AN ABSTRACT OF THE DISSERTATION OF

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The ability to independently age in place requires an appropriate match between a person and the environment, or P-E fit. The person-environment interaction helps describe the adaptation processes employed in older age to achieve P-E fit, but is little understood. Therefore, the objective of this two-part study was to gain a better understanding of the P-E interaction among functionally limited older adults aging in place. To explore the P-E interaction, two studies were conducted: the first included adapting and establishing a reliable version of the environmental component of the Housing Enabler tool (Iwarsson & Slaug, 2010) for use in the United States, and the second explored adaptive strategies used by older adults in response to losses in function or environmental support. A reliable U.S. HE was created through a comprehensive adaptation process and inter-rater reliability testing involving 50 pairwise environmental assessments. Using the Housing Enabler objective assessments as well as participants' perceptions of P-E fit, reactive, deferred reactive, and proactive strategies employed by 12 functionally limited older adults were found in a mixed methods exploration of the adaptive P-E interaction. An exploration of the role of P-E fit in the interactive relationship between people and their environments has pointed implications for aging well.

Person-Environment Fit and Adaptation:
Exploring the Interaction between Person and Environment in Older Age

by
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I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

Laura L. Lien, Author

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CHAPTER 1

INTRODUCTION

Aging healthfully and successfully, under the broader concept of aging well, is an acknowledged goal of many older adults, and has been a primary focus of gerontological research for decades (Wahl, Iwarsson, & Oswald, 2012). This concept has been regaining significant attention in the field of gerontology due to increased longevity and the influx of the proportion of people aging with disabilities (Sheets, 2005). The graying of America and an increasing elder population is at the forefront of social policy, making the conceptualization and quantification of aging well a priority among researchers, policymakers, and practitioners (Hayes, 2002; Myers & Ryu, 2008; Wahl et al., 2012).

One specific component of aging well relates to how older adults manage themselves and their environment, across physical, social, and psychological perspectives. The match, or balance, between a person's functional competence and his/her surrounding environment is known as person-environment (P-E) fit (Lawton & Nahemow, 1973). P-E fit is an important component of aging well, as accommodating environments that support declines in functional capacity help maintain overall health, independence, and well-being in old age (Iwarsson, Horstmann, & Slaug, 2007; Oswald et al., 2007; Wahl et al., 2012).

Increasing frailties among aging adults suggests that the environment plays a greater role in supporting independence in the face of declining abilities and is therefore a good target for interventions (Iwarsson, 2005). Since older adults spend the majority of their time at home (Gitlin, 2003; Oswald & Wahl, 2004), accommodating home environments can help modify rates of potential disability by meeting and supporting declining health needs, perhaps more than current medical and social interventions or health promotion programs alone (Cohen, Scribner, & Farley, 2000; Iwarsson, 2005). Similarly, environmental modifications that help enhance the functional capacities of older adults can subsequently help reduce environmental stressors that inhibit general activities of daily living (Lawton, 1990). As such, environmental support within the home becomes an important aspect of older adults' ability to live independently and age in place when facing limitations in health (Iwarsson & Wilson, 2006; Oswald, Jopp, Rott, & Wahl, 2011). The specific characteristics of the environment that affect the overall health and well-being of older adults, however, is not well understood (Wahl et al., 2012).

Since the home environment plays a critical role in aging well on a multitude of levels, it is important to quantify physical P-E fit by objectively measuring how well a person's functional capacities match his/her surrounding environment. However, there are currently few valid and reliable instruments to measure the presence and magnitude of accessibility problems within a person's home, especially in the United States (Mitty, 2010). Regardless, a prominent and promising assessment instrument utilizing an objective P-E fit approach is the Housing Enabler (HE; Iwarsson & Slaug, 2010; Iwarsson, Haak, & Slaug, 2012), although it has thus far only been used and adapted to several European contexts (Helle et al., 2010; Iwarsson, Nygren, & Slaug, 2005). Similarly, while beneficial in quantifying the magnitude of accessibility problems within the home environment, the HE instrument does not include perceptions of P-E fit nor consider the adaptive processes people use to mitigate P-E fit problems. As such, it is important to use objective assessments and perceptions of P-E fit to shed light on the interactive relationship between people and their environments to gain a better understanding of how person-environment relationships contribute to aging well.

Purpose of Study

While P-E fit theories propose the interactive relationship between a person and his/her environment requires a certain level of adaption (Lawton, 1990), the role of objective and perceived aspects of P-E fit and the extent to which each contributes to the person-environment interaction is less clear (Wahl et al., 2012). Without a clear understanding of the interactive relationship between people and their environments, successful interventions that allow older adults to age well in place are uncertain. Therefore, the following leading questions directed the focus of this study: 1) How can objective and perceived P-E fit be evaluated?, and 2) How do objective assessments and perceptions of P-E fit together contribute to a better understanding of the person-environment interaction?

One significant impediment to understanding the P-E interaction lies in the ambiguity of its measures. The challenge of identifying indicators that help measure the P-E interaction supersedes those specific to the physical, social, and psychological person or environment. Also, while the interaction between a person and the environment helps describe how older adults adapt themselves or their environments to achieve optimal P-E fit (Lawton, 1990), the actual strategies used by aging persons with functional limitations to mitigate barriers in their environment are not well understood (Wahl et al., 2012).

Therefore, the overarching objective of this two-part study was to gain a better understanding of the interactive relationship between person and environment among functionally limited older adults aging in place. Specific aims were: (1) to adapt and establish a reliable version of the Housing Enabler instrument (Iwarsson & Slaug, 2010) for use in the United States to appropriately assess objective P-E fit, or the magnitude of accessibility problems and weighted environmental barriers present within the home environments of older adults; and (2) to explore adaptive strategies used in response to losses in function or environmental support and how these behaviors contribute to a better understanding of the person-environment interaction and P-E fit.

Rationale

According to the 2011 American Community Survey (ACS), 41,385,026 persons comprising 13.3% of the U.S. population are aged 65 and older (with a median age of 73.9 years). Within this age group, 78.5% live in owner-occupied housing (ACS, 2011b). Additionally, upwards of 36.6% of the U.S. population aged 65 and older have a documented disability; of those, 23.6% have ambulatory difficulties and 16.2% have difficulties living independently (ACS, 2011a). Although one of the greatest fears among older adults involves growing old and ending life in a care facility (Thorson, 2000), few older adults have specifically planned for aging in place with functional limitations and environmental barriers that inhibit desired and necessary activities for independent living (American Association of Retired Persons [AARP], 2003). This points to a need for a greater understanding of how older adults manage functional decline and environmental barriers through the dynamic, interactive P-E relationship.

It is believed that processes of adaptation related to decreased function with older age and subsequent need for control over and reliance on the built environment are important factors in understanding P-E fit (Wahl et al., 2012). The magnitude of the relationship between a person and the environment is extremely important, as health and well-being of older adults is more a product of the P-E interaction than environmental indicators alone (Iwarsson et al., 2007; Iwarsson, Horstmann, Carlsson, Oswald, & Wahl, 2009; Oswald et al., 2007). While both objective and perceived P-E fit are acknowledged as critical components of the interaction between people and their environments, few studies have simultaneously explored the P-E interaction and how it contributes to the overarching concept of aging well (Wahl et al., 2012). A deeper understanding of the P-E interaction would considerably enhance theoretical P-E fit models and would serve to inform appropriate and adequate research, policy, and practice interventions. To achieve this understanding, several methodological and explorative approaches using both objective assessments and perceptions of P-E fit are needed.

Theoretical Framework

Lawton and Nahemow's (1973) well-respected ecological model of aging (ETA) is often used as the theoretical framework in explorations of P-E fit among older adults (Iwarsson & Slaug, 2010; Oswald & Kaspar, 2012; Steinfeld & Danford, 1999). The ETA posits that persons with lowered functional capacities are less able to overcome or adapt to barriers within their environment, making them more vulnerable to environmental challenges than persons with higher functional competencies. Furthermore, performance and comfort with daily necessary and desired activities is possible when an appropriate match between people and their environments is achieved. Using the ETA as a framework, a person's functional competence and the environment's physical press, or barriers that may threaten the performance of and engagement with activities, can be assessed to further understand P-E fit and the adaptive interaction between people and their environments.

The selection, optimization, and compensation (SOC) model (Baltes & Baltes, 1990), on the other hand, helps explain the specific behaviors older adults employ in response to losses in function or environmental support. Generally, this model proposes that physical, social, and psychological losses in older age can be mitigated through the adaptive processes of selection, optimization, and compensation. Although its origins are primarily in psychology, the SOC model may be helpful in explaining the specific adaptive strategies employed by functionally limited older adults aging in place. This, as noted by Wahl et al. (2012), is an encouraging approach toward a greater understanding of P-E fit processes and in particular, its role in understanding the interactive relationship between people and their environments.

Limitations

This study, like all research, does not come without limitations. For one, this is a small study using a convenience sample, which constrains its reach and applicability to other populations of older adults. Also, assessing the home environments of older adults aging in place does not necessarily extend to other types of senior living such as co-ops, co-housing, and long-term care facilities. It is hoped that future research will explore P-E fit and person-environment interactions in alternative housing consumed by a wider variety of older adults.

Second, this study will be primarily conducted in one smaller urban geographical region in the U.S. Pacific Northwest, which limits its applicability to other regions, countries, or international contexts. The concepts of aging and housing may be approached differently in other countries across the world; the material in this study relates primarily to older adults aging in place in one region of the United States. The region of study is unique, with a relatively healthy, affluent, and highly-educated population, further preventing the results of this study from being generalized to other groups or locations of older adults, including those of very poor health, low socioeconomic status, or lower levels of education. Ideally, this type of study could be conducted in other locations within the United States and with other groups of older adults with differing demographics to further understand P-E fit and person-environment interactions from a broader perspective. Similarly, expanding this study within an international context would strengthen its findings and applicability to countries outside of the United States.

Third, assessing objective P-E fit with one all-encompassing instrument is near impossible given the great variety in living environments available in the United States. Iwarsson and Slaug (2010) also acknowledge this, stating that "research-based instrument development is a continuous process, and the results of ongoing and planned research projects will lead to further successive changes to the Housing Enabler" (p. 26). Therefore, more studies will need to be conducted to further ensure appropriate reliability of the U.S. version of the HE for multiple and varied research and practice applications. Furthermore, establishing reliability of the personal component of the Housing Enabler instrument and the incorporation of a measure of awareness (i.e., awareness of age-related change [AARC], Diehl & Wahl, 2010) to reinforce the findings would be beneficial in future related studies.

Similarly, exploring the interactive relationship between people and their environments is a difficult and highly variable task (Wahl et al., 2012). Using qualitative interviews to solicit perspectives and experiences of P-E fit problems within the home environment with respect to daily activity is but one small aspect of the bigger picture. Additionally, qualitative research approaches are not generalizable, as they utilize the "voice" and lived experience of only participants in the study. Regardless, as one of few studies that explored the role of objective assessments and perceptions of P-E fit in the adaptive strategies employed by functionally limited older adults aging in place, this study is an important empirical step toward a greater understanding of person-environment interactions and P-E fit theories.

CHAPTER 2

LITERATURE REVIEW

The overall purpose of this two-part study was to gain a better understanding of the interactive relationship between person and environment among functionally limited older adults aging in place. Aims included: (1) the establishment of a reliable U.S. version of the Housing Enabler (HE; Iwarsson & Slaug, 2010) to assist in assessing objective P-E fit; and (2) an exploration of the adaptive strategies used by functionally limited older adults in response to losses in function or environmental support. The role and contributions of aging persons and their home environments in the P-E interaction was examined as it relates to P-E fit and aging well.

Although argued as a critical component of the person-environment interaction, few studies have actually explored the specific adaptive strategies employed by older adults with regard to a P-E fit perspective, and furthermore how these behaviors relate to aging well. To explore this relationship, it was important to conduct an in-depth review of the literature, including the core concepts and key terms, relevant theoretical frameworks, and the history of the Housing Enabler tool. This review sheds light on the assessment of P-E fit and its role in the P-E interaction and concept of aging well.

Core Concepts and Key Terms

Aging

According to the National Institute on Aging (2012), aging "reflects all the changes that occur over the course of life." While general, this definition encompasses the many dimensions of aging that occur throughout a person's lifespan. Aging is not only characterized by a general slowing of the body and its processes, but also changes in physical, social, and psychological functioning (Woodrow, 2002d).

Physical aging. When distinguishing the young-old versus the old-old (or oldest-old) most people rely on physical aging cues, including physical appearance and physical health (Thorson, 2000; Woodrow, 2002d). Older adults most often define themselves as young-old until faced with declines in health, particularly if they can still complete necessary and desired activities of daily living (Pipher, 1999; Thorson, 2000). Age-related physical losses in later life can be debilitating on a number of levels, including challenging a person's ability to function safely, comfortably, and independently within his/her home environment (Iwarsson & Wilson, 2006; Oswald et al., 2007; Stoeckel & Porell, 2010).

Aging tends to cause declines in vision, loss of hearing, and declines in taste, smell, and sensitivity of touch (Thorson, 2000; Woodrow 2002c). The ability of older adults to utilize their home environments to meet their daily needs is further challenged by particular changes in the brain and nervous system. A slowing of the circulatory system, reductions in muscle strength and power, bone weakness, declines in balance ability, lack of postural control, lowered agility, and decreases in fine motor control are some of the major physical changes that occur with aging (Madigan, 2006; McMurdo, 2000). Older adults traditionally exhibit more postural sway, a slowing of reactive and voluntary functional responses, difficulties in adjusting to lateral instabilities, deficiencies in adequate limb support, and an overall decline in sensory processing (McIlroy & Maki, 1996; Pavol & Pai, 2007; Schillings, Mulder, & Duysens, 2005). Certain medications, diseases, or lifelong medical conditions may intensify such physical changes in the aging body (American Planning Association [APA], 1994).

Perhaps most importantly, aging persons often have increasing trouble physically navigating their home environments. Age-related declines in the physical body can alter and transform how older adults react to particular environmental situations including slip and trip hazards or variable sensory feedback. Age-related deficiencies in reaction type, time, or strategy often challenge the functional capacities necessary to remain independent at home. Falls are a growing concern for older adults, as upwards of one-third to nearly one-half of the community-dwelling population will experience such an event in old age (Parijat & Lockhart, 2012; Schillings et al., 2005; Woodrow, 2002b). Additionally, a substantial percentage of falls among older adults lead to serious injury and even unintentional-injury death (Pavol, Owings, Foley, & Grabiner, 2001; Pavol & Pai, 2007; Schillings et al., 2005).

Social and psychological aging. Social and psychological aging can affect older adults in a number of ways. While social and emotional functioning remain largely intact with advancing age, the maintenance of social relationships and psychological health can be challenged (Franklin & Tate, 2009). Aging persons have varying needs related to self-concept, self-esteem, belonging, independence, autonomy, and socialization, especially as physical changes affect how they see themselves and how they relate to their surroundings (Charles & Carstensen, 2010; Pipher, 1999).

The relationship between physical aging and social/psychological aging is quite pronounced, with one affecting the other in multiple ways. For instance, declines in physiological regulation can create marked shifts in how social relationships are maintained and self-identity is defined (Charles & Carstensen, 2010). On the other hand, when social and psychological stressors are significant, and a person's ability to reduce or adapt to the strain is impossible, physical health can deteriorate. In this respect, social/psychological aging and physical aging are interactive in nature.

In general, social and emotional maintenance is important to aging well. Strong social networks and supportive interpersonal relationships help preserve emotional well-being and life satisfaction, and furthermore aid in reducing stress (Charles & Carstensen, 2010). While social connectivity can become strained in older age, particularly as friends and family are lost through death, relocations, or retirement, most research shows that social networks are actively "pruned" by older adults in an effort to maintain stronger, more intimate, and more supportive relationships with people who provide their lives with meaning and value (Carstensen, 2006; Charles & Carstensen, 2010). Emotional well-being is also heightened through this process, as older adults' smaller social networks provide more positive social exchanges and fewer instances of interpersonal distress (Birditt & Fingerman, 2003; Charles & Piazza, 2007; Newsom, Rook, Nishishiba, Sorkin, & Mahan, 2005).

Independence and autonomy, including privacy and control over the environment, are other aspects of social and psychological health highly valued by aging persons (APA, 1994). Health in later life is also highly dependent on mastery and competence in managing the environment (Lawton & Nahemow, 1973; Ryff, Singer, & Love, 2004). In fact, the influence of the environment in social and psychological health in old age is quite pronounced. Optimal physical, social, and psychological health can be achieved with appropriate and adequate environmental conditions, relative to the person (Oswald et al., 2007). Therefore, understanding older adults' psychosocial needs can help explain how they relate to, identify with, and navigate their physical environment (APA, 1994; Oswald et al., 2007).

The Ideals of Aging

The terms *healthy aging*, *successful aging*, and *aging well*, have been widely used across the literature. With foundations in biology, public health, medicine, psychology, and sociology, among others, these three terms have been used interchangeably in gerontological research and across disciplines. Because of this, each term carries multiple meanings, classifications, descriptions, and use in research, making their conceptualization an important and necessary step.

Healthy aging. Many studies stemming from the biological sciences consider healthy aging to be manifest in the physical condition of the person. For example, Benfante, Reed, and Brody (1985) defined healthy aging as disease-free persons over a period of time. Guralnik and Kaplan (1989) extend this definition to include functional capacity as an indicator of disability, the absence of which could lead to positive outcomes among older adults. In their study, high functioning was predicted by race, family income, absence of certain chronic conditions (hypertension, arthritis, back pain) and habits (smoking), consumption of moderate levels of alcohol, and falling within a normal weight range.

While the maintenance or improvement of physical wellness is important, there are also many significant subjective markers of aging healthfully. According to Peel, McClure, and Bartlett (2005), the concept of healthy aging should also include quality of life, successful life-course transitions, and social and mental wellness indicators.

Furthermore, level of functioning, or the ability to perform necessary and desired activities of daily living, is also key to life satisfaction and healthy aging among older adults (Thorson, 2000). In this respect, healthy aging is best measured through consideration of a person's objective and subjective physical, social, and psychological condition.

The environment as an enabler of health is also a key indicator for aging healthfully. As described by Quinn (2008), livable communities, especially in urban areas, are needed to maintain elders' well-being and quality of life from a social and psychological perspective. Adequate and supportive housing, mobility options, and social connections and services are all predictors of many physical health issues facing older adults (Iwarsson et al., 2007; Quinn, 2008; Stewart & Law, 2003). In fact, environmental factors have been argued as more important in predicting health outcomes than the personal component alone (Bonnefoy, 2007; Newman, 2003). Additionally, the ability of people to interact with and make sense of their environments is critical to overall quality of life (Woodrow, 2002c). Therefore, a person's physical, social, and psychological condition is either supported or impaired by environmental resources, making supportive home environments essential to overall health (Woodrow, 2002a).

Successful aging. Successful aging, on the other hand, has roots in biology, sociology, and psychology, encompassing both healthy living and an increased healthspan. An increased healthspan encompasses longevity with compressed morbidity, or the idea that people can live long lives with little, or shortened, physical, social, or psychological disability (Fries, 1990). Successful aging is therefore related to positive health behaviors, including physical activity, good nutrition, mental health, self-efficacy, personal control, and socialization, among others (Baltes & Baltes, 1990; Franklin & Tate, 2009). In this respect, successful aging is physical, but also involves socialization and feelings of self- and societal-worth, engagement, and productivity.

The conceptual roots of successful aging began in the early 1960's (i.e., Havighurst, 1963; Williams & Wirths, 1965). In the 1970's, Fozard and Popkin (1978) highlighted "success" as the ability of older adults to adapt and adjust to the various processes of aging by considering the dynamic interplay between persons and their environments. The 1980's saw a resurgence of successful aging as a concept vital to both gerontological research and social policy (i.e., Ryff, 1982). Even today, the quest for theoretical clarity and empirical evidence surrounding the concept of successful aging continues to be popular among gerontologists.

Like healthy aging, successful aging involves a transactional component between a person and his/her surrounding context. This includes their resilience and ability to adapt to personal and environmental challenges (Baltes & Baltes, 1990; Franklin & Tate, 2009; Rowe & Kahn, 1997). Challenges related to aging involve biology, socioeconomics, culture, and environment, and have differing meanings and priorities unique to a person's self-concept, interpersonal relationships, and societal discourse and structure (Featherman, Smith, & Peterson, 1990).

Aging well. The concepts of healthy aging, successful aging, and aging well are used frequently and often interchangeably in gerontological literature without acknowledgment of conceptual overlap. It could be argued that each concept is referring to the same overall goal, or the ability of older adults to maintain physical, social, and psychological health, quality of life, and well-being well into old age. If healthy and successful aging are both defined as involving health and wellness, from a biological and psychosocial perspective (Baltes & Baltes, 1990; Franklin & Tate, 2009; Peel et al., 2005; Rowe & Kahn, 1997), then both relate to quality of life and well-being, or the more generalized concept of aging well.

Aging well is the context within which the interactive relationship between person and environment was explored in this study. Based on the literature, *aging well* is defined in this study as the maintenance or improvement of physical, social, and psychological health. This includes participation in, adaptation to, and engagement with daily necessary and desired activities made available by a person's surrounding environment. Challenges experienced by older adults within their home environments provide a context within which the person-environment interaction can be assessed.

Housing Environments

Skilled Nursing Homes

Nursing homes are the most conventional among the leading types of long-term care facilities for older adults (Brandi, Kelley-Gillespie, Liese, & Farley, 2004). Stringent regulations and a focus on medical care in nursing homes are influenced by Medicaid funding, which pays for 68.4% of residents (Ilminen, 1999). Primarily due to federal regulatory oversight and their elderly residents, nursing homes follow a medical model and resemble hospital environments (Golant, 2008; Regnier, 1999). They are designed with institutional furniture, shared rooms with little privacy, nursing stations, staff in medical uniforms, and double-loaded corridors. The focus on staff efficiency, controlled routines, safety over risk, and functional building design and organization also contribute to their institutional feel (Marsden, 2005).

Nursing homes are designed for people requiring 24-hour care, monitoring, and support with most activities of daily living. Older adults who cannot be cared for in their homes, primarily due to multiple comorbidities and extensive healthcare needs, are those most likely to reside in a nursing home facility (Brandi et al., 2004). Nursing home environments can also be used for short-term rehabilitation purposes, particularly for older adults who are recovering from acute illnesses, injuries, or surgeries.

Most aging persons want to avoid institutional living (Hayes, 2002; Marsden, 2005; Regnier, 1999; Thorson, 2000). With institutional design features, staff focus on efficiency, reduction in resident choice, and lack of privacy, nursing homes create an environment in which older adults are at risk of losing independence, autonomy, sense of self, and self-determination (Schwarz & Brent, 1999). Additionally, such facilities may hinder personalization, obstruct flexible use of space, and minimize supportive care tailored to a person's needs and desires (Cutler, 2007; Marsden, 2005).

Assisted Living

Originally, assisted living (AL) was intended to bridge the gap between skilled nursing homes and independent living. However, many AL facilities now offer a similar level of medical care offered in nursing homes. In fact, the difference between nursing homes and AL facilities in the type and amount of care is increasingly vague, as residents at either type of facility require similar daily physical, social, and psychological services (Eckert, Carder, Morgan, Frankowski, & Roth, 2009; Golant, 2008). Regardless, assisted living offers residents a viable option that retains many aspects of independence and a means to avoid institutionalization (Schwarz & Brent, 1999).

The primary focus of AL as a model of care is on its residential rather than institutional character (Cutler, 2007; Marsden, 2005). Its philosophy emphasizes personalized care, tailored services, and flexibility (Brandi et al., 2004). Medical and supportive services may include physical check-ups, housekeeping, laundry service, preparation of meals, and assistance with medications, bathing, dressing, or other activities of daily living. AL units are mostly private with a personal bathroom, kitchen, and a sitting space capable of accommodating personal furniture and belongings. Such features are designed to enhance comfort, safety, and security while still generating a sense of independence, autonomy, and community (Schwarz & Brent, 1999).

The increased focus on individualized care and support, autonomy, and comfort makes AL facilities traditionally expensive in terms of rent and services (Marsden, 2005; Schwarz & Brent, 1999). While Medicare increasingly covers some medical expenses in assisted living, it does not cover non-skilled care (called “custodial care”) for activities of daily living common in most AL facilities (medicare.gov, 2012). Therefore, older adults needing supportive care outside of home-based or skilled nursing care are able to move into market-rate AL facilities, pending they have enough expendable income and meet certain levels of independence criteria. Those with fewer monetary resources or extremely high care needs are often forced into subsidized AL facilities with less medical or support services or long-term nursing care facilities that provide 24-hour care and accept Medicaid funds (Golant, 2008; Schwarz & Brent, 1999).

Independent Living

Older adults in the United States prefer to age in place independently, despite current or future health needs (Greenfield, 2012). This preference remains strong even when life circumstances change, including children moving away, marriage separation, divorce, or widowhood (Wagnild, 2001). In fact, 78.5% of older adults aged 65 years and older live in owner-occupied housing (ACS, 2011b). Most often, older adults prefer to age in place and remain at home rather live out their remaining years of life in a care facility (Hayes, 2002; Thorson, 2000).

Generally, older adults who are able to live independently have a variety of housing choices available to them. Traditional types of independent housing include single-family homes, apartment complexes, condominiums, townhomes, and duplexes. Independent living can also include cooperatives, retirement communities, or age-regulated, senior-only complexes. A unique housing circumstance for aging persons includes the "Naturally Occurring Retirement Community" (NORC). This particular type of independent living is becoming more and more common as older adults continue to age in place in increasingly aging neighborhoods, both in terms of maturity of the environment and of the remaining residents. NORCs tend foster a sense of community, reduce isolation, and provide informal caregiving, support, and in-home services if needed (Calkins & Keane, 2008; Lanspery, 1995).

While life circumstances can change quickly, older adults in good health and with sufficient economic resources are most able to live independently. Since most elders have experienced a wide range of living situations throughout their lifetime, the privacy, autonomy, and control of independent housing is especially attractive to those of an increased age (Wagnild, 2001). Additionally, the deinstitutionalization movement, or the attempt to move elders out of long-term care and back into the community, has consequently created more effective and far-reaching community-based services including adult day programming, in-home care, and personal care assistance. These services often supplant those found in care facilities, thereby allowing older adults to live in their homes independently for longer periods of time (Regnier, 1999).

Housing Standards

Housing standards, regulations, and guidelines vary among differing geographies, policies, and cultures of the world (Fänge & Iwarsson, 2005; Wahl & Gitlin, 2003). Most standards, if defined and regulated, are determined by national, state, and local governments in the interest of inhabitant safety. Many U.S. housing standards were initially based on public health initiatives to alleviate the extremely high rates of infectious diseases that were rampant in inner-city tenement buildings in the nineteenth century (Krieger & Higgins, 2002). Aside from the spread of disease, housing and neighborhood conditions, including the physical, social, and psychological environment, impact resident health (Howden-Chapman, 2004).

One particular aspect of safety and health in housing is related to accessibility and usability. According to Iwarsson and Wilson (2006), an important indicator in the maintenance and promotion of health is a person's ability to be independent in daily activities, thereby marking supportive environments instrumental to overall well-being. As such, most guidelines and regulations created through federal, state, and local policies across countries are intended to provide better access to the built environment and increase user well-being, independence, autonomy, and overall health and safety.

Accessibility

Accessibility is both a driving force and the outcome of housing standards in any given country. It is also a primary indicator of objective P-E fit, best defined as a relationship between a person's functional capacities and the demands of the physical environment (Iwarsson & Ståhl, 2003). In this respect, accessibility closely aligns with current P-E fit theories, namely Lawton and Nahemow's (1973) Ecological Theory of Aging and press-competence model (to be described later).

The meaning of accessibility may change drastically across different countries and professional contexts depending on the application (Iwarsson & Ståhl, 2003). Some scholars define accessibility in terms of the environment only, or how the design or management of a space fulfills the building codes, regulations, and guidelines that provide access to both able-bodied and disabled individuals (Preiser & Ostroff, 2001). While valid, this perspective ignores the interaction inherent between people and their surroundings, as well as the plasticity of both a person and his/her environment and variations over time (Iwarsson & Isacsson, 1997; Iwarsson, Nygren, Oswald, Wahl, & Tomsone, 2006; Oswald et al., 2007). When considered with the concept of disability, accessibility points more specifically to a balance, or match, between people's abilities and the challenges of their environment (Iwarsson, et al., 2009; Oswald et al., 2007).

Therefore, accessibility can be measured using objective assessments of the person (functional limitations), their surrounding environment (environmental barriers), and the interaction between the two, or a description of what problems arise as a result of an imbalance between a person's capabilities and the demands of their surrounding environment (Nygren et al., 2007). It is important, however, to consider how accessibility is defined according to building codes, regulations, and guidelines of the particular country of interest, as the "norms" surrounding disability and accessibility often differ between different countries. Assessments of P-E fit need to ensure indicators of accessibility in the environment are objective and clear according to current national regulatory guidelines, as the prevalence and impact of accessibility problems is dependent on the current societal and cultural norms of any given country (Iwarsson & Ståhl, 2003).

Although housing accessibility standards have improved in the past few decades, many environmental deficiencies still exist across the spectrum of spaces found in the built environment (Iwarsson & Wilson, 2006). Functional decline is the primary cause of accessibility problems, making the environment a convincing target for P-E fit interventions (Iwarsson, 2005; Iwarsson & Wilson, 2006; Oswald et al., 2007). As such, it is important to understand the role of accessibility in P-E fit, and its affect on the design, maintenance, and inhabitability of home environments.

In the United States, there are several guidelines and regulations that specifically address accessibility. Equal access to the built environment, regardless of ability, is the focus of five prominent sets of policies and guidelines: the Fair Housing Accessibility Guidelines (FHA), Accessibility Guidelines of the Americans with Disabilities Act (ADA), Department of Justice (DOJ), American National Standards Institute (ANSI), and the International Building Codes (IBC). All are intended to provide regulations and guidelines for equal access to the built environment, especially in housing, transportation, and access to public spaces, including retail stores, restaurants, schools, and recreation sites, among others.

By and large, ADA accessibility guidelines (ADAAG) are the most widely known and implemented in the United States. Regardless, each set of guidelines between ADA and FHA, DOJ, ANSI, and IBC policies are loosely related to the concept of barrier-free design (outlined by Steinfeld et al., 1979), and overlap in most categories. As such, ADA guidelines will be primarily discussed in this review.

The 1950's marked the first legislative effort to eliminate architectural barriers and thereby enhance accessibility among those with disabilities. In the early 1960's, the U.S. federal government awarded a research grant to the University of Illinois to develop permanent accessibility standards for public buildings (Steinfeld et al., 1979). The design recommendations stemming from this project became American National Standards Institute (ANSI) 117.1, which provided technical provisions for the adoption of accessibility among U.S. states. Although efforts were made to ensure state compliance with these provisions, only 24 states met (albeit in a varied fashion) the required standards by 1965.

Disappointing adoption of ANSI 117.1 led to the National Commission on Architectural Barriers' brief titled "Design for all Americans," which highlighted issues related to the widespread lack of accessibility compliance by U.S. states. This brief indicated a lack of awareness of the new standards by architects, building suppliers, and the general public, the absence of accessibility measures from building code regulations, a lack of focus on residential and transportation structures, and unclear specifications as a few of the many issues facing ANSI 117.1 compliance (Steinfeld et al., 1979). As a result, the Architectural Barrier Act was passed in 1968, mandating accessibility in all new construction and renovations of government facilities (Steinfeld et al., 1979). ANSI 117.1 guidelines were incorporated into this act, which eventually became a driving force behind ADA accessibility guidelines.

Official ADA accessibility guidelines derived from the disability rights movement in the late 1980's, especially with respect to discrimination and use of public spaces (Steinfeld et al., 1979). The Americans with Disabilities Act became federal law in 1990, and while it focused on eliminating discrimination with respect to disabilities, it also contained accessibility guidelines (as outlined in ADAAG) related to ANSI 117.1 standards created decades prior. ADA enforcement only requires compliance in public buildings and recreation sites, not private residences. As warned by Steinfeld et al. (1979), "eliminating barriers in public buildings is not sufficient when people remain prisoners in their own houses or institutions" (p. 18).

Usability

Usability is the subjective compliment to accessibility in the P-E fit interactive relationship. The concept is primarily based on individual perceptions of functionality with regard to activity, personal goals, self-image, culture, and societal expectations (Iwarsson & Ståhl, 2003; Steinfeld & Danford, 1999; Vischer, 2008). While accessibility and usability both impact a person's ability to functionally navigate their environment, *accessibility* is more concerned with compliance with official regulatory guidelines and norms. *Usability*, on the other hand, focuses on the user's perception of his/her individual functionality within the environment across physical, social, and psychological levels (Fänge & Iwarsson, 2005; Golant, 2003). Accessibility and usability are equally important considerations in the interaction between persons and their environments, although accessible environments are not always usable (and vice versa).

Like accessibility, the definition of usability depends quite heavily on context. Iwarsson and Ståhl (2003) define usability as "a measure of the effectiveness, efficiency, and satisfaction with which specified users can achieve specified goals in a particular environment" (p. 60). An emphasis on the activity component or the achievement of goals helps distinguish usability from accessibility. In this respect, usability is not simply a product of the physical person and his/her surrounding environment, but rather a measure of how needs, desires, and goals are fulfilled through performance in and engagement with the environment.

As such, usability should be considered as an entirely different construct from accessibility. It evokes self-perceptions and personal experiences of a person's ability to navigate, access, and interact with their environment with respect to their personal preferences, activities, and goals (Iwarsson & Ståhl, 2003; Oswald et al., 2007; Vischer, 2008). It also considers the supportive or constraining aspects of the environment relative to a person's perceptions (Fänge & Iwarsson, 2005; Gitlin, 2003). Therefore, usability is not only a measure of how the environment supports or obstructs function, but is also an indicator of human behavior and self-perception (Vischer, 2008).

Most usability studies employ the concept of user satisfaction as the outcome measure at the P-E fit level. However, user satisfaction is a complicated outcome to unpack, as it typically includes multiple factors (physical, social, and psychological) in its quantification. As such, usability is complex and multivariate, and as an indicator of perceived P-E fit, it can afford a unique perspective into how the person-environment interaction is perceived among functionally limited older adults.

Person-Environment (P-E) Fit

According to Lawton and Nahemow (1973), aging well involves an interactive relationship between a person (P) and their environment (E). This has come to be known in environmental gerontology as person-environment (P-E) fit. To measure P-E fit, a person, his/her environment, and the interaction between the two need to be evaluated using a set of indicators encompassing physical, social, and psychological perspectives. When appropriate measures are used, P-E fit more closely aligns with health and well-being in older age than the assessment of the environment alone (Iwarsson et al., 2009; Oswald et al., 2007).

Many theoretical models have explored the P-E perspective, starting with Lewin's (1951) concept of "life space." Others followed in the 1970's and 1980's, including Lawton and Nahemow's (1973) ecological theory of aging (ETA), Kahana's (1982) congruence model, Danford's (1983) dynamic reciprocal determinism model, and Carp and Carp's (1984) model focused on individual and environmental conditions. All P-E fit models over the years have attempted to quantify aging well beyond the simple measurement of a person or his/her environment, as the interaction between the two helps define situational human behavior (Oswald & Kaspar, 2012; Steinfeld & Danford, 1999).

Among the first to consider how individuals relate to their surrounding environment, Lewin (1951) coined the concept of "life space." His theoretical foundation argues that human behavior (B) is a function (f) of the person (P) and his/her environment (E), or

$$B = [f(P, E)]$$

P-E fit is therefore a function of both the physical and psychological environment and a product of an individual's current, past, and future experiences and conditions. While related, Lewin (1951) did not specifically signify an interactive relationship between person and environment. He did, however, argue that the physical and psychological components of the P-E relationship are subject to change over time.

From this foundation, Lawton and Nahemow (1973) created the ecological theory of aging (ETA), a pivotal theoretical framework within environmental gerontology. This theory introduced the concept of press-competence, defined as the dynamic between a person's functional competence (or capacities) and his/her surrounding environmental press (or stress). The press-competence model hypothesizes that maximum comfort and functional performance is achieved when the competencies of a person align within a range of appropriate levels of environmental press. A decline in functional capacities or an increase in environmental press (due to barriers or hazards) jeopardizes P-E fit. Likewise, high functioning people can fall outside of the zone of maximum comfort and performance when low environmental press fails to present an appropriate challenge to maintain functional capacities through overcoming stressors in the environment. In essence, too little press for people with high functional capacity and too much press for people with low functional capacity both result in a lack of P-E fit (Danford & Steinfeld, 1999).

The ETA framework posits that modifications to the environment that decrease press can help improve P-E fit for those with low functional capacity, and therefore increase the chances of maximum comfort and performance. Designers, health care professionals, and other practitioners frequently apply the ETA in this way to increase P-E fit in both private and public environments for persons with disabilities or other dependencies. Since the press-competence model argues that behavior is the result of competence levels matching environmental demands, a focus on modifying the environment using P-E fit indicators is a valid and traditional choice for researchers and practitioners alike (Iwarsson, 2005).

The press-competence model has been criticized for its passive stance on the role of the person within the environment. The environmental docility hypothesis (Lawton & Simon, 1968), a foundation of the original ETA, implies that all people, regardless of functional capacity, are subject to P-E fit challenges when environmental barriers are present. Critics of this hypothesis argue that it places too much emphasis on the person as a passive receiver of the environment rather than an active, dynamic, and engaged contributor.

Following this criticism, Kahana (1982) proposed the idea of P-E congruence, or the existence of a mutual relationship between people and their environments. The congruence concept is that human behavior results from the environment meeting a person's needs, not his/her competence matching the demands of the environment. Kahana's original congruence model (1982) highlighted seven important dimensions of P-E relationships: segregate, congregate, control, engagement, structure, affect, and impulse. These seven dimensions can be person-specific or environment-specific. For instance, the segregate dimension might explore a person's need for privacy in conjunction with the provision of requisite privacy in the environment. The examination of a person's needs being met by his/her environment places P-E fit at the individual level, acknowledging that the environment may have different meanings for different people. In this respect, congruence aligns more with perceived indicators of P-E fit, and represents a departure from a primary focus on the physical environment, as often seen in applied studies using Lawton and Nahemow's (1973) ETA and press-competence model.

Carp and Carp (1984) extended the congruence model (Kahana, 1982) by advocating for a heightened focus on a person's perceptions of the salience and relevance of the environment as an essential component of P-E fit. As such, they introduced the concept of PcE, or the conditions of the person and the environment, as the interactive component in the P-E fit equation. Their equation

$$B = [f(P, E, PcE)]$$

highlights the person-environment interaction, and suggests that the condition of one or the other can affect the salience, relevance, or perception of P-E fit. This interaction is a critical component in examining older adults' experiences and relationships to place by considering concurrent objective and perceived evaluations of P-E fit.

The dynamic reciprocal determinism model (Danford, 1983) explores the impact and influence of the environment on the individual. Using the model as a guide, human behavior can be better understood through the mechanisms that people use to monitor and act upon environmental cues (Danford & Steinfeld, 1999). In other words, the environment has the power to influence a person's behavior as long as the person is able to physically, mentally, and emotionally inhabit environmental space. The model distinguishes between impairment, disability, and handicap by indicating thresholds of capacity and comfort in occupying the environment. For instance, an unaccommodating, unresponsive environment can lead to disability or handicap among persons with lowered functional abilities (Danford & Steinfeld, 1999).

Overall, these theoretical frameworks and models have been adopted among environmental gerontologists as foundational orientations toward understanding P-E fit. Researchers interested in how the environment affects people (and vice versa) have used

P-E fit models to frame research questions, methods, and analyses of theoretical and applied scholarly work. These theoretical models also serve as appropriate frameworks for design, policy, and technology solutions that allow older adults to maintain or improve well-being and quality of life within their surrounding environments.

While Lawton and Nahemow's (1973) ETA is the most widely cited, the impact of Kahana (1982), Danford (1983), and Carp and Carp's (1984) work has served to modify the docility hypothesis (Lawton & Simon, 1968) into one that highlights proactive behaviors. Seeing elders as both receivers of and contributors toward their environments can help researchers, policymakers, and practitioners more fully understand the importance of P-E fit and its applications in research and practice. The relationship between a person and his/her environment is not merely a function of one upon the other, but rather an interactive relationship in which the objective and perceived conditions of one affects the objective and perceived conditions of the other (Fänge & Iwarsson, 1999; Oswald & Kaspar, 2012; Steinfeld & Danford, 1999).

The experience of place is a critical aspect of P-E fit. Furthermore, the organizational, psychosocial, and architectural components of place are important elements of that experience (Weisman, Chaudhury, & Diaz Moore, 2000). The importance of P-E fit calls for a design approach that encompasses the physical, social, and psychological aspects of person and environment—three dimensions essential in creating well-fit spaces for older adults (Iwarsson et al., 2007; Oswald & Kaspar, 2012).

The Housing Enabler

Using a P-E fit perspective, objective accessibility of the home environment can be evaluated using assessment tools that consider a person's functional capacities and his/her surrounding environment, per Lawton and Nahemow's (1973) ETA. One such instrument, the Housing Enabler (HE; Iwarsson & Slaug, 2010), provides an objective evaluation of a person's home and its immediate surroundings to assess accessibility relative to his/her specific functional limitations. To help increase the understanding of accessibility in housing, Iwarsson, an occupational therapist, searched for existing environmental assessment instruments that would provide insight into the implementation, usability, and perception of home adaptations among older adults living at home. Reliable and valid objective assessment tools within occupational therapy literature were scarce, however, and Iwarsson's desire to quantify physical P-E fit to increase housing accessibility required exploration outside of her primary discipline.

It was at this point that Iwarsson discovered "The Enabler." Originally conceived by Steinfeld et al. (1979), the Enabler idea was based on a desire for and movement toward a U.S. national standard of barrier-free design. The idea that all people, regardless of age or ability, could benefit from a reduction in everyday environmental barriers was novel and an attempt at congruence between architectural design and housing policy. Steinfeld et al. (1979) argued that the American National Standards Institute's (ANSI) policies were outdated, ambiguous, limited in scope, poorly adopted, and lacking a target population. This was the impetus behind attempting to standardize access to and the assessment of public and private environments. The Enabler, therefore, could assist practitioners in identifying human factors issues, or assess the fit between functional abilities and environmental press (Steinfeld et al., 1979).

The original Enabler (Steinfeld et al., 1979) was designed to assess major accessibility and usability issues within public buildings. It focused on the interaction between functional limitations, dependence on assistive devices, and existing environmental barriers. Accessibility was calculated through a personal assessment of physical capacities and an environmental assessment of barriers or demands. The two separate aspects of the Enabler concept (Steinfeld et al., 1979) together helped predict the magnitude of accessibility problems present between a person and his/her environment. This idea considered accessibility on an individual level, as people with unique functional limitations may experience accessibility in a particular environment differently than others (Iwarsson, 1999). Functional limitations, dependence on assistive devices, and the overall interaction with environmental barriers were identified through an extensive review of the (then) very limited U.S. accessibility building codes and regulations (Steinfeld et al., 1979).

Discovery of Steinfeld et al.'s (1979) Enabler provided a foundation upon which Iwarsson could adapt accessibility concepts to occupational therapy practice in a European context (namely Swedish housing standards). Her identified need for a measure of accessibility within the private homes of people to determine appropriate in-home solutions was the driving force behind her quest to create an assessment instrument capable of being used both in research and practice. Such an instrument could help provide a greater understanding of objective P-E fit and quantify the magnitude of accessibility problems between people and their environments. It could also help determine occupation-specific implications for rehabilitation and public health promotion (Iwarsson, 1999).

The Housing Enabler (HE; as named by Iwarsson, 1997) is rooted in Cooper, Cohen, and Hasselkus' (1991) occupational therapy theory exploring the relationship between individual physical capacities and surrounding environmental demands. This theoretical perspective is congruent with Lawton and Nahemow's (1973) and Lawton and Simon's (1968) press-competence model: a balance between personal competence and environmental demand can be achieved if one or the other is altered to accommodate appropriate and necessary functionality. In essence, the perspective used in creating the HE is objective, or a means to focus on measurable competencies and environmental barriers (Iwarsson, 1999).

The HE assesses both the person and his/her surrounding home environment to quantify accessibility problems, a major objective indicator of P-E fit. Outcomes from the assessment can be used to inform appropriate design, policy, or practice interventions, including home modifications and assistive technologies. Performing an assessment using the HE involves three steps: 1) an evaluation of a person's functional limitations (12 items) and dependence on mobility devices (2 items), 2) the identification of environmental barriers present within the home environment (161 items), and 3) the calculation of the magnitude of accessibility problems and weighted environmental barriers experienced by that person with his/her combination of functional limitations in his/her specific home (see Appendix A for the original HE). The foundational element of the HE is based on the principal concept of P-E fit, or how the environment influences everyday activity (Iwarsson, 1999).

Relationship to Universal Design

The HE, as an objective, norm-based assessment of P-E fit, has been criticized as reductionist without regard to perceptions of and experiences of the person-environment interaction (Helle et al., 2012). A focus on housing standards and norms may be perceived as a step away from a universal design perspective currently gaining international attention. Universal design includes design principles aimed at reducing barriers within the built environment to encourage and support full inclusion and participation in daily activity for all persons, regardless of age or ability (Follette Story, Mueller, & Mace, 1998). It relates to the concept of usability through the consideration of age, size, preferences, and abilities, and consists of seven principles related to accommodation, usefulness, experience, communication, efficiency, comfort, and the minimization of hazards (Center for Universal Design, 1997). The seven universal design principles are based on research surrounding consumer products and the built environment, and were originally strengthened through collaboration with a working group of engineers, architects, product designers, and environmental design researchers (Follette Story et al., 1998).

The concept of universal design arose with the creation of Federal legislation surrounding fair housing, architectural barriers, and disabilities. However, its principles are not based specifically on the Federal accessibility guidelines that inspired its creation. The idea of universal design, or design for all needs and abilities, slowly grew out of a “barrier-free design” aesthetic that often led to segregated accessible design features from more attractive, less expensive standardized products. In this sense, the universal design movement strove to create and provide design features that were common, easy to obtain, less expensive, aesthetically pleasing, and not stigmatizing (Crews & Zavotka, 2006; Iwarsson & Ståhl, 2003; Follette Story et al., 1998).

While the principles of universal design strive to achieve inclusion and participation in society for all persons, regardless of age or ability, it is currently required only for public facilities. Although it may be considered for new residential construction and remodels, most people in the U.S. and globally live in homes designed and built without the benefit of accessibility standards. Therefore, valid accessibility standards and the assessment of objective P-E fit using standardized instruments (i.e., the HE) help provide appropriate guidance for the housing design or modification process, including the incorporation of universal design in the home environments of older adults and persons with disabilities.

Placemaking and Relationships to Place

There are many key elements instrumental in how people experience “place.” Theories are still developing across various disciplines, but place-based theorists agree upon three critical elements of the placemaking concept: the physical environment, the social environment, and the psychological environment (Chaudhury & Rowles, 2005; Moore, 2000; Oswald et al., 2006). In essence, a combination of objective assessments and subjective perceptions help explain how people actively create place from space (Gustafson, 2001; Manzo, 2003).

Simply put, the physical, social, and psychological environments of a person’s life world may be used to conceptualize how a sense of place is created and maintained. The physical environment typically comprises the physical structure of a person’s home, his/her possessions, and the greater surrounding neighborhood, city, or region (Annison, 2000; Botticello, 2007; Cloutier-Fisher & Harvey, 2009). The social environment relates to family and friends, social roles, and opportunities for social interaction (Leith, 2006; Somerville, 1997; Tanner, Tilse, & de Jonge, 2008). The psychological environment involves a person’s self-perceived identity, continuity of self throughout the life course, and individual values, beliefs, and emotions (Atchley, 1999; Hauge & Kolstad, 2007; Swift, 1997). Together, physical, social, and psychological environments comprise meanings of home and self, and therefore the creation of “place” throughout the life course.

Cuba and Hummon (1993) suggest that a sense of place is shaped by people’s personal characteristics, as well as their interpretations, perceptions, and experiences. For older adults in particular, the home environment plays a major role in placemaking. According to Wahl (2003), the homes of older adults are places of memory and experience, attachments, “materialized biography,” and personal expression, among others (p. 3). Additionally, the living arrangements of older adults provide opportunities to express independence, autonomy, and privacy. Homes can also be places of negative experiences, including lack of socialization, decreasing health, limitations in daily activities, and, ultimately, death. Therefore, older adults’ homes affect the course of aging through supports or constraints to physical and social well-being (Wahl, 2003).

The importance of home in older age is acknowledged as a critical aspect of well-being and quality of life, from physical, social, and psychological perspectives (Iwarsson et al., 2007; Oswald et al., 2007). Rykwert (1991) distinguishes the terms “house” and “home” as a difference between the physical environment and the psychosocial environment, respectively. Although the physical and psychosocial environments of any particular space are different conceptually, both are necessary and important in understanding the overall concept of P-E fit.

Any changes to the capacities of a person or his/her surrounding environment, especially with age, can impact how home is experienced. In general, aging in place is the preferred option for older adults when considering other senior living environments, as the home environment provides a sense of independence, attachment, emotional connection, and continuity to former and current selves (Greenfield, 2012; Wagnild, 2001; Wahl, 2003). Regardless, declines in physical or cognitive health can challenge the ability of older adults to remain "at home" unless appropriate interventions are employed. In this respect, the accessibility, usability, and placemaking that older adults perceive and experience in their home environments are equally important in defining P-E fit and determining research, policy, and practice implications that will allow older adults to age in place.

Theoretical Frameworks

Ecological Theory of Aging (ETA)

The majority of environmental gerontology research utilizes Lawton and Nahemow's (1973) ETA as a framework for assessing the fit between people and their surroundings. Objectively, this fit is a product of a person's functional competence and the environment's physical press. Lawton (1989) defined competence as: "the ability to respond adaptively, as judged by social norms, in the domains of physical health, activities of daily living (ADL), sensorimotor and perceptual functions, and cognition" (p. 59). In essence, competence is a function of physical and cognitive processes, or what is referred to as functional capacity (Iwarsson, 2005). The ability to respond to environmental press relies on the ability to effectively manage the environment, and perceived efficacy cannot be achieved without functional competence (Murray, 1938). According to Danford and Steinfeld (1999), an unsupportive environment can strain or prevent functional performance if its demands are greater than a person's competencies.

Accessibility and usability are therefore important indicators of P-E fit that influence how people navigate and utilize their home environments. Through principles of the ETA, accessibility can be quantified by evaluating the relationship between a person's functional competence and the barriers present within his/her home environment (Iwarsson & Ståhl, 2003). The interpretation and evaluation of the environment as supportive or restrictive specifically to the person and his/her desired activities and goals is the key factor in usability. As such, psychosocial factors, ranging from self-identity to socialization, also affect P-E fit (Steinfeld & Danford, 1999). In this respect, P-E fit can be seen as both objective (accessibility) and perceived (usability). Accessibility and usability indicators are also key measurable outcomes of the interaction between person and environment (Iwarsson, 2012; Nygren et al., 2007; Steinfeld & Danford, 1999).

Lawton and Nahemow (1973) utilized Murray's (1938) concept of "press" to characterize the environmental effects upon people. According to Lawton (1989), press is defined as a person's response to environmental demand. Lawton continues:

> Favorable behavioral and affective outcomes are likely to result from a match between personal competence and environmental demand. An excess of press over competence at a particular time occasions maladaptive behavior and negative affect, as does a deficiency of press with respect to competence. (p. 63)

In other words, unaccommodating environments can shift impairments into disabilities by restricting certain activities, whereas overly accommodating environments can provoke early dependence and put functional abilities at risk (Danford & Steinfeld, 1999).

While the ETA claims that a supportive environment for aging adults may elicit greater competence, more favorable behavior, and greater quality of life, it also asserts that such support can heighten control over the environment (Lawton, 1974). The ability to live independently is a product of a person's capacity to perform certain tasks, or activities of daily living (ADLs), in the context of a functionally supportive environment (Iwarsson, 2005). Therefore, the adaptation, or outcome of the interaction between person and environment, can be considered a measure of a person's performance, or ability and desire to function independently within certain environmental contexts (Danford & Steinfeld, 1999; Iwarsson, 2005). This multidimensional approach to P-E fit, with an emphasis on accessibility and usability, can aid in an older adult's ability to age in place (Iwarsson et al., 2007; Oswald & Kaspar, 2012; Steinfeld & Danford, 1999).

Environmental docility/proactivity hypotheses. Lawton and Nahemow's (1973) press-competence model and environmental docility hypothesis (Lawton & Simon, 1968) provide a framework within which the role of environmental design on functional performance and self-continuity can be analyzed (Iwarsson, 2005; Satariano, 2006). Fundamentally, Lawton (1974) believed that many age-related effects are environment related, particularly for older adults. These effects can be understood in terms of functional competencies: the magnitude of environmental issues present in a person's home is a product of that person's overall capacity to adapt to or overcome such barriers (Danford & Steinfeld, 1999; Iwarsson, 2005). Individuals with lower competence are more susceptible to environmental demands, and may experience more "press" than those with higher levels of competence (Lawton & Nahemow, 1973). As a result, environmental modifications that enhance older adults' physical capacities can help reduce environmental-press, or stressors that inhibit general activities of daily living (Iwarsson, 2012; Iwarsson & Wilson, 2006; Oswald et al., 2007).

The environmental docility hypothesis suggests that the environment is the strongest determinant of behavior as functional competence decreases (Lawton, 1990). A high press environment is challenging for persons with lowered competence to adapt to since their functional ability to overcome such barriers is low, whereas persons with high competence may have few or no problems navigating the same environment. In this sense, the environmental problems perceived by a person are a product of their functional competencies, or ability to adapt to their surroundings. When the environment matches a person's level of competence, the ability of that person to adapt to and function within their surroundings can be maximized (Danford & Steinfeld, 1999; Iwarsson, 2005).

Although used as a framework in many P-E fit studies, the press-competence model, and particularly the environmental docility hypothesis, has been criticized for its one-way approach to the interaction between persons and their surrounding environments. Peine and Neven (2011) believe the docility hypothesis labels older adults as submissive to their environment. Iwarsson (2005) believes the model largely ignores the subjective nature of P-E fit, including a person's needs and perceptions, while depicting the environment as a locus for demands rather than a potential resource. Lawton himself agreed that docility as a strategy to enhance functional outcomes of impaired persons is too one-dimensional, placing older adults as submissive recipients of a "built environment designed by others" (1989, p. 64).

Within the shortcomings of the environmental docility hypothesis, Lawton later revised his framework to include the *environmental proactivity hypothesis*. This hypothesis defies the traditional assumptions of older adults as products of their life trajectories, or as inactive recipients of their own life course decisions (Lawton, 1989;

1990; Peine & Neven, 2011). In contrast to the docility hypothesis, environmental proactivity contends that older adults' management of environmental press is achieved through an active adaptation process (Lawton, 1990). This reflects a person's needs, desires, and preferences by considering how older adults actively utilize a large variety of environmental resources within the home as a way to live and function independently (Lawton, 1990). This process of actively minimizing press can further improve levels of competence and well-being, therefore enhancing overall P-E fit (Danford & Steinfeld, 1999; Peine & Neven, 2011).

Selection, Optimization, and Compensation (SOC) Model

It is well established in the literature that older adults engage in particular adaptation activities, whether consciously or subconsciously, that help mitigate and ease the process of growing older. The selection, optimization, and compensation (SOC) model is one theoretical framework that helps explain proactivity and adaptability among older adults (Baltes, Lindenberger, & Staudinger, 2006). In general, it suggests that functional losses (physical, social, and psychological) in old age can be mitigated through three adaptive processes: selection, optimization, and compensation (Baltes & Baltes, 1990). Although not specific to environmental gerontology or to P-E fit theories, the SOC model can further explain how the perceived self (including social and psychological processes) may be aggravated or alleviated by the environment.

The SOC model originated in psychology as a theoretical means to understand human developmental processes throughout the lifespan (Baltes, 1997; Wahl et al., 2012). While applicable to any age group, SOC processes take on added significance in older age due to losses in physical, social, and psychological reserves (Baltes, 1997).

More specifically, selection (S) focuses on desired outcomes or goals, optimization (O) involves the means necessary to achieve goal-related success, and compensation (C) explores how older adults maintain desired levels of functional outcomes in response to a loss in goal-related achievement (Baltes et al., 2006). These processes can be intentional (conscious) or unintentional (subconscious), and may be internally or externally motivated. Like P-E fit frameworks, the SOC model depends on both the person and the context, or surrounding environmental conditions (Baltes & Baltes, 1990). While older age brings about a refinement and certain level of maintenance in adaptive processing, each SOC component is dynamic and subject to change over time depending on physical, social, or psychological alterations to either a person or the environment (Baltes et al., 2006).

Baltes et al. (2006) argue that a person's ability to obtain and practice selection, optimization, and compensation should ultimately lead to higher functioning with consideration to goal-related outcomes. However, as people age, their functional needs tend to increase within environments providing fewer usable resources. As such, older adults tend to use optimization and compensation processes less, instead focusing their efforts on elective and loss-based selection, or self-directed, desirable goals and adjusted or adapted goals due to loss of functioning with age (Baltes et al., 2006). Older adults will tend to change their goals or outcomes to correlate with their lowered level of functioning (or toward maintenance or avoidance of further losses) before they will work to change the means by which they achieve their goals (Baltes, 1997).

Older adults' need for accessible environments grows with advancing age. Although U.S. building codes and regulations are in place to make public environments accessible, there are few that are mandated in the private sector, including single family homes and other types of ordinary housing. Therefore, losses in functional capacities from physical aging often result in a need for environmental or assistive device supports (Baltes & Baltes, 1990). When physical declines limit high-priority activities or goals due to constraints found in the environment, the SOC model predicts that processes of selection, optimization, and compensation may prove fruitful in helping older adults adapt to their changing physical capacities.

Selection may involve the need for increased attention on a particular goal at the expense of other daily activities. For example, a person might spend the entirety of a day preparing the home for visitors instead of completing other necessary or desired activities. *Optimization* may include additional practice or knowledge in terms of navigating or utilizing the environment, such as choosing furniture that makes it easier to get in and out of a seated position or adding a ramp to the house to accommodate wheeled mobility devices. *Compensation* may include limiting dwelling functions to one floor, such as moving bedroom furniture from the second story to a main floor living room to accommodate a reduction in lower extremity function.

An objective assessment of accessibility for people and their environments neglects perceptions of self and place, which are important to the adaptive capabilities of older adults. Therefore, the usability of the environment with respect to a person's physical, social, and psychological needs must also be considered. Environments for older adults must be conducive to life span developmental trajectories but also compensatory with respect to functional limitations and reductions in older adults' behavioral plasticity.

Chapter Summary and Discussion

The home environment is an important and memorable space, especially for those of an older age (Gitlin, 2003; Oswald et al., 2007; Oswald & Kaspar, 2012). Older adults tend to spend increased time within the home, primarily because of changes to their physical and social life worlds (Nygren et al., 2007). Aging of the body, decreased social interaction due to retirement, death of family and friends, lessened overall mobility, and other changes and life events can lead to transformations in how the home environment and the aging self are experienced and perceived (Leith, 2006; Thorson, 2000). As a critical component of everyday life, the home environment of older adults provides a context within which the interactive person-environment relationship can be examined (Oswald et al., 2007).

The home environment is also a context for meaningful and necessary activity in older age. Based on the theoretical foundations provided by Lawton and Nahemow (1973) and Baltes and Baltes (1990), it is apparent that P-E fit and adaptation to aging is a product of the person and their environment and is both objective and perceptive in nature. In this regard, it is important to utilize objective assessments and perceptions of P-E fit when exploring person-environment interactions. A greater understanding of P-E fit and P-E interactions will generate implications and recommendations for future research, policy, and practice that will allow older adults to age well in place.

CHAPTER 3

FIRST MANUSCRIPT

Objective Assessment of Person-Environment Fit: Adapting the Environmental Component of the Housing Enabler to United States Applications

With increasing age, older adults spend the majority of their waking hours either within or immediately outside of their homes, making it the primary context for basic and instrumental activities of daily living (Nygren et al., 2007). Increasing frailties among aging adults suggests that the environment plays a greater role in supporting independence in the face of declining abilities and is therefore a good target for interventions (Iwarsson, 2005). The specific characteristics of the environment that affect the overall health and well-being of older adults, however, are not well understood (Wahl, Iwarsson, & Oswald, 2012).

The concept of person-environment (P-E) fit suggests that an appropriate balance between a person's functional competence and his/her environmental surroundings is important in maintaining overall health and well-being, especially in older age (Iwarsson, Horstmann, Carlsson, Oswald, & Wahl, 2009; Iwarsson, Horstmann, & Slaug, 2007; Oswald et al., 2007). Lawton and Nahemow's (1973) well-respected ecological theory of aging (ETA) posits that persons with lower competence are more susceptible to environmental demands and may experience more "press" than those with higher levels of competence. Fundamentally, Lawton (1974) argued that many age-related declines result from poorly designed, unsupportive environments that do not accommodate needs in older age. These effects can be understood in terms of functional competencies: the magnitude of environmental issues present in a person's home is a product of his/her overall capacity to adapt to or overcome such barriers (Iwarsson, 2005). Therefore, environmental modifications that enhance the functional capacities of older adults can subsequently reduce environmental press, or stressors that inhibit general activities of daily living (Lawton, 1990).

The interactive relationship between an aging person and their home environment makes the home a primary focus of many P-E fit studies. Older adults are particularly sensitive to P-E fit interactions, especially with increased functional limitations and physical dependencies common with age (Wahl et al., 2012). The ability to live independently in old age is often challenged by declines in health and the presence of environmental hazards (Iwarsson, Nygren, Oswald, Wahl, & Tomsone, 2006; Werngren-Elgström, Carlsson, & Iwarsson, 2009; Yuen & Carter, 2006). With medical advances increasing longevity, the proportion of people aging with disabilities is increasing (Sheets, 2005). Since the home environment plays a critical role in aging well on a multitude of levels, it is important to quantify physical P-E fit by objectively measuring how well a person's functional capacities match his/her surrounding environment.

Although the home environment is a worthwhile target for P-E fit assessments and subsequent interventions, there are currently few valid and reliable instruments to measure the presence and magnitude of accessibility problems within a person's home, especially in the United States (Mitty, 2010). Accessibility, through a P-E fit perspective, is defined as a balance, or match, between a person's abilities and the challenges of his/her environment (Iwarsson & Ståhl, 2003). To capture this important objective indicator of P-E fit, an instrument must include a well-rounded evaluation of a person's functional capacities and the physical environmental barriers present within their home environment. One of the most prominent and promising assessment tools utilizing this objective P-E fit approach is the Housing Enabler (HE; Iwarsson & Slaug, 2010; Iwarsson, Haak, & Slaug, 2012). With this instrument, it is possible to objectively evaluate the magnitude of accessibility problems and weighted environmental barriers present within a person's home environment according to his/her specific combination, or profile, of functional limitations.

Reliability and validity of the HE instrument have been established across European contexts and several European versions (Helle et al., 2010; Iwarsson, Nygren, & Slaug, 2005). However, environment-specific items within the HE instrument are based on national accessibility standards and guidelines, and therefore require careful adaptation for use in other countries (Helle et al., 2010). Although the original Enabler idea was conceived in the United States as a means to move toward a U.S. national standard of barrier-free design (Steinfeld et al., 1979), the HE instrument itself has not been reliably established in a U.S. context. Housing standards, housing stock, and housing norms are different between Europe and the United States. A well-informed and collaborative process of adapting the HE to U.S. applications is needed to provide a reliable method of assessing accessibility problems in the United States. Furthermore, a U.S. version of the HE would make it possible to add U.S. research to the multiple cross-national studies of the HE among European countries (i.e., Helle et al., 2010; Iwarsson, Wahl, & Nygren, 2004; Nygren et al., 2007), therefore moving toward a more universal understanding of accessibility and P-E fit.

To assess environmental barriers and magnitude of accessibility problems within the home environments of older adults and persons with disabilities, the purpose of this study was to adapt the environmental component of the HE (Iwarsson & Slaug, 2010) for use in the United States. More specifically, the aims of this study were (1) to adapt the 161 environmental component items in the HE to meet U.S. accessibility guidelines, and (2) to investigate the inter-rater reliability of the adapted environmental component items and establish a reliable version of the HE suitable for U.S. applications.

Conceptual, Theoretical, and Empirical Background of the Housing Enabler Methodology

The HE (Iwarsson & Slaug, 2010) has been established as a reliable and valid means of evaluating physical accessibility problems, a major component of objective P-E fit (Fänge & Iwarsson, 2003; Iwarsson & Isacsson, 1997). It has also been used in a number of empirical studies with this express purpose (e.g., Helle, Brandt, Slaug, & Iwarsson, 2012; Iwarsson, 2005; Nygren et al., 2007; Oswald et al., 2007). The basis of the HE instrument is congruent with the ETA (Lawton & Nahemow, 1973), which states that a balance between competence and environmental demand can be achieved if one or the other (or both) is modified to accommodate appropriate and necessary performance of activities.

The ETA (Lawton & Nahemow, 1973) is therefore an appropriate framework within which the fit between people and their home environments can be evaluated. Objectively, by means of the HE, a person is assessed of his/her functional limitations while the home environment is evaluated in terms of prevalence of physical environmental barriers that—according to the national standards for housing design—

may threaten accessibility. Thus, accessibility is considered an important indicator of objective P-E fit that influences a person's ability to perform and engage in meaningful activity within their home environment (Iwarsson, 2005; Nygren et al., 2007). It is also a key measurable objective outcome of the interaction between the personal and environmental components of the P-E fit equation (Iwarsson, 2012).

The HE instrument (Iwarsson & Slaug, 2010) evaluates both a person and his/her environment to quantify the magnitude of accessibility problems within the home, based on the P-E interactive relationship. Originally developed in Sweden (Iwarsson & Isacsson, 1996), the HE provides an objective measure of P-E fit through a three-step assessment and analysis process: 1) an assessment of a person's functional limitations (12 items) and dependence on mobility devices (2 items), 2) an evaluation of the physical environmental barriers in the home and the close exterior surroundings (161 items), and 3) the calculation of an overall magnitude of accessibility problems score (ranging from zero to 1832; zero meaning no accessibility problems within the home environment and 1832 equating the largest magnitude of accessibility problems. In addition, rank-ordered, weighted environmental barriers based on the individual or sample-specific prevalence of functional limitations in relation to the occurrence of environmental barriers can be computed. This computation generates environmental barrier item-specific P-E fit scores and results in a list ranking the environmental barriers from those generating the highest magnitude of accessibility problems to the least. This ranking is based on the relative contribution of each environmental barrier item to the variance in the total HE score (Iwarsson & Slaug, 2010). Quantifying objective P-E fit using the HE instrument helps practitioners understand the magnitude of accessibility problems anticipated within the home environment as well as why such problems might occur (Iwarsson, 1999). It also helps researchers gain a broader understanding of P-E fit and how it can be measured objectively within the home environment.

With the HE instrument (Iwarsson & Slaug, 2010), accessibility problems and environmental barriers defined by housing regulations and legislation in a Swedish context can be assessed. Among the 161 items in the HE environmental component, 70 are considered norm-based items, while 91 are considered non norm-based. This component is divided into three subsections: exterior surroundings (subsection A; 28 items), entrances (subsection B; 46 items), and indoor environment (subsection C; 87 items). Each item is dichotomously assessed—"yes" meaning the barrier exists, and "no" signifying the barrier does not exist. In addition, there is a "not rated" response option, to be used only when an environmental feature cannot be assessed (e.g., when access is not granted by participant, communal spaces are locked, or weather prohibits a feature's assessment).

The original Swedish HE has undergone numerous iterations, adopting some new features and eliminating others (Iwarsson & Slaug, 2010). Through the ENABLE-AGE project (Iwarsson et al., 2005), it has also been adapted for reliable and valid use for research purposes in several countries within Europe: Germany, Hungary, Latvia, and the United Kingdom. More recently, the environmental component of the HE was adapted to the Nordic context, including Sweden, Finland, Iceland, and Denmark (Helle et al., 2010). In each of these versions, methods of adaptation to other national contexts followed specific guidelines set forth by Iwarsson et al. (2005), including strict adherence to national standards for housing design addressing accessibility and validation of content using experts representing multiple fields of study.

Since its creation and adaptation to other European contexts, the HE has been used in multiple empirical studies. For example, Fänge and Iwarsson (2005) investigated the longitudinal effects of home modifications on activities of daily living (ADL) dependence and spatial usability among older adults. Among the numerous publications based on the ENABLE-AGE Project (Iwarsson et al., 2007), Iwarsson et al. (2009) found that the use of the HE in assessing objective P-E fit was more effective at predicting falls within the home than the evaluation of environmental barriers alone. More recently, Helle et al. (2012) used the HE to assess differences in housing standards addressing accessibility to further define and problematize the proportion of housing environments not meeting standards and persons categorized with accessibility problems.

The HE has been translated into multiple languages (Danish, Finnish, German, Hungarian, Latvian, British English, Icelandic, and Portuguese) and has been used in multiple European contexts (e.g., Helle et al., 2010; Iwarsson et al., 2005). However, the accessibility guidelines used to evaluate environmental barriers in these countries does not match regulations in the United States. Therefore, careful adaptations need to be made to the instrument to correspond appropriately to differing countries' norms and guidelines and to ensure its reliable and valid use (Helle et al., 2010; Iwarsson & Slaug, 2010).

Methods

To adapt the HE to a U.S. context and explore the reliability of its future use, two different, yet related procedures following similar methods for multi-professional inter-rater reliability outlined by Iwarsson et al. (2005) and Helle et al. (2010) were employed. This study did not include conversion of the personal component of the HE, as the functional limitations assessment from the original Swedish HE is appropriate for use in the U.S. without changes. However, the environmental component required a systematic procedure of adaptation and reliability testing. Translation of the British English version of the current Swedish HE (Iwarsson & Slaug, 2010), along with the comparison and selection of U.S. accessibility guidelines to match the 161 items present in the environmental component of the HE instrument, was completed. Inter-rater reliability testing was investigated by collecting and analyzing 50 pairwise assessments of home environments.

Research and Data Collection Procedures

Two comprehensive steps were required in the systematic process of converting the environmental component of the original HE (Iwarsson & Slaug, 2010) to U.S. applications. The first step necessitated a thorough examination of the most recent version of the environmental component of the British English HE (Iwarsson & Slaug, 2010) and the proper conversion of terminology, measures, and accessibility guidelines to a U.S. context. After completing the HE formal training program (L.L. & C.S.), the second step of the U.S. HE adaptation process involved the creation and execution of rater training for the present study, and subsequent pairwise assessments of the environmental component to evaluate inter-rater reliability.

Adaptation of the environmental component of the HE to a U.S. context. It was important that the environmental component of the U.S. HE not only met U.S. building codes, regulations, and guidelines but also correlated item by item with the original 2010 version for the purpose of future cross-national comparisons. To ensure this, all 161 items within the environmental assessment section of the current British English version of the HE (Iwarsson & Slaug, 2010) were first translated from British English to American English to ensure raters would understand each item in a U.S. context. For example, two items within the indoor environment subsection of the environmental component (subsection C) ask raters to assess “hobs,” which in American English is equivalent to “stove.” This process made certain that chosen terminology in the U.S. version of the HE were equivalent to its original meaning.

Next, a thorough summary and evaluation of existing U.S. building codes and regulations was conducted. Complete guidelines from the Department of Justice (DOJ), American National Standards Institute (ANSI), Americans with Disabilities Act (ADA), Federal Housing Act (FHA), and the International Building Codes (IBC) were obtained. U.S. researchers (L.L. & C.S.) searched for existent equivalent guidelines that matched all 161 HE environmental barrier items. Equivalent item guidelines between DOJ, ANSI, ADA, FHA, and IBC regulations were organized side-by-side in a matrix.

Once item-specific guidelines were organized between the five sets of U.S. accessibility regulations, dimensions in the original HE were converted from metric to Imperial units of measure. Next, each item and its equivalent U.S. guideline, as found among the five sets of regulations, were analyzed based on the systematic comparison approach used in previous HE adaptations (Helle et al., 2010; Iwarsson et al., 2005). In many cases, item-specific guidelines among the five sets of regulations were identical. However, when guidelines varied between sets of U.S. regulations, decisions regarding which guideline to include in the U.S. HE were made first among the U.S. team of researchers (L.L. & C.S.) and were triangulated through the inclusion of an undergraduate research assistant familiar with U.S. building codes. Outstanding questions regarding content of environmental items between the original HE and the U.S. version were further validated through collaboration with Swedish counterparts (S.I. & B.S.) to ensure valid cross-national comparisons.

Several iterations of the U.S. HE were developed throughout the initial adaptation process. Direct collaboration between the U.S. research team knowledgeable about U.S. building codes and guidelines and the European HE research team familiar with the nuances of the HE tool itself ensured that each iteration advanced the quality and content validity of the U.S. HE. This extensive process was important in developing a content valid version of the U.S. HE that met U.S. accessibility standards and was equivalent in meaning to the already validated HE instrument.

Reliability analysis of the U.S. version of the environmental component of the HE. To ensure that the newly adapted environmental component of the U.S. HE could be reliably used in research and practice, inter-rater reliability was investigated. Since the reliability study only focused on the environmental component of the newly adapted U.S. HE, a formal ethical review and approval by the Institutional Review Board was not needed. However, all raters completed and passed the online ethics course available to U.S. researchers prior to data collection to ensure the ethical execution of research.

Eleven rater pairs completed a total of 50 pairwise assessments of independent home environments in both urban and rural areas in a wide-ranging region of the U.S. Pacific Northwest. Raters chose home environments for assessment based on personal connections—only homes where raters personally knew the inhabitants were assessed.

Permission to assess the home was given by inhabitants, and raters accommodated their personal schedules. Confidentially of home environments was ensured through use of a coding system.

Although homes were selected for assessment by convenience, raters selected home environments following specific criteria for housing type. Criteria included community-dwelling, traditional single-family and multifamily housing (i.e. apartments, condos, townhomes, etc.). Group homes, cooperative homes, and supportive housing for the aging were excluded. Care was taken to ensure that an appropriate mix of housing environments in multiple areas of the identified region of the U.S. Pacific Northwest was assessed.

Raters were undergraduate students in the upper division stage of the interior design and housing studies programs. Familiarity with housing design, accessibility, and building codes varied only slightly, as each rater had taken specific, related coursework as required for the degree program. In addition, HE training and supervision of all raters occurred throughout the data collection process.

Rater training was conducted prior to the start of pairwise U.S. HE data collection. The research team (L.L. & C.S.) that had completed official HE training by the originators of the current version of the HE (Iwarsson & Slaug, 2010) was authorized to conduct introductory training with U.S. raters once the environmental component of the U.S. HE had been established. Training activities and documents for U.S. raters were based on the HE training format developed by the instrument originators (S.I. & B.S.). All raters conducted one U.S. HE environmental assessment prior to their official training. This was done to identify initial misunderstandings and to reduce discrepancies between measurement and interpretation of items.

Training included in-depth examination of each environmental barrier item and further clarification of questions that arose from the practice assessment. During the data collection for the present study, each rater within a pair independently assessed each home environment within one week of one another. Immediately following each home assessment, rater pairs completed a pairwise rating sheet that identified differences in ratings between each assessor. Pairwise rating sheets and full environmental assessment forms were submitted to the first author (L.L.) as assessments were concluded. Cross-checking between assessment forms and pairwise rating sheets was performed by a thorough and complete proofreading of each assessment before data were digitized.

Data Analysis

Once pairwise data were collected and aggregated, data were analyzed using StataIC 12 and SAS 9.2. Percentages of agreement and Cohen's kappa (Cohen, 1960) were calculated between rater pairs and across all 161 environmental barrier items to evaluate the inter-rater reliability of the U.S. HE environmental component. Cohen's kappa statistic is considered a valid measure of reliability that accounts for inter-observer agreement due to chance, especially when an existing scale is already deemed reliable and valid (Altman, 1999; Cohen, 1960). Since a significant limitation of kappa relates to its dependency on prevalence (Hallgren, 2012; Sim & Wright, 2005), percentages of agreement were also calculated between raters and across all items as a means to complement the analysis.

Analysis of reliability for the U.S. HE followed the same procedures and standards set forth through previous adaptations of the Swedish version of the original HE to other European countries (i.e., Helle et al., 2010; Iwarsson et al., 2005). Individual and mean values of kappa and percentage of agreement were calculated for each item and subgroup of the environmental component. Appropriate kappa values were defined as <0.20 = poor agreement, 0.21 – 0.41 = fair agreement, 0.41 – 0.60 = moderate agreement, 0.61 – 0.80 = good agreement, and 0.81- 1.00 = very good agreement, following Altman's (1999) guidelines. Because this study also examined percentage of agreement, good agreement was defined as >80% agreement with a k > 0.61 and moderate agreement was defined as >80% agreement with a k > 0.41 (as outlined by Iwarsson et al., 2005).

Results

The in-depth adaptation process for the final version of the environmental component of U.S. HE resulted in 34 changes from the original. Differences were attributed solely to the variation in accessibility guidelines and standards between Sweden and the United States. The majority of the differences between HE versions were found in items representing the indoor environment (see Table 1).

The mean percentage of agreement for the environmental component of the U.S. HE was greater than 80% across all 161 items, while the mean kappa values indicated moderate agreement (see Table 2). More specifically, 110 items obtained a percentage of agreement at or above 80%, while 34 items had between 70 – 79% agreement. Kappa values ranged from poor to very good; 32 items fell within the poor range and 54 items were valued as fair. Regardless, the majority of kappa values (126 items) fell within the fair to good range, while 75 items were moderate to very good (see Table 3).

In terms of the reliability of the three environmental component subsections, subsection A (exterior surroundings) had the lowest percentage of agreement (77%). However, subsection A also had the best mean kappa, indicating moderate agreement. Subsections B (entrances) and C (indoor environment) had percentages of agreement above 80%, but kappa values indicating only fair agreement. Furthermore, norm-based as well as non norm-based environmental component items had percentages of agreement above 80%. Norm-based items, however, had a mean kappa score in the moderate range, while non norm-based items had a kappa score in the fair range (see Table 2). Fifteen items with the lowest kappa values were accompanied by percentages of agreement ranging from 88% to 99%.

Discussion

Following similar procedures to studies adapting the Swedish HE to other cross-national applications (i.e., Helle et al., 2010; Iwarsson et al., 2005), a content valid environmental component of the HE was created for use in the United States. The results of this study show that the inter-rater reliability was moderate across mean kappa values and mean percentages of agreement. Therefore, the U.S. version of the environmental component of the HE instrument can be considered sufficiently reliable for use in the study region of the U.S. among well-trained raters. However, lower percentages of agreement and kappa values for certain items within particular subsections warrant a further discussion, as a number of factors may have contributed to their less than ideal levels of agreement (Slaug et al., 2012).

There are many methodological challenges to analyzing inter-rater reliability using multiple pairs of raters and varying home environments. Percentage of agreement does not consider chance, while kappa is limited by its dependence on prevalence (Hallgren, 2012; Sim & Wright, 2005). Therefore, one possible explanation for low kappa values across certain environmental component items in the U.S. version of the environmental component of the HE may relate to the issue of prevalence. When prevalence of a certain item is low, two observers may reach a high percentage of agreement with simultaneously low values of kappa (Feinstein & Cicchetti, 1990; Hallgren, 2012). In this study, the lowest kappa values were found in subsection B (entrances), and more specifically the items regarding elevators. While the percentages of agreement were all above 90% for these items, the lack of an elevator in all but three of the fifty assessed home environments draws attention to the fact that the low kappa values found among these items may be attributable to their low rates of prevalence. Similarly, low kappa values but high percentages of agreement were found in environmental items in subsection B related to ramps at entrances; very few homes within the housing stock in the region of study had this feature. Therefore, while the inclusion of such items may be required for instrument use on an individual level, the lack of prevalence of some features encompassing a number of assessment items may skew inter-rater reliability in a negative direction.

Furthermore, item-specific cross-tables of agreement often showed symmetrical unbalancing of marginals in the statistical analysis. Without the ability to assign correct standardized values across various housing environments assessed by different rater pairs, kappa ends up being calculated from observed marginal total values (or coefficients of concordance), considered “surrogates for prevalence” (Feinstein & Cicchetti, 1990, p. 545). Therefore, although raters more often agreed, the presence or non-presence of certain items was similarly symmetrically unbalanced with respect to marginal totals, thereby lowering the kappa values.

Low agreement values between rater pairs may be attributable to insufficient training of raters. The ability to conduct reliable HE assessments is partially reliant on overall rater competence for this type of complex assessments, but more so on appropriate and consistent training regarding use of the specific instrument (Helle et al., 2010; Iwarsson & Slaug, 2010). Although raters in this study were knowledgeable and familiar with environmental accessibility guidelines, building codes, and housing-specific elements and features, they were relatively inexperienced in terms of conducting assessments and therefore may have benefitted from additional training. The comprehensive nature of the HE instrument requires consistent comprehension by raters, and the completion of only one practice assessment is not considered sufficient. In fact, HE guidelines state that a minimum of 25 assessments is required to attain the skill level required for reliable assessments (Iwarsson & Slaug, 2010). Similarly, the introductory training was study-specific and not a full training course, and therefore may not have been enough with respect to practice and specificity for this particular group. Additional training, the creation of a comprehensive training guide (currently in development between U.S. and Swedish research teams), and supervised field practice will most likely result in higher levels of agreement across rater pairs and environmental component items in the future.

The results show a similar level of percentage of agreement between norm-based and non norm-based types of environmental items, although the kappa value is higher for the norm-based items (0.448, moderate) than the non norm-based items (0.361, fair). The majority of norm-based items are evaluated through very specific measures (i.e., width of doorways, height of steps/thresholds, presence of discernible features), making them less open to interpretation than non norm-based items. In other words, many non norm-based items require the subjective interpretations of raters (i.e., heaviness of doors) whereas norm-based items can most often be specifically measured or observed. Although both types are needed in the instrument to capture P-E fit, the differences between environmental item types may also have played a role in the moderate levels of agreement.

Levels of agreement may also relate to the individual raters. In this particular rater pool, there were some instances where raters left items blank. With the high number of items present in the environmental component of the HE, it is not surprising that a few raters occasionally missed evaluating a small number of items. In two specific cases, whole sections or pages of items were missing from rater forms, indicating that these raters may have skipped around certain sections of the assessment and failed to go back and finish. This type of result is certainly possible within the variety of human raters, and is well in line with the experience of previous empirical studies using the HE. Such variety should be monitored closely in the future by lead researchers when managing a large number of raters within one project and over time.

Another important consideration with these results is that assessments were completed by students with little professional experience. In this regard, the level of understanding and experience necessary to achieve higher levels of agreement may reside with a pool of raters with more field experience. Among the eleven rater pairs, some pairs completed more assessments than others throughout the course of this study. In other words, the small number of houses assessed by a few rater pairs may have affected the overall percentages and kappa scores across the total sample. Also, home environments were selected by convenience within a limited region of the U.S. Pacific Northwest. Housing in this region is unique in design, size, and age compared to other, more historic areas of the U.S., thereby potentially affecting resultant prevalence and reliability estimates possible among other types of housing. Therefore, although overall agreement in this study was considered moderate, other empirical explorations of inter-rater reliability of the U.S. HE is warranted, including the examination with other raters, locations, and home environments.

Importantly, the personal component of the original HE (Iwarsson & Slaug, 2010) was not included in this study. While the personal component items are universal among human beings, terminology and assessment techniques are not. Therefore, before the U.S. HE can be fully implemented, similar training procedures and inter-rater reliability studies must be conducted on the personal component of the instrument. Such studies will be forthcoming from the current researchers. When reliability is established for both the personal component and the environmental component across other U.S. contexts, the full instrument can be used for standardized, objective assessments of accessibility problems within the home environments of older adults and persons with disabilities both in research and practice.

The objective assessment of P-E fit based on housing standards and norms has been criticized as reductionist without regard to perceptions of and experiences of the person-environment interaction (Helle et al., 2012). Therefore, adapting the HE to U.S. applications may be perceived as a step away from the universal design perspective currently gaining international attention. While we acknowledge this criticism related to norm-based assessments, universal design is possible for new-build housing (and to some extent renovations), and most people in the U.S. and globally live in homes designed and built without the benefit of accessibility standards. Therefore, we believe that valid accessibility standards provide an appropriate guide for the housing design or modification process, including the incorporation of universal design in the home environments of older adults and persons with disabilities. Further, a greater understanding of person-environment interactions, including the perceptions of P-E fit and the adaptive processes people employ to maintain optimal P-E fit, can supplement norm-based objective assessments. While this is a current trend of P-E fit studies (e.g., Lien, Steggell, & Iwarsson, 2013), more research needs to incorporate how persons with functional limitations use and perceive the home environment.

Conclusion

There are multiple implications of this study. A reliable U.S. HE can be used by practitioners in the field to assess the magnitude of accessibility problems and weighted environmental barriers with the purpose of establishing appropriate home modifications that encourage the performance of daily activities. This is especially important for the older adult population, as their independence is often threatened by age-related functional limitations and the presence of environmental barriers (Iwarsson et al., 2006; Werngren-Elgström et al., 2009; Yuen & Carter, 2006). Further, determining in-home interventions that increase the ability of older adults to remain in place in ordinary housing may foster physical, social, and psychological health and well-being (Iwarsson, 2012; Oswald & Wahl, 2004).

Establishing reliability of the U.S. HE is also important for future use of the tool, including future cross-national comparisons of accessibility and objective P-E fit within home environments that are currently lacking (Iwarsson et al., 2004; Nygren et al., 2007). Nationally, U.S. policymakers and public health specialists could use the U.S. HE on a broad scale to determine population-level accessibility problems and assist in creating appropriate policies and solutions on a national or community scale. Similarly, comparing cross-national accessibility problems on a global scale could contribute to greater worldwide empirical knowledge and understanding of accessibility and objective P-E fit.

In conclusion, the HE was chosen for adaptation to the U.S. for a number of reasons. First, there are very few assessment tools in existence that are capable of measuring the magnitude of accessibility problems within a person's home (Gitlin, 2003; Iwarsson, 2005; Mitty, 2010). Second, the HE is considered a high-quality, exceptional tool for use in assessing accessibility within the built environment, and has established appropriate inter-rater reliability and validity in the countries of Sweden, Germany, United Kingdom, Hungary, Latvia, Denmark, Finland, and Iceland (Helle et al., 2010; Iwarsson et al., 2005; Iwarsson & Slaug, 2010). The expansion of the HE and possibility for cross-national comparisons emphasizes a significant need for a reliable U.S. HE for inclusion in future studies exploring objective P-E fit among older adults aging in place both in the U.S. and abroad. Although the U.S. HE assessment tool, including the personal component, requires additional reliability and validity testing for acceptable use in other regions of the U.S., the present study represents a first step in a process of affording researchers and practitioners the ability to reliably and validly evaluate environmental barriers and the magnitude of accessibility problems in the home environments of functionally limited older adults within and across the U.S. in the years ahead.

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Table 1.

Items changed in the U.S. Housing Enabler (HE) compared with the current original HE instrument (Iwarsson & Slaug, 2010) (N = 34)

	Environmental Barrier Item	
Environmental Component Subsection	United States HE version	2010 original HE version
A. Exterior	A23. Insufficient maneuvering space at seating places (lacking 60" diameter/standard t-shaped space)	1.5 m x 1.5 m
B. Entrances	B1. Narrow door openings at entrance (< 32")	84 cm
	B2. High thresholds/steps at entrance (> 1/2")	15 mm
	B3. Insufficient maneuvering space at doors (< 60" x 42", inside and outside)	1.5 m x 1.5 m
	B13. Stair treads w/narrow or irregular depth (< 11")	26 cm
	B14. High, low, or irregular heights of risers (outside 4 – 7")	15 – 17 cm
	B18. Handrails too high/low (outside 34 – 38")	15 – 17 cm
	B22. Steep slopes (more than 1:12)	1:20
	B27. Wide gap between elevator/floor (max. 1 1/4")	3 cm
	B43. Narrow door to sitting out place (< 32")	84 cm
	B44. High threshold/step to sitting out place (> 1/2")	15 mm
	B46. Steep transition from one level to another (1:12)	1:20
C. Indoor	C1. Stairs/thresholds/differences in level (> 1/2")	15 mm
	C3. Narrow passages—design of building (< 36")	1.3 m
	C4. Narrow doors (< 32" clearance)	76 cm
	C6. Insufficient maneuvering spaces where turning is necessary (< 60" x 60" turning circle)	1.3 m x 1.3 m
	C11. Stair treads with narrow/irregular depth (< 11")	26 cm
	C12. High, low, or irregular height of risers (outside 4 – 7")	15 – 17 cm
	C15. Handrails too high/low (outside 34 – 38")	15 – 17 cm
	C42. Kitchen/laundry controls too high (> 44")	1.1 m

C43. Kitchen/laundry controls too low (< 15”)	80 cm
C44. Insufficient maneuvering spaces where turning is required in bathroom (< 60” x 60” turning circle)	1.3 m x 1.3 m
C48. Grab bars in high position (> 36”)	90 cm
C49. Grab bars in low position (< 33”)	80 cm
C61. Bathroom controls too high (> 44”)	1.1 m
C62. Bathroom controls too low (< 15”)	80 cm
C63. Bathroom sink placed at height for use only when standing (top edge 34” or more above finish floor)	81 cm
C64. Toilet lower than 17”	47 cm
C66. Insufficient leg room under bathroom sink (clearance height < 27”, depth < 19”, width < 30”)	60 cm, 80 cm
C67. Bathroom mirror at height only for use when standing (lower edge > 40” above finish floor)	90 cm
C68. Toilet roll holder in inaccessible position (outside range of 7 – 9” from center, height other than 15 – 48”)	40 cm, 80 cm
C69. Bathroom storage cupboards, towel hooks, etc. placed high/low (outside range of 40 – 48”)	0.9 – 1.2 m
C83. Other controls too high/inaccessible (> 44”)	1.1 m
C84. Other controls too low (< 15”)	80 cm

Note. U.S. HE item specifications based on DOJ, ANSI, ADA, FHA, & IBC accessibility guidelines. In many cases, guidelines among five sets of regulations were identical. In cases when they were not, decisions were made among U.S. research team and further validated through collaboration with European counterparts.

Table 2.

Agreement for sub-section/type of environmental item in the U.S. Housing Enabler among 11 pairs of raters (N = 50 cases)

	Agreement Coefficient	
Environmental barrier Subsection/type of item	Mean kappa	Mean percentage
A. Exterior surroundings (n = 28 items)	0.448	77
B. Entrances (n = 46 items)	0.389	86
C. Indoor environment (n = 87 items)	0.382	84
Norm-based items (n = 70 items)	0.448	82
Non norm-based items (n = 91 items)	0.361	83
Total (n = 161 items)	0.410	82

Note. Kappa values 0.21 – 0.40 indicate fair agreement, 0.41 – 0.60 moderate agreement, 0.61 – 0.80 good agreement, and 0.81 – 1.0 very good agreement (Altman, 1999).

Table 3.

Agreement levels for the 161 environmental items in the U.S. Housing Enabler (N = 50 cases)

Agreement level	No. items
Kappa	
Very good	3
Good	30
Moderate	42
Fair	54
Poor	32
Percentage	
≥ 80%	110
70 – 79%	34
< 70%	17

Note. Kappa values as interpreted by Altman (1999).

CHAPTER 4

SECOND MANUSCRIPT

Adaptive Strategies and Person-Environment Fit Among Functionally Limited Older Adults Aging in Place in the United States: A Mixed Methods Approach

The ability to remain independent well into old age is a fundamental desire among older adults. In fact, the majority of older adults live in ordinary dwellings versus supportive housing facilities (Gitlin, 2003; Oswald, Jopp, Rott, & Wahl, 2011). Increased time spent within the home, as well as the privacy, autonomy, and control offered through living independently (Wagnild, 2001; Wahl, 2003) are but a few reasons why older adults predominantly choose to age in place in ordinary dwellings versus move to more supportive housing (Greenfield, 2012). Older adults who face declines in health and barriers within their home environments, however, are challenged in their ability to remain at home (Iwarsson, Nygren, Oswald, Wahl, & Tomsone, 2006; Werngren-Elgström, Carlsson, & Iwarsson, 2009; Yuen & Carter, 2006).

According to the U.S. Census Bureau (2012), the United States' population aged 65 and older is expected to rise by close to 76% by the year 2050. Within our global aging society, older adults over the age of 60 are steadily outnumbering populations of the young, thereby changing the dynamics of living arrangements and housing provisions in drastic ways (United Nations, 2002). While housing is important in older age in terms of residential stability and personal meaning, it also serves as an environmental support to overcome or compensate for reductions in functional capacity common with age (Oswald et al., 2006).

As such, environmental support within the home becomes an important aspect of older adults' ability to live independently and age in place when facing limitations in health (Iwarsson & Wilson, 2006; Oswald et al., 2011). According to Lawton and Nahemow's (1973) ecological theory of aging (ETA), persons with lowered functional capacities are less able to overcome or adapt to barriers within their environment, making them more vulnerable to environmental challenges than persons with higher functional competencies. The ETA posits that performance of and comfort with daily necessary and desired activities is possible when an appropriate match between a person and his/her environment is achieved. This match, or zone of maximum performance and comfort, is otherwise known as person-environment (P-E) fit (Lawton & Nahemow, 1973).

A P-E fit approach has proven important in understanding the dynamic relationship between people and their environments, especially in older age. Using the ETA (Lawton & Nahemow, 1973) as a framework, a person's functional competence and the environment's physical press, or barriers that may threaten the performance of and engagement with activities, can be assessed to further understand how older adults adapt to their home environments. One means of objectively evaluating P-E fit is through an assessment of accessibility, which is defined as a balance, or match, between people's abilities and the challenges of their environment (Iwarsson & Ståhl, 2003). The magnitude of accessibility problems is a key objective outcome of the assessment of a person and their environment, and can be used as a P-E fit indicator in the exploration of the interactive person-environment relationship (Nygren et al., 2007).

The interaction between a person and his/her environment describes how older adults adapt themselves or their environments to achieve a match between competence and environmental press (Lawton, 1990). The interactive component of P-E fit, or P-E interaction, is more closely aligned with health and well-being than assessments of either the person or the environment alone (Iwarsson, Horstmann, & Slaug, 2007; Oswald et al., 2007). Furthermore, the P-E interaction is a better indicator than environmental barriers of multiple functional and health-related outcomes within the built environment, including falls, perceived housing, and residential satisfaction (Iwarsson, Horstmann, Carlsson, Oswald, & Wahl, 2009; Kahana, Lovegreen, Kahana, & Kahana, 2003; Nygren et al., 2007).

While the P-E interaction is known to require a certain level of adaptation on behalf of the person or their environment (Lawton, 1990), the specific adaptive strategies employed by older adults in response to losses in function or environmental support are little understood both conceptually and empirically (Wahl, Iwarsson, & Oswald, 2012). In order to deepen our understanding of the adaptive strategies that older adults employ as they experience P-E fit challenges, Baltes and Baltes' (1990) selection, optimization, and compensation (SOC) model might be helpful. This model suggests that functional losses (physical, social, and psychological) in old age can be mitigated through three adaptive strategies: selection, optimization, and compensation. More specifically, selection focuses on desired outcomes or goals, optimization involves the means necessary to achieve goal-related success, and compensation explores how desired functional outcomes are maintained in response to losses in goal-related achievement (Baltes, Lindenberger, & Staudinger, 2006). These processes can be intentional (and therefore conscious), unintentional (subconscious), and internally or externally motivated. Like P-E fit frameworks, the SOC model depends on both objective and perceived aspects of person and context, or surrounding environmental conditions (Baltes & Baltes, 1990). In contrast to P-E fit frameworks, the SOC model focuses more on specific behaviors in response to functional loss and/or environmental challenges that help people adapt to their self and environment in older age.

To date, very few studies have explored the specific adaptive strategies utilized by older adults to overcome or compensate for a lack of P-E fit (Wahl et al., 2012). To assist older adults in maintaining independence while aging in place, appropriate interventions based on knowledge of adaptive strategies employed in old age to mitigate losses in functional or environmental support are needed. Through the use of two frameworks—the ETA (Lawton & Nahemow, 1973) and SOC model (Baltes & Baltes, 1990)—the P-E interaction, expressed through the adaptive strategies and behaviors utilized in older age, can be explored among functionally limited older adults aging in place. Therefore, the aim of this study was to explore the adaptive strategies employed by U.S. older adults living in ordinary or age-restricted housing in response to functional limitations and/or environmental barriers with regard to activity in and around the home environment. Furthermore, this study examined how these adaptive behaviors contribute to a greater understanding of objective and perceived P-E fit.

Methods

This was a mixed methods study. Quantitative data were collected using objective measures of P-E fit among functionally limited older adult participants in their own home environments; qualitative data were focused on participants' perceptions of the objective measures and of the adaptive strategies they use with regard to performance of activities within their home environments. Framing the general study design, Lawton and Nahemow's (1973) ecological theory of aging (ETA) provided the framework essential for the incorporation of P-E fit indicators. Baltes and Baltes' (1990) SOC model was used to inform qualitative interview questions aimed at describing participants' adaptive behaviors.

A mixed methods concurrent embedded approach was used, which "nests," or embeds, one method (i.e., quantitative) within another (i.e., qualitative). Concurrent embedded designs use a secondary, but supportive form of data to inform the primary research method guiding the project (Creswell, 2013; Creswell & Plano Clark, 2007). In this case, embedding quantitative data within a primarily qualitative approach provided the means by which adaptive behaviors could be explored (see Figure 1). Therefore, qualitative methods generated the primary data source of this mixed methods study.

Study District and Sample

Participants lived within the city center to the more rural surrounding areas of a smaller urban region of the Pacific Northwest in the United States. According to the 2011 American Community Survey (U.S. Census Bureau), this region has a population under 100,000 persons, and 12.2% of its population is aged 65 and older. Almost 90% of residents are white. Mean income is $60,000, with 30% of the population earning $75,000 or more per year. Upwards of 46% of the region's population has a Bachelor's degree or higher, which is likely attributable to its proximity to a major research university. In 2010, 55.9% of housing units were owner-occupied. Generally, this region of the United States is highly educated, affluent, and predominantly white.

Twelve participants were selected using concurrent mixed methods sampling, which combines probability and purposive sampling techniques (Creswell & Plano Clark, 2007). This approach is appropriate for mixed methods research, as it provides both depth and breadth to yield rich cases (Teddlie & Yu, 2008). Additionally, this sampling procedure provided a range of different perspectives through which the adaptive strategies utilized by functionally limited older adults aging in place could be explored. Inclusion criteria required participants to be aged 65 years or older, living independently in ordinary or age-restricted housing (without formal support), and have some level of functional limitation. Care was taken to purposively select a range of functional limitations and housing types from the initial probability sample (characteristics summarized in Table 1). To recruit initial participants, comprehensive email announcements were sent to all older adults aged 65 and older living in ordinary or age-restricted housing within the study region who were members of a university research center's participant registry. Initial participants recruited through registry emails helped identify later participants with varying types of functional limitations and home environments, per concurrent mixed methods sampling procedures (Creswell & Plano Clark, 2007).

Prior to participant recruitment, the protocol was reviewed and approved by the university's Institutional Review Board. The review included ethical considerations for audio recordings, photographs, and the informed consent process, and was formally approved. All participants read, signed, and were given a copy of the consent form prior to any data being collected.

Participants ranged in age from 66 to 89 years of age. One participant was identified with only one functional limitation; the other eleven had between three and eight limitations. The most common limitation involved declines in motor function—more specifically, poor balance, incoordination, and limitations of stamina. Limitations in upper and lower extremity function characterized the next most common type of functional decline among participants, primarily related to hip, knee, shoulder, and wrist injuries or arthritis. Five of the twelve participants used a mobility device, ranging from the use of a cane in the exterior environment to complete dependence on a wheelchair both inside and out. All participants utilized at least one assistive device, and all but one had made some type of modification to their home after establishing residence.

The majority of participants lived in single-family, detached, owner-occupied homes. Time lived in dwellings ranged from one month to 47 years. Five of the twelve participants had lived in their home for over 40 years, and four identified with a residency less than ten years. Three participants lived in single-family houses either custom designed to accommodate aging or specifically purchased as appropriately supportive for potential future age-related needs. The two participants who lived in independent senior-specific housing at a Continuing Care Retirement Community (CCRC) were the only participants who lived in multifamily housing—one in a townhome and the other in an apartment.

Data Collection and Procedures

Two separate scheduled visits per participant were completed during the data collection phase. The first author (L.L.) completed all participant visits between one to one and a half weeks apart apiece. Each visit ranged anywhere from forty-five minutes to three and a half hours per participant. The total time spent with each participant averaged three and a half hours across the two visits and all 12 people.

Quantitative data. Quantitative data were collected during the first visit. Demographic information for each participant was recorded, including sex, age, type of home, and years lived in present dwelling. Objective P-E fit data were gathered using a U.S. version (Lien, Steggell, Slaug, & Iwarsson, 2013) of the Housing Enabler (HE; Iwarsson & Slaug, 2010). The HE, originally developed in Sweden, provides an objective measure of P-E fit through a three-step assessment process: 1) an evaluation of a person's functional limitations and dependence on mobility devices (14 items), 2) the identification of surrounding environmental barriers (161 items), and 3) calculation of the resultant accessibility score (ranging from 0 to 1832) and weighted environmental barriers (rank-ordered) based on the relationship between a person and his/her home environment (Iwarsson & Slaug, 2010). Environmental barrier items within the HE assessment are defined based on national accessibility standards and guidelines, and therefore require careful adaptation for use in other countries (Helle et al., 2010). The U.S. version of the HE was adapted for use through collaboration with its originators (Iwarsson & Slaug, 2010). It was used in this study to assess and present the magnitude of accessibility problems and weighted environmental barriers within the home environment to the participants during the qualitative phase of the data collection as well as to incorporate such data into the mixed methods analysis.

Reliable and valid use of the HE tool has been shown across European contexts (Iwarsson, Nygren, & Slaug, 2005; Helle et al., 2010). Most important, efficient and consistent use of the tool requires specialized training and practice (Iwarsson & Slaug, 2010). The first author (L.L.), responsible for appropriate use of the instrument, was formally trained by completing an official HE course given by the originator of the instrument (last author, S.I.). This training, along with her principal involvement in the adaptation process of the HE to U.S. applications, provided the necessary credentials to utilize the U.S. version of the HE in this study.

Qualitative data. The primary form of qualitative data collected was from semi-structured interviews conducted during the second visit. Five questions aimed at describing adaptive strategies were asked of each participant based on the SOC model (Baltes & Baltes, 1990) (see Figure 2). Quantitative P-E fit results stemming from individual U.S. HE assessments (Iwarsson & Slaug, 2010) were shared with each participant via a study-specific report sheet during the interview. The report described the magnitude of accessibility problems score, as well as the top ten rank-ordered, weighted environmental barriers present within each individual dwelling (see Figure 3). Sharing the HE results with participants during the qualitative interview helped solicit perspectives and experiences of accessibility problems within the home environment with respect to daily activity, thereby embedding the quantitative results into the primarily qualitative findings, as outlined in the mixed methods concurrent embedded approach (Creswell, 2013; Creswell & Plano Clark, 2007). Probing questions were asked throughout, and were tailored for each participant to elicit their personal and unique lived experience through their own words. All interviews were audio taped for accuracy in transcription.

Direct observations, field notes, and photographs taken during both visits further supported the interview data. While the interviews pointedly asked about activities participants regularly performed in their home environments, in-person observations of activity performance and reflective field notes provided additional validity to the interview data. Photographs taken of the physical built environment of each participant were generally taken during the administration of the U.S. HE assessment at the first visit, but were occasionally supplemented in subsequent visits, depending on the time of day, weather, or physical traces/cues left through participant activity. Photographs were an important component, as they helped visually describe how the participants used, performed, and engaged in activities within their home environments. Most importantly, however, the photographs also helped corroborate or juxtapose participant interview responses by assuming an objective role contrasting or supporting participants' perceived evaluations of P-E fit.

Data Analysis

Data analysis was primarily inductive in its consideration of the mixed methods data as a means to generate themes related to the adaptive person-environment interactions. Descriptive statistics were used to analyze the quantitative data. The magnitude of accessibility problems and type and prevalence of weighted environmental barriers assessed through the HE (Iwarsson & Slaug, 2010) described the objective P-E fit of the participants (see Tables 2 and 3). Integrated in the analysis process, the quantitative data from the HE assessment completed during visit one was used to inform the qualitative data (i.e., perceptions of P-E fit and P-E interaction using HE results) as illustrated in the concurrent embedded mixed methods approach (Creswell, 2013; Creswell & Plano Clark, 2007).

The qualitative data were primarily analyzed through an inductive approach using multiple steps outlined by Creswell (2013). First, the audiotapes from each interview were listened to multiple times to gain familiarity with the interview data, the personalities of the participants, and the settings in which the data collection was contextualized. All interviews were transcribed verbatim, and were formatted in one document for the purposes of exploring themes. Two members of the research team (L.L. & C.S.) individually and separately read the transcriptions multiple times. Emerging themes were cross-analyzed with observations, field notes, photographs, and the quantitative results from the HE assessment, and further organized into three categories of prevailing strategies. This process is appropriate for organizing groups of themes, per Creswell's (2013) data analysis guidelines.

Trustworthiness was established through multiple discussions of evolving themes until consensus among the primary research team (L.L. & C.S.) was found. Validity of themes was strengthened by the identification of significant statements that helped describe how participants accommodated, performed, experienced, and engaged in activity, as well as their perceptions of objective P-E fit (as assessed through their reactions to the quantitative U.S. HE instrument results) within their home environments. These statements further helped establish a thorough description of the adaptive strategies participants used in response to losses in function or environmental support.

Once themes, significant statements, and prevailing strategy categories were appropriately aggregated and organized, a third senior member of the research team (S.I.) acted as an external reviewer to further validate the credibility and trustworthiness of the findings. Similar to the initial data analysis, themes were reviewed through consideration of both the qualitative and quantitative data and with respect to their organization into the three categories of prevailing strategies. This process was iterative, and required a number of discussions among the entire research team to reach consensus.

Findings

Three primary categories organized the prevailing adaptive strategies employed by study participants: reactive strategies, deferred reactive strategies, and proactive strategies. Within each of the three prevailing categories, multiple themes related to each type of strategy emerged. While the majority of participants used reactive, deferred reactive, or proactive type strategies, some of them used a combination of these strategies depending on the salience of certain elements of objective or perceived P-E fit.

Category One: Reactive Strategies

The majority of participants in this study employed reactive-type strategies to overcome or compensate for losses in functional or environmental support. A common and recurring element of this particular category was a low level of awareness of age-related limitations, environmental barriers, and the potential intensification of P-E fit problems in the future. This was often paired with lowered intentions to make necessary changes to achieve appropriate P-E fit. Participants' level of awareness often played a substantial role in what types of reactive strategies were selected. Four themes emerged.

Making environmental modifications only in time of perceived need. In most cases, participants perceived their home environment as supportive to many activities without awareness of the restrictions it caused. Barriers experienced through use of the home environment were commonly associated with typical activities of daily living (i.e., cooking, showering). In response, often minor, simple modifications (i.e., task lighting, grab bars in bathrooms, railings at stairs) were added as a means to support essential functional needs. Regardless of motivation, modifications were only implemented when critical, and often in response to a health event or injury that challenged participants' ability to perform and engage in necessary and desired activities.

> *[We have plans for modifications] only if and when we need them. We do things as needed. And actually we're very good at that. I think.* (participant A12)

Additionally, modifications were often temporary solutions aimed at short-term perceived ease, safety, and comfort. Environmental barriers were also addressed through the expressed need of visitors—homes that did not accommodate visitability (especially with respect to getting into and out of the home at entrances) were modified to overcome obstructions to participation in social activities and events held within participants' home environments.

Adjustment to home "as is"—denial or lack of awareness of functional or environmental needs. Other participants, in spite of suboptimal objective P-E fit (as found using the U.S. HE), lacked awareness or were in denial of functional or environmental support needs. Most participants were able to define their individual age-related limitations, but some of them lacked the ability to foresee potential progression of decline over time. Participants were unable to identify or recognize environmental barriers, even if they consciously adjusted their daily activities to compensate for a lack of environmental support.

> *It's not really light enough in here for me to read. Well, if I turn on all the lights and turn on that lamp, and sit in this chair, and wear those magnifying glasses, I can read in here. But I can't see well enough to read [in the living room] and even in the dining room, which is probably the lightest room for breakfast, it's hard for me to read the newspaper even with those magnifiers.* (participant A3)

The adjustment of daily activities to meet environmental barriers was especially prevalent when the environmental barriers presented to participants were related to the land (i.e., unstable ground, sloping yard) or public features (i.e., mailbox, curb ramps) of their property. In these cases, participants were uncertain how features of the exterior home environment, including the plot of land their house was built upon, were actual barriers to their functional capacities (see Figure 4). Regardless, some participants denied the presence of any environmental barriers—in spite of P-E fit results, nothing was perceived as a barrier as long as it was (or could be) overcome through the conscious or subconscious alteration of activity on behalf of participants.

Therefore, the practice of adjusting to the home environment "as is" appeared partially in response to a lack of awareness regarding the definition and identification of environmental barriers, but also a subconscious reaction to the denial or deficient understanding of how functional capacities may change over time. Environmental barriers found in the exterior surroundings of the home environment were seen as normative—participants felt that barriers related to the land or public utilities of their homes were out of their control. Additionally, some were unaware of their functional limitations and potential future progression that would continue to restrict activities. Instead, participants habitually adjusted the parameters of their activities (either in performance, engagement, or execution) to alleviate the challenges presented by their home environment (see Figure 4).

Use of assistive devices or reliance on family to mitigate environmental stress. Participants having experienced more recent functional decline were more apt to utilize assistive devices or family members as supports in the performance of necessary or desired activities within unaccommodating home environments. Some participants utilizing this strategy agreed with the objective P-E fit assessment, especially with respect to the presentation of weighted barriers. However, these participants perceived assessed barriers not as constraints of their activities but rather as minor obstacles they could overcome easily with the aid of assistive devices or family assistance.

> *Upper shelves too deep? I don't have an issue with that with my grabber, step stool, and my husband. If those things were all missing or I was on my own, and if I got to the point where my balance got so bad I couldn't use my step stool safely, that might be an issue.* (participant A1)

Devices became extensions of themselves, acting largely as a prosthesis or addition to their bodies that would help accommodate activities that challenged their functional capacities. The assistance of family members in completing necessary and desired activities solidified the meaning of social support to participants, heightening the salience of supportive connections between family and friends.

The importance of home and community makes staying put a priority, no matter what. Although participants were frequently challenged by changes in their ability to use their home environment for activity, their sense of place remained strong. Some participants likened their home environment and surrounding community as extensions of themselves, places of memories, comfort, and familiarity, a means to display important possessions, and settings for maintaining meaningful social connections to friends and family:

> *This house—they're going to carry me out in a cigar box, that's what they're going to do. And my dogs. We're all going to be mixed up together. I'm just used to [my house]. I like the furniture. I like all my junk because you can see I have a lot of stuff. And everything just seems to fit okay in this house. I wouldn't have the energy to put it in another house anyway.* (participant A3)

In this sense, participants employing this type of reactive strategy described their desire to remain "at home," no matter the adjustments or modifications needed in the future. Most of them were confident that potential future barriers to occupation or use could be easily overcome, even though this had not yet been contemplated, planned, nor implemented. Furthermore, participants were convinced that no loss in functional or environmental support would compromise their ability to age in place since their familiarity and understanding of their home environment and its features were sufficient to overcome present barriers and maintain the performance of daily activities.

Category Two: Deferred Reactive Strategies

Deferred reactive strategies involved a more conscious consideration of objective and perceived P-E fit, especially with regard to environmental barriers and accessibility problems as found through the quantitative HE assessment. In this respect, strategies were proactive in terms of heightened awareness of person-environment interactions, but reactive in terms of executing or implementing appropriate or needed solutions. This category contained five themes, as described below.

Lack of knowledge or information challenges the implementation of needed modifications. Participants who would consider modifying their home environments but were lacking the knowledge or proper information necessary to make appropriate changes were predominantly unsure of how modifications could be implemented. These participants agreed with the weighted environmental barriers presented to them through the HE report, but did not know what steps or supports were available to them to make appropriate modifications. Such agreement was primarily in response to experiencing restricted use of certain elements of their home environment. However, the awareness of accessibility problems within their home environments was overshadowed by the lack of knowledge of how to fix or modify those issues.

> *High thresholds and steps. Where's a threshold? This door's brand new. So I would hope it met something. How do you get around that then? Putting a small lip of some kind?* (participant A12)

Furthermore, participants were tentative about how to alter or modify elements of their home environments of a public nature (i.e., mailboxes, curbs, sidewalks) to accommodate appropriate levels of activity, as they were unsure of who (public works/the city or themselves) was ultimately responsible for implementing any necessary changes.

Hanging on to possessions to retain important memories—at the expense of accessibility. A few participants discussed the need to de-clutter their home, but hesitated due to important memories attached to certain possessions. Accumulation of items over time was common, and the behaviors surrounding the display and retention of these possessions within participants' home environments were a means to hang on to important memories and subconsciously create a sense of place. Possessions were continuously described by their meaningful value to participants, and were displayed as reminders of personal memories or relationships.

> *I am getting older and I discovered I have so many things I have accumulated over the years. I'm really trying to eliminate the unnecessary things, but that's not an easy thing to do I've discovered. You have memories associated with certain items and even though you have to dust them and you think 'Oh crap, why didn't I get rid of this?' You think 'Oh well, Barbie gave that to me' or 'Maybe that was an anniversary gift.' And so I just haven't gotten rid of everything I could have. But I'm trying.* (participant A2)

Regardless of meaning, the exhibition of possessions within the home environment was often at the expense of accessibility—certain items cluttered passageways, cabinets and shelving, and added to trip and slip hazards (see Figure 5). Nonetheless, participants were not aware of, or did not care about, the accessibility problems that the display of possessions caused. The importance of these possessions as described by participants often exceeded the ability or desire to reduce or eliminate the clutter, even if it challenged objective P-E fit.

Environmental barriers as positive challenges. Many participants were aware of the obvious barriers within their home environments that challenged activity and use, especially stairs in the interior or exterior environment. While technically a barrier in terms of objective P-E fit, some participants described stairs as appropriate and positive challenges to their daily function:

> *I feel that the steps that we go through up and down stairs are good for our body. So that's the way we feel about our stairs. As long as we can navigate them and do them with relative ease, then we feel that they are a benefit.* (participant A6)

With age and increasing functional limitations, many participants described stairs as a mediator to a general reduction in daily activity. Challenges to performance stemming from common, normative design features (such as stairs) within typical housing in the United States were often seen as beneficial to participants' daily functioning. Although these barriers could one day wholly restrict activity without appropriate modifications, they were presently seen as valuable, manageable challenges that could potentially help stave off further declines in health and function.

Alternative supportive housing options do not fit perceived physical, social, or psychological needs. Another deferred reactive strategy employed by participants was related to exploring alternative supportive housing options. Some participants had actively considered moving to senior-specific independent housing (i.e., retirement communities) or CCRC's, but for reasons related to a perceived anticipated loss in autonomy, privacy, and control with such a move had decided to remain in their current homes.

> *We've [checked out] a number of different places of living: [one senior independent living complex] seems like a really good place except that it's in [a big city] and it's a high rise. You can't have a garden and everything else . . . . There's something wrong with each of them. So we'd just as soon live here."* (participant A7)

These participants were aware of their functional limitations and had subsequently experienced some level of reduced P-E fit within their current home environment to warrant the exploration of other supportive housing options. Regardless, the perceived reduction or elimination in their ability to perform or engage in desired activities with a move to supportive housing provided enough incentive to instead deal with and modify barriers to activity and use within their current home environment when and if the need presented itself.

Active discussions and planning for potential age-related needs in the future. While proactive in thought, actual plans for altering the home environment based on the potential for further age-related decline in the future were only discussed after the onset of functional limitations. In other words, some participants had very specific plans for future modifications should their current functional or environmental support needs worsen (i.e., moving to more supportive housing, limiting living space to one floor only). Regardless, they described implementing potentially necessary modifications with ease—installing ramps, higher toilets, lower cabinets, and necessary dwelling spaces (i.e., bedrooms, bathrooms, laundry rooms) on the first floor were but a few modifications discussed as straightforward changes to the home environment requiring little organization, planning, or funding:

> *The thing about the necessary dwelling functions on the upper story . . . if one of us became disabled we have a plan in mind of what we would do. And that would be to modify the laundry room to put in some sort of bathing facility. And I think that was something that came up when [my wife] and I were looking at the house to buy it.* (participant A11)

Participants equally displayed a lack of awareness of the effort required to implement appropriate modifications, and were furthermore unaware of whether the physical characteristics of their home environments could actually accommodate these plans (i.e., necessary yard grading to construct a ramp at a required slope needed for occupation and use, structural requirements of the house necessary to accommodate remodeling).

Category Three: Proactive Strategies

Elucidated under the third category of emergent themes, proactive strategies used by participants in this study were those implemented in anticipation, or before the onset of need. These types of strategies required an advanced level of awareness regarding the future of their functional capacities or the ability of their home environments and communities to meet potential needs. Participants utilizing proactive strategies were knowledgeable of age-related declines and environmental design features that would help support the performance of and engagement in daily activities. These participants met potential functional and environmental needs in advance to avoid costly, complicated, or emotionally difficult changes in the future, as described in the following two themes.

Active selection or design of a home and community that accommodates age-related needs prior to onset of functional decline. Participants actively aware of their aging selves prior to the onset of functional decline sought out existing or custom designed homes that would assist in supporting activity performance and engagement (see Figure 6). This type of proactive strategy was employed well before a need arose, and was made with the expressed intent of aging in place. Most often homes were chosen or designed to accommodate necessary dwelling functions on one floor, and in all but one case, homes were selected for this feature without consideration of other potential environmental barriers to activity in the future (i.e., steps, thresholds, and kitchen, bathroom, and laundry features). Other participants sought out a continuum of care housing option that would accommodate any level of need over time—these participants did not want to deal with the effort required to make appropriate home modifications, and were grateful to have age-friendly design features already implemented within their home environments:

> *Well, I think people that are independent like I am and their children don't live around here, or near enough . . . they should begin to be thinking about moving into places of this sort [a CCRC] at a much earlier age. There would have been no point to my coming here when I was on my deathbed practically. Hanging on to your independence just because it was a house you loved or a house you grew up in or this sort of thing. Lacking the desire to make a decision on your own about those things. It wasn't for me. I mean I've always been pretty independent; I've had to be. So I just think people wait too long to find out how they want to spend the last 10, 15, 20 years of their life.* (participant A5)

Some participants spoke of their selection of a home environment due to the activity conveniences provided by the surrounding community. In these cases, the location of the home afforded participants a sense of security knowing that the performance of and engagement in necessary and desired activities was still possible, regardless of potential age-related limitations in the future. This was mainly discussed with respect to accessible transportation options available within their neighborhoods. Participants expressed comfort in knowing they would not be bound to their immediate home with the presence of adequate neighborhood support, including bus service, low traffic/safe streets, and community services and amenities within walkable distance to their dwellings. Choosing a community based on accessibility options that would accommodate potential changes in age-related function over time was a means for participants to maintain activity performance and engagement.

Modifying elements of the home environment to avoid future declines in activity performance. The awareness of potential age-related changes on behalf of some participants increased their consciousness of modifications needed to ensure active participation within the home environment before health issues occurred. Minor modifications were made to elements of the home environment prior to the onset of functional decline, including the addition of handrails, grab bars, pullout/turntable shelves, among others. Such modifications were primarily made for ease and comfort of use.

> *We remodeled the kitchen. We put in those round revolving shelves [lazy susans] in the closet, the pantry closet. They are so useful.* (participant A12)

Some participants described this strategy as a response to the needs experienced over time on behalf of their friends or family—contemplating and reflecting upon their own future functional needs was easier after they had witnessed the personal and environmental supports required by persons they were close to. Some of these minor modifications did not meet standards as regards accessibility from an objective P-E fit perspective, but were nevertheless perceived as serving participants reasonably well in terms of their daily use and performance.

Discussion

The findings of this study help shed light on the various adaptive strategies employed among functionally limited, community-dwelling U.S. older adults aging in place in ordinary or age-restricted housing. In response to losses in functional or environmental support, participants utilized various combinations of reactive, deferred reactive, and proactive strategies. A mixed methods approach using objective assessments and perceptions of P-E fit provided a holistic understanding of the P-E interaction, or how older adults adapt themselves and/or their home environments to achieve a match between competence and environmental press. A greater understanding of these adaptive strategies provides new empirical knowledge to the consideration of the interaction between person and environment, further strengthening P-E fit frameworks that formerly lacked conceptual and empirical understanding (Wahl et al., 2012).

Adaptive strategies employed in this study related to how participants felt about the ability of their space to accommodate activity. The perceptions of and experiences with the appropriate and desired use of their home environments for daily activity were expressed as a relationship between functional capacities and environmental barriers. In other words, participants perceived appropriate levels of performance and engagement with activities when their functional capacities matched the support provided through the home environment. This finding aligns with the ETA (Lawton & Nahemow, 1973), that posits maximum performance and comfort is possible when an appropriate match between a person's functional capacities and their surrounding environmental barriers is present.

Unlike the ETA, however, the findings in this study demonstrate that declines in functional capacity problematized certain environmental elements of the home environment. While P-E fit frameworks suggest that the environment alone is the strongest determinant of behavior (Lawton, 1990; Lawton & Simon, 1968), a closer exploration of the P-E interaction in this study showed that adaptive strategies were a response to perceptions of the ability of the home environment to support daily activity with respect to age-related functional declines. This finding correlates with other studies that suggest objective P-E fit better aligns with perceptions of the home environment than assessments of the environment in isolation (Nygren et al., 2007).

Moreover, an environment that supports individual functional capacities and subsequent activities is related to a person's ability to live independently (Danford & Steinfeld, 1999; Iwarsson, 2012). In this study, participants perceived barriers within the home environment with respect to their awareness of limitations in function. Those most aware of limitations in function were more likely to utilize proactive or deferred reactive strategies in response to accessibility problems, whereas those least aware of their functional limitations were more likely to employ reactive strategies. In other words, the home environment would not have been discussed as needing modifications now or in the future to accommodate continued independence without the participants perceiving their own functional limitations.

The desire to remain independent, and more specifically age in place without facing a move to supportive housing was a primary goal of participants. The SOC model was helpful in interpreting the multiple types of strategies employed to achieve this goal (Baltes & Baltes, 1990). Self-directed strategies used by participants to achieve the desired goal of aging in place were in response to functional limitations or constraints in the home environment. According to Gitlin (2003), remaining in place may be one key optimization strategy that older adults use to achieve successful adaptation, or the perception that they are capable of maintaining appropriate interactions with the home environment. Similarly, losses in functional or environmental supports subsequently directed participants' focused efforts on this goal using strategies aligned with selection, optimization, and compensation outcomes.

Interestingly, the adaptive strategies employed by participants in this study mostly aligned with a level of awareness of age-related decline, which speaks to the human development and psychology foundation of the SOC model (Baltes & Baltes, 1990). In this study, those most aware of their functional limitations selected elements of their home environment (or acknowledged needed changes to their home environment) that would compensate for, or support, their functional losses as a means to optimize their ability to remain in place and live independently. These types of participants were those more likely to employ deferred reactive or proactive strategies, as their awareness of their age-related limitations predisposed an acknowledgement of needed change now or in the future. In contrast, however, those least aware of their functional limitations opted instead to select or alter their activities according to the compensatory supports of their home environment to maintain the perceived capacity to age independently in place. These types of participants primarily utilized reactive strategies, as their inability to acknowledge age-related decline precipitated reactive adjustments to the home environment in times of need.

While level of awareness by the aging person is not explicitly discussed in the SOC model, it may relate to the propositions of reserve capacity and resiliency in older age as outlined by Baltes and Baltes (1990). The SOC model suggests that reductions in the adaptive reserve capacities of people in older age are most evident when the limits of performance are tested. In this sense, reactive strategies may have been employed in response to environmental accessibility problems overpowering participants' capacity to adapt. Proactive strategies, on the other hand, may have been a product of resiliency in older age. The SOC model argues that older adults' adjustment to new goals and expectations is framed through social comparisons to other older adults in similar situations (Baltes & Baltes, 1990), which was also found in our analysis of proactive strategies. Therefore, awareness of functional limitations may prescribe social comparative behaviors while a lack of awareness may serve to prolong reactive-type behaviors until the limits of performance are reached.

Nevertheless, the concept of awareness is central to the themes that emerged in this study, and may serve to deepen our understanding of both P-E fit frameworks and adaptive theoretical models of aging well. Similarly, the connection between adaptive strategies employed in response to P-E fit problems and SOC processes warrants further study. Longitudinal studies exploring adaptive change over time may also help strengthen the empirical and conceptual understanding of the P-E interaction.

Additionally, a better understanding of the P-E interaction and the adaptive processes utilized by older adults in response to losses in function and environmental support has important implications for practice. A better understanding of clients' level of awareness of age-related decline and knowledge of environmental barriers within their home environment can prescribe appropriate methods for approaching the education of older adults and practitioners, and further guide the selection and implementation of appropriate home modifications. Similarly, if a person has already adapted themselves or their environment to accommodate daily activity, an objective assessment of P-E fit alone (i.e., through the HE) is not likely to capture the desired modifications to the home that will meet perceived P-E fit needs. Therefore, exploring perceptions and awareness of P-E fit problems within the home environment can help practitioners determine suitable interventions that support both objective and perceived P-E fit.

While this study provided empirical support for the adaptation processes utilized by people within their home environments across the ETA (Lawton & Nahemow, 1973) and SOC models (Baltes & Baltes, 1990), it is limited in generalizability by a number of factors. First, the sample was small, and participants were all functionally capable of living independently in ordinary or age-restricted housing (without formal support). Participants also lived in a relatively homogenous, affluent, and highly educated smaller-urban region in one specific area of the United States. Moreover, data were collected using a cross-sectional design, which cannot capture variations of adaptive strategies over time. Therefore, these findings cannot necessarily be applied to the situation of older adults living in supportive housing, with lower socioeconomic status, lower levels of education, within large urban or small rural areas, or in other parts of the U.S. or in other national contexts. Still, the findings elucidate situations that bear resemblance to the circumstances of people in similar situations. Also, adaptive behaviors employed over time with respect to changing limitations or environmental supports remain unknown.

As such, the strategies employed by older adults across a broader range of demographic characteristics should be explored for a more comprehensive understanding of adaptive behaviors with age. It would be interesting to see if adaptive strategies differ among older adults with lower education and socioeconomic status living in more depressed regions of the United States—this approach could help elicit whether financial or educational resources play a role in P-E interactions. Additionally, adaptive strategies employed by community-dwelling older adults aging in place in other countries would provide unique cross-national comparisons that would foster the strengthening of P-E fit theoretical frameworks and knowledge. Furthermore, adaptive strategies may vary among older adults living in various types of supportive housing. The type of home, location, functional limitations, and social support may also affect adaptive behaviors in different ways. This would especially be true over time, as functional and environmental supports may change.

Furthermore, one of the primary findings of this study was the importance of awareness of age-related decline in older age. In this respect, the concept of awareness needs to be explored further. One potential avenue to accomplish this might include the incorporation and exploration of Diehl and Wahl's (2010) emerging concept of awareness of age-related change (AARC). While the findings from this study help strengthen AARC as a concept integral to gerontological research, a more specific focus on this concept and its relationship to P-E fit and the P-E interaction is warranted.

Conclusion

This study is among the first to explore the use of objective assessments and perceptions of P-E fit in a mixed methods study to explore the adaptive strategies utilized by functionally limited older adults aging in place. Empirical results from this study generated new knowledge surrounding person-environment interactions and furthermore help strengthened P-E fit frameworks and adaptive theoretical models of aging well. A better understanding of the adaptive strategies that older adults employ in response to losses in functional and environmental support show that the P-E interaction is a better predictor of adaptive behavior than either the person or environment alone. Similarly, the focus on the environment as a primary determinant of behavior evident in P-E fit frameworks could benefit from theoretical models focusing on a person's adaptive capacities in older age.

Knowledge of P-E fit can assist in the design and implementation of appropriately accessible and usable spaces for older adults, especially among those experiencing age-related functional decline (Nygren et al., 2007). Home environments that promote activity through a match between functional capacities and environmental support are a critical factor in promoting health, independence, and aging well (Iwarsson & Wilson, 2006; Wahl et al., 2012). Policies that support and assist in the modification of existing housing stock to accommodate activity is one method of ensuring older adults are able to age well in place (Iwarsson, 2012). Furthermore, assessments of objective and perceived P-E fit can better equip practitioners responsible for the well-being of older adults to prescribe appropriately suitable functional or environmental supports that accommodate performance and engagement in activities (Fänge, Risser, & Iwarsson, 2007; Mitty, 2010).

Perhaps most importantly, knowledge and use of objective assessments and perceptions of P-E fit to explore the adaptive strategies utilized by older adults in response to losses in functional or environmental support within their home helps researchers and practitioners further understand the interaction between a person and their environment. According to Lawton (1989), “ways of characterizing the central tendencies and individual differences in persons and environment are necessary if we are to design housing, affect the growth of cities and neighborhoods, or fashion usable objects for people” (p. 58). To do this, characteristics of both a person and their environment must be considered to ensure that research or practice-oriented interventions are most appropriately shaped through a better understanding of how people adapt to their home environments.

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Table 1.

Demographic Characteristics of Study Participants, N =12

Characteristic	n
Sex	
Men	5
Women	7
Age	
65 – 69	1
70 – 79	6
80 – 89	5
Type of Functional Limitation	
Visual	4
Hearing	7
Motor	10
Upper extremity	8
Lower extremity	8
Mobility device	5
Type of Housing	
Single-Family, detached	7
Age-specific	2
Custom/planned for age	3
Years Lived in Current Home	
0 – 10	4
11 – 20	3
21+	5

Note. Functional limitation items are grouped together by type for the purposes of demographic characteristics. Visual = vision restrictions in one or both eyes, blindness. Hearing = hearing restrictions in one or both ears, loss of hearing, hearing aids. Motor = poor balance, incoordination, limitations of stamina, difficulty in moving head. Upper extremity = reduced arm/hand function in one or both arms and hands, reduced fine motor skills, loss of function. Lower extremity = reduced mobility/strength in spine or joints of one or both legs. Mobility device = whole or partial dependence on walking aids (canes, crutches, sticks, walkers, etc.) or wheelchair. Adapted from *Housing Enabler: A method for rating/screening and analysing accessibility problems in housing* (Iwarsson & Slaug, 2010).

Table 2.

Objective Indicators of Person-Environment Fit in the Home Environments of Study Participants, N =12

Participant ID	Age	Functional limitations*	Mobility devices*	Assistive devices**	Mods**	Magnitude of accessibility problems***
A1	77	4	none	8	1	59
A2	70	4	none	2	3	218
A3	86	4	none	6	3	155
A4	78	1	none	2	4	22
A5	89	7	2	3	2	251
A6	79	4	1	3	4	249
A7	87	2	none	2	4	114
A8	77	4	2	3	0	89
A9	73	4	2	1	3	233
A10	88	6	4	2	1	170
A11	66	3	none	1	1	79
A12	80	4	none	4	4	108

Note. *U.S. Housing Enabler assessment, number of functional limitations (out of 12 items), number of mobility devices (out of 2 items). **Number of assistive devices and home modifications (Mods) based on participant observation and interview responses. ***Magnitude of accessibility problems calculated through the full U.S. Housing Enabler, including an assessment of functional limitations and environmental barriers. Sample-specific scores range from zero to 400—zero indicating no accessibility problems and 400 indicating more severe accessibility problems within the home environment. The theoretical maximum is 1832 (Iwarsson & Slaug, 2010).

Table 3.

Group-Based Analysis of Prevalence of Top Ten Weighted Environmental Barriers (Displayed in Descending Rank Order) in the Home Environments of Study Participants, N =12

U.S. HE item (weighted environmental barrier)	Prevalence/Frequency
Wall-mounted cupboards and shelves placed high	11
Stairs the only route at entrance	8
High thresholds and/or steps at the entrance	6
Routes with steps in exterior surroundings	5
Garbage bin can only be reached via steps or other difference in level	5
No grab bars at shower/bath and/or toilet	5
Shelves too deep in kitchen & laundry	5
Controls (general indoor environment) in high/inaccessible position	3
Controls in kitchen & laundry in high/inaccessible position	3
High threshold/level difference/step to sitting-out space	3
Inappropriate design of door to laundry room	3
Irregular/uneven surface in exterior surroundings	3
Mailbox can only be reached via steps or other difference in level	3
Mailbox difficult to reach (too high above ground)	3
No handrails on steep slopes in exterior surroundings	3
Shower stall with curb/level difference	3
Steep slopes in exterior surroundings	3
Storage areas can only be reached via stairs/threshold/difference in level	3
Working surfaces in kitchen & laundry too deep	3
Other (27 barriers)	≤ 2

Note. Weighted environmental barriers identified through use of the full U.S. (Lien et al., unpublished manuscript) HE assessment (Iwarsson & Slaug, 2010). Prevalence/frequency is equivalent to the number of participants for whom each barrier was computed in the top ten weighted barriers using the U.S. HE. There were 27 weighted barriers that only appeared once or twice in the top ten lists.

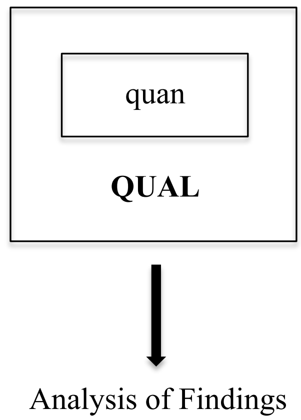

Figure 1. Graphic representation of concurrent embedded mixed methods strategy (adapted from Creswell, Plano Clark, Gutmann, & Hanson, 2008). In this study, the quantitative data played a secondary role in a primarily qualitative approach.

Case ID: ___________________

Rater: ___________________

Interview Guide

Date:

Time of Day:

Demographic Information:
Year you were born—
Years/months lived in current home—
Type and tenure of housing—

Interview Questions:

1. Describe the spaces within and immediately surrounding your home that you utilize the most.
   Probe: Why do you spend the most time in those particular spaces?

2. Describe what kinds of activities you do in those particular spaces.
   Probe: What about each space makes it easy and/or difficult to pursue such activities? Why?

**Prior to Q3, results from the Housing Enabler assessment will be shared with participants.*

3. a) Based on the results from the environmental assessment I conducted during our last visit, what aspects of your home identified as problematic do you agree with? Why?
   b) What don't you agree with? Why?
   Probe: Do you feel that your home provides a preferred level of challenge to you? Why or why not?

4. Describe what, if anything, you have done to make it easier to access your favorite spaces and/or complete your favorite activities within or immediately surrounding your home.
   Prompts: (if nothing, ask) Do you have plans to make any changes in the future? Why?

5. Is there anything else you would like to tell me regarding how you feel about where you live now?

Figure 2. Copy of interview guide. Interview questions were based on Baltes and Baltes' (1990) SOC model to describe adaptive strategies employed on behalf of participants to overcome or compensate for losses in function or environmental support.

Housing Enabler Assessment Results
Functional Profile + Environmental Barriers

Participant: **A1**
Date: **4/15/13**

Based on our assessment of your functional capacities and surrounding home environment using the U.S. Housing Enabler tool, we found the following results:

Sum score of magnitude of accessibility of your home: **59/1832***

*A score of zero means no accessibility issues were found within your home. The closer this score is to 1832, the greater the accessibility issues based on your current functional profile.

The following list presents the top ten problematic environmental barriers (of 161 possible) present within your home with regard to your functional capacities.

These are objective results based on your functional profile, and are not intended to prescribe essential and/or required changes to your home. Rather, this list can help identify particular environmental areas or aspects of your home where modifications can be made. It can also help start a dialogue surrounding how your home can be more supportive of your needs.

Top barriers according to the results of the U.S. Housing Enabler assessment:

Stairs at entrance/stairs the only route
Wall-mounted cupboards and shelves placed high
Irregular/uneven surface in exterior surroundings
Steep slopes in exterior surroundings
No handrails at entrance
Kitchen shelves too deep/greater than 12”
Toilet in main bathroom lower than 17”
Shower stall with curb/level difference
High force required to activate window locks
No working surface in kitchen with appropriate leg room

Figure 3. Example of HE report sheet presented to participants during qualitative interviews. Report described magnitude of accessibility problems score and top ten weighted environmental barriers present within their home environment.

Figure 4. Adjusting to home as-is: steep property created environmental barriers with respect to how the home was designed and built (left); garden was moved to deck to mitigate use of the steep slope of the yard (right).

Figure 5. Possessions as accessibility hazards: in both cases, display of memorable possessions, trinkets, furniture, and books narrowed the passageway to necessary dwelling functions. In some cases, such displays created slip and trip hazards as well (left).

Figure 6. Active selection or design of home to accommodate age-related needs prior to onset: participant homes that accommodated necessary dwelling functions on one floor.

CHAPTER 5

CONCLUSION

A global increase in the aging population necessitates new ideas, perspectives, and approaches to creating appropriate solutions that allow older adults to age well in place. By and large, aging in place in ordinary housing is the preferred option among older adults in the United States (Greenfield, 2012). The ideal of aging in place is attributed to increased time spent within the home, as well as the privacy, autonomy, and control offered through living independently (Wagnild, 2001; Wahl, 2003). The home environment is also considered a place of memory, familiarity, comfort, and personal expression (Gitlin, 2003; Wahl, 2003). Therefore, the home environment is not simply a place to live, but also a place of experience and attachment for older adults. With increasing age, the home also becomes the primary context for necessary and desired activities of daily living (Nygren et al., 2007).

Community dwelling older adults require a certain level of independence in daily activities to remain in place, and declines in health and barriers within the home environment can often challenge this ideal (Iwarsson et al., 2006; Werngren-Elgström et al., 2009; Yuen & Carter, 2006). As such, environmental support within the home becomes an important aspect of older adults' ability to live independently and age in place when facing limitations in health (Iwarsson & Wilson, 2006; Oswald et al., 2011). This support can be achieved through a match, or balance, between a person's functional competence and surrounding environment, otherwise known as P-E fit (Lawton & Nahemow, 1973). The P-E fit perspective suggests that the magnitude of environmental problems within a person's home is a product of their overall capacity to adapt to or overcome such barriers (Iwarsson, 2005). The performance of necessary daily activities and engagement in desired activities is possible with appropriate levels of P-E fit (Lawton & Nahemow, 1973).

The fit between a person and the environment also requires consideration of the person-environment interaction. This interaction helps describe how older adults adapt themselves or their environments to achieve a match between competence and environmental press (Lawton, 1990). The P-E interaction is more closely aligned with health and well-being than assessments of either the person or the environment alone (Iwarsson et al., 2007; Oswald et al., 2007). The specific characteristics of the home environment that affect the fit between people and the environment, however, are not well understood. Similarly, the specific adaptive strategies employed by older adults in response to losses in functional or environmental support have not been empirically studied to date (Wahl et al., 2012).

Therefore, the overarching objective of this two-part study was to gain a better understanding of the interactive relationship between person and environment among functionally limited older adults aging in place. The assessment of P-E fit allowed for the exploration of the adaptive strategies employed in older age in response to functional limitations and environmental barriers within the home environment, providing insight into the P-E interaction. A greater understanding of the role and contributions of aging individuals and their home environments in the interactive relationship between person and environment has pointed implications for aging well. As such, the specific aims of this two-part study were: (1) to adapt and establish a reliable version of the Housing

Enabler instrument (Iwarsson & Slaug, 2010) for use in the United States to appropriately assess objective P-E fit, or the magnitude of accessibility problems and weighted environmental barriers present within the home environments of older adults; and (2) to explore adaptive strategies used in response to losses in function or environmental support and how these behaviors contribute to a better understanding of the person-environment interaction and P-E fit.

Study Design

This study involved two separate research projects that comprehensively explored objective and perceived P-E fit and the P-E interaction among functionally limited older adults aging in place. The first quantitative study concerned adapting the Housing Enabler (HE; Iwarsson & Slaug, 2010) to U.S. applications as a means to assess objective P-E fit within the home environments of older adults. The second mixed methods study used objective assessments and perceptions of P-E fit to explore the adaptive strategies employed by functionally limited older adults aging in place. This provided a better understanding of the interactive relationship between people and the environment.

Creating a U.S. version of the HE instrument (study one) required careful adherence to a comprehensive process as outlined in previous HE adaptation studies (i.e., Iwarsson, Nygren, & Slaug, 2005; Helle et al., 2010). This process included a thorough examination of the environmental barrier items within the most recent British English version of the HE (Iwarsson & Slaug, 2010), as well as the proper conversion of terminology, measures, and accessibility guidelines to a U.S. context. Items were translated to American English, converted from metric to Imperial measures, and validated to meet U.S. accessibility guidelines through multiple rigorous iterations between researchers in the U.S. and Sweden. This process also involved inter-rater reliability testing of the U.S. version of the HE instrument, achieved through 50 pairwise assessments of various independent home environments within multiple urban and rural areas in a wide-ranging region of the U.S. Pacific Northwest.

Exploring the adaptive strategies employed by functionally limited older adults aging in place in response to losses in function and environmental support was accomplished in study two. This study required two separate visits per participant—the first an objective assessment of P-E fit using the U.S. HE, and the second a semi-structured interview exploring perceived P-E fit and adaptive strategies used by participants. Semi-structured interviews based on Baltes and Baltes' (1990) SOC model were conducted during the second visit and were aimed at eliciting participants' adaptive behaviors and perceptions of objective P-E fit results. Twelve total participants encompassing a variety of functional limitations and housing environments were selected for this mixed methods study.

Summary of Findings

Generally, inter-rater reliability for the U.S. version of the HE was moderate using Altman's (1999) guidelines and following Iwarsson et al.'s (2005) HE adaptation procedures. The mean kappa value was 0.410, with a mean percentage of agreement at 82% across all 161 environmental barrier items. While additional reliability testing is warranted, the U.S. HE is considered sufficiently reliable for use in the region of study among well-trained raters.

Using the U.S. HE in study two to assess the objective P-E fit of participants showed that the majority of home environments had accessibility problems ranging from high cupboards and shelves to inaccessible stairs and thresholds. Magnitude of accessibility problem scores ranged from 22 – 251 of a theoretical maximum 1832, and were dependent on the personal and environmental component of the HE. Participants with the lowest magnitude of accessibility scores had either very few functional limitations or a relatively accommodating home environment. While eleven of the twelve participants had between three and eight functional limitations, three had either custom designed or specifically purchased their home to accommodate or support aging and future age-related needs.

When used in the mixed methods study, the U.S. HE provided the means by which perceived P-E fit and the P-E interaction could be explored. Perceptions of the magnitude of accessibility problems and weighted environmental barriers presented to participants as measured through the U.S. HE provided the foundation for exploring perceived P-E fit and the adaptive strategies participants used in response to losses in function or environmental support. Through data analysis, adaptive strategies emerged in themes and were organized into prevailing strategic categories.

Three prevailing categories encompassed the themes: *reactive strategies, deferred reactive strategies, and proactive strategies*. Within these three categories, four reactive themes, five deferred reactive themes, and two proactive themes emerged for a total of eleven emergent themes (see Appendix D for details). In this study, adaptive strategies were primarily categorized by reactive or deferred reactive behaviors, with some participants communicating their proactive behaviors in light of an awareness of age-related functional decline. By and large, the adaptive strategies employed by participants were a product of the person-environment interaction, or how losses in function or environmental support affect performance of and engagement in daily activities.

Ties to Theoretical Frameworks

Both studies used Lawton and Nahemow's (1973) ecological theory of aging (ETA) to explore objective and perceived P-E fit. The ETA posits that performance of and comfort with daily necessary and desired activities is possible when an appropriate match between a person and his/her environment is achieved. In essence, persons with lowered functional capacities are less able to overcome or adapt to barriers within their environment, making them more vulnerable to environmental challenges than persons with higher functional competencies. Using these ETA principles, P-E fit can be assessed to quantify challenges to performance and comfort with daily activities. The original Swedish HE was developed based on this theoretical foundation, and uses the concept of accessibility, or a match between people's abilities and the challenges of their environment, as a means of assessing objective P-E fit within the home environment (Iwarsson & Slaug, 2010).

While the ETA (Lawton & Nahemow, 1973) provides an appropriate framework through which the magnitude of accessibility problems and weighted environmental barriers can be quantified within the built environment, it also stipulates that the interactive relationship between person and environment requires a certain level of adaptation on behalf of the person or their environment to maintain adequate P-E fit (Lawton, 1990). Regardless, the ETA does not prescribe the actual or specific adaptive strategies utilized by older adults in response to losses in function or environmental support. Therefore, to deepen our understanding of the adaptive strategies that older adults employ as they experience P-E fit challenges, Baltes and Baltes' (1990) selection, optimization, and compensation (SOC) model was utilized as a secondary theoretical framework in study two.

Generally, the SOC model suggests that physical, social, and psychological functional losses in older age can be mitigated or overcome through three adaptive processes: selection, optimization, and compensation (Baltes & Baltes, 1990). All three processes relate to older adults' desired outcomes or goals, including how goals are chosen, the means necessary to achieve goals, and the response to losses in goal-related achievement (Baltes, Lindenberger, & Staudinger, 2006). Like the ETA (Lawton & Nahemow, 1973), the SOC model involves both objective and perceived aspects of a person and their surrounding context, or environmental conditions. However, its main theoretical focus is on the specific behaviors utilized in response to functional loss and environmental challenges that help people adapt to themselves and their environment in older age (Baltes & Baltes, 1990).

Therefore, using both the ETA (Lawton & Nahemow, 1973) and the SOC model (Baltes & Baltes, 1990), study two provided insight into the specific adaptive strategies that functionally limited older adults aging in place employ in response to a lack of P-E fit within their home environments. More specifically, the ETA (Lawton & Nahemow, 1973) guided the incorporation of objective measures of P-E fit and the SOC model (Baltes & Baltes, 1990) was used to inform qualitative interview questions aimed at describing the adaptive behaviors of participants. While the data analysis procedure in study two was inductive, the theoretical frameworks framed the study design and shed light on the multifaceted and complicated nature of P-E fit and the interactive relationship between people and their environments.

The findings in study two related to both theoretical frameworks, albeit in different ways. First, participants' perceptions of the ability of their homes to accommodate daily activity were expressed as a relationship between functional capacities and environmental barriers. More specifically, participants perceived appropriate levels of performance and engagement with necessary and desired activities when their functional abilities matched the support available within their home environments. While the match between functional capacities and environmental barriers as a precursor to activity performance aligns with the ETA (Lawton & Nahemow, 1973), study two found that adaptive strategies were in response to perceptions of the ability of the home environment to support daily activity with respect to age-related functional declines. As such, the home environment alone was not the strongest determinant of behavior, as posited in P-E fit frameworks (Lawton, 1990; Lawton & Simon,1968). Instead, older adults' awareness of age-related functional limitations may play a key role in the conceptualization of perceived P-E fit, and warrants further exploration in terms of theoretical importance in P-E fit frameworks.

The SOC model (Baltes & Baltes, 1990) was helpful in interpreting reactive, deferred reactive, and proactive strategies used by participants in study two as a means to retain independence and age in place without facing a move to supportive housing. Strategies selected by participants were in response to age-related functional limitations or environmental barriers within the home—losses in functional or environmental supports directed a focused effort on the goal of remaining in place. Interestingly, however, the strategies utilized by participants were also aligned with a level of awareness of age-related decline. While level of awareness may relate to the propositions of reserve capacity and resiliency in older age as outlined by Baltes and Baltes (1990), it is not explicitly discussed in the SOC model. Therefore, the concept of awareness is central to the themes that emerged in this study, and may serve to strengthen both P-E fit frameworks and adaptive theoretical models of aging well.

Ties to Research, Policy, and Practice

Establishing a reliable instrument for use in assessing objective P-E fit in the United States provides the opportunity for standardized evaluations of accessibility problems within home environments that are beneficial to both research and practice. Practitioners can use the U.S. HE instrument to assess magnitude of accessibility problems and weighted environmental barriers to establish priorities for appropriate and adequate home modifications that support the performance of and engagement in daily activities. Using the HE instrument to determine suitable in-home interventions can help older adults age in place and live independently, thereby helping foster physical, social, and psychological health and well-being (Iwarsson, 2012; Oswald & Wahl, 2004). Furthermore, using the U.S. HE on a broader scale could assist in creating appropriate policies and solutions based on population-level accessibility problems. Similarly, a reliable U.S. HE instrument can support the inclusion of the United States in future cross-national comparisons of accessibility and objective P-E fit within the home environment, which are currently lacking (Iwarsson et al., 2004; Nygren et al., 2007).

Findings from study two can also help strengthen our knowledge of person-environment interactions, P-E fit frameworks, and theoretical models of aging well. In research, a better understanding of objective and perceived P-E fit can help strengthen current P-E fit theories, and when paired with complimentary theoretical models from other disciplines can help shed light onto the specific nuances of the P-E interaction. Also, knowledge of P-E fit and adaptive strategies used in response to losses in function or environmental support can assist in the design and implementation of appropriately accessible and usable spaces for functionally limited older adults aging in place. Home environments that meet functional and environmental support needs are more likely to promote activity and therefore health, independence, and aging well (Iwarsson & Wilson, 2006; Wahl et al., 2012). Policies and practice-based interventions aimed at creating well-fit home environments for older adults will be better informed through a greater understanding of P-E fit and the interactive relationship between people and their environments.

Implications for Future Research

While ties to research, policy, and practice are vast, specific research based on this study's foundation is needed in the future to reach particular objectives. For one, although the U.S. HE has the potential to inform home modifications, the design of age-specific housing, and policies surrounding aging well on individual and population levels, it still requires additional reliability and validity testing. Additional assessments using various types of raters and housing environments would help further establish appropriate reliability. It would be especially beneficial to approach this task through the creation of various partnerships with other P-E fit researchers from across the United States. This would help ensure that the greatest range of rater and home environment types could be reached. Furthermore, specific validity testing is needed for the environmental component of the U.S. HE. While the process began in this study, it would be advantageous to explore validity in a more concrete way.

Also, the adaptation and reliability testing of the U.S. HE in this study only included the environmental component of the instrument. While the personal component does not require adaptation for use in the United States, it would be appropriate to investigate its reliability among raters in future studies. This would require additional training of raters, and subsequently necessitate collaborative training efforts between U.S. and Swedish research teams to ensure appropriate use and execution of assessments.

U.S. HE training efforts are also an area for improvement in future research. Reliability of both the personal and environmental components of the HE require appropriate and extensive training, and as shown in the first study's findings, inter-rater reliability of the U.S. HE may be improved with additional training and field practice. While it is believed the U.S. HE training manual would be beneficial for these purposes, it is still in the development stages and will therefore require more work and validation of photographic images before it can be used in the field.

To continue explorations of the P-E interaction, more participants across a larger variety of housing types and geographic locations are needed. This study used a small sample in a relatively homogenous, affluent, and highly educated area of one specific region of the United States. Therefore, future research should include persons with alternative demographic characteristics. It would also be interesting to explore adaptive P-E interactions longitudinally to capture any change in strategies over time. The use of alternative research approaches (i.e., ethnographies, narratives) could also provide in-depth insight into the P-E interaction, helping tease out the nuances inherent in the relationships between people and the environment.

The future establishment of a reliable and valid U.S. version of the HE would furthermore assist in the United States' inclusion in future cross-national comparisons of accessibility and P-E fit. Until the start of this process, the U.S. has been limited in its ability to participate in direct comparisons of objective P-E fit on an international scale. Future research could explore proportions of disability and accessibility problems between sets of national accessibility standards as a means to quantify the global impact of age-related decline. Also, further exploration into the P-E interaction using this study as a framework would assist in strengthening P-E fit and adaptation theories, and similarly help with P-E fit scale development. The creation of a U.S. version of the HE and the continued exploration of P-E fit and P-E interactions using new, unique perspectives will nonetheless help move environmental gerontology knowledge and research forward into new arenas of inquiry.

Final Reflection

All in all, this study resulted in two separate projects that are among the first to explore the adaptation of a reliable and valid P-E fit assessment instrument for use in the United States and how P-E fit influences the adaptive strategies utilized by functionally limited older adults aging in place. These studies have produced new perspectives related to P-E fit frameworks and helped generate empirical knowledge surrounding the interactive relationship between people and the environment. This knowledge will assist researchers, policymakers, and practitioners in the assessment and quantification of accessibility problems across a variety of scales. It will also serve to deepen our understanding of P-E fit on a theoretical level. While more research is needed related to P-E fit and the P-E interaction in the future, these studies provide a solid foundation upon which theoretical and applied implications can be further explored to assist older adults to age well in place now and in the years ahead.

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APPENDICES

APPENDIX A

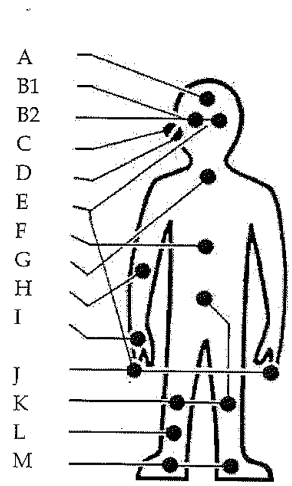
Original Housing Enabler (Iwarsson & Slaug, 2010)

PERSONAL COMPONENT

FUNCTIONAL LIMITATIONS AND DEPENDENCE ON MOBILITY DEVICES

Sex: ____________ Year of birth: ____________ Other information: ____________________________

Yes	No			A	B	C[a]
□	□	A.	Difficulty interpreting information			
□	□	B1.	Visual impairment			
□	□	B2.	Blindness			
□	□	C.	Loss of hearing			
□	□	D.	Poor balance			
□	□	E.	Incoordination			
□	□	F.	Limitations of stamina			
□	□	G.	Difficulty in moving head			
□	□	H.	Reduced upper extremity function			
□	□	I.	Reduced fine motor skills			
□	□	J.	Loss of upper extremity function			
□	□	K.	Reduced spine and/or lower extremity function			
□	□	L.	Dependence on walking aid(s)	□	□	□
□	□	M.	Dependence on wheelchair	□	□	□



[a]Section in the environmental component: A. Exterior surroundings. B. Entrance. C. Indoor environment

Environmental component

Personal component / functional profile		Yes / No																
A. EXTERIOR SURROUNDINGS	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
General																		
A1. Paths narrower than 1.5 m. *A width of 1.0 m is acceptable provided there are 1.5 m turning zones at least every 10 m.*	□ Yes □ No □ *Not rated*	p. 304					3	3							3	3		*A1*
A2. Irregular/uneven surface (irregular surfacing, joins, sloping sections cracks, holes; 5 mm or more).	□ Yes □ No □ *Not rated*	p. 305		2	3		1	1		3				1	3	3		*A2&4*
A3. Unstable surface (loose gravel, sand, clay, etc.). *Mark if it causes difficulties e.g. when using a wheelchair or rollator.*	□ Yes □ No □ *Not rated*			2	3		3	3	2					1	3	4		*A3*
A4. Steep gradients (more than 1:20). *Does not include ramp at entrance; rate under B22.*	□ Yes □ No □ *Not rated*	p. 96		2	3		2	2	3					1	3	3		*A5*
A5. Routes with steps. *An alternative route with a ramp that meets the standard is accepted.*	□ Yes □ No □ *Not rated*	p. 98		2	3		3	3	3	1				1	3	4		*A6*
A6. No/insufficient tactile cues of abrupt level changes/other hazards.	□ Yes □ No □ *Not rated*	p. 100	1	2														*A7*
A7. High kerbs (more than 4 cm).	□ Yes □ No □ *Not rated*	p. 304		1	1		3	3	3	1					3	4		*A8*
A8. Kerb ramps with steep gradients.	□ Yes □ No □ *Not rated*						3	3	3						3	3		*A9*

A. EXTERIOR SURROUNDINGS	RATING	Bygg ikapp* page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
A9. Poorly drained paths and roadways.	☐ Yes ☐ No ☐ *Not rated*			2	2		3	2	1	2					3	3		*A11*
A10. No handrails on steep gradients. *Handrail on only one side is sufficient.* *Definition of "steep", see A4.*	☐ Yes ☐ No ☐ *Not rated*	p. 285		1	1		4	3	4						1			*A12*
A11. No resting surfaces (2 m) or too short/long distances between them on slopes (max. 6 m between resting surfaces).	☐ Yes ☐ No ☐ *Not rated*	p. 96 p. 301					3	3	4						3	2		*A13*
A12. Poor/uneven/dazzling lighting along circulation paths. *Note whether the rating is performed in daylight or darkness.*	☐ Yes ☐ No ☐ *Not rated*	p. 311	1	2		1	2			1					3	3		*A14*
A13. Poor/uneven/dazzling illumination of walking surface.	☐ Yes ☐ No ☐ *Not rated*	p. 311	1	4														*A15*
A14. Complicated/illogical routes to/from entrance.	☐ Yes ☐ No ☐ *Not rated*		2	1	3				1						1	1		*A16*
<u>Parking</u> **A15.** Parking place far from entrance (more than 25 m walking distance).	☐ Yes ☐ No ☐ *Not rated*	p. 321	4				1	1	4						1	2		*A18*
A16. Passenger loading zones far from entrance (more than 5 m). *Note whether there is a locked barrier.*	☐ Yes ☐ No ☐ *Not rated*	p. 322		3	3				4						1	2		*A19*
A17. No shelter from weather in passenger loading zone.	☐ Yes ☐ No ☐ *Not rated*	p. 324					1	1	3						3	3		*A20*

A. EXTERIOR SURROUNDINGS	RATING	Bygg ikapp* page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
A18. No stable, even, non-slip surface in car park (loose gravel, sand, clay, etc.).	☐ Yes ☐ No ☐ *Not rated*	p. 321		1	1		3	3	3	4					3	3		*A21*
Points A19–A24 are rated only for multi-family dwellings. **A19.** No reserved parking for people with disabilities within 10 m of the entrance.	☐ Yes ☐ No ☐ *Not rated*	p. 323	3							3					3	3		*A22*
<u>Seating places</u> **A20.** No/too few seating places (should be located every 25 m close to the entrance, thereafter at least every 100 m).	☐ Yes ☐ No ☐ *Not rated*	p. 312					3	3	4						3			*A24*
A21. Low/high seating surfaces (outside the range 45–50 cm)/no armrest.	☐ Yes ☐ No ☐ *Not rated*	p. 312					1	1	1					1	1	1		*A25*
A22. Rough/unstable ground at seating places.	☐ Yes ☐ No ☐ *Not rated*	p. 312					3	3	1						3	3		*A26*
A23. Insufficient manoeuvring space at seating places (1.5 × 1.5 m).	☐ Yes ☐ No ☐ *Not rated*	p. 312													3	4		*A27*
A24. Furniture placed in the path of travel.	☐ Yes ☐ No ☐ *Not rated*	p. 312		3	3										3	3		*A28*
<u>Other features</u> **A25.** Refuse room/refuse bin can only be reached via steps or other differences in level (more than 15 mm). *Note that a route assessed under another section should NOT be assessed here again.*	☐ Yes ☐ No ☐ *Not rated*	p. 248		3	3		3	3		1					3	4		*A29*

A. EXTERIOR SURROUNDINGS	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
A26. Letterbox can only be reached via steps or other differences in level (more than 15 mm).	☐ Yes ☐ No ☐ *Not rated*	p. 223		3	3		3	3		1					3	4		*A30*
A27. Refuse bin difficult to reach (not at 0.8–1.0 m above ground, or other problem) *Refers to the opening of the bin; all refuse containers including battery boxes.*	☐ Yes ☐ No ☐ *Not rated*	p. 223 p. 249					3	2	1		3	3	4		3	4		*A31*
A28. Letterbox difficult to reach (not at 0.8–1.1 m above ground, no basket on the inside of the apartment door, or other problem).	☐ Yes ☐ No ☐ *Not rated*	p. 223 p. 249					3	2	1		3	3	4		3	4		*A31*

B. ENTRANCES	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[a]
Refers to stairs, ramps, and lifts outdoors and/or in stairwells. Steps in the actual dwelling are rated under C. INDOOR ENVIRONMENT. Note that a sitting-out place is rated under a separate heading below. *All dimensions = clearance. Note whether there are alternative entrances and if so which of them is/are used most frequently.* <u>General</u> **B1.** Narrow door openings (less than 84 cm clearance). *Refers to all doors from entrance door to apartment door (equivalent), including lift door.*	☐ Yes ☐ No ☐ *Not rated*	p. 102													3	4		*B1*
B2. High thresholds and/or steps at the entrance (more than 15 mm). *If there is a rubber strip: Press it down and measure the maximum height.*	☐ Yes ☐ No ☐ *Not rated*	p. 110		3	3		3	3		1					3	4		*B2*
B3. Insufficient manoeuvring space at doors (clearance less than 1.5 × 1.5 m, outside and inside, 70 cm on the opening side of the door at the main entrance, 50 cm at apartment door). *Refers to clearance; note the difference between B3 and B5.*	☐ Yes ☐ No ☐ *Not rated*	p. 85													3	4		*B3*
B4. Door swing that obstructs use. *Refers to door leaves that obtrude when opening and/or closing.*	☐ Yes ☐ No ☐ *Not rated*			1	**1**										**1**	4		*B4*
B5. No resting area in front of entrance door (maximum gradient 1:50, less than 1.5 × 1.5 m). *Refers to a level area; note difference between B3 and B5.*	☐ Yes ☐ No ☐ *Not rated*	p. 112													3	3		*B5*

B. ENTRANCES	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
B6. Heavy doors without automatic opening.	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 109					3	3	3		3		4		3	3		*B6*
B7. Automatic opening on side-hung doors.	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 109	1	3	3													*B7*
B8. Inappropriate design of glass sections.	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 107	1	3	3										1	1		*B8*
B9. Doors that do not stay in open position/ close quickly.	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 109	2	3	4		3	3	3						3	3		*B9*
B10. Doors than cannot be fastened in open position (locking device required).	☐ **Yes** ☐ **No** ☐ *Not rated*						3	2	3						3	3		*B10*
B11. Complicated/illogical opening procedure. *Also includes entry phone.*	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 85	4	1	3			3			1	1	1		1	1		*B11*
<u>Stairs</u> **B12.** Stairs the only route (no lift/ramp).	☐ **Yes** ☐ **No** ☐ *Not rated*			3	3		3	3	3				1		3	4		
	If M is marked: circle 12 extra points. *Otherwise, if B1, B2, D, E, F, or L are marked (but not M): circle 9 extra points.* *Otherwise, if only J is marked : circle 3 extra points.*																Extra points 12 Extra points 9 Extra points 3	*B12*
B13. Stair treads with narrow depth (less than 26 cm) or irregular depth.	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 100	3	3	3		3	3	3						3			*B13*
B14. High, low, and/or irregular heights of risers (other height than 15–17 cm).	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 100		3	3		3	3	3						3			*B14*

B. ENTRANCES	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
B15. Projecting nosing/open-riser stairs.	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 100		1	1										3			*B15*
B16. No handrails/handrail on one side only. *Note whether handrails are missing on one or both sides.*	☐ **Yes** ☐ **No** ☐ *Not rated*		1	2	2		3	3	3						4			*B16*
B17. Handrails too short (must continue 30 cm before/after the stairs) and/or interrupted at landing. *This requirement is considered met if <u>one of the handrails</u> continues without interruption at landing.*	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 286	1	1	1		1	1	1						2			*B17*
B18. Handrails placed too high/low (higher/lower than 90 cm). *Measure at the centre of the stair tread.*	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 286					1	1	1						1			*B18*
B19. No tactile cues to stairway in circulation path.	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 100	1	3														*B19*
B20. Visual pattern on the surface of stair treads camouflages edges of treads.	☐ **Yes** ☐ **No** ☐ *Not rated*		1	3														*B21*
B21. Poor illumination of walking area and/or handrails. *Note also whether there is sufficient time before automatic lighting goes off.*	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 268		4														*B22*
<u>Ramps</u> **B22.** Steep gradients (more than 1:20).	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 96					3	3	3						3	3		*B23*
B23. No level resting surface (2.0 m) or too short/ too long spaces between resting surfaces on slopes (max. 6 m between resting surfaces).	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 95					3	3	3						3	3		*B24*

B. ENTRANCES	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
B24. No handrails (required on both sides, without interruption).	☐ Yes ☐ No ☐ *Not rated*	p. 285					3	3	3						3	3		*B26*
B25. No or too low protection (lower than 40 mm) against slipping off sides.	☐ Yes ☐ No ☐ *Not rated*	p. 95		3	3										3	3		*B27*
__Lifts__																		
B26. Lift does not stop at the same level as building floor (difference in level of more than 15 mm). *The width of the lift door is rated at B1.*	☐ Yes ☐ No ☐ *Not rated*	pp. 117–118		3	3		3	3		3					3	3		*B28*
B27. Wide gap between the lift and the building floor (max. 3 cm).	☐ Yes ☐ No ☐ *Not rated*		1	3	3		2	3		3					3	3		*B29*
B28. Heavy doors without automatic opening.	☐ Yes ☐ No ☐ *Not rated*						3	3	3		3		4		3	3		*B30*
B29. Automatic opening on swing doors.	☐ Yes ☐ No ☐ *Not rated*		1	3	3													*B31*
B30. Doors that do not stay in open position or close quickly.	☐ Yes ☐ No ☐ *Not rated*		2	3	4		3	3	3						3	3		*B32*
B31. Doors that cannot be fastened in open position (locking device required).	☐ Yes ☐ No ☐ *Not rated*						3	2	3						3	3		*B33*
B32. Lift stops abruptly.	☐ Yes ☐ No ☐ *Not rated*						1	1							1			*B34*
B33. No handrail in lift.	☐ Yes ☐ No ☐ *Not rated*	p. 120					1	1	1						1			*B35*
B34. No seat in lift.	☐ Yes ☐ No ☐ *Not rated*	p. 121					3	1	2						3			*B36*

B. ENTRANCES	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
B35. Cramped lift (less than 1.1 × 1.4 m).	☐ Yes ☐ No ☐ *Not rated*	p. 117													1	3		*B37*
B36. Illogical design of controls. *Note whether controls have to be pressed continuously when the lift is moving.*	☐ Yes ☐ No ☐ *Not rated*	p. 120	3	3	3													*B38*
B37. Controls placed too high/low (other height than 0.9–1.0 m). *Refers to both outside and inside the lift*	☐ Yes ☐ No ☐ *Not rated*	p. 120								2	3	1		1	2	4		*B39*
B38. Controls require good hand function.	☐ Yes ☐ No ☐ *Not rated*	p. 121										3	4					*B40*
B39. No audio signal when the lift arrives.	☐ Yes ☐ No ☐ *Not rated*	p. 121	1	3	4				3						1	1		*B41*
B40. No visual signal when the lift arrives.	☐ Yes ☐ No ☐ *Not rated*	p. 121				3			3						1	1		*B42*
B41. Lift signals do not indicate the direction of the lift up or down.	☐ Yes ☐ No ☐ *Not rated*	p. 121	3	3	4	3			3						1	1		*B43*
__Sitting-out place/balcony__																		
B42. Sitting-out place/balcony too narrow (less than 1.5 m). *Requires a specially built place, not just a lawn or the like. Note if sitting-out place/balcony is used as an entrance.*	☐ Yes ☐ No ☐ *Not rated*	p. 214													3	4		*B45*
B43. Narrow door (less than 84 cm clearance).	☐ Yes ☐ No ☐ *Not rated*	p. 215													3	4		*B46*

B. ENTRANCES	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
B44. High threshold/level difference/step (more than 15 mm).	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 110		3	3		3	3		1					3	4		*B47*
B45. Wide gaps in the floor (more than 5 mm).	☐ **Yes** ☐ **No** ☐ *Not rated*														3	3		*B48*
B46. Steep transition from one level to another (gradient more than 1:20).	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 114					3	3	3						3	3		*B49*

C. INDOOR ENVIRONMENT	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
<u>**General**</u> **C1.** Steps/thresholds/differences in level between rooms/floor spaces (more than 15 mm). *If there is a rubber strip: Press it down and measure the maximum height.*	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 111		3	3		3	3		1					3	4		*C1*
C2. Complicated/illogical circulation routes.	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 58	3	3	3				4						1	1		*C2*
C3. Narrow passages/corridors in relation to fixtures/design of the building (less than 1.3 m). *Note the difference between items C3 and C5.*	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 90													3	4		*C3*
C4. Narrow doors (less than 76 cm clearance). *Also applies to arches etc. without door/door leaf.*	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 215													4	4		*C4*
C5. Insufficient manoeuvring spaces in relation to movable furnishings. *Note the difference between items C3 and C5.*	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 192		2	3		3	3							3	4		*C9*
C6. Insufficient manoeuvring spaces where turning is necessary (less than 1.3 x 1.3 m) (does not apply to hygiene rooms, which are rated separately).	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 191						2							3	4		*C10*
C7. Inappropriate design of wardrobes/clothes cupboards.	☐ **Yes** ☐ **No** ☐ *Not rated*	p. 212		1	1						3				2	3		*C11*
<u>**Stairs**</u> **C8.** Stairs to upper storey with necessary dwelling functions. *C8–C10 concern stairs between floors = no lift. More than one of these items may be marked.*	☐ **Yes** ☐ **No** ☐ *Not rated*			3	3		3	3	3				1		3	4		*C12*

C. INDOOR ENVIRONMENT	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
C9. Stairs to basement with necessary dwelling functions.	☐ Yes ☐ No ☐ *Not rated*			3	3		3	3	3				1		3	4		*C13*
C10. There are stairs, but all necessary dwelling functions are located on the ground floor.	☐ Yes ☐ No ☐ *Not rated*			1	1		1	1	1				1		1	1		*C14*
C11. Stair treads with narrow depth (lower than 26 cm) or irregular depth.	☐ Yes ☐ No ☐ *Not rated*	p. 100	3	3	3		3	3	3						3			*C15*
C12. High, low, and/or irregular height of risers (other height than 15–17 cm).	☐ Yes ☐ No ☐ *Not rated*	p. 100		3	3		3	3	3						3			*C16*
C13. Projecting nosing/open-riser stairs.	☐ Yes ☐ No ☐ *Not rated*	p. 100		1	1										3			*C17*
C14. No handrails/handrail on one side only.	☐ Yes ☐ No ☐ *Not rated*	p. 285	1	1	1		3	3	3						4			*C18*
C15. Handrails too short (must continue 30 cm before/after the stairs) and/or interrupted at the landing.	☐ Yes ☐ No ☐ *Not rated*	p. 286	1	1	1		2	2	2						3			*C19*
C16. Handrails placed too high/low (higher/lower than 90 cm).	☐ Yes ☐ No ☐ *Not rated*	p. 286					1	1	1						1			*C20*
C17. No tactile cues to stairway in circulation path.	☐ Yes ☐ No ☐ *Not rated*	p. 100		3	4													*C21*
C18. Visual pattern on the surface of stair treads camouflage edges of treads.	☐ Yes ☐ No ☐ *Not rated*		1	3														*C23*
C19. Poor/uneven/dazzling illumination of walking area and/or handrails.	☐ Yes ☐ No ☐ *Not rated*	p. 268		4														*C24*

C. INDOOR ENVIRONMENT	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
Kitchen, laundry room, utility kitchen *Refers to furnishings and equipment, including washing and drying machines even if they are located in the hygiene room. Equipment in communal laundry room is NOT rated, but getting to/into the laundry room is rated generally in section A and at C86.*		pp. 196–202																
C20. Insufficient manoeuvring spaces around white goods/storage units (service area less than 1.2 m in front). *Insufficient area because of furniture is rated under C5.*	☐ Yes ☐ No ☐ *Not rated*	p. 197		3	3		3	3	1		3				3	4		*C25*
C21. Wall-mounted cupboards and shelves placed high (lowest shelf more than 50 cm above the working surface or more than 1.4 m above the floor).	☐ Yes ☐ No ☐ *Not rated*			3	3		4	3	3	2	4	3	4	3	3	4		*C26*
C22. No surface at a height suitable for sitting while working (84 cm or lower required). *Refers to fixtures, not furniture; leg clearance rated at C24.*	☐ Yes ☐ No ☐ *Not rated*						1		1						3	3		*C27*
C23. Low working surfaces (84 cm or lower). *Refers to fixtures, not furniture.*	☐ Yes ☐ No ☐ *Not rated*									3				3				*C28*
C24. No working surfaces with leg room (less than 65 cm clearance, depth 60 cm, width 80 cm). *Refers to fixtures, not furniture.*	☐ Yes ☐ No ☐ *Not rated*						2		2						2	3		*C29*
C25. Working surfaces too deep (more than 60 cm).	☐ Yes ☐ No ☐ *Not rated*										3	1	4		3	3		*C30*

C. INDOOR ENVIRONMENT	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
C26. Shelves too deep (more than 30 cm). Deeper shelves require pullout shelves/ turntable units. *Mark this if more than 50% of floor cupboards and full-height cupboards are too deep and lack these facilities.*	☐ Yes ☐ No ☐ *Not rated*										4		4	3	3	3		*C31*
C27. Hobs with ordinary rings. *Also includes gas stoves, coil stoves, etc.*	☐ Yes ☐ No ☐ *Not rated*	p. 199									3	2						*C32*
C28. Ceramic hobs or the like.	☐ Yes ☐ No ☐ *Not rated*	p. 199	1	3	4													*C33*
C29. Door swings (inner doors) which impede the use of storage units.	☐ Yes ☐ No ☐ *Not rated*									1			4	4	1	4		*C34*
C30. Insufficient/inappropriately designed/ placed lighting of working surfaces, sink top, cooker and storage areas.	☐ Yes ☐ No ☐ *Not rated*	p. 201		3														*C35*
The respective environmental barrier is marked if one or more permanent functions in the kitchen/utility kitchen/laundry room cause problems (equipment in communal laundry rooms is NOT rated).		pp. 183-189																
C31. Illogically designed controls. *A microwave oven not built in should NOT be rated.*	☐ Yes ☐ No ☐ *Not rated*	p. 183	4	2	3													*C36*
C32. High force required to activate controls.	☐ Yes ☐ No ☐ *Not rated*	p. 184							3			1			3	1		*C37*
C33. Ultra-sensitive activation of controls.	☐ Yes ☐ No ☐ *Not rated*		3	3	3			3				1	1					*C38*

C. INDOOR ENVIRONMENT	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
C34. Use requires intact fine motor control. *Refers to fine-motor, composite "manipulation", cf. C41.*	☐ Yes ☐ No ☐ *Not rated*		1					3				1			1			*C39*
C35. Very small controls.	☐ Yes ☐ No ☐ *Not rated*			2	2							3	2					*C40*
C36. Very large controls.	☐ Yes ☐ No ☐ *Not rated*											2	3					*C41*
C37. Turning motion of wrist required.	☐ Yes ☐ No ☐ *Not rated*											2	4					*C42*
C38. Complex manoeuvres (more than one operation/movement) and good precision required.	☐ Yes ☐ No ☐ *Not rated*		2		1			2				1	1		1			*C43*
C39. Use requires two hands.	☐ Yes ☐ No ☐ *Not rated*		1					2				1	4		3			*C44*
C40. Use requires hands.	☐ Yes ☐ No ☐ *Not rated*											3	4		1			*C45*
C41. Use requires fingers (i.e. isolated grip, e.g. pinch and lateral grip).	☐ Yes ☐ No ☐ *Not rated*											2	4					*C47*
C42. Controls in high/inaccessible position (more than 1.1 m above the floor). *Refers to switches, sockets, handles of cupboards and drawers, etc. Note the proportion (approximate %) of all functions problematically placed.*	☐ Yes ☐ No ☐ *Not rated*	p. 184								2	3	1			2	4		*C48*

C. INDOOR ENVIRONMENT	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
C43. Controls in low position (less than 80 cm above the floor). *Refers to switches, sockets, handles of cupboards and drawers, etc. Note the proportion (approximate %) of all functions problematically placed.*	☐ Yes ☐ No ☐ *Not rated*	p. 184												1	1			*C49*
Hygiene area **C44.** Insufficient manoeuvring spaces where turning is required (less than 1.3 × 1.3 m).	☐ Yes ☐ No ☐ *Not rated*	pp. 205–211 p. 191						2							3	4		*C10*
C45. Insufficient space for stool, bath board, or equivalent, or other problem in shower/bath.	☐ Yes ☐ No ☐ *Not rated*						2							3	3	3		*C50*
C46. No grab bar at shower/bath and/or toilet.	☐ Yes ☐ No ☐ *Not rated*			1	1		4	4	4					4	4	4		*C51*
C47. Grab bar difficult to reach/inappropriately positioned (NOT as regards height). *Applies to all types, including armrests at toilet.*	☐ Yes ☐ No ☐ *Not rated*						1	1	2		3			2	1	1		*C52*
C48. Grab bars in high position (higher than 90 cm).	☐ Yes ☐ No ☐ *Not rated*															1		*C53*
C49. Grab bars in low position (lower than 80 cm).	☐ Yes ☐ No ☐ *Not rated*														1			*C54*
Controls in hygiene area concern fixtures, e.g. taps, handles of bathroom cupboards, etc. Controls on washing/drying machines are rated under the section where the equipment is located. **C50.** Illogical controls.	☐ Yes ☐ No ☐ *Not rated*	pp. 183–189 p. 183	4	2	3													*C58*

C. INDOOR ENVIRONMENT	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
C51. High force required to activate controls.	☐ Yes ☐ No ☐ *Not rated*	p. 184							3			1			3	1		*C59*
C52. Ultra-sensitive activation.	☐ Yes ☐ No ☐ *Not rated*		3	3	3			3				1	1					*C60*
C53. Use requires intact fine motor control. *Refers to fine-motor, composite "manipulation", cf. C41.*	☐ Yes ☐ No ☐ *Not rated*		1					3				1			1			*C61*
C54. Very small controls.	☐ Yes ☐ No ☐ *Not rated*			2	2							3	2					*C62*
C55. Very large controls.	☐ Yes ☐ No ☐ *Not rated*											2	3					*C63*
C56. Turning motion of wrist required.	☐ Yes ☐ No ☐ *Not rated*											2	4					*C64*
C57. Complex manoeuvres (more than one operation/movement) and good precision required.	☐ Yes ☐ No ☐ *Not rated*		2		1			2				1	1		1			*C65*
C58. Use requires two hands.	☐ Yes ☐ No ☐ *Not rated*		1					2				1	4		3			*C66*
C59. Use requires hands.	☐ Yes ☐ No ☐ *Not rated*											3	4		1			*C67*
C60. Use requires fingers (i.e. isolated grip, e.g. pinch and lateral grip).	☐ Yes ☐ No ☐ *Not rated*											2	4					*C69*

C. INDOOR ENVIRONMENT	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
C61. Controls in high/inaccessible position (more than 1.1 m above the floor). *Refers to switches, sockets, handles of cupboards and drawers, etc. Note the proportion (approximate %) of all functions problematically placed.*	☐ Yes ☐ No ☐ *Not rated*	p. 184								2	3	1			2	4		*C70*
C62. Controls in low position (less than 80 cm above the floor). *Refers to switches, sockets, handles of cupboards and drawers, etc. Note the proportion (approximate %) of all functions problematically placed.*	☐ Yes ☐ No ☐ *Not rated*	p. 184												1	1			*C71*
C63. Wash-basin placed at a height for use only when standing (top edge 81 cm or more above floor).	☐ Yes ☐ No ☐ *Not rated*								3							3		*C72*
C64. Toilet 47 cm or lower. *Including seat.*	☐ Yes ☐ No ☐ *Not rated*	p. 137												3	3	1		*C73*
C65. Toilet 48 cm or higher. *Including seat.*	☐ Yes ☐ No ☐ *Not rated*	p. 137														1		*C74*
C66. Insufficient leg room under wash-basin (clearance depth to the wall minimum 60 cm, clearance width minimum 80 cm, and the wash-basin, pipes, water trap, etc.).	☐ Yes ☐ No ☐ *Not rated*	p. 138					2		2						1	3		*C76*
C67. Mirror placed at a height for use only when standing (lower edge more than 90 cm above floor).	☐ Yes ☐ No ☐ *Not rated*	p. 139							2							3		*C77*
C68. Toilet roll holder in inaccessible position (more than 40 cm from the toilet, other height than 80 cm above the floor, placed on the wall behind the toilet, etc.).	☐ Yes ☐ No ☐ *Not rated*	p. 138			1			1		1	2	1						*C78*

C. INDOOR ENVIRONMENT	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
C69. Storage cupboards, towel hooks, etc. placed high/low (other height than 0.9–1.2 m above floor).	☐ Yes ☐ No ☐ *Not rated*	p. 139			1		1	1		1	2					3		*C79*
C70. Shower stall with kerb/level difference. *A soft rubber edge that allows passage with wheeled mobility devices is acceptable.*	☐ Yes ☐ No ☐ *Not rated*						1							3	3	3		*C80*
C71. Bathtub instead of shower space.	☐ Yes ☐ No ☐ *Not rated*						3							2	3	4		*C81*
<u>**Other controls and operable hardware**</u> (except in kitchen and hygiene area, which are rated separately) *Refers to window and door fittings, locks, switches, and other fixtures.*		pp. 183–189																
C72. Illogically designed controls.	☐ Yes ☐ No ☐ *Not rated*	p. 183	4	2	3													*C83*
C73. High force required to activate controls.	☐ Yes ☐ No ☐ *Not rated*	p. 184							3			1			3	1		*C84*
C74. Ultra-sensitive activation.	☐ Yes ☐ No ☐ *Not rated*		3	3	3			3				1	1					*C85*
C75. Use requires intact fine motor control. *Refers to fine-motor, composite "manipulation", cf. C41.*	☐ Yes ☐ No ☐ *Not rated*		1					3				1			1			*C86*
C76. Very small controls.	☐ Yes ☐ No ☐ *Not rated*			2	2							3	2					*C87*
C77. Very large controls.	☐ Yes ☐ No ☐ *Not rated*											2	3					*C88*

C. INDOOR ENVIRONMENT	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
C78. Turning motion of wrist required.	☐ Yes ☐ No ☐ *Not rated*											2	4					*C89*
C79. Complex manoeuvres (more than one operation/movement) and good precision required.	☐ Yes ☐ No ☐ *Not rated*		2		1			2				1	1		1			*C90*
C80. Use requires two hands.	☐ Yes ☐ No ☐ *Not rated*		1					2				1	4		3			*C91*
C81. Use requires hands.	☐ Yes ☐ No ☐ *Not rated*											3	4		1			*C92*
C82. Use requires fingers (i.e. isolated grip, e.g. pinch and lateral grip).	☐ Yes ☐ No ☐ *Not rated*											2	4					*C94*
C83. Controls in high/inaccessible position (more than 1.1 m above the floor). *Refers to switches, sockets, handles of cupboards and drawers, etc. Note the proportion (approximate %) of all functions problematically placed.*	☐ Yes ☐ No ☐ *Not rated*	p. 184								2	3	1			2	4		*C95*
C84. Controls in low position (less than 80 cm above the floor). *Refers to switches, sockets, handles of cupboards and drawers, etc. Note the proportion (approximate %) of all functions problematically placed.*	☐ Yes ☐ No ☐ *Not rated*	p. 184												1	1			*C96*

C. INDOOR ENVIRONMENT	RATING	Bygg ikapp[a] page ref.	A	B1	B2	C	D	E	F	G	H	I	J	K	L	M	NOTES	Orig. no.[b]
Supplementary housing facilities *Accessibility via footpaths etc. outdoors is rated under EXTERIOR SURROUNDINGS. A whole indoor flight of stairs is rated at C8–C19.* *Note that a circulation path that has been rated in a previous section should NOT be rated once more here.*		pp. 219–221																
C85. Storage areas can only be reached via stairs/threshold or other difference in level (more than 15 mm) and/or more than 25 m from entrance.	☐ Yes ☐ No ☐ *Not rated*	p. 220		3	3		3	3		1					3	4		*C97*
C86. Laundry room can only be reached via stairs/threshold or other difference in level (more than 15 mm) and/or more than 25 m from entrance.	☐ Yes ☐ No ☐ *Not rated*	p. 219		3	3		3	3		1					3	4		*C99*
C87. Inappropriate design of door to laundry room (clearance less than 84 cm, heaviness, etc).	☐ Yes ☐ No ☐ *Not rated*						1		1		2		1		3	4		*C100*

APPENDIX B

U.S. Version of Environmental Component of Original Housing Enabler

Housing Enabler Environmental Assessment | U.S. Version

CASE ID____ **RATER:**____

Instructions:
Please mark YES when the problematic condition exists; NO when the problem does not exist. NOT RATED may be used only where the rater has no access to the area.

Section A. EXTERIOR SURROUNDINGS

GENERAL		RATING	NOTES
A1	Paths narrower than 60". *A width of 39" is acceptable provided there are 60" turning zones at least every 32'-10".*	❑ **Yes** ❑ **No** ❑ *Not rated*	
A2	Irregular/uneven surface (irregular surfacing, joints, sloping sections, cracks, holes; 1/4" or more).	❑ **Yes** ❑ **No** ❑ *Not rated*	
A3	Unstable surface (loose gravel, sand, clay, etc.). *Mark if it causes difficulties: e.g. when using a wheelchair or walker.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
A4	Steep slopes (more than 1:20). *Does not include ramp at entrance; rate under B22.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
A5	Routes with steps. *An alternative route with a ramp that meets the standard is acceptable.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
A6	No/insufficient tactile cues of abrupt level changes/other hazards.	❑ **Yes** ❑ **No** ❑ *Not rated*	

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GENERAL		RATING	NOTES
A7	High curbs (more than 1 1/2").	❑ **Yes** ❑ **No** ❑ *Not rated*	
A8	Curb ramps with steep slopes.	❑ **Yes** ❑ **No** ❑ *Not rated*	
A9	Poorly drained paths and roadways.	❑ **Yes** ❑ **No** ❑ *Not rated*	
A10	No handrails on steep slopes. *Handrail on only one side is sufficient. Definition of "steep," see A4.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
A11	No or too short of resting surfaces (min. 6'-7") and/or long distances between them on slopes (max. 20' between resting surfaces).	❑ **Yes** ❑ **No** ❑ *Not rated*	
A12	Poor/uneven/dazzling lighting along circulation paths. *Note whether the rating is performed in daylight or darkness.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
A13	Poor/uneven/dazzling illumination of walking surface.	❑ **Yes** ❑ **No** ❑ *Not rated*	
A14	Complicated/illogical routes to/from entrance.	❑ **Yes** ❑ **No** ❑ *Not rated*	

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PARKING		RATING	NOTES
A15	Parking space far from entrance (more than 82’ walking distance).	❑ **Yes** ❑ **No** ❑ *Not rated*	
A16	Passenger loading zones far from entrance (more than 16'-5"). *Note whether there is a locked barrier.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
A17	No shelter from weather in passenger loading zone.	❑ **Yes** ❑ **No** ❑ *Not rated*	
A18	No stable, even, non-slip surface in parking lot (loose gravel, sand, clay, etc.).	❑ **Yes** ❑ **No** ❑ *Not rated*	
A19	*RATE FOR MULTI-FAMILY DWELLING ONLY:* No reserved parking for people with disabilities within 33’ of the entrance.	❑ **Yes** ❑ **No** ❑ *Not rated*	

OUTDOOR SEATING		RATING	NOTES
A20	*RATE FOR MULTI-FAMILY DWELLING ONLY:* No/too few outdoor seating surfaces (should be located every 82’ close to the entrance, thereafter at least every 328’).	❑ **Yes** ❑ **No** ❑ *Not rated*	
A21	*RATE FOR MULTI-FAMILY DWELLING ONLY:* Low/high seating surfaces (outside the range of 18 – 20")/no armrest.	❑ **Yes** ❑ **No** ❑ *Not rated*	
A22	*RATE FOR MULTI-FAMILY DWELLING ONLY:* Rough/unstable ground at seating places.	❑ **Yes** ❑ **No** ❑ *Not rated*	

OUTDOOR SEATING		RATING	NOTES
A23	*RATE FOR MULTI-FAMILY DWELLING ONLY:* Insufficient maneuvering space at seating places (lacking clear space of 60" in diameter or standard t-shaped space).	❑ **Yes** ❑ **No** ❑ *Not rated*	
A24	*RATE FOR MULTI-FAMILY DWELLING ONLY:* Furniture placed in the path of travel.	❑ **Yes** ❑ **No** ❑ *Not rated*	

OTHER FEATURES		RATING	NOTES
A25	Garbage bin (the final destination handled by the resident) can only be reached via steps or other difference in level (more than 1/2”). *Note that a route assessed under another section should NOT be assessed here again.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
A26	Mailbox can only be reached via steps or other difference in level (more than 1/2”).	❑ **Yes** ❑ **No** ❑ *Not rated*	
A27	Garbage bin difficult to reach (not at 31 1/2" – 39" above ground, or other problem). *Refers to the opening of the bin; all refuse containers including battery boxes.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
A28	Mailbox difficult to reach (not at 31 1/2" – 43" above ground, no basket on the inside of the apartment door, or other problem).	❑ **Yes** ❑ **No** ❑ *Not rated*	

Section B. ENTRANCES

Refers to stairs, ramps, and elevators outdoors and/or in stairwells. Steps inside the actual residence are rated under C. INDOOR ENVIRONMENT.
Note that a separate sitting out place is rated in B42 – B46. All dimensions = clearance.
Note whether there are alternative entrances, and if so, which of them is/are used most frequently.

GENERAL		RATING	NOTES
B1	Narrow door openings (less than 32" clearance). *Refers to all doors from the entrance door to apartment door, including elevator door.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
B2	High thresholds and/or steps at the entrance (more than 1/2"). *If there is a rubber strip: press it down and measure the maximum height.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
B3	Insufficient maneuvering space at doors (clearance less than 60" x 42", outside and inside). *Refers to clearance; note the difference between B3 and B5.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
B4	Door swing that obstructs use. *Refers to door leaves that obtrude when opening and/or closing.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
B5	No resting area in front of entrance door (max. slope 1:50, area less than 60" x 60"). *Refers to a level area; note differences between B3 and B5.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
B6	Heavy doors without automatic opening.	❑ **Yes** ❑ **No** ❑ *Not rated*	
B7	Automatic opening on side-hung doors.	❑ **Yes** ❑ **No** ❑ *Not rated*	

GENERAL		RATING	NOTES
B8	Inappropriate design of glass sections.	❑ **Yes** ❑ **No** ❑ *Not rated*	
B9	Doors that do not stay in open position/close quickly.	❑ **Yes** ❑ **No** ❑ *Not rated*	
B10	Doors that cannot be fastened in open position (locking device required).	❑ **Yes** ❑ **No** ❑ *Not rated*	
B11	Complicated/illogical opening procedure. *Also includes entry phone.*	❑ **Yes** ❑ **No** ❑ *Not rated*	

STAIRS AT ENTRANCE *If no stairs at entrance, each item is rated NO—this problem does not exist.*		RATING	NOTES
B12	Stairs the only route (no elevator/ramp).	❑ **Yes** ❑ **No** ❑ *Not rated*	
B13	Stair treads with narrow depth (less than 11") or irregular depth.	❑ **Yes** ❑ **No** ❑ *Not rated*	
B14	High, low, and/or irregular heights of risers (height other than 4" – 7").	❑ **Yes** ❑ **No** ❑ *Not rated*	
B15	Projecting nosing/open-riser stairs.	❑ **Yes** ❑ **No** ❑ *Not rated*	

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STAIRS AT ENTRANCE *If no stairs at entrance, each item is rated NO—this problem does not exist.*		RATING	NOTES
B16	No handrails/handrails on one side only. *Note whether handrails are missing on one or both sides.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
B17	Handrails too short (must continue 12" before/after the stairs) and/or interrupted at landing. *This requirement is considered met if one of the handrails continues without interruption at the landing.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
B18	Handrails placed too high/low (higher than 38" or lower than 34"). *Measure at the center of the stair tread.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
B19	No tactile cues to stairway in circulation path.	❑ **Yes** ❑ **No** ❑ *Not rated*	
B20	Visual pattern on the surface of stair treads camouflages edges of treads.	❑ **Yes** ❑ **No** ❑ *Not rated*	
B21	Poor illumination of walking area and/or handrails. *Note whether there is sufficient time before automatic lighting goes off.*	❑ **Yes** ❑ **No** ❑ *Not rated*	

RAMPS AT ENTRANCE *If no ramp at entrance, each item is rated NO—this problem does not exist.*		RATING	NOTES
B22	Steep slopes (more than 1:12).	❑ **Yes** ❑ **No** ❑ *Not rated*	

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RAMPS AT ENTRANCE *If no ramp at entrance, each item is rated NO—this problem does not exist.*		RATING	NOTES
B23	No level or too short of resting surfaces (min. 6'-7") or too far of a distance between resting spaces on slopes (max. 19'-8" between resting surfaces).	❑ **Yes** ❑ **No** ❑ *Not rated*	
B24	No handrails (required on both sides, without interruption).	❑ **Yes** ❑ **No** ❑ *Not rated*	
B25	No or too low protection (lower than 1 1/2") against slipping off sides.	❑ **Yes** ❑ **No** ❑ *Not rated*	

ELEVATORS AT ENTRANCE *If no elevator at entrance, each item is rated NO—this problem does not exist.*		RATING	NOTES
B26	Elevator does not stop at same level as building floor (difference in level of more than 1/2"). *The width of the elevator door is rated at B1.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
B27	Wide gap between the elevator and the building floor (max. 1 1/4").	❑ **Yes** ❑ **No** ❑ *Not rated*	
B28	Heavy doors without automatic opening.	❑ **Yes** ❑ **No** ❑ *Not rated*	
B29	Automatic opening on swing doors.	❑ **Yes** ❑ **No** ❑ *Not rated*	

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ELEVATORS AT ENTRANCE *If no elevator at entrance, each item is rated NO—this problem does not exist.*		RATING	NOTES
B30	Doors that do not stay in open position or close quickly.	❑ **Yes** ❑ **No** ❑ *Not rated*	
B31	Doors that cannot be fastened in open position (locking device required).	❑ **Yes** ❑ **No** ❑ *Not rated*	
B32	Elevator stops abruptly.	❑ **Yes** ❑ **No** ❑ *Not rated*	
B33	No handrail in elevator.	❑ **Yes** ❑ **No** ❑ *Not rated*	
B34	No seat in elevator.	❑ **Yes** ❑ **No** ❑ *Not rated*	
B35	Cramped elevator (less than 3'-7" x 4'-7").	❑ **Yes** ❑ **No** ❑ *Not rated*	
B36	Illogical design of controls. *Note whether controls have to be pressed continuously when the elevator is moving.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
B37	Controls placed too high/low (height other than 2'-11" – 3'-11"). *Refers to both outside and inside the elevator.*	❑ **Yes** ❑ **No** ❑ *Not rated*	

ELEVATORS AT ENTRANCE *If no elevator at entrance, each item is rated NO—this problem does not exist.*		RATING	NOTES
B38	Controls require good hand function.	❑ **Yes** ❑ **No** ❑ *Not rated*	
B39	No audio signal when the elevator arrives.	❑ **Yes** ❑ **No** ❑ *Not rated*	
B40	No visual signal when the elevator arrives.	❑ **Yes** ❑ **No** ❑ *Not rated*	
B41	Elevator signals do not indicate the direction of the elevator up or down.	❑ **Yes** ❑ **No** ❑ *Not rated*	

SITTING-OUT PLACE / BALCONY / DECK *Shared outdoor sitting-out places in multi-family housing are rated in A20 – A24. Do not duplicate the rating here.*		RATING	NOTES
B42	No sitting-out place/balcony too narrow (less than 4'-11" in any direction). *Requires a specially built place, not just a lawn or the like. Note location, and if sitting-out place is used as an entrance.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
B43	Narrow door (less than 32" clearance).	❑ **Yes** ❑ **No** ❑ *Not rated*	
B44	High threshold/level difference/step (more than 1/2").	❑ **Yes** ❑ **No** ❑ *Not rated*	

SITTING-OUT PLACE / BALCONY / DECK *Shared outdoor sitting-out places in multi-family housing are rated in A20 – A24.* *Do not duplicate the rating here.*		RATING	NOTES
B45	Wide gaps in the floor (more than 1/4”).	❑ **Yes** ❑ **No** ❑ *Not rated*	
B46	Steep transition from one level to another (slope more than 1:12).	❑ **Yes** ❑ **No** ❑ *Not rated*	

Section C. INDOORS
This section refers to inside the actual residence itself.
Public areas that are indoors in a multi-family building are part of the chain of travel and should be rated in Section B | Entrances.

INDOORS		RATING	NOTES
C1	Stairs/thresholds/differences in level between rooms/floor spaces (more than 1/2”). *If there is a rubber strip: press it down and measure the maximum height.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
C2	Complicated/illogical circulation routes.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C3	Narrow passages/corridors in relation to fixtures/design of building (less than 36"). *Note the difference between items C3 and C5.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
C4	Narrow doors (less than 32” clearance). *Also applies to arches etc. without door/door leaf.*	❑ **Yes** ❑ **No** ❑ *Not rated*	

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INDOORS		RATING	NOTES
C5	Insufficient maneuvering spaces in relation to movable furnishings. *Note the difference between items C3 and C5.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
C6	Insufficient maneuvering spaces where turning is necessary (less than 60" x 60" turning circle). *Does not apply to hygiene rooms, which are rated separately.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
C7	Inappropriate design of wardrobes/clothes closets.	❑ **Yes** ❑ **No** ❑ *Not rated*	

INDOOR STAIRS		RATING	NOTES
C8	Stairs to upper story with necessary dwelling functions. *C8 – C10 concern stairs between floors (no elevator). More than one of these items may be marked.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
C9	Stairs to basement with necessary dwelling functions.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C10	There are stairs but necessary dwelling functions are located on ground floor.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C11	Stair treads with narrow depth (less than 11") or irregular depth.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C12	High, low, and/or irregular height of risers (height other than 4" – 7").	❑ **Yes** ❑ **No** ❑ *Not rated*	

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INDOOR STAIRS		RATING	NOTES
C13	Projecting nosing/open-riser stairs.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C14	No handrails/handrail on one side only.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C15	Handrails too short (must continue 12" before/after the stairs) and/or interrupted at the landing.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C16	Handrails placed too high/low (higher than 38" or lower than 34"). *Measure at the center of the stair tread.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
C17	No tactile cues to stairway in circulation path.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C18	Visual pattern on the surface of stair treads camouflages edges of treads.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C19	Poor/uneven/dazzling illumination of walking area and/or handrails.	❑ **Yes** ❑ **No** ❑ *Not rated*	

KITCHEN, LAUNDRY ROOM, UTILITY KITCHEN *Refers to furnishings and equipment, including washing and drying machines no matter the location. Equipment in communal laundry room is NOT rated, but getting to/into the laundry rooms is rated in section A and at C86.*		RATING	NOTES
C20	Insufficient maneuvering areas around appliance/storage cupboards (service areas less than 3'-11" in front). *Insufficient area because of furniture is rated under C5.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
C21	Wall-mounted cupboards and shelves placed high (lowest shelf more than 20" above the working surface or more than 55" above the finish floor).	❑ **Yes** ❑ **No** ❑ *Not rated*	
C22	No surface at a height suitable for sitting while working (33" or lower required). *Refers to fixtures, not furniture, leg clearance rated at C24.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
C23	Low working surfaces (33" or lower). *Refers to fixtures, not furniture.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
C24	No working surfaces with leg room (less than 26" high, 24" deep, and 32" wide). *Refers to fixtures, not furniture.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
C25	Working surfaces too deep (more than 24").	❑ **Yes** ❑ **No** ❑ *Not rated*	
C26	Shelves too deep (more than 12"). Deeper shelves require pullout shelves/turntable units. *Mark this if more than 50% of floor cupboards and full-height cupboards are too deep and lack these facilities.*	❑ **Yes** ❑ **No** ❑ *Not rated*	

KITCHEN, LAUNDRY ROOM, UTILITY KITCHEN *Refers to furnishings and equipment, including washing and drying machines no matter the location. Equipment in communal laundry room is NOT rated, but getting to/into the laundry rooms is rated in section A and at C86.*		RATING	NOTES
C27	Electric or gas cooktop with standard rings.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C28	Ceramic or smooth cooktop or the like.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C29	Door swings (inner doors) that impede the use of storage units.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C30	Insufficient/inappropriately designed or placed lighting of working surfaces, sink top, stove top, and storage areas.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C31	Illogically designed controls. *A microwave oven not built-in should NOT be rated.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
C32	High force required to activate controls.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C33	Ultra-sensitive activation of controls.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C34	Use requires intact fine motor control. *Refers to fine-motor, composite "manipulation," cf. C41.*	❑ **Yes** ❑ **No** ❑ *Not rated*	

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KITCHEN, LAUNDRY ROOM, UTILITY KITCHEN *Refers to furnishings and equipment, including washing and drying machines no matter the location. Equipment in communal laundry room is NOT rated, but getting to/into the laundry rooms is rated in section A and at C86.*		RATING	NOTES
C35	Very small controls.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C36	Very large controls.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C37	Turning motion of wrist required.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C38	Complex maneuvers (more than one operation/movement) and good precision required.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C39	Use requires two hands.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C40	Use requires hands.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C41	Use requires fingers (i.e. isolated grip, e.g. pinch and lateral grip).	❑ **Yes** ❑ **No** ❑ *Not rated*	

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KITCHEN, LAUNDRY ROOM, UTILITY KITCHEN *Refers to furnishings and equipment, including washing and drying machines no matter the location. Equipment in communal laundry room is NOT rated, but getting to/into the laundry rooms is rated in section A and at C86.*		RATING	NOTES
C42	Controls in high/inaccessible position (more than 44" above the finish floor). *Refers to switches, sockets, handles of cupboards and drawers, etc.* *Note whether reach is obstructed or unobstructed and if controls are higher than 48" above the finish floor. Also note the proportion (approximate %) of all functions problematically placed.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
C43	Controls in low position (less than 15" above the finish floor). *Refers to switches, sockets, handles of cupboards and drawers, etc.* *Note the proportion (approximate %) of all functions problematically placed.*	❑ **Yes** ❑ **No** ❑ *Not rated*	

HYGIENE AREA *Refers to the bathroom most often used. Must include sink, toilet, shower and/or bathtub.*		RATING	NOTES
C44	Insufficient maneuvering spaces where turning is required (less than 60" x 60" turning circle).	❑ **Yes** ❑ **No** ❑ *Not rated*	
C45	Insufficient space for stool, bath bench, or equivalent, or other problem in shower/bath.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C46	No grab bars at shower/bath and/or toilet.	❑ **Yes** ❑ **No** ❑ *Not rated*	

C47	Grab bars difficult to reach/inappropriately positioned (NOT related to height, but poor placement). *Applied to all types, including armrests at toilet.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
C48	Grab bars in high position (higher than 36").	❑ **Yes** ❑ **No** ❑ *Not rated*	
C49	Grab bars in low position (lower than 33").	❑ **Yes** ❑ **No** ❑ *Not rated*	
C50	*Controls in hygiene area concern fixtures, (e.g. taps, handles of bathroom cupboards, etc.)* *Controls on washing/drying machines are rated under the section where the equipment is located.* Illogical controls.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C51	High force required to activate controls.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C52	Ultra-sensitive activation.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C53	Use requires intact fine motor control. *Refers to fine-motor, composite "manipulation," cf. C41.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
C54	Very small controls.	❑ **Yes** ❑ **No** ❑ *Not rated*	

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C55	Very large controls.	❑ **Yes** ❑ **No** ❑ *Not rated*
C56	Turning motion of wrist required.	❑ **Yes** ❑ **No** ❑ *Not rated*
C57	Complex maneuvers (more than one operation/movement) and good precision required.	❑ **Yes** ❑ **No** ❑ *Not rated*
C58	Use requires two hands.	❑ **Yes** ❑ **No** ❑ *Not rated*
C59	Use requires hands.	❑ **Yes** ❑ **No** ❑ *Not rated*
C60	Use requires fingers (i.e. isolated grip, e.g. pinch and lateral grip).	❑ **Yes** ❑ **No** ❑ *Not rated*
C61	Controls in high/inaccessible position (more than 44" above the finish floor). *Refers to switches, sockets, handles of cupboards and drawers, etc.* *Note whether reach is obstructed or unobstructed and if controls are higher than 48" above the finish floor. Also note the proportion (approximate %) of all functions problematically placed.*	❑ **Yes** ❑ **No** ❑ *Not rated*

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C62	Controls in low position (less than 15" above the finish floor). *Refers to switches, sockets, handles of cupboards and drawers, etc.* *Note the proportion (approximate %) of all functions problematically placed.*	❑ **Yes** ❑ **No** ❑ *Not rated*
C63	Sink placed at a height for use only when standing (top edge 34" or more above the finish floor).	❑ **Yes** ❑ **No** ❑ *Not rated*
C64	Toilet lower than 17" (including seat).	❑ **Yes** ❑ **No** ❑ *Not rated*
C65	Toilet higher than 19" (including seat).	❑ **Yes** ❑ **No** ❑ *Not rated*
C66	Insufficient leg room under sink (clearance height less than 27", depth to the wall less than 19", clearance width less than 30", and the sink, pipes, water traps, etc.).	❑ **Yes** ❑ **No** ❑ *Not rated*
C67	Mirror placed at a height for use only when standing (lower edge more than 40" above finish floor).	❑ **Yes** ❑ **No** ❑ *Not rated*
C68	Toilet roll holder in inaccessible position (less than 7" or more than 9", measured from front of toilet to centerline of dispenser), height other than 15 – 48" above the finish floor, placed on the wall behind grab bars/toilet, etc.).	❑ **Yes** ❑ **No** ❑ *Not rated*
C69	Storage cupboards, towel hooks, etc. placed high/low (height other than 40" – 48" above finish floor).	❑ **Yes** ❑ **No** ❑ *Not rated*

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C70 Shower stall with curb/level difference. *A soft rubber edge that allows passage with wheeled mobility devices is acceptable.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
C71 Bathtub instead of shower stall/space.	❑ **Yes** ❑ **No** ❑ *Not rated*	

OTHER CONTROLS AND OPERABLE HARDWARE *Refers to window and door fittings, locks, switches, and other fixtures. (Note that controls and operable hardware in kitchen and hygiene areas are rated separately.)*	**RATING**	**NOTES**
C72 Illogically designed controls.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C73 High force required to activate controls.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C74 Ultra-sensitive activation.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C75 Use requires intact fine motor control. *Refers to fine-motor, composite "manipulation", cf. C41.*	❑ **Yes** ❑ **No** ❑ *Not rated*	
C76 Very small controls.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C77 Very large controls.	❑ **Yes** ❑ **No** ❑ *Not rated*	

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OTHER CONTROLS AND OPERABLE HARDWARE *Refers to window and door fittings, locks, switches, and other fixtures. (Note that controls and operable hardware in kitchen and hygiene areas are rated separately.)*	**RATING**	**NOTES**
C78 Turning motion of wrist required.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C79 Complex maneuvers (more than one operation/movement) and good precision required.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C80 Use requires two hands.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C81 Use requires hands.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C82 Use requires fingers (i.e. isolated grip, e.g. pinch and lateral grip).	❑ **Yes** ❑ **No** ❑ *Not rated*	
C83 Controls in high/inaccessible position (more than 44" above the finish floor). *Refers to switches, sockets, handles of cupboards and drawers, etc.* *Note whether reach is obstructed or unobstructed and if controls are higher than 48" above the finish floor. Also note the proportion (approximate %) of all functions problematically placed.*	❑ **Yes** ❑ **No** ❑ *Not rated*	

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OTHER CONTROLS AND OPERABLE HARDWARE *Refers to window and door fittings, locks, switches, and other fixtures. (Note that controls and operable hardware in kitchen and hygiene areas are rated separately.)*	**RATING**	**NOTES**
C84 Controls in low position (less than 15" above the finish floor). *Refers to switches, sockets, handles of cupboards and drawers, etc.* *Note the proportion (approximate %) of all functions problematically placed.*	❑ **Yes** ❑ **No** ❑ *Not rated*	

SUPPLEMENTARY HOUSING FACILITIES *Accessibility via footpaths, etc. outdoors is rated under EXTERIOR SURROUNDINGS. An indoor flight of stairs is rated at C8 – C19. Note that a circulation path rated in a previous section should NOT be rated here.*	**RATING**	**NOTES**
C85 Storage areas can only be reached via stairs/threshold or other difference in level (more than 1/2") and/or more than 82' from entrance.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C86 Laundry room can only be reached via stairs/threshold or other difference in level (more than 1/2") and/or more than 82' from entrance.	❑ **Yes** ❑ **No** ❑ *Not rated*	
C87 Inappropriate design of door to laundry room (clearance less than 33", heaviness, etc.).	❑ **Yes** ❑ **No** ❑ *Not rated*	

ADDITIONAL NOTES

APPENDIX C

Consent Form for Study Two

Oregon State University

School of Design and Human Environment
224 Milam Hall
Corvallis, Oregon 97331-5101
T 541.737.3796 | **F** 541.737.0993
http://business.oregonstate.edu/node/25163

CONSENT FORM

Project Title:	Assessment of Person-Environment Fit Among Older Adults Aging in Place: Relationships to Accessibility, Usability, and Aging Well
Principal Investigator:	Dr. Carmen Steggell
Student Researcher:	Laura Lien
Version Date:	March 5, 2013

1. WHAT IS THE PURPOSE OF THIS FORM?

This form contains information you will need to help you decide whether to be in this study or not. Please read the form carefully and ask the study team member(s) questions about anything that is not clear.

2. WHY IS THIS STUDY BEING DONE?

The purpose of this study is to gain an understanding of accessibility, usability, and placemaking within the home. This study is being conducted for the completion of Laura Lien's dissertation.

Up to 40 older adults may be invited to take part in this study.

3. WHY AM I BEING INVITED TO TAKE PART IN THIS STUDY?

You are being invited to take part in this study because you have indicated an interest in research participation as a LIFE Registry member. This study is focused on older adults who are 65 years of age or older, native speakers of English, and who are living in a private home (not in a co-op, assisted living facility, or nursing home) and who have some level of functional limitation.

4. WHAT WILL HAPPEN IF I TAKE PART IN THIS RESEARCH STUDY?

If you take part in this research study, two interviews will be conducted with you in your home. We will ask you to identify your physical limitations and to discuss aspects of your home that may present challenges to you.

In the first visit, we will ask a few short questions about your functional limitations. We will also complete an assessment of your home. In the assessment, we will examine physical attributes of your home that may impact usability and accessibility, including living areas, kitchen, your bedroom, and bathroom. The second visit will be scheduled at your convenience at the completion of the first visit.

In the second visit, we will discuss the results of the home assessment and ask about your own perceptions of the usability and sense of place in your home. There will be five questions about how you use your home, modifications you've made to meet your needs, and how you feel about your home. These questions address your personal perceptions only, and there are no right or wrong answers.

Study duration: There will be two visits for this study. The first visit will take approximately one to one and a half hours. Of this, only 10 to 15 minutes will require your full participation; we will use the remaining time for the assessment of your home. The second visit will also take approximately one to one and half hours., and will include a series of questions about your home. We anticipate that the second interview will be completed within 60 days of the first interview.

Recordings and photographs: During the second visit, we will ask to audio record your interviews to ensure that we have records that accurately reflect your responses. If you agree, photographs may also be taken of your home. We will not photograph anything you do not want us to. If you agree to the study, but not to recordings or photos, the study may move forward without them. Please initial options for which you provide permission:

______ I agree to be audio recorded.
Initials
______I agree to have aspects of my home photographed.
Initials
______I do <u>not</u> agree to be audio recorded.
Initials
______I do <u>not</u> agree to have aspects of my home photographed.
Initials

Future contact: We may contact you in the future for another similar study. You may ask us to stop contacting you at any time.

5. WHAT ARE THE RISKS AND POSSIBLE DISCOMFORTS OF THIS STUDY?

The risks for this study are negligible. We seek to be sensitive to your needs. If at any time you need a break or want to decline answering any question, please let us know. There will be no repercussions for rescheduling visits or declining participation in any aspect of the study.

The security and confidentiality of information collected from you online cannot be guaranteed. Confidentiality will be kept to the extent permitted by the technology being used. Information collected online can be intercepted, corrupted, lost, destroyed, arrive late or incomplete or contain viruses.

6. WHAT ARE THE BENEFITS OF THIS STUDY?

There is no direct benefit from participating in this study. However, some people may find it helpful to think about the fit of their home with their own needs. This study may influence policy and design towards more inclusive and appropriate homes for healthy and successful aging in place. Results will contribute to an international effort to create universal measurement and analysis of appropriate home attributes for older adults.

7. WILL I BE PAID FOR BEING IN THIS STUDY?

We are pleased to offer you a $10 gift certificate to a local store of your choice with our thanks when you have completed both interviews.

8. WHO WILL SEE THE INFORMATION I GIVE?

The information you provide during this research study will be kept confidential to the extent permitted by law. Research records will be stored securely and only researchers will have access to the records. Federal regulatory agencies and the Oregon State University Institutional Review Board (a committee that reviews and approves research studies) may inspect and copy records pertaining to this research. Some of these records could contain information that personally identifies you.

In accordance with Center for Healthy Aging (CHAR) policies, the names of individuals who have agreed to participate in this study will be reported back to CHAR, but no identifiable data will be shared with anyone, including CHAR.

If the results of this project are published your identity will not be made public. Photographs that illustrate various aspects of accessibility may be included in published work, but no identifiable aspects will be provided.

Audio recordings will only be accessible by the researchers throughout the study. They will be used to ensure accuracy in interview responses.

To help ensure confidentiality, we will not identify any participant by name, but rather by an identification code that will only ensure the data from both visits will remain together. Notes taken on paper will be kept in a locked filing cabinet, and audio recordings/photographs will be stored on a password-protected computer. Any photographs taken will require your approval and will not include any identifiable information, including you or any other people. Only the researchers listed on this form will have access to any of the notes or recordings used in this study.

All confidential records will be destroyed after three years, per requirements of Oregon State University. However, unidentifiable data may be kept indefinitely. Because it is not possible for us to know what studies may be a part of our future work, we ask that you give permission now for us to use your responses without being contacted about each future study. Future use of aggregated answers will be limited to studies about accessibility, usability, placemaking, or aging in place. We will not pay you for the use of your responses or any products, patents, or licenses that result from these responses.

______I agree to my unidentifiable data being used in future research
Initials

______I do not agree to my unidentifiable data being used in future research
Initials

If you agree now to future use of your aggregated answers, but decide in the future that you would like to have them removed from research tests, please contact Dr. Carmen Steggell, Oregon State University, carmen.steggell@oregonstate.edu, 541-737-0995.

9. WHAT OTHER CHOICES DO I HAVE IF I DO NOT TAKE PART IN THIS STUDY?

Participation in this study is voluntary. Though the research is based on complete and honest responses, you are free to skip any questions that you would prefer not to answer. If you decide to participate, you are free to withdraw at any time without penalty. You will not be treated differently if you decide to stop taking part in the study. If you choose to withdraw from this project before it ends, the researchers may keep information collected about you and this information may be included in study reports.

10. WHO DO I CONTACT IF I HAVE QUESTIONS?

If you have any questions about this research project, please contact: Dr. Carmen Steggell, Associate Professor, at (541) 737-0995 or carmen.steggell@oregonstate.edu.

If you have questions about your rights or welfare as a participant, please contact the Oregon State University Institutional Review Board (IRB) Office, at (541) 737-8008 or by email at IRB@oregonstate.edu.

11. WHAT DOES MY SIGNATURE ON THIS CONSENT FORM MEAN?

Your signature indicates that this study has been explained to you, that your questions have been answered, and that you agree to take part in this study. You will receive a copy of this form.

Do not sign after the expiration date: 03/04/2014

Participant's Name (printed): ____

____ ________________________________
(Signature of Participant) (Date)

____ ________________________________
(Signature of Person Obtaining Consent) (Date)

APPENDIX D

Categories and Emergent Themes of Prevailing Adaptive Strategies

Category One: Reactive Strategies

Theme One: Making environmental modifications only in time of perceived need.

Theme Two: Adjustment to home "as is"—denial or lack of awareness of functional or environmental needs.

Theme Three: Use of assistive devices or reliance on family to mitigate environmental stress.

Theme Four: The importance of home and community makes staying put a priority, no matter what.

Category Two: Deferred Reactive Strategies

Theme One: Lack of knowledge or information challenges the implementation of needed modifications.

Theme Two: Hanging on to possessions to retain important memories—at the expense of accessibility.

Theme Three: Environmental barriers as positive challenges.

Theme Four: Alternative supportive housing options do not fit perceived physical, social, or psychological needs.

Theme Five: Active discussions and planning for potential age-related needs in the future.

Category Three: Proactive Strategies

Theme One: Active selection or design of a home and community that accommodates age-related needs prior to onset of functional decline.

Theme Two: Modifying elements of the home environment to avoid future declines in activity performance.