in the introduction, this study combines the usage of three types of measurement tools that are commonly used in BUENPA research. They are distinguished by Brownson et al (2009) as audit tool based observation, questionnaires/interviews to obtain information on environmental perception and GIS analysis based on existing data. The usage of these different measurement tools will be explained in this chapter. First the softGIS methodology will be introduced as it forms the overarching methodology that combines the three measurement tools.

3.2 SoftGIS

GIS is the abbreviation of 'Geographical Information Systems' and can be seen as computer programs that help to collect, handle, store and visualize spatial data. With GIS, digital spatial data can be analyzed and visualized in maps (Kahila and Kyttä, 2006). SoftGIS is a relatively new GIS methodology of which the first prototype was launched in 2004. SoftGIS combines 'hard' objective data about the environments physical structure with 'soft' subjective data based on residents' perceived quality of the environment. The term softGIS also refers to the collection of theories, concepts and ideas behind the development of the tools (Kahila and Kyttä, 2009). A collection of internet-based surveys, that combine traditional open and closed survey questions with an active map tool in which people are asked to draw their behavior/feelings/preferences on maps, forms the bases of softGIS. The methodology includes different tools that differ both in the specific users they target (e.g. children or adults) and the specific themes they encompass (e.g. perceived safety or perceived environmental quality). Examples of current softGIS tools are *softGISsafety* and *softGISchildren*. The softGIS methodology enables the study of locality-based human experiences and their everyday behavior (Kahila and Kyttä, 2006; 2009).

Up to now the softGIS tool has not specifically been used to analyze the connection between the built environment and physical activity. Also, no current softGIS tool especially for older adults exists, although Kahila and Kyttä (2009) do note the potential for a *softGISelderly* tool to analyze mobility constrains of the environment from the perspective of ageing women. Their only concern is the challenge to approach this group through the internet. In this research no online survey was used to gather the data, instead an interview tool helped to collect the experiential knowledge data of seventeen participants. Another deviation from the traditional softGIS methodology is the way the data produced by the residents is

analyzed in this study. In current softGIS research both quantitative and qualitative methods are used for analyzing soft data, but the researchers find quantitative analysis to be more useful for the purpose of combining the 'soft' and 'hard' data (Kahila and Kyttä, 2009). Because this research is based on the experiential knowledge of 17 participants in a detailed case study, only qualitative methods are part of the analysis. Moreover, this study uses 'hard' data produced by the audit tool instead of statistical or register-based data as used in traditional softGIS methods (Kahila and Kytta, 2006). These 'hard' data will be combined with 'soft' data conducted through interviews and together analyzed in GIS. In this sense, the softGIS approach should be seen as an overarching umbrella that combines the three measurement tools as shown in figure 3.1. In the next section the usage of the different measurement tools for collecting, processing and analyzing the data will be further explained.
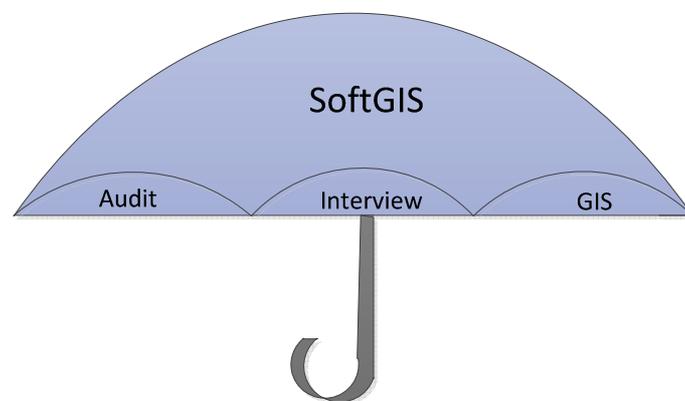
Figure 3.1: The softGIS approach used as an umbrella

3.3 Data-collection, processing and analyzing methods

The four built environment factors: function, destination, safety and aesthetics as indicated by Pikora et al (2003) in the theoretical framework, are used as a guideline for both the data collection and analysis in this research. The usage of the three measurement tools will now be individually explained starting with the tools used for the data collection and ending with the tool used for processing and analyzing the data.

3.3.1 Audit tool

The first step in gathering 'hard' objective data about the physical form of Friendship Village is through an analysis of the built environment guided by the PEDS audit tool. The Pedestrian Environmental Data Scan (PEDS) is a complete environmental audit methodology developed by the University of Maryland, US and helps to collect primary data about the environment, pedestrian facilities, road attributes and the walking/cycling environment. The PEDS tool has been developed to facilitate the need in BUENPA research for consistent, reliable and efficient methods for collecting data about the walk environment (Clifton et al, 2007). An example of the PEDS tool (Clifton et al, 2012) is available in appendix 2.

The PEDS tool is intended for the analysis of different street segments within a research area (Clifton et al, 2012). In the case of Friendship Village, many observable characteristics (e.g. the material used for the paths and roads and their condition) are the same throughout the community, as it is built in a homogeneous fashion. Therefore, the PEDS tool is not performed per segment but is used as guide to note differences in the availability of sidewalks (function), access to different amenities and transportation facilities (destination and aesthetics) and safety characteristics (safety) throughout the community. The output of the tool is added to GIS and will be used in the fourth chapter for the BUENPA analysis of Friendship Village.

3.3.2 Interview tool

The interview tool is used to collect 'soft' data about the FV residents' perceived quality of their direct living environment. The data are collected through interviews, in which both closed and open questions are asked to the participants. The interview is divided into three parts. Part one focuses on personal information, transportation behavior and general physical activity (exercise) patterns. The second part involves drawing personal experiences and preferences on maps based on the four environmental features identified by Pikora et al (2003). To these four features the extra feature 'behavior' is added to allow for an analysis of the physical activity and transportation behavior of the participants as shown in table 3.2.

Feature	DESCRIPTION
Behavior	Reported physical activity behavior for transportation and leisure
Function	(opinion about) the physical attributes of streets and path
Destination	(experience with) the availability of (PA) facilities and transportation modes
Safety	(the perceived) personal safety and safety from traffic
Aesthetic	(opinion about) the attractiveness of the environment and amenities

Table 3.2: Environmental domains used in the research (Pikora et al, 2003; author, 2012)

The third part of the interview consists of an evaluation of the questions asked in part one and two of the interview and the respondents' opinion about different maps that are available for the purpose of orientation. Also, comments and suggestions for improvement of the interview questions are elements of part three. The evaluations of the interview will be used in chapter five of this research in which the potential of the softGIS based methodology for BUENPA research on older adults will be discussed. The complete interview is available in appendix 3.

To attract participants for the interview, a recruitment flyer has been made with information about the project. Residents could subscribe to participate at the fitness center in Friendship Village. Health and fitness director Mary Lockhart functioned as the main contact person who distributed the recruitment flyers and presented the research in a weekly meeting to the residents of Friendship Village. In total, seventeen residents of the community gave their informed consent to participate in the study. The main characteristics of the participants group are visualized in table 3.3.

CHARACTERISTICS OF PARTICIPANTS	AVERAGE	MEDIAN	MIN	MAX
Age	82,9	83,5	72	92
Number of years living in FV	6,9	6,5	2	16
Number of months per year living in FV	11,9	12,0	11	12

CHARACTERISTICS OF PARTICIPANTS	FREQUENCY	PERCENTAGE %
Male	9	52,9
Female	8	47, 1
Person(s) in household : 1 person	6	35,3
2 persons	11	64,7
Residence type in FV:		
Independent living apartment homes	7	41,2
Garden homes	10	58,8
Nunnenkamp Center	0	0
Car ownership	15	88,2
Bicycle ownership	3	17,3

Table 3.3: Characteristics of respondents (FV interviews, 2012)

3.3.3 GIS tool

As previously described in this chapter, GIS are computer programs that help to collect, handle, store and visualize spatial data (Kahila and Kyttä, 2006). In this research, ArcCatalog and ArcGIS are used for storing and analyzing the data collected with the audit and survey tool. The base map used in the research is a satellite image derived from the ArcGIS online database (ESRI, 2012). The drawn answers on a paper map by the FV in part two of the interview have been manually added to a personal geodatabase (figure 3.4). Small errors in markings made by the participants (e.g. small gaps in drawn lines and routes drawn through non-walkable areas as houses/ gardens etc.) have been corrected, but only if the error could be corrected in an obvious manner. An example of the editing in ArcGIS is visible in figure 3.5, in which a drawn line illustrates an unfriendly path type as perceived by the interviewee, including the respondent's comment *'no path, you have to walk on the grass'* (FV interviews, 2012). After collecting and storing both the 'hard' and 'soft' data, GIS is used for comparing the data and visualizing the results in maps that will be presented in the next chapter.
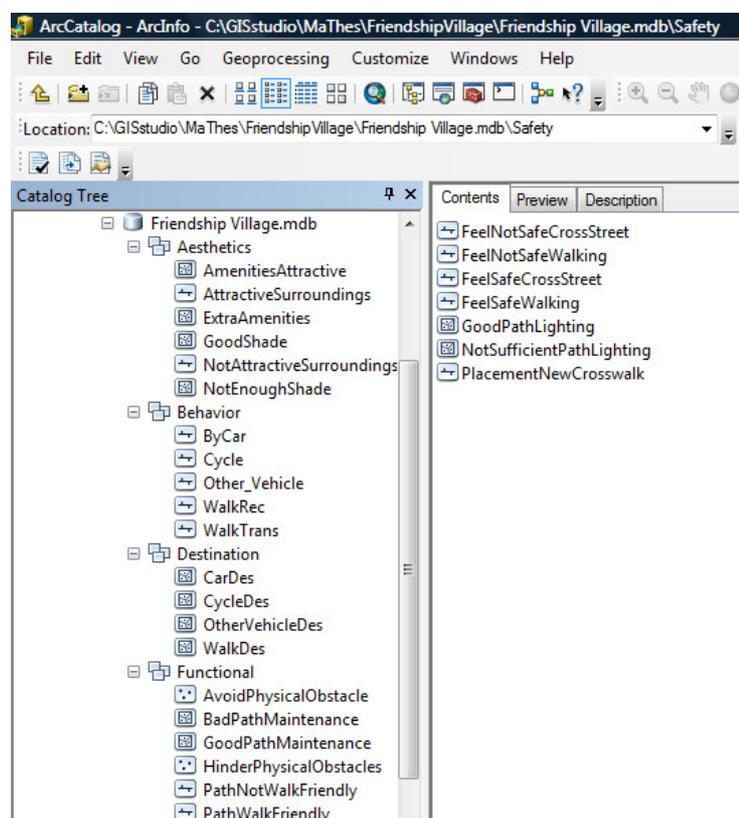
Figure 3.4: FV geodatabase in ArcCatalog (author, 2012)
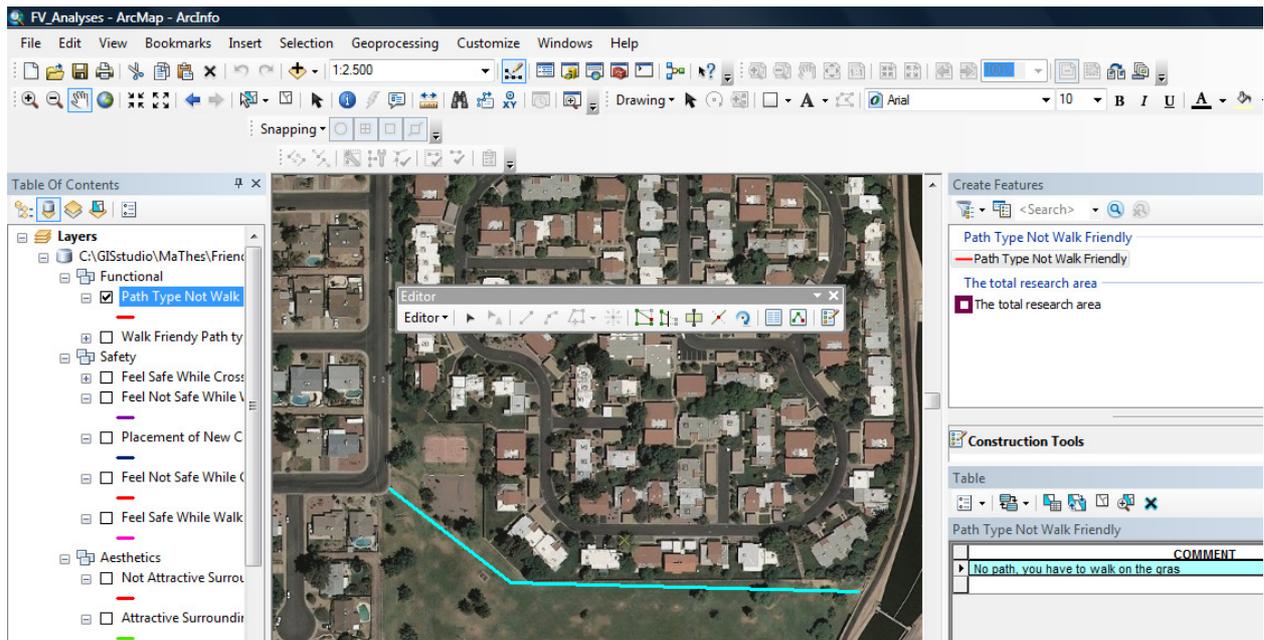
Figure 3.5: Editing in ArcGIS (author, 2012)
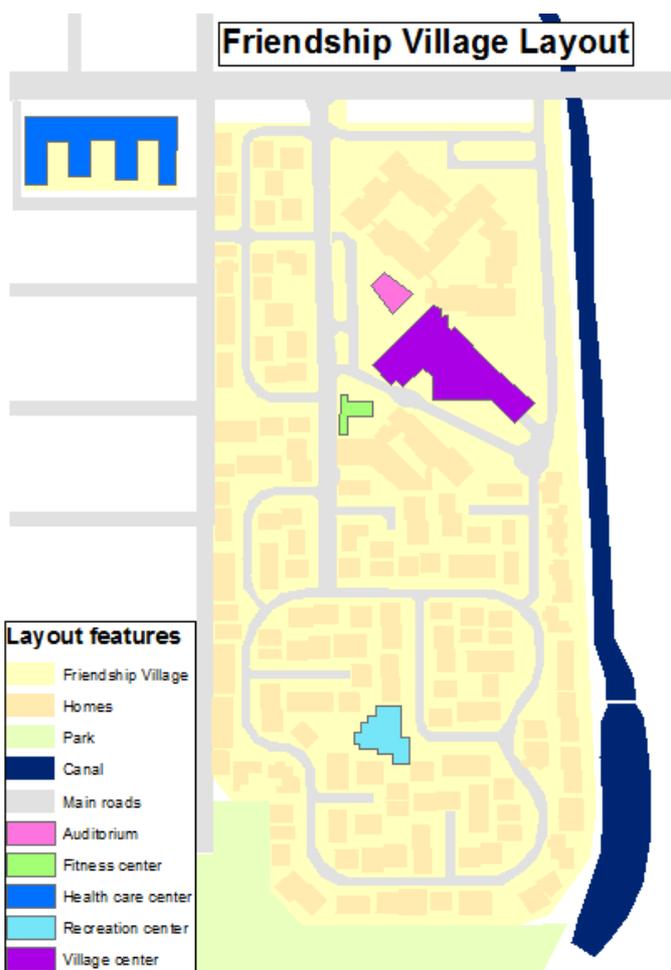
Figure 3.6: Friendship Village base map (author, 2012)

Because the satellite image contains a lot of details, some of the information becomes less visible after adding it to GIS. This happens especially when multiple lines run through the same location. To account for this, a new base map is made based on the satellite image (figure 3.6). This Friendship Villages layout will be used for the analysis and visualization of the results in the next chapter.

This chapter has explained the usage of the softGIS based methodology, including the audit, interview and GIS tool that are used for analyzing the built environment of Friendship Village in relation to physical activity behavior of its residents. In the next chapter the results of the analysis will be presented as the 'insights from Friendship Village'.

Chapter 4: Insights from Friendship Village

4.1 Introduction

A major growth period of purpose built CCRCs happened during the 1970s and 1980s (CCRC Task Force, 2010). Friendship Village (figure 4.1) was developed in the late 1970s as an initiative of Tempe residents, looking for a retirement facility that was non-existent in the city at that time (Keane, 1995). Today, Friendship Village offers Life Care to about 850 residents and has 475 employees (Lockhart, 2012). As stated in the introduction of this thesis, Friendship Village is a relatively large CCRC with 573

Figure 4.1: Friendship Village (Author, 2012)

housing units. In this chapter Friendship Village will be further explored by presenting and discussing the results derived from the softGIS analysis to get a better understanding of how the FV residents use and evaluate their direct living environment for physical activity. First, the focus is on features of the built environment that can be related to (moderate) physical activity levels as identified in the theoretical framework. The results of the audit tool will be presented and discussed with a map that shows how the built environment features are present in Friendship Village. After this, the focus shifts to the results of the interview tool in the second section. Here, some characteristics of the interviewees with a focus on their choice for living in Friendship Village, their transportation behavior and physical activity patterns will be presented. In the third section, the map-drawing exercise will be presented and interpreted with the goal to understand how the built environment characteristics of Friendship Village shape the older adult residents' physical activity behavior.

4.2 BUENPA attributes in Friendship Village

As demonstrated in the theoretical framework, four features of the built environment can be distinguished to enable the analysis of the relative importance of specific environmental characteristics (Pikora et al, 2003). With the help of the audit tool, these features: **Function** (path type), **Destination** and **Aesthetics** (access to different amenities), and **Safety** (crosswalks, traffic signs) are shown in photographs of Friendship Village in figure 4.2 and visualized on a map in figure 4.3.

The audit map shows:

- The non-existence of sidewalks in various parts of the community;
- An interior path between the homes that leads from the recreation center up north;
- The equal distribution of benches and trash cans on the property;
- The clustering of bike racks and fountains around the main buildings;
- The location of traffic signs around the main boulevard and exit roads.

The audit tool map will be compared with the actual behavior of residents of Friendship Village and their opinion about the BUENPA attributes later in this chapter.
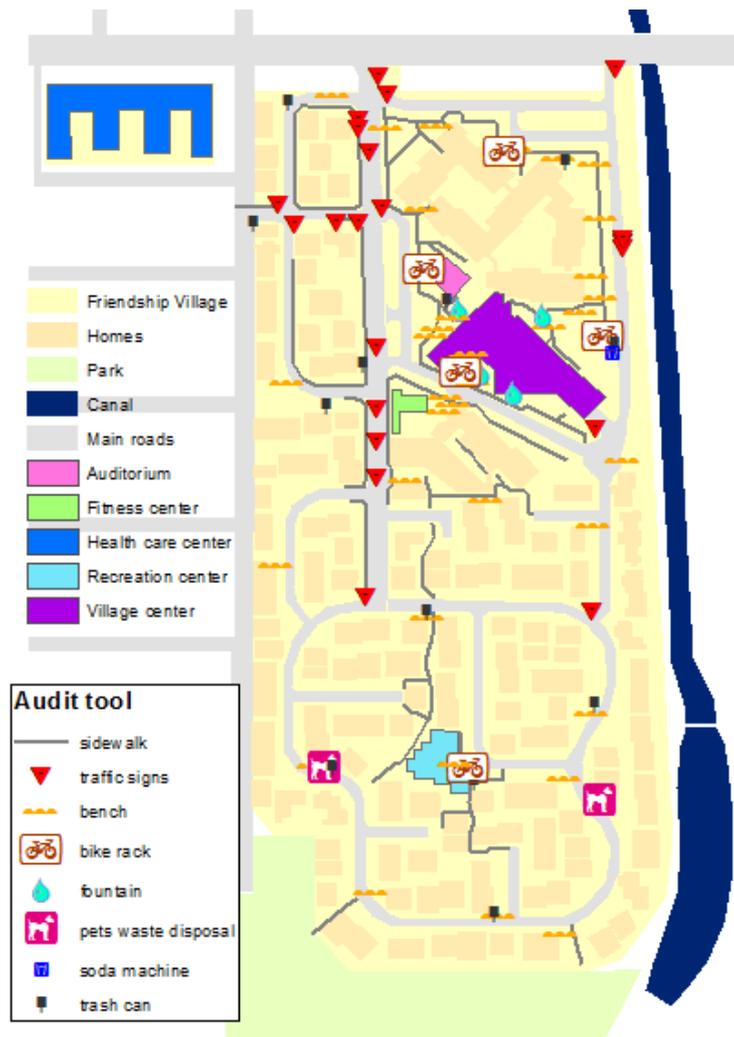

Figure 4.2: Built environment attributes in Friendship Village (Author, 2012)

Figure 4.3: Audit analysis map of Friendship Village (Author, 2012)

4.3 Living in Friendship Village, transportation behavior and PA patterns

Before presenting the results of the softGIS analysis in section 4.4, the FV participant group will be introduced. A clear view of the type of residents that participate in the study contributes to a better understanding of personal and social/organizational factors that may influence physical activity behavior. As shown in a table in the methodology and operation chapter, 17 residents (9♂/8♀) of Friendship Villages participated in the study of which the youngest person is 72 and the oldest 92 years old, with an average age of 83. Especially their motivation for living in the community and transportation and physical activity behavior is important background information for the map drawing exercise and interpretation of the research findings. In the next section this information about the participants will be presented, starting with their motivation for living in Friendship Village.

4.3.1 Friendship Village as a place to live

As mentioned before, Friendship Village is a Continuing Care Retirement Community offering life care to its residents. The concept of life care implies that residents can stay in the same community when their healthcare needs change. The website of Friendship Village (2012) indicates that besides life care, the community offers multiple amenities and facilities to its residents. Examples include a library, auditorium, shop, clubrooms for cards and games and a fitness center with swimming pool and on-site personal trainer. There are also several restaurants and different meal plans available to the residents so they don't have to cook at home. Because of the many activities organized in Friendship Village, one of the respondents compared the community to a cruise ship but then without the water. Another respondent called Friendship Village a 'resort' and a third participant jokingly used the term 'prison' to indicate that there is no reason to leave the place because everything you need is located within the walls of the community (FV interviews, 2012).

On average, the participants in the study have lived in Friendship Village for seven years, ranging between two and sixteen years and all but one participant live in the retirement community throughout the year. A total of eleven participants live in a household consisting of two persons and six people live alone. By far the most popular answer to the question why the participant had chosen Friendship Village as a place to live, was *'the need for health security because of getting older'* (FV interviews, 2012). Other factors directly related to age, included concerns about house and yard maintenance, giving up the car due to decreasing eye-sight and a preference to live around like-minded people with same experiences. For some of the respondents, family and friends also played an important role in their decision to move to Friendship Village. Motivations included: living closer to family, making sure the children don't have to worry and encouragement by friends with experience with living in a CCRC. There were also factors mentioned that distinguish Friendship Village from other CCRCs as many of the respondents had looked around in other places before moving to the community. These factors included intangible things like the friendliness and general energy of the people and the good treatment (longevity of contracts) of (lower level) employees.

Other factors included the type of facilities in the community and the availability of more services for less money than in other places (FV interviews, 2011). The mentioned reasons of the participants to move to Friendship Village match part of the push and pull factors for moving to a CCRC as identified by Groger and Kinney (2007) in the theoretical framework. These factors include fear of burdening family, burden of house/yard maintenance, declining health, being ready for a change, nearness to family, community attachment and prospect of long-term care and amenities of the CCRC.

4.3.2 Transportation behavior

For transportation assistance in Friendship Village there is a tram system working within the borders of the community that residents can order by phone (FV Tram). There is also a bus available with set grocery, doctor's office and church runs (FV Bus) (Lockhart, 2012). The question is whether/how the participants use these transportation modes and how they generally get around and get to places. To answer this question, the participants were asked about their transportation behavior in the last seven days. Table 4.2 shows the answers of the respondents to the question: In the last seven days, how did you travel to the following…
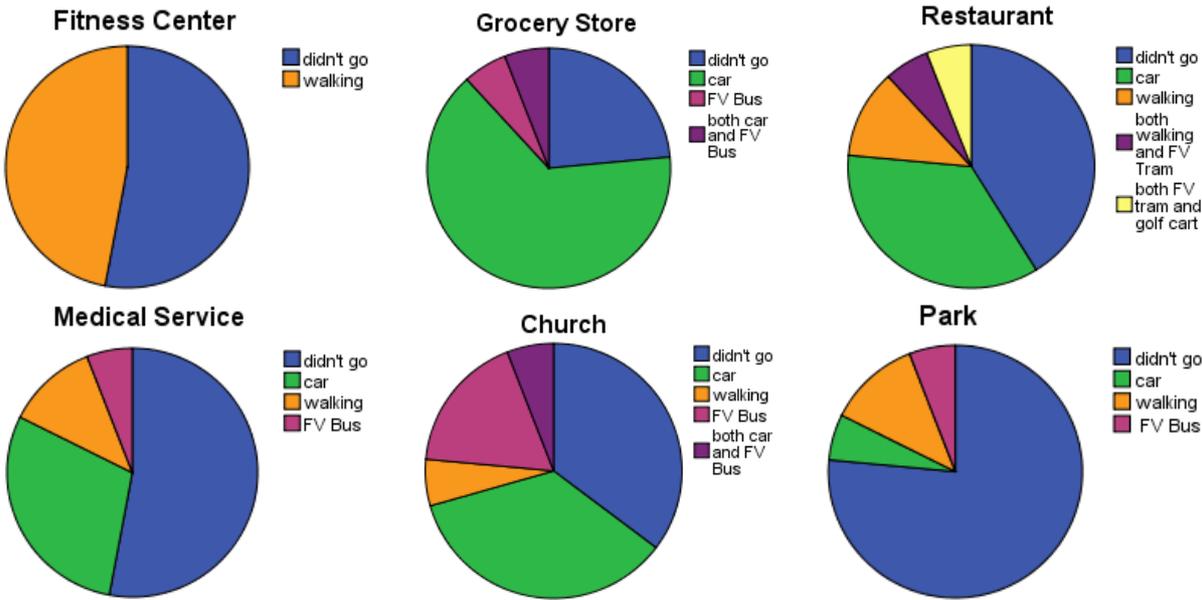
Figure 4.3: Pie charts of transportation behavior respondents in last seven days (Residents FV, 2012)

The used destinations in the pie charts are an interpretation of the author, partly based on a selection of commercial and recreational land uses found in neighborhoods, as suggested in researches by Giles Corti et al (2009), the TRB (2005) and Southworth (2005). These land uses include: parks, sports centers, neighborhood shops, cinemas and public services, schools, transit stops, church and recreational facilities and fitness centers.

The pie charts show clearly that to every question, a large proportion of the respondents answered 'didn't go'. Still, all of the respondents had gone to at least one of the destinations and two of them had gone to all destinations in the previous seven days. When looking at the pie charts, the car seems to be the most used transportation mode to get to places

outside of Friendship Village, like the grocery store and church. The proportion of car usage is also relatively high for restaurants and medical services but these destinations can also be found within the borders of Friendship Village. Walking appears to be the most popular form of transportation to get to a park, which may be explained by the presence of Ehrhardt Park, just south of Friendship Village. Also, walking is the only transportation type used to get to the fitness center, which is located within Friendship Village. Though, it must be noted that during the week that the interviews took place, the fitness center was undergoing a floor renovation. Therefore, the fitness center was temporarily located on the other side of Southern Avenue, the street north of the community. The temporary relocation had a clear effect on the usage of the facility. Some of the interviewees mentioned that they normally used the facility but now didn't because the fitness center on the property was 'closed'. Another interview question asked how many of the last seven days the FV respondents had used different types of transportation vehicles like the car, public transport, bicycle, FV bus, FV tram or a golf cart. The answers of the residents show that the car had been used the most often with an average of three days in the previous week for each person with a car (which are fifteen out of the seventeen people). Public transport proved to be the least popular with only two users. Six people had used either the FV bus or FV tram or both in the past week. Two of them made use of these facilities almost every day, but the other four only once. The three FV respondents with a bicycle, had cycled about five times and the two golf cart owners had used their vehicle practically every day in the last week. These results show that the respondents use a wide variation of transportation modes to get around.

4.3.3 Health situation and physical activity patterns

Lockhart (2012) explains that there are specific age and health restrictions for older adults who want to move to Friendship Village. The minimum age of the first person is 62 and the second person can be as young as 55, but has to pay the market rate in the Health Care community until he or she reaches the age of 62 (Lockhart, 2012).

Figure 4.4: Independent living apartments (left) and garden homes (right) in Friendship Village (Author, 2012)

Al the participants were very positive about their general health condition considering their age. Eleven participants found their health 'excellent' and four participants found their health 'good' compared to other people their age. The relatively good health of the participants is also apparent through their choice of residence type in the community, which

is all independent living. Most of the participants live in the garden homes (ten) and the other seven live in independent living apartment homes (figure 4.4). No resident of the assisted living Nunnenkamp Center of Friendship Village participated in the study.

Despite the relative good perceived health of the FV participants, three of them mentioned that their current health condition constrains them from being physically active. The main reason for this is age-related physical deterioration resulting in back or knee problems. Most participants were satisfied about the amount of physical activity (exercise) they got, but four people in total were not satisfied. Similar reasons as for the previous question were mentioned, but also *'a lack of time'* and the general feeling of *'I wish I'd do more'* were used to describe why they were not satisfied with their current level of PA participation. (FV interviews, 2012). The participants were also asked about the type(s) of physical activity they engage to, which turned out to be a various group of activities, including outdoor activities like walking, power walking, hiking, cycling, golf, swimming and aquarobics. Inside, the FV participants engage to weight lifting, treadmill and body work in the fitness center. For other physical activities like tai chi, yoga, chair yoga, body recall exercises and balance floor exercises they go the recreation center.

To get an impression of how often the participants are physically active, they were asked how many times in the last seven days they had participated in both vigorous and moderate physical activity for at least ten minutes at the time. Ten out of the seventeen participants had engaged in vigorous exercise in the last seven days, with an average of 3,8 times. The total minutes of vigorous exercise ranged between 40 and 180, with an average of 100 minutes of reported vigorous exercise per person in the last seven days. The most popular types of vigorous activity are exercise programs in both the fitness and recreation center. All the participants of the study had engaged in moderate physical activities in the last seven days with an average of eight times and 250 minutes in total, ranging from 70 to 750 minutes. By far the most popular type of moderate physical activity of the FV respondents is walking. All of the participants engaged in walking, both for exercise and to get around in the community. This corresponds with Joseph and Zimrings (2007, p75) statement that *'walking is the most popular physical activity for older adults, for recreation and as part of everyday activity'*.

According to King et al (2011) fewer than five per cent of adults over the age of 65 meet physical activity recommendations that are set on 150 min or more per week of moderate to vigorous physical activity for U.S. adults and older adults. In this study, all but one of the participants met these national recommendations by far. Though, it must be noted that this research only includes self-reported physical activity which may deviate slightly from actual physical activity behavior. Beside their physical activity behavior, the participants were asked where they had been physically active in the last seven days. It turned out that on average, 68 percent of all the vigorous and moderate physical activities they had engaged to, took place outdoors. Also, on average 80 percent of the physical activities they had engaged to in

the last seven days took place within the borders of Friendship Village. Twelve out of the seventeen participants even reported that all of their physical activities took place within the borders of Friendship Village. This information is valuable for the analysis of the map drawing exercise. It leads to the expectation that a large proportion of for example the walk routes for recreation, will lay within the borders of the community. The information about the health condition, residence type and amount of physically activity that the participants engage to, learns that the people who chose to participate in the study have a relative good health condition and are fairly physically active. This may not be totally representative for all residents of Friendship Village, as there are visibly also people living in the community that use canes and wheelchairs to get around. Nevertheless, even if the participants group would represent the healthiest older adults living in Friendship Village, the way they use and evaluate the built environment characteristics, provides meaningful information for the whole community. The fact that 80 per cent of their physical activity behavior takes places within the borders of Friendship Village, indicates the importance of this geographical space for even the most mobile community residents, who are the least constrained in where they spend their time. The way the FV participants use and evaluate their direct living environment for physical activity will be presented in the next section.

4.4 Personal experiences and preferences drawn on maps

The second part of the interview involved the drawing on maps, based on the four environmental features identified by Pikora et al (2003) plus the extra feature 'behavior'. The aim of the map drawing exercise is to learn more about how the FV participants get around for transportation and leisure and evaluate their direct living environment for physical activity. The results will be presented in the different sections: behavior and destination, function, safety and aesthetics.

4.4.1: Behavior and destinations

To learn more about the walking behavior of the FV participants, they were asked where they had walked for transportation (to get somewhere) and where they had walked for recreation (including exercise) in the previous seven days. Especially the walking for recreation question caused the reaction that "*when you retire, it's all recreation*" (FV interviews, 2012). Hence, many respondents were consciously walking for exercise rather than walking for recreation. No participant engaged in jogging or running with the common argument given that it is too hard on the knees. Some of the respondents did mention that they had gone power walking which is *"brisk walking as a form of aerobic exercise"* (Oxforddictionaries, 2012). The clear orientation on walking for exercise shows on the map (figure 4.5). Many participants knew exactly how many miles their lap was and they rather used the exterior roads than the interior paths to walk extra distance. This is different from the walk for transportation routes which usually included the shortest route for getting to a certain destination, for which both the interior paths and exterior roads were used.
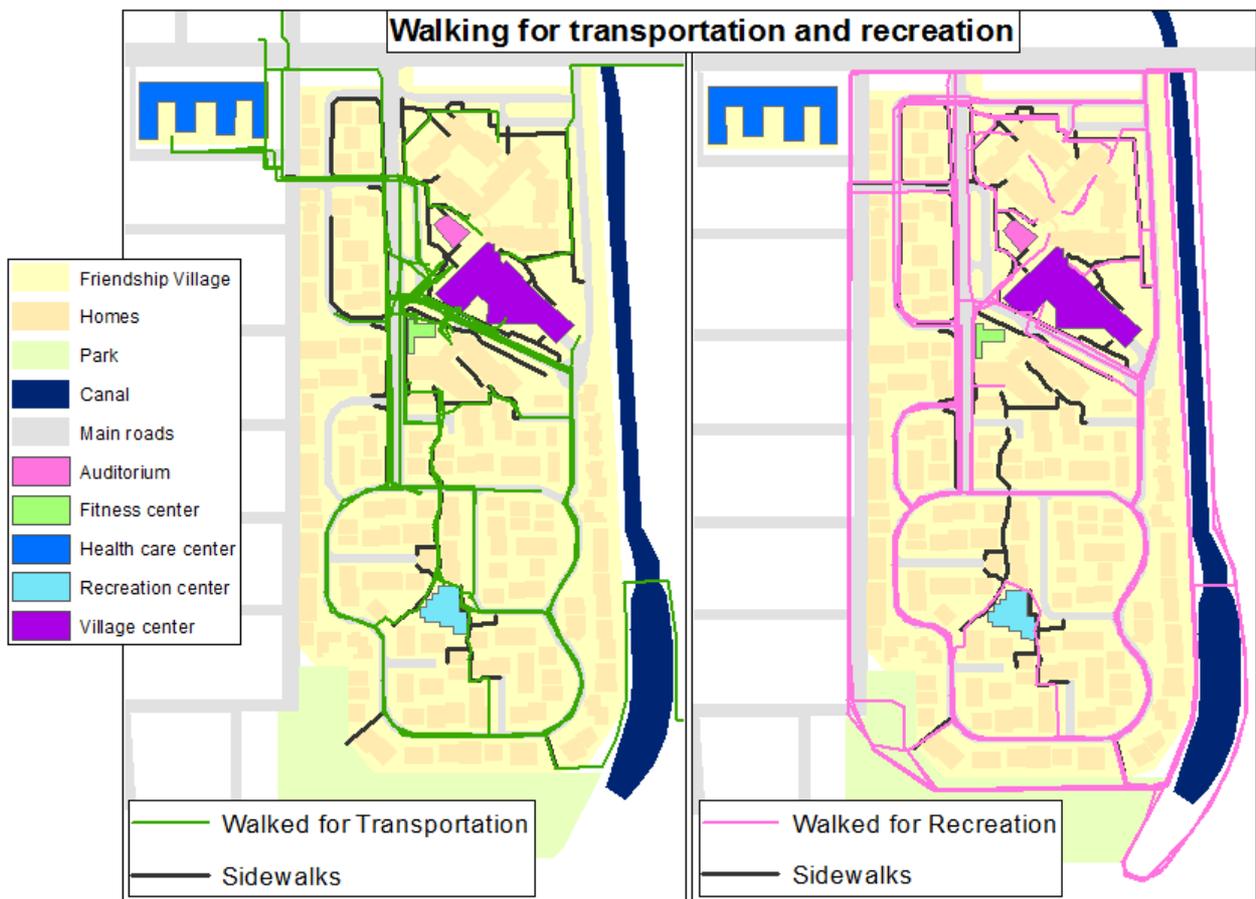
In the previous seven days, common destinations within the village had been the entrance of the village center (dining location), the recreation center and the health care center. Other reasons for walking besides transportation and exercise, included walking the dog and devotion time with the spouse. The FV participants mostly walked alone but people with a spouse were sometimes accompanied by that person. The routes taken for recreational walking were quite standard in the sense that the participants walked the same route quite often. Though, most participants did have various different routes to choose from, depending on the time of the day and the amount of minutes they wanted to spend walking. Also, one participant mentioned that the dog sometimes decided whether they walked another lap or not. As figure 4.5 indicates, by far the most walking trips of the FV participants took place within the borders of Friendship Village. In the category walking for recreation, some of the respondents extended their walk outside the borders of Friendship Village, especially along the canal, but only during the daytime. For transportation, a few participants walked to locations outside Friendship Village like the church, hospital and hairdresser. Though, the fact that most of the walking trips of the older adult residents took place within Friendship Village indicates the importance of the community for the moderate physical activity behavior of these residents.

Figure 4.6: Walk, Cycle, Car and Other vehicle type routes and destinations in Friendship Village (Residents FV, 2012)

When looking at the other transportation modes, figure 4.6 shows that in the previous seven days, most of the destinations in Friendship Village had been reached either by walking or with other vehicle types, like the FV tram and golf carts. Some of the respondents mentioned that the FV tram functions as a substitute for walking when they are in a hurry or when it is too hot for walking. The 'other vehicle types' (golf carts) are sometimes also used for voluntary work, for example to pick up old newspapers throughout the community. Friendship Village has a lot of different committees chaired by its residents, to organize voluntary work on the property. Examples of these committees include the safety committee, introduction committee, flower committee and the paper boys. One FV participant explained that there are a lot of ASU (Arizona State University) graduates living in the community, who are happy to chair the committees and volunteer. (FV interviews).

When looking again at figure 4.6, the maps show that mainly the car had been used to get to places outside the retirement community in the previous week. The bicycle route appears both in and outside Friendship Village, as one person had cycled a little route for recreation outside the property. In general, the maps show that most physical activity and transportation behavior had taken places within Friendship Village. The next section will discuss (built environment) characteristics that may contribute to the residents' preference of being active within the borders of the community.

4.4.2 Function

The feature 'function' is defined by Pikora et al (2003, p1696) as *"the physical attributes of the street and path that reflect the fundamental structural aspects of the local environment"*.
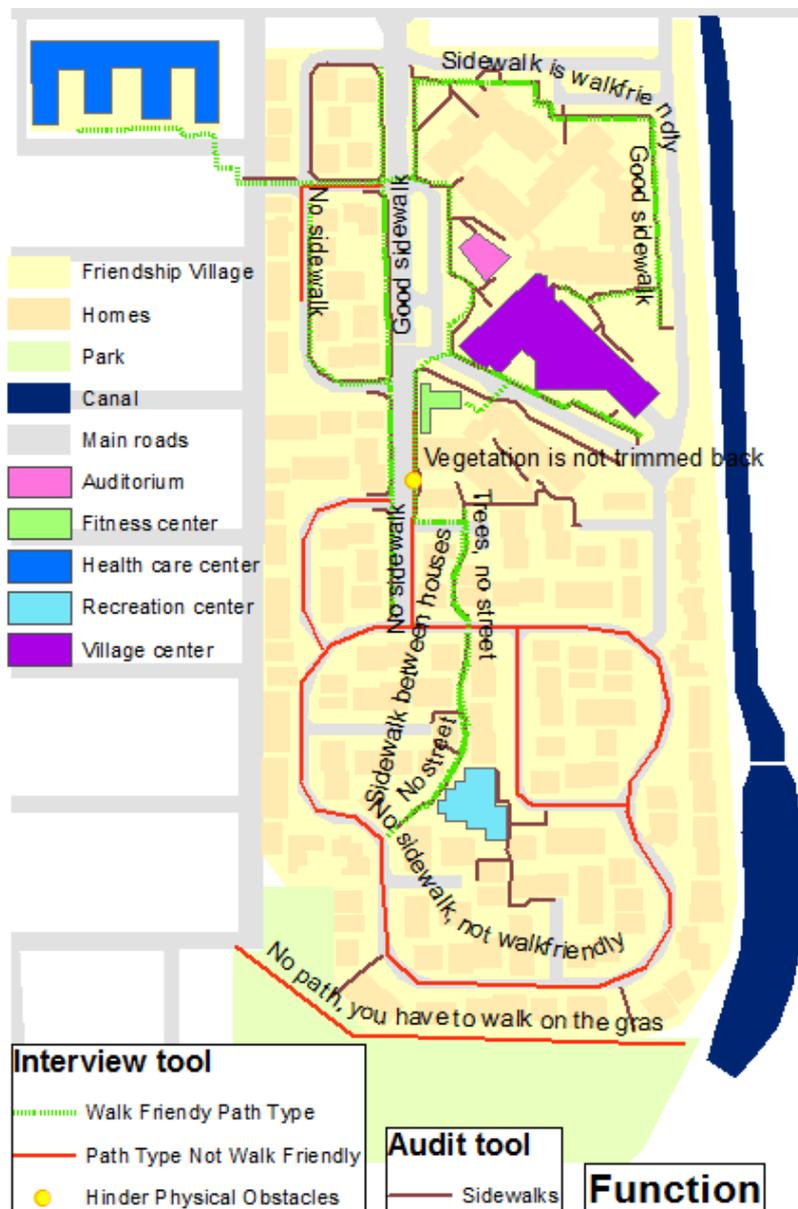

Figure 4.7: Functional elements in Friendship Village (Residents FV, 2012)

The participants were asked if/where they thought the path type (street/sidewalk/ footpath/ paved trail) is walk friendly and where not. By far the most common answer to this question was that it is everywhere walk friendly within the borders of the community. One FV participant gave as an explanation that Friendship Village has been built by the first residents of the place, who were retired university people (from ASU). In 1980, the land was cheap and the residents could design the community how they wanted it, instead of how a developer wanted it (FV interviews, 2012).

The participants were also very satisfied with the maintenance of the paths. Many of them indicated that whenever a bump or hole in the path is reported to the 'safety committee' the problem is usually fixed the next day. None of the participants were able to mention places where physical obstacles (e.g. poles/signs/parked cars/ garbage cans) made them consciously avoid that place while walking. One FV participant did mention a place in the village where the vegetation hangs a bit over the street, which hinders walking at that location, but not to the extent that the place is avoided. The only element of the feature 'function' that caused disagreement between the participants was the non-existence of sidewalks in part of the community. Some of the respondents really didn't mind that there are no sidewalks there, while others really preferred to have sidewalks throughout the entire village. Most of the respondents mentioned that they do walk on the sidewalks whenever they are there, but most of the people don't have problems with walking on the

street. In contrast, there were quite some arguments given in favor of walking on the streets. For example, respondents mentioned that the asphalt street is flatter and softer on the knees than the concrete sidewalks. Also, walking side by side in a group is easier on the street and sometimes it is just faster to get to places (e.g. the dining hall) while choosing the route over the streets. One of the respondents literally said that the absence of sidewalks is not walk friendly, *"but we don't need walk friendly here"* (FV interview, 2012). The reason why walk friendly paths were not seen as necessary, has a lot to do with the feeling of safety, which will be discussed in the following section.

4.4.3 Safety

The feature safety is described by Pikora et al (2003, p1696) as *"The need to provide safe physical environments for people. The framework incorporates two elements of safety: personal… and traffic"*. The safety feature seems to have an important influence on the participants' behavior. Friendship Village is a gated community with 24-hour security. The property can only be entered though the main gate where a guard house and barriers are located. There are three car exits on the north/northwest side of the property and another two walk exits on the south side that can be opened with either passes or keys. All the participants were very satisfied with the security system in the community. Also, traffic safety was experienced as very good compared to outside the borders. *"I am more alert when I'm outside the borders of Friendship Village"* and *"Once you're in the gate you're fine"* were responses of participants when talking about safety during the FV interview (2012). Another FV participant mentioned: *"My wife doesn't want me to go outside the gate, it makes her nervous, so I don't argue and don't go too far"* (FV interviews, 2012). An important reason why the participants feel safe on the FV property seems to be that the residents take good notice of each other, or as one respondents puts it *'the intangible feeling of courtesy'* in Friendship Village. Pedestrians have the right of way in the community and everybody is very aware of that and gives more than enough space for people who walk. Generally, there is very little traffic on the property and the speed limit of ten miles per hour is watched carefully by the residents. The only vehicles that sometimes drive faster are from delivery people who are in a hurry. Mentioned places on the property where pedestrians are a bit more cautious are at the main entrance, the service entrance and parking garage. Figure 4.8 shows where the respondents feel especially safe while walking, which is the interior path located between homes and the sidewalks around the main building. However, it must be noted that just a few people mentioned these routes as most of the respondents feel safe everywhere in community. Some of the participants even stated that if they can't sleep, they sometimes walk around the community in the middle of the night and still feel completely safe. The path lighting at night was very well evaluated by the respondents, although quite some of them did not have an opinion about the topic as they didn't go out that much at night. Extra path lighting was not seen as necessary, because in the current situation you could *"see the time on you watch at any time during the night"* and at the same time *"still see the stars a little"* (FV interviews, 2012).
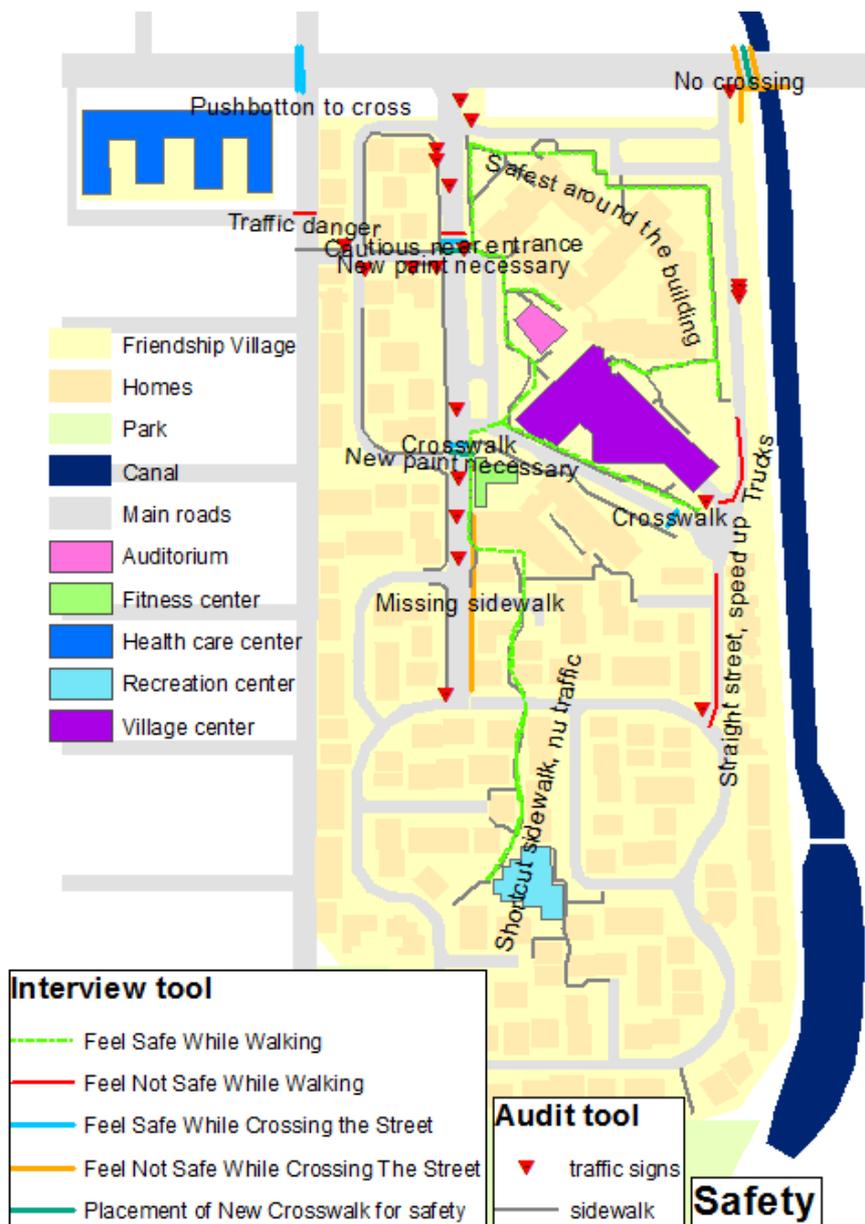
Figure 4.8: Safety elements in Friendship Village (Residents FV, 2012)

Figure 4.8 shows some interesting views of the respondents of places where they did think safety could be improved. An example is the absence of a crosswalk with a traffic light over the six lane wide Southern Avenue, northeast of Friendship Village. Currently, the northern part of the canal east of the retirement community is hard to reach for the residents, because they have to cross the street near the health center where there is a pedestrian crossing. The extra walk appears to be a barrier for the people for walking along the northern part of the canal. Within the borders of Friendship Village there are some crosswalks along the main boulevard of which the participants are satisfied with the location. One person suggested that the crosswalks could use some new painting to make them stand out even more. The respondents had mixed feelings about the absence of sidewalks at certain places in the community, but most of the residents preferred them to be there. The participants explained that whenever they (have to) walk on the street, they make sure that they walk against traffic. The only problem with this is the fact that many American cars have tinted front glass, which makes it difficult to make eye-contact. Still, many participants mentioned that they feel safe on the street as long as they walk against traffic. One location where this is not always possible is on the southeast side of the main boulevard where the sidewalk suddenly stops. This forces the residents to either walk in the same direction of the traffic or walk extra distance to cross the street to the other side. An extension of the current sidewalk on this particular location may increase the perceived traffic safety of the residents

in Friendship Village. Except this comment, the respondents were overall very satisfied with both personal and traffic safety within the borders of Friendship Village. The next section will discuss the respondents' opinion about the attractiveness of amenities and surroundings for walking in Friendship Village.

4.4.4 Aesthetics

Built environment characteristics that can be attributed to the feature Aesthetics, are according to Pikora et al (2003, p1696): *"the presence, condition and size of trees; the presence of parks and private gardens; the level of pollution; and the diversity and interest of natural sights and architectural designs within the neighborhood"*. Not all these factors really account for Friendship Village due to its size and specific setup (e.g. no diversity of design and the presence of parks). Therefore, slightly different elements of the built environment are included in the discussion about aesthetics in this study. Also, the fact that the research specifically focuses on a retirement community in a desert climate requires extra attention for the availability of for example benches and shadow. These factors, together with the presence of other amenities and the attractiveness of the surroundings were elements discussed with the participants during the interview. Overall, the respondents found the surroundings of Friendship Village very attractive and there was high praise for the maintenance of the community by the staff who keep the place up. There are quite strict rules for landscaping in Friendship Village as the residents need approval for planting vegetation in their own garden, as it is normally done by the staff. If the residents choose to take care of their own garden, they also become responsible for its maintenance. Nevertheless, the presence of certain flowers and trees in particular gardens were seen by the participants as important factors influencing the attractiveness of the surrounding for walking (figure 4.7). Also the presence of plant labels with information about the vegetation was very much appreciated by the participants. There was some disagreement between the respondents about the degree to which the landscaping in the community should fit the desert climate. Most of the participants preferred the current landscaping with the green grass, citrus trees and flowers, over a landscape that includes more sand, rocks and cacti. The concern of others was mainly fed by the high costs and difficulties of maintenance of the green landscape. Although the watering of the trees and plants works through a drip system, the lawns are watered by sprinklers. There was also critique on the several fountains around the main building. A participant noted that although they look nice, the also require a lot of water and due to the presence of hard water, they need a lot of maintenance to keep them look attractive. There was no reported need for the planting of more trees in Friendship Village, as most of the respondents didn't think that there was room for it and they didn't see the benefits of increasing the amount of shade on the property. A common argument was *"you don't walk outside in Arizona in the middle of the summer",* meaning that if it is too hot outside, the residents make sure they stay inside. (FV interviews, 2012). Many participants reported that they adjust their walking patterns in the hot summer months. Walks around the canal are avoided because shade is complete absent there. Also, many walk trips move from outdoor to indoor, for example through the hallways of the

independent living apartment complexes. Also, outdoor walk trips are done more in the morning and evening instead of during the day. The times that the participants really have to walk outside during a hot summer day, hats and umbrellas were seen as the most important protectors against the sun, instead of 'shadow-hopping'. Still, there were participants who mentioned particular areas on the property with good shade for walking and places where shade is lacking as shown on figure 4.9.

The respondents were also asked about their opinion about the importance of amenities on the property of Friendship Village for walking. An important topic was the presence of benches, as seating is seen as an important contributor to activity-friendly outdoor spaces for older adults (Larkin, 2009). Practically all the respondents had the same response in the sense that they hardly ever use a bench to sit down but they found it important that they are there for other people who do need them. The relative good health condition of the participants might be an explanation for this, but one participant also mentioned that the well functioning tram service makes the need for benches

Figure 4.9: Aesthetics in Friendship Village (Residents FV, 2012)

less important in the community. Participants who reported that they do use the benches, only use them when they wait for a person or pick up, for example at the FV Bus stop or the bus stop outside Friendship Village. The participants did agree that the benches are well situated throughout the village. Only one person mentioned that the creation of an extra bench on the way to the health center would be helpful. The other amenities on the property like the bike racks, soda machine, trashcans and pets waste disposal boxes were seen as necessities of modern living, but do not look particularly attractive.

4.5 Research findings in the BUENPA model

This chapter presented insights derived from the softGIS based analysis in Friendship Village. The audit tool showed the location of amenities and the presence/absence of sidewalks throughout the community. The first part of the interviews with seventeen FV residents demonstrated that the FV participants perceive their health as excellent or good compared to other people their age. Still, the FV participants' most important reason for moving to Friendship Village had been the need for health security related to their age. The amount of physical activity the FV participants engaged to in the previous week was fairly high. Almost all the participants easily met the recommendation for USA adults and older adults, which is minimal 150 minutes per week of moderate to vigorous physical activity. In the second part of the interview, the behavior maps showed that most of the moderate physical activity of the residents takes place within the borders of Friendship Village. This outcome suggests the importance of the scale of the retirement community for physical activity behavior of the older adult residents. The reason why the FV participants mostly engage to physical activity within Friendship Village has been clarified in the built environment feature maps.

The function, safety, destination and aesthetics maps showed how certain built environment and intangible characteristics of Friendship Village shape the older adult residents' physical activity behavior. Overall, the respondents were very positive about living in the retirement community and it was hard for them to think of elements for improvement. The residents praised the aesthetics of the surroundings for walking, especially the good maintenance of the gardens with citrus trees and flowers in Friendship Village. The function map showed some advantages of walking on the street over walking on the sidewalk within the community borders. Examples include the flatter and softer feeling of the asphalt streets compared to the concrete sidewalks and the greater space the street provides for walking side by side in a group. On the safety map, the discussion about the presence of sidewalks continued. Some people preferred to always walk on the sidewalks in the community and especially the sudden end of a sidewalk on the main boulevard was not appreciated. However, the general opinion of the FV participants was that the personal and traffic safety everywhere in the community is very good, both during the day and during the night. The feeling of safety can be partly explained by the fact that Friendship Village is a 'gated-community' with 24-hour security. It also has different built environment characteristics that that slow down traffic, like traffic signs and crosswalks. Beside these tangible characteristics, also intangible characteristics of the community were mentioned by the FV respondents. Examples include the feeling of courtesy and taking notice of each other while driving in a vehicle on the FV property. In general, it seems as if the intangible characteristics in Friendship Village create a safety feeling among the residents, which enables them to be physically active within the walls of the community. Outside Friendship Village, the residents spend less PA time, they are more cautious and they only go there during the day.

The output of the softGIS analysis is added to the BUENPA model below in figure 4.10. Beside the built environment factor, this model also includes personal and social/

organizational factors as shapers of the physical activity behavior of older adults. The research findings suggest that especially the personal and social/organization factors are responsible for the intangible characteristics of the retirement community. The FV residents have similar personal characteristics like age, health and resources. This enables the feeling of *'being around like-minded people'* as one FV participant explained it (FV interviews, 2012). Also, social/organizational factors in Friendship Village, like different PA programs, activities and voluntary work committees that are available to the residents, benefit the older adults' social engagement. Together the personal and social/organizational factors appear to positively affect the residents' sense of 'being a community' in which the people feel safe and take notice of each other. The community feeling in Friendship Village also prevailed in the discussion about benches in the aesthetics map. Although the respondents hardly ever use the benches themselves, they still found the benches very important for other people in the community. This example also shows the interrelatedness of personal, social/organizational and built environment factors as shapers of physical activity behavior, as indicated with the pink arrows in figure 4.10. These interrelations are topic of discussion in the conclusion chapter. First, an evaluation of the softGIS based methodology will be presented in the next chapter.
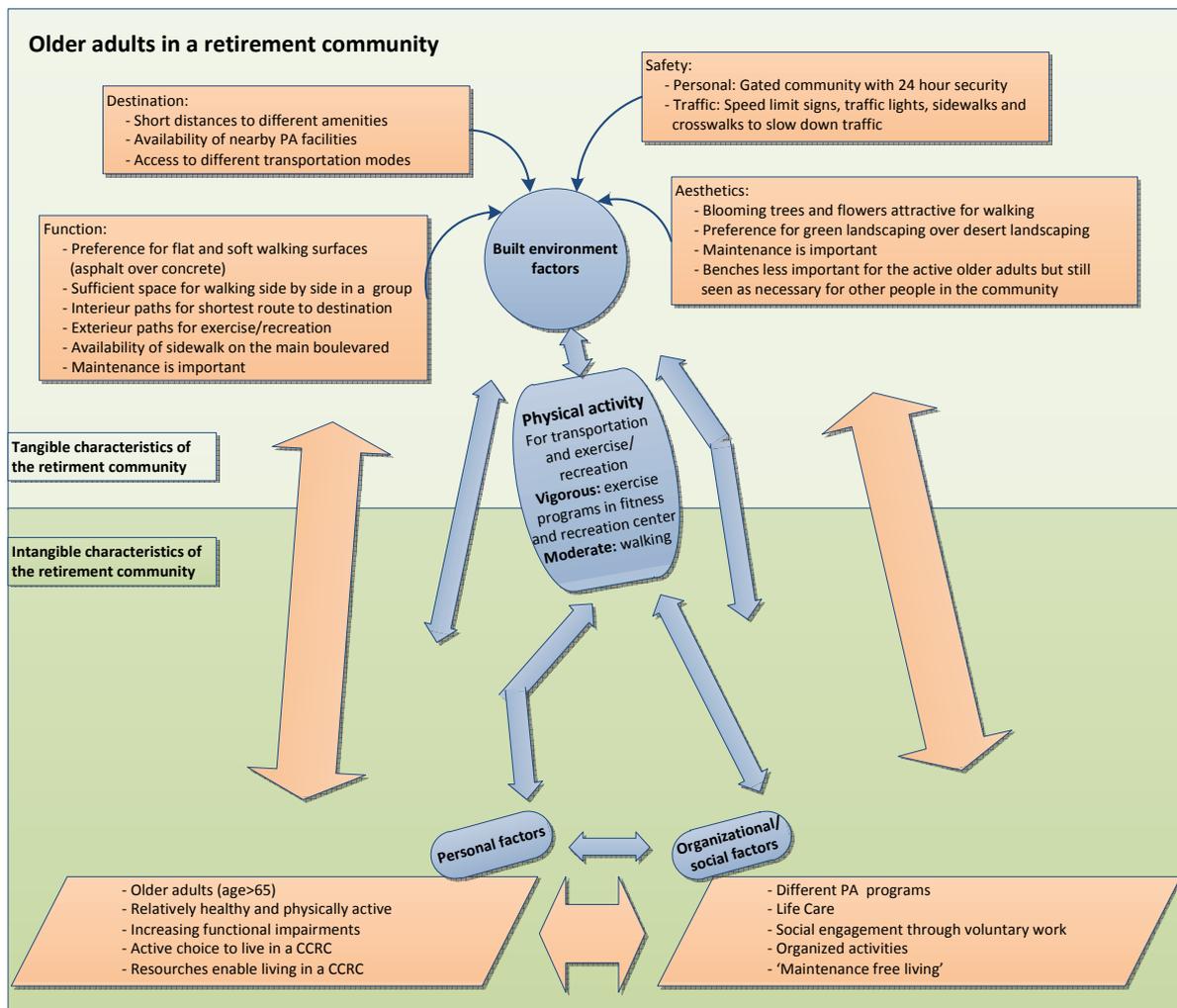

Figure 4.10: Insights from Friendship Village in the BUENPA model (author, 2012)

Chapter 5: SoftGIS potential for BUENPA research on older adults

5.1 Introduction

Beside an analysis of how built environment characteristics shape the physical activity behavior of older adults in Friendship Village, this study aims to evaluate the potential of a softGIS based methodology for this (type of) research. As stated before in the introduction of this thesis, a softGIS based methodology has not been used in BUENPA research before, although the separate usage of the three measures: audit, interview/questionnaire and GIS is common (Brownson et al, 2009). This chapter addresses the potential of the softGIS methodology for BUENPA research (on older adults) by discussing the responses of the FV participants to methodology review questions in the interview. These review questions focused on the perceived difficulty of the interview questions and how well the participants could orientate themselves on the map. Also, general comments and suggestions for future research were gathered from the participants. The results of the review are presented in this chapter.

5.2 Interview evaluation by FV residents

To get a better understanding of how the FV participants perceived the (difficulty) of the research questions, they were asked if/which questions were difficult for them to answer during the interview and why. This question was asked both about the first part of the interview in which personal questions were asked (e.g. about the participants physical activity and transportation behavior) and the second part of the interview in which the participants had to draw on a satellite map. For both parts, there were no specific questions named by any of the participants that were difficult to answer. The only comment about the difficulty of the interview questions came from a participant who explained that he/she did not always have a strong opinion about something. This made it hard to answer certain questions in the map drawing exercise. More response came when the participants were asked about how well they could orientate themselves on the maps available during the interview. The map orientation evaluation will now be presented.

5.2.1 Map orientation

Four different maps were available during the interview to help the FV participants with their orientation: 1. The grayscale satellite map to draw on (ESRI, 2012); 2. The same satellite map in color (ESRI, 2012); 3. A FV example map (Friendship Village, 2012); 4. Google maps to zoom in details (Googlemaps, 2012) (figure 5.1). A concern of using satellite images in this type of research is that the research area is watched from an aerial perspective. It could be hypothesized that older adults are less able to orientate themselves on satellite maps in comparison to younger generations, because they didn't grow up using Google maps or

navigation systems etc on the internet like current young generations do. No literature could be found to support this hypothesis, but research does indicate that spatial learning abilities are adversely affected by aging and that older adults tend to acquire spatial knowledge from maps less proficiently than young adults do (Yamamoto and DeGiroLamo, 2012). Though, it must be noted that Yamamoto and DeGiroLamo (2012) themselves did find a competent performance of senior participants in a map reading exercise.

←1.

2. →
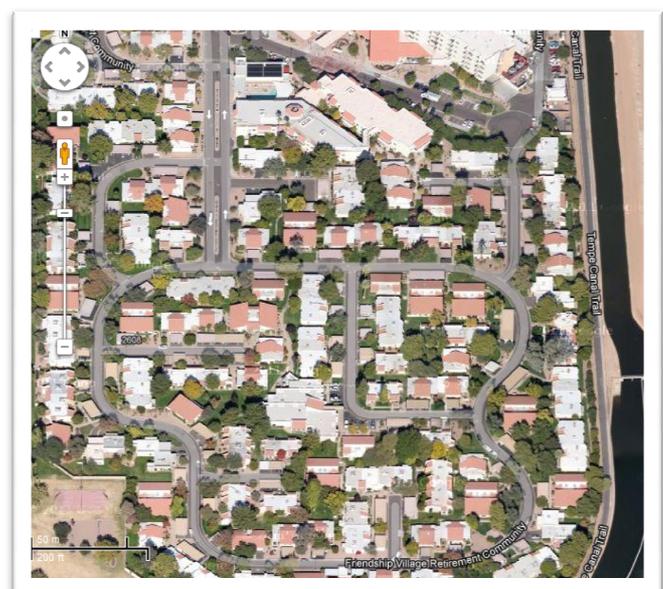
←3.   ↑4.

Figure 5.1: Maps used in the interviews (ESRI, 2012; Friendship Village, 2012; Google Maps, 2012)

In this research, the responses to the review questions about map orientation were very mixed. They will be discussed separately for the four different maps that were available during the interview.

5.2.2 Draw map

The draw map used for this research is a grayscale satellite image of Friendship Village, to make the colored drawings of the FV participants stand out well. The participants of Friendship Village responded very differently to this map when it comes to their orientation. Some participants directly pointed out where their own home was located, while others needed more time to get orientated on the draw map. One person explained why it was difficult to get orientated *"I don't think of this like from an airplane but from the perspective of a pedestrian"* (FV interviews, 2012). On average the men seemed to be a bit quicker in finding their location than the women and there didn't seem to be any connection between orientation ability and age within the participants group. It also seemed as if the people with previous experiences in map reading or blue prints (for example in their former profession) had less trouble with their orientation. Furthermore, the people who had trouble with their eye-sight had more problems with their orientation. However, conclusions cannot be made based on these observations, as the participant group in this research is too small.

The big differences in how well the participants could orientate themselves on the draw map also appeared when the participants were asked how much they agreed with the statement *'I could orientate myself well on the map I had to draw on'*. One participant answered *'strongly disagree'*, six persons answered 'somewhat disagree', one person 'somewhat agree' and nine persons 'strongly agree'. In general, the people who had trouble with their orientation mostly blamed themselves instead of criticizing the map, although some participants did mention that they would have preferred a simplified map to draw on.

5.2.3 Color satellite map

To help the participants with their orientation, the grayscale satellite map was also available in color. Six out of the seventeen participants used the color satellite map to help them with their orientation. To the statement *'For my orientation, the color satellite map was useful'* three of them *'strongly'* and the three others *'somewhat'* agreed. The common response was that the colors made the image clearer than the draw map, although one person mentioned that it was still not very clear.

5.2.4 FV map

The Friendship Village map is a simplified map of Friendship Village, available on the Friendship Village website (Friendship Village, 2012). Again, six out of the seventeen participants used the FV map, though they were partly different people than who had used the color satellite map. To the statement '*For my orientation, the FV example map was useful'* two people *'strongly'* and four people *'somewhat'* agreed. Responses of the participants were that the FV map is less cluttered than the other maps and has stronger colors that are differentiating better. Also the simplification of the maps, the spaces and the

fact that the streets are highlighted was appreciated by the respondents. One participant mentioned that it was still hard to see where the sidewalks are.

5.2.5 Google maps

Because all the previous maps presented are at one fixed geographic scale, Google maps was available to the FV participants, so they could zoom in to the research area if they wanted to. Google maps was not so much used by the participants for clarification, as only three out of the seventeen had looked something up. Still, two of them *'strongly'* and one of them *'somewhat'* agreed to the statement *"For my orientation, Google Maps was useful"*. One participant mentioned that *"a tiny spot was visible that was not very clear on the map"* (FV interviews, 2012).

The evaluation of the four different maps that were used during the interviews, shows that the grayscale satellite image was the most difficult map for orientation. This indicates a disadvantage of this research method, in which the draw maps have to be clear enough to enable the author to add them into GIS. In web-based softGIS questionnaires people are able to zoom in and out on colored satellite images which potentially make the orientation easier for the participants. Still, for the research method used in this thesis, the grayscale satellite image is more precise than the FV map. Also, the colored drawings stand out more than on a colored satellite map. Therefore, the grayscale satellite map is probably still the best option for the drawing exercise. Nevertheless, the evaluation of the maps by the FV participants shows that the availability of other different maps is very important for orientation purposes in this type of research.

5.2.6 Comments and suggestions

The final question to the FV participants during the interview was if they had any comments or suggestions to improve the interview questions. For most of the participants this was not the case, but one participant did have an interesting suggestion. The participant explained that it would have been very helpful if the recruitment letter had clearly indicated that the interview questions were about the last seven days. In this case, the respondents could have brought their diary to help them remember what activities they had in the past week. The suggestion of the participants is likely to enhance the accuracy of the responses of the participants, as it was clear during the interviews that it was sometimes hard for the respondents to remember what they had done and where they had been in the last seven days.

5.3 SoftGIS in BUENPA research on older adults

What has become clear from the review of the interview questions is that the participants did not have problems with answering the question and it was only difficult to answer a question when the participants didn't have a strong opinion about a topic. In the map drawing exercise it was important to have different maps for orientation and different participants preferred different maps for this. When it comes to orientation, it has been

mentioned that the research method based on interviews and actual drawing on paper maps has a disadvantage compared to the originally web-based softGIS questionnaires. Still, there are also advantages of the research method used in this study. This section will discuss the deviations in this study from traditional softGIS research, after which the combined use of the audit, interview and GIS tool for BUENPA research will be evaluated.

5.3.1 Deviations from original softGIS research

As explained in the third chapter, the softGIS inspired methodology used in this research deviates from traditional softGIS research. An important difference concerns the data collection method, which is done through web-based questionnaires in traditional softGIS research and through in-depth interviews in this study. Another deviation is the way the data are analyzed. In traditional soft GIS research, quantitative analysis is preferred to combine the 'soft' and 'hard' data (Kahila and Kyttä, 2009). This research incorporates a case study in which only qualitative methods are part of the analysis. The qualitative research method used in this study, needs and justifies the data collection through interviews based on several arguments.

The first thing is that in a qualitative analysis, it is important to get in-depth information about how the participants experience their environment. During the interviews the FV participants were explaining and talking while they were drawing on the map. A web-based questionnaire only allows for 'comments' which are likely to be less extensive than answers and motivations given in an interview. It is therefore understandable that original softGIS methods are mostly used as input for quantitative analysis (Kahila and Kyttä, 2009). Related to this argument, is that interviews also allow for probing extra questions to get a better understanding of the motivation behind the answers given by the participants. This is also an important element in this qualitative study and wouldn't have been possible through a web-based survey. When looking at the specific group of people that are topic of research, the older adults, interviews may also be a better tool than online surveys. Kahila and Kyttä (2009) indicate that the majority of online softGIS survey participants are middle-aged, busy inhabitants, while older adults tend to dominate in public hearings. This might be explained by time-constrains that are more apparent for people who still work, but it might also be the case that older adults are less likely to participate in online surveys in general. Kahila and Kyttä (2009) note that they are thinking about developing a method that targets the elderly, but they indicate that people in this age category are a challenging group to approach through the internet. Further research would be necessary to get a better insight in this situation.

5.3.2 The usage of the three tools: audit, interview and GIS

New in this study is the combined usage of the three measurement tools: audit, interview and GIS. Especially for qualitative research, the combination of these three tools has shown to be very effective:

- The audit tool is useful for the researcher to get an impression of the built environment characteristics present in a research area and to note striking elements. In the case of Friendship Village, this was for example the non-existence of sidewalks in part of the community. The audit tool analysis helped to probe themes and questions for the interviews.
- The interview tool is a crucial element of this qualitative study as it helps the researcher to get a thorough understanding of how the research participants experience their direct living environment as a place to be physically active. The division of the interview into three parts: personal introduction, map drawing exercise and evaluation proved to be a logical order. By getting an impression of the type of older adults who participated in the study first, it was easier to interpret their behavior and opinion about the direct living environment for physical activity. Also, the evaluation questions in the end of the interview helped to reflect what had been done and said during the interview
- The GIS tool helped at the start of the research to create maps that could be used in the map-drawing part of the interview. The tool was later essential for adding and analyzing the data collected from both the audit and interview tool and to compare the results.

Based on the evaluation of the interview questions by the FV participants and the personal experience of the author of using the softGIS based methodology, it can be concluded that the softGIS based methodology is very useful for the qualitative analysis in this research. Especially for older adults who may need a little assistance in getting oriented, the presence of the interviewer is very important to get accurate map drawing data. Also the usage of a dairy by the respondents and the availability of different maps that can be used for orientation, are also important for achieving this. The combination of the three tools audit, interview and GIS, allow the researcher to analyze the research area in three different ways with the same research question in mind. This enables a comprehensive analysis of how built environment characteristics of a retirement community shape the older adult residents' physical activity behavior.

Chapter 6 Conclusions and implications

6.1 Introduction

The research goal of this qualitative study was to analyze how built environment characteristics of a retirement community shape the older adult residents' physical activity behavior. A comprehensive softGIS based methodology was used (and evaluated) that includes three types of commonly used measurement tools in BUENPA research: audit, survey and GIS. For the analysis, a literature review was conducted to produce a conceptual framework that shows the interrelatedness of organizational/social and built environment factors that are believed to influence physical activity. The main focus of this BUENPA model lay on the built environment features: function, destination, safety and aesthetics. The audit tool was used to determine how these built environment features are present in Friendship Village (e.g. the presence of sidewalks and amenities in the community). The interview tool helped to gather data about how the built environment features are used and evaluated by the residents of the retirement community. The GIS tool was used to analyze and interpret the research findings that were finally added to the BUENPA model.

The previous chapter evaluated the potential of the softGIS methodology for BUENPA research on older adults. This chapter presents the conclusions derived from the study results and discusses the implications they have for literature, methodology and practice.

6.2 Conclusions

The main research question of this study was basically twofold. It asked: *How do the built environment characteristics of a retirement community shape the older adult residents' physical activity behavior?* and *What potential has a softGIS based methodology for this (type of) analysis?*

When focusing on the first part of the research question, a literature review in the theoretical framework chapter showed that there is not much previous BUENPA research focusing on older adults. Also, the research findings of available studies are inconsistent (van Cauwenberg, 2011). The theoretical framework also presented a research of Wert et al (2010). These researchers hypothesized that retirement communities may be designed to reduce barriers for walking and that they provide a sense of security that enables physical activity in older adults. The research findings of this study support the two hypotheses of Wert et al (2010) and also suggest the interrelatedness of the two.

The first hypothesis of Wert et al (2010) is that that retirement communities are designed to reduce barriers to being physically active. This study found various built environment characteristics in Friendship Village that not only reduce barriers but also shape opportunities and influence the attractiveness of physical activity for the older adult

residents. These characteristics can be subdivided to the features function, destination, safety and aesthetics in the BUENPA model.

For the feature **function,** good path maintenance and the feeling (flatness/softness) of the path material on the knees, appear to be important features for older adults in a retirement community for choosing where to walk and be physically active.

For the feature **destination,** the availability of near 'access to' and 'choice between' different amenities, (PA) facilities and transportation modes seem to be important criteria in a retirement community to enable or stimulate physical exercise of the older adults residents.

For the feature **safety**, the research findings indicate the importance of built environment characteristics like security (gates) and sidewalks, crosswalks and signs that slow down traffic to provide personal and traffic safety for older adults while being physically active.

For the feature **aesthetics**, landscaping with blooming flowers and trees appear to be important elements in making an area attractive for physical activity in older adults as they offer changing views in a uniform environment.

Beside these tangible characteristics of the retirement community, the study findings also suggest the importance of intangible characteristics for shaping the older adults' physical activity behavior in Friendship Village. Literally intangible means "*unable to be touched; not having physical presence"* (Oxford dictionary, 2012). Examples of intangible characteristics of Friendship Village include the feeling of courtesy and friendliness among the residents, who take good notice of each other while driving a vehicle in the community. These intangible characteristics seem to provide a feeling of safety for the FV residents, for being physically active within the borders of the community. This finding relates well to the hypothesis of Wert et al (2011) in which they state that retirement communities may provide a sense of security that enables physical activity in older adults. This study argues that in particular personal and social/organization factors in Friendship Village appear to be responsible for the intangible characteristics of the retirement community. They not only increase social engagement among the residents, they also provide the feeling that the residents are among like-minded people and part of a community.

The intangible characteristics are clearly only present within the walls of the Friendship Village. Over there, the residents feel safe to walk both on the sidewalk and on the street, during the day and during the night. Outside the borders of the community, the residents are more cautious; they use the sidewalks and only walk there during the day. This suggests that the intangible characteristics do have a physical presence in Friendship Village in the form of the borders of the retirement community. Therefore, the intangible characteristics of Friendship Village can be seen as elements of an 'intangible environment'. Together with the built environment, the intangible environment seems to shape the physical activity behavior of the older adults in the retirement community. This new insight leads to a revision of the BUENPA model (figure 6.1).
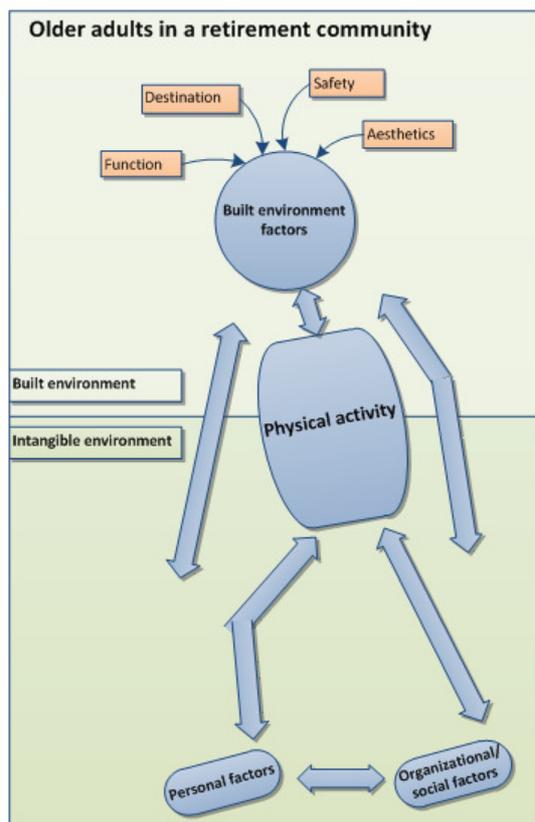
Figure 6.1: Revised BUENPA model (author, 2012)

The main conclusion of this thesis is that characteristics of the built environment and the intangible environment are interrelated. Together they shape opportunities, reduce barriers and influence the attractiveness for older adults to be physically active at a location. This conclusion indicates that in order to get a comprehensive understanding of environmental influences on physical activity in older adults, also personal and social/organizational factors should be part of the analysis. An ecological model, like the BUENPA model can be used to make sense of these complex interrelations.

Also, the softGIS based methodology can be used for BUENPA research on older adults. The second part of the main research question asks: *What potential has a softGIS based methodology for this type of analysis?* This question has been discussed in the previous chapter. The study concludes that the combination of the three measurement tools in the softGIS based methodology enables the researcher to analyze the research area in three different ways with the same research question in mind. When focusing specifically on the potential for qualitative BUENPA research, the presence of a researcher during the interviews allows for follow-up questions. This enables rich descriptions of experiences and evaluations of the built environment by the participants. Also, the data collection through interviews enables the assistance of older adults with map orientation problems, which may help to improve the accuracy of the map drawing data. All together, the softGIS based methodology can be used to make a comprehensive analysis of how built environment characteristics of a retirement community shape the older adult residents' physical activity behavior, which was exactly the aim of this study.

6.3 Implications

The conclusions based on the main research findings in this study have different implications for current BUENPA literature, methodology and practice. These implications will be presented in this section.

6.3.1 Implications for the literature

In current BUENPA research, the main focus in most studies is on the influence of the built environment on physical activity while ignoring intangible characteristics created by individual and social/organizational factors. An example of this is a statement made by the

Transportation Research Board (TRB, 2005) in which they warn for the 'problem' of self-selection in BUENPA research. They ask the question: *"Do people walk more in a particular neighborhood because of pleasant tree-lined sidewalks, or do they live in a neighborhood with pleasant tree-lined sidewalks because they like to walk?"* (TRB, 2005 p134). By asking this question, the TRB stresses the importance to distinguish between the role of personal attitudes/preferences/motivation and external influences on observed behavior (TRB, 2005). However, when considering the logic of the ecological model, the 'problem' of self-selection should not be seen as a problem, but merely as an expression of the complex interrelations of shapers of PA behavior. For example, it could be possible that people, who like to walk, choose to live in neighborhoods with tree-lined sidewalks. However, at the same time they may walk more now than in their previous neighborhood, where tree-lined sidewalks were non-existent. This study argues that the exclusion of non-physical elements in BUENPA research could be a possible explanation for the inconsistency of research findings in this field of study. On the other hand, because of the complexity of BUENPA interrelations, it may be logical that different types of neighborhoods require different neighborhood design for increasing the physical activity of their residents. The example of Friendship Village shows that in a strong intangible environment, built environment characteristics for pedestrian safety (e.g. sidewalks) may be less important to provide a sense of security for being physically active than outside the community where an intangible environment is non-existing.

6.3.2 Methodological implications

Measuring the effect of the built environment on physical activity is very complex and therefore requires a research method that acknowledges this complexity. A qualitative analysis that incorporates an ecological model is suitable for this, because it doesn't treat the different 'shapers' of physical activity as independent variables, as is usually done in the more popular quantitative types of BUENPA research. This study has shown the potential for a softGIS based methodology, specifically for qualitative BUENPA research on older adults. New about this softGIS based methodology is that it combines the three measurement tools: audit, interview and GIS. Individually, these measures are common tools in BUENPA research. However, as explained in the introduction of this thesis, researchers like Brownson et al (2012) emphasize that further research is necessary to improve the technical quality of these measures. The suggestion of this study is that future BUENPA studies should make more use of ecological models and qualitative softGIS based methodologies to make sense of the complexity of BUENPA relations. The qualitative research methods should not function as substitutes of the quantitative methods, but rather as complements that help to identify built environment characteristics that could later function as input for quantitative studies.

6.3.3 Implications for practice

In this study, retirement community residents are seen as experts of their own living environment. In the case of Friendship Village, the residents were already very satisfied with their community as a place to live. This may be partly explained by the fact that the community has originally been developed by local residents who could implement their own ideas in the project instead of depending on a developer. The research findings of this study can be used for future housing developments for the elderly, but also existing retirement communities could potentially benefit from the results. Like Friendship Village, CCRCs are usually controlled by a single organizational owner. This enables changes to the existing built environment relatively quickly (Joseph and Zimring, 2007). One of the research findings of this case study is the importance of the feeling (softness, flatness) of the path on the knees of the older adults. CCRCs could potentially use this knowledge and adjust the material of existing paths when they need maintenance. They could also make more use of their residents' opinion when new paths in the community are being created.

Ultimately, the goal of BUENPA research and the practice of (re)designing neighborhoods for physical activity should be how Frank et al (2003) imagine it in the introduction chapter of this thesis:

Environments that encourage moderate physical activity may also have features that make them more liveable in other ways, by improving one's quality of life – they may generate more social interaction, foster less dependence on the automobile, be safer for their inhabitants, and give people more choices with respect to how they get around and spend their time" (Frank et al., 2003 p8).

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Appendix

1.The recruitment/information letter

3-26-12

Dear Resident of Friendship Village,

You are invited to participate in a research project which is being conducted by Nienke Boneschansker, a visiting research master student at the Arizona State University from the Netherlands. The aim of the research is to examine the effect of built environment characteristics on physical activity. Friendship Village is selected as a case study and as a resident your contribution is very much appreciated.

Please participate in an in depth-interview about your perception of how the built environment of Friendship Village influences your physically activity behavior. **Participants must be residents of Friendship Village.**

The interview consists of three different parts. In the first part you will be asked questions about living in Friendship Village, the modes of transportation you use and your physical activity behavior. In the second part of the interview you will be asked to draw on maps your physical activity pattern of the last 7 days and your opinion about the quality of the paths, safety, aesthetics and destinations. The third part of the interview contains questions to evaluate the interview and the methodology of drawing on maps. **Any question you don't wish to answer you can skip.**

Your responses to this voluntary interview will be kept completely confidential. The data from the study will be grouped together for analysis. The interview will take about one hour and will be conducted in the last week of march. If you would like to participate please subscribe at Mary Lockhart's office at the Fitness Center. **You can withdrawal your participation in the research at any time.**

If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788.

Should you require any further information, or have any concerns, please do not hesitate to contact me.

Thank you in advance,

Nienke Boneschansker, visiting research scholar.

School of Geographical Sciences and Urban Planning. E-mail: nbonesha@asu.edu

2. PEDS audit tool

Name: _____   **Date:** _____   **Study Area:** _____   PEDS

Segment Number: _____   **Time:** _____   **Weather:** _____

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0. Segment type

Low volume road	1
High volume road	2
Bike or Ped path - skip section C	3

A. Environment

1. Uses in Segment *(all that apply)*

Housing - Single Family Detached	1
Housing - Multi-Family	2
Housing - Mobile Homes	3
Office/Institutional	4
Restaurant/Café/Commercial	5
Industrial	6
Vacant/Undeveloped	7
Recreation	8

2. Slope

Flat	1
Slight hill	2
Steep hill	3

3. Segment Intersections

Segment has 3 way intersection	1
Segment has 4 way intersection	2
Segment has other intersection	3
Segment deadends but path continues	4
Segment deadends	5
Segment has no intersections	6

B. Pedestrian Facility *(skip if none present)*

4. Type(s) of pedestrian facility *(all that apply)*

Footpath (worn dirt path)	1
Paved Trail	2
Sidewalk	3
Pedestrian Street (closed to cars)	4

The rest of the questions in section B refer to the best pedestrian facility selected above.

5. Path material *(all that apply)*

Asphalt	1
Concrete	2
Paving Bricks or Flat Stone	3
Gravel	4
Dirt or Sand	5

6. Path condition/maintenance

Poor (many bumps/cracks/holes)	1
Fair (some bumps/cracks/holes)	2
Good (very few bumps/cracks/holes)	3
Under Repair	4

7. Path obstructions *(all that apply)*

Poles or Signs	1
Parked Cars	2
Greenery	3
Garbage Cans	4
Other	5
None	6

8. Buffers between road and path *(all that apply)*

Fence	1
Tress	2
Hedges	3
Landscape	4
Grass	5
None	6

9. Path Distance from Curb

At edge	1
< 5 feet	2
> 5 feel	3

10. Sidewalk Width

< 4 feet	1
Between 4 and 8 feet	2
> 8 feet	3

If no sidewalk, skip now to section C.

11. Curb cuts

None	1
1 to 4	2
> 4	3

12. Sidewalk completeness/continuity

Sidewalk is complete	1
Sidewalk is incomplete	2

13. Sidewalk connectivity to other sidewalks/crosswalks

number of connections _____ 1

C. Road Attributes *(skip if path only)*

14. Condition of road

Poor (many bumps/cracks/holes)	1
Fair (some bumps/cracks/holes)	2
Good (very few bumps/cracks/holes)	3
Under Repair	4

15. Number of lanes

Minimum # of lanes to cross	1
Maximum # of lanes to cross	1

16. Posted speed limit

None posted	1
(mph):	1

17. On-Street parking *(if pavement is unmarked, check only if cars parked)*

Parallel or Diagonal	1
None	2

18. Off-street parking lot spaces

0-5	6-25	26+
1	2	3

19. Must you walk through a parking lot to get to most buildings?

Yes	1
No	2

20. Presence of med-hi volume driveways

< 2	1
2 to 4	2
> 4	3

21. Traffic control devices *(all that apply)*

Traffic light	1
Stop sign	2
Traffic circle	3
Speed bumps	4
Chicanes or chokers	5
None	6

22. Crosswalks

None	1
1 to 2	2
3 to 4	3
> 4	4

23. Crossing Aids *(all that apply)*

Yield to Ped Paddles	1
Pedestrian Signal	2
Median/Traffic Island	3
Curb Extension	4
Overpass/Underpass	5
Pedestrian Crossing Warning Sign	6
Flashing Warning Light	7
Share the Road Warnign Sign	8
None	9

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24. Bicycle facilities *(all that apply)*

Bicycle route signs	1
Striped bicycle lane designation	2
Visible bicycle parking facilities	3
Bicycle crossing warning	4
No bicycle facilities	5

D. Walking/Cycling Environment

25. Roadway/path lighting

Road-oriented lighting	1
Pedestrian-scale lighting	2
Other lighting	3
No lighting	4

26. Amenities *(all that apply)*

Public garbage cans	1
Benches	2
Water fountain	3
Street vendors/vending machines	4
No amenities	5

27. Are there wayfinding aids?

No	1
Yes	2

28. Number of trees shading walking area

None or Very Few	1
Some	2
Many/Dense	3

29. Degree of enclosure

Little or no enclosure	1
Some enclosure	2
Highly enclosed	3

30. Powerlines along segment?

Low Voltage/Distribution Line	1
High Voltage/Transmission Line	2
None	3

31. Overall cleanliness and building maintenance

Poor (much litter/graffiti/broken facilities)	1
Fair (some litter/graffiti/broken facilities)	2
Good (no litter/graffiti/broken facilities)	3

32. Articulation in building designs

Little or no articulation	1
Some articulation	2
Highly articulated	3

33. Building setbacks from sidewalk

At edge of sidewalk	1
Within 20 feet of sidewalk	2
More than 20 feet from sidewalk	3

34. Building height

Short	1
Medium	2
Tall	3

35. Bus stops

Bus stop with shelter	1
Bus stop with bench	2
Bus stop with signage only	3
No bus stop	4

Subjective Assessment: Segment…

Enter 1,2,3, or 4 for 1=Strongly Agree 2= Agree, 3=Disagree, 4=Strongly Disagree

……is attractive for walking.	1
……is attractive for cycling.	1
……feels safe for walking.	1
……feels safe for cycling.	1

Kelly J. Clifton, PhD - National Center for Smart Growth - University of Maryland, College Park

4. Complete interview

Part I: Personal information   Resp.nr…………..

1- What is your gender? ❑ male ❑ female

2- What is your age?....................

3- How many individuals live in your household, including yourself?………………………………..

4- What is your housing type?   ❑ Independent living apartment homes ❑ Nunnenkamp Center   ❑ Garden Homes

5- How many years have you been living in Friendship Village?…………………………..

6- How many months of the year do you occupy your residence?………………………..

7- Before moving to your current residence, which of the following describes the community in which you lived?   ❑ City   ❑ Suburb   ❑ Rural, outside of a city or town   ❑ Small town

8- Do you agree or disagree with the following statement: **The type of neighborhood where I lived before moving to FV, is similar to FV:**

	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
	❑	❑	❑	❑

9- What was your reason to choose Friendship Village to live?………………………………………………

The next questions are about your transportation behavior in the last 7 days.

10a- Do you have a car? Yes / No
b- In the **last 7 days**… How many days did you use your car?……………………………………

11- In the **last 7 days**… How many days did you use public transport?………………………………

12a- Do you have a bicycle? Yes / No
b- In the **last 7 days**… how many days did you use your bicycle?………………………………

13a- In the **last 7 days**… Did you use any other vehicle for transportation? Yes / No
b- What kind?……………………………………………
c- How many days?………………………………………………………………………..

14- In the **last 7 days** how did you travel to the following.. (more than one answer possible)

	Didn't go	Car	Public transp.	Walking	Cycling	Other transportation…what?
Grocery store	❑	❑	❑	❑	❑	❑………………………………..
Park	❑	❑	❑	❑	❑	❑………………………………….
Fitness center	❑	❑	❑	❑	❑	❑……………………………….

Restaurant	❏	❏	❏	❏	❏	❏………………………………..
Medical service	❏	❏	❏	❏	❏	❏………………………………..
Church	❏	❏	❏	❏	❏	❏………………………………..
Friends/relatives	❏	❏	❏	❏	❏	❏………………………………..

The next question is about your transportation behavior compared to where you lived before moving to Friendship Village.

15- Compared to where you lived before, how often do you do each of the following now?
a-Driving your car? ❏ less often ❏ about the same ❏ more often. Why?…………………………….

b- Walking?   ❏ less often ❏ about the same ❏ more often. Why?………………………………….

c- Cycling?   ❏ less often ❏ about the same ❏ more often.Why?………………………………….

d- Other transportation?   ❏ less often ❏ about the same ❏ more often. Why?………………

The next questions are about your general physical activity (exercise) patterns. This includes both moderate physical activity as walking or cycling and more intensive vigorous physical activity that is associated with heavier breathing and an increasing hart beat: e.g. running/fitness).
16- In general, compared to other people your age, would you say your health is…
❏ Excellent   ❏ Good   ❏ Fair   ❏ Poor

17a- Is your health condition constraining you from being physically active? Yes / No
b- If yes, in what way?……………………………………………………………………………………………………

18- In what type of physical activity (exercise) do you engage?………………………………….

19a- Are you satisfied with the amount of physical activity (exercise) you get?   Yes / No
b- Why?……

The next questions concern your physical activity (exercise) pattern of the last 7 days.
There are questions about moderate exercise (e.g. walking and cycling) and vigorous exercise (more intense exercise that is associated with heavier breathing and an increasing hart beat: e.g. running/fitness).

20a- In the **last 7 days**… How many times did you engage in vigorous exercise for at least 10 minutes at a time?……………
b- What type(s) of exercise was it?……………………………………………………………………
c- How many minutes in total did you engage in vigorous exercise? ………………………….

21a- In the **last 7 days**… How many times did you engage in moderate exercise (walking or cycling) for at least 10 minutes at a time?……………
b- What type(s) of exercise was it?……………………………………………………………………

c- How many minutes in total did you engage in moderate exercise? …………………………..

22- In the **last 7 days**… How many of the ……………… (Q20a + Q21a) times you engaged in physical exercise (vigorous and moderate) took place outdoors?………………………………………

23- In the **last 7 days**… How many of the ……………… (Q20a + Q21a) times you engaged in physical exercise (vigorous and moderate) took place within Friendship Village?……………

24a- Do you agree or disagree with the following statement: **The last 7 days were representative for my overall physical activity levels during the last 12 months:**

Strongly Disagree	somewhat Disagree	somewhat Agree	strongly Agree
❏	❏	❏	❏

b- Why? ……

Part II Drawing on the Map

1. Behavior

Thinking about the last 7 days**. Could you indicate the <u>full route</u> on the map of Friendship Village….**

1- Where you <u>walked for transportation</u> (to get somewhere) in the **last 7 days**
Blue lines —

2- Where you <u>walked for recreation</u> in the **last 7 days**
Pink lines —

3- Where you <u>jogged/ran</u> for sports in the **last 7 days**
Green lines —

4- Where you <u>cycled</u> in the **last 7 days**
Yellow lines —

5- Where you drove in <u>your car</u> in the **last 7 days**
Orange lines —

6- Where you used <u>any other vehicle type</u> in the **last 7 days**
Purple lines —

2. Destination

Could you indicate on the map of Friendship Village**….**

1- Destinations you <u>walked</u> to in the **last 7 days**
Pink circles O

2- Destinations you <u>cycled</u> to in the **last 7 days**
Yellow circles O

3-Destinations that you drove to in <u>your car</u> in the **last 7 days**
Orange circles O

4-Destinations that you drove to in <u>any other vehicle type</u> in the **last 7 days**
Purple circles O

3. Functional

Could you indicate on the map of Friendship Village **where….**

1- You think the path type (street/sidewalk/footpath/paved trail) is walk friendly
Green lines —

2- You think the path type (street/sidewalk/footpath/paved trail) is **not** walk friendly
Red lines —

3- You think the condition/maintenance (many bumps/cracks/holes) of the path is good
Pink circles O

4- You think the condition/maintenance (many bumps/cracks/holes) of the path is bad
Purple circles O

5- There are physical obstacles (e.g. poles/signs/parked cars/garbage cans) that hinder you when you walk at that location
Blue dots •

6- There are physical obstacles (e.g. poles/signs/parked cars/garbage cans) that makes you consciously avoid that place while walking
Orange dots •

4. Safety

Could you indicate on the map of Friendship Village **where….**

1-You feel very safe from traffic while walking
Pink lines —

2- You don't feel safe from traffic while walking
Purple lines —

3- You feel very safe to cross the street
Green lines —

4- You don't feel safe to cross the street
Red lines —

5- You think the placement of a new crosswalk would help to improve safety
Blue lines —

6- You think the path lighting is very good
Yellow circles O

7- You think there is not sufficient path lighting
Orange circles O

5. Aesthetics

Could you indicate on the map of Friendship Village **where…**

1- You think the view of the surroundings are the most attractive for walking
Green lines —

2- You think the view of the surroundings are the least attractive for walking
Red lines —

3- You think there is enough shade when it is hot outside
Yellow circles O

4- You think there is not enough shade when it is hot outside
Orange circles O

5- You think the presence of amenities (public garbage cans, benches, water fountains, vending machines) makes it attractive to walk at that location
Pink circles O

6- You think the placement of extra amenities (public garbage cans, benches, water fountains, vending machines) would make it more attractive to walk at that location.
Purple circles O

The draw map

Part III Evaluation

1- In part I of the interview before you had to draw on the map. Were there any questions difficult to answer? Which and why? (questions are shown)

………

2- In Part II of the interview where you had to draw on the maps. Were there any questions difficult to answer? Which and why? (questions are shown)

………

3- Do you agree or disagree with the following statement: **I could orientate myself well on the map I had to draw on:**

Strongly Disagree	somewhat Disagree	somewhat Agree	strongly Agree
❑	❑	❑	❑

4- Would you agree or disagree with the following statements:

	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree
a. For my orientation, the color satellite map was useful	❑	❑	❑	❑

Why?……….

| b. For my orientation, the FV example map was useful | ❑❑ | ❑ | ❑ | |

Why?……….

| b. For my orientation, GoogleMaps was useful | ❑ | ❑ | ❑ | ❑ |

Why?……….

5- Do you have any suggestions to improve the interview questions?…………………………………………………

Thank you very much for your participation.