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The Role of Home Environments in Residential Adjustment Decision Making in Later Life

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THE ROLE OF HOME ENVIRONMENTS IN RESIDENTIAL ADJUSTMENT DECISION MAKING IN LATER LIFE

A Dissertation Presented

by

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ABSTRACT

THE ROLE OF HOME ENVIRONMENTS IN RESIDENTIAL ADJUSTMENT DECISION MAKING IN LATER LIFE

December 2011

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Using the nationally representative Health and Retirement Study, this research explored the multi-faceted influence of the accessibility of housing environments on the occurrence and characteristics of residential adjustments made by older adults aged 70 or older. A range of housing adjustment outcomes were examined, including home modifications and relocation into age-segregated senior housing. Analysis of the accessibility gains following relocation was also included in the empirical analyses.

The Ecological Theory of Aging (Lawton & Nahemow, 1973) provided the conceptual framework for the research. The longitudinal design of the HRS empirically advanced understanding of the key theoretical constructs by sensitizing the results to how change in competency and how competency uniquely intersects with housing environment in later life.

The analyses findings suggested that structural supportive environmental features in homes, such as wheelchair accessibility, reduce the odds of making subsequent housing adjustments. Declines in physical competency and negative person-environment encounters were shown to be predictive of increased risk of housing adjustment. However, the preference of older adults to age in place was underscored by the findings showing that home modification rather than relocation was predicted by greater person-environment misfit. Age-segregated senior housing moves were not found to be influenced by the built environment of prior homes, but more so by spouse competency and household financial wealth. Moves that resulted in gains in accessibility features were also predicted by greater levels of person-environment misfit.

The person-environment misfit variable, introduced in this study as an exploratory methodological advance, highlighted the heterogeneous nature of older adults in their interactions with the built home environments. The analyses findings revealed that it is the unique intersection of competency and the built environment for each individual that has the greatest impact on subsequent housing adjustments made in later life. This research provides empirical backing for policy advocates seeking to promote universal design and visitability standards for housing as a way to support successful aging in place within the aging population.

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INTRODUCTION

With advancing age, disability and physical health declines become more predominant. According to Census 2000 data, 43% of people age 65+ reported having at least one disability that limits physical mobility, sensory ability, cognitive functioning or self-care, compared to only 17.6% of those age 18-64 (Waldrop & Stern, 2003). However, evidence of downward trends in the disability rate among elderly persons over the past fifteen years has been reported in the literature (Spillman, 2004). Although partially attributed to better services and greater access to disability aides, improvements in contextual environments are also considered to be influential (Spillman, 2004). The growing recognition of the important role of environment in later life is evidenced in the integration of external contextual features as principal components of the development of disability and its trajectory within international disability frameworks (Schneidert, Hurst, Miller & Ustun 2003; WHO, 2001).

The interaction between older adults and the environment is an individualized encounter influenced by the unique health and competency characteristics of the person (Wahl, 2003). When health declines and disability advances, the home environment can either serve to compensate for or accentuate functional limitations and disability (Oswald,

Wahl, Naumann, Mollenkopf & Hieber, 2006). Worsening physical health and functional capacity that might not otherwise occur can result from residing in unsupportive environments (Steinfeld & Danford, 1999). Decreased capacity to adapt to environmental demands in later life escalates the saliency of environmental features on individual outcomes (Oswald & Wahl, 2004). Homes with supportive features, such as wheelchair accessibility, can provide the necessary support to allow aging persons to safely age in place, even when experiencing increasing frailty (Pynoos & Nishita, 2003, Wahl & Weisman, 2003).

Likewise, homes without these supportive features often highlight functional losses common in late life and can influence an array of outcomes, including the likelihood of needing to make a late life residential adjustment. Although generally considered to be an asset, home ownership and housing can also be viewed as a form of health capital that can positively or negatively affect the quality of life and ability to function within home settings (Smith, Easterlow, Munro & Turner, 2003). For physically sick or frail older adults, housing can become a rigid setting demanding behaviors beyond the capacity of the individual if housing adaptations are not implemented (Smith, et. al., 2003). In addition, residing in an excessively demanding housing environment that accentuates physical and functional losses can contribute to negative psychosocial responses and feelings of incompetence (Golant, 2011). Distinctions between housing that functions as a preventative resource for older adults and housing that intensifies downward disability, health trajectories and negative environmental demands (Oswald & Wahl, 2004) have yet to be well defined in the literature.

The saliency of the relationship between housing environment characteristics and health and functional well-being in later life is highlighted above. It is therefore necessary to more clearly identify what characterizes a supportive home environment which contributes positively towards successful aging in place. Empirical evidence of this nature would provide clearer verification about how the built environment should be structured in order to further improve trajectories of health and disability among older people.

Analysis of the occurrence of residential adjustments in later life is one way to help disentangle how the built environment positively and negatively intersects with successful aging in place. Residential adjustments, including home modifications and relocation, can be a solution for older adults residing in homes which highlight vulnerability, intensify frailty, and accelerate disability or health trajectories. Residential adjustments that reduce these environmental demands can stabilize negative interactions between elderly persons and their homes.

1.1 Research Goals and Overview

This research's purpose was to ascertain the multifaceted influence of the built housing environment on the occurrence and characteristics of residential adjustments in later life. Three research goals provided the framework for the development and exploration of the research questions examined. One research goal was to identify what supportive environmental features in homes may be most effective as preventative resources for older adults desiring to remain at home despite increasing frailty associated with advancing age. A second goal was to examine the intricate interplay between elderly people, their home environments and the occurrence of residential adjustments. The study

analyses were sensitized to the intersection of competency, defined as the range of internal abilities exhibited by an individual (Lawton & Nahemow, 1973), and the availability of supportive features specific to the individual's needs. The third research goal was to investigate if and what gains in accessibility were achieved when older adults relocated in later life and whether or not prior negative encounters with housing environments increased the likelihood of making such improvements. Multiple housing adjustment outcomes were considered in the research, including home modifications, relocation into age-integrated housing, and moves into age-segregated senior housing.

Literature from several research domains was reviewed to develop the five research questions explored in this study. Literature about home modification, relocation, and the interaction between person and environment provided the framework for the study. However, review of literature that examined personal attitudes about aging in place and the prevalence of housing that offers supportive features was also essential to highlight the underlying circumstances influencing residential decisions.

The research questions of this study were empirically examined using a nationally representative sample drawn from the American longitudinal panel survey, The Health and Retirement Study (HRS). The longitudinal design of the HRS allowed for analysis of how change in individual competency influenced residential adjustments, as well as exploration of whether or not accessibility gains were achieved upon relocation. However, the HRS survey data also imposed limitations on the empirical analyses performed in this research, as discussed in more detail in Section 5.3. The study is restricted to analysis of the built environment of the home itself because of the limited availability of information in the HRS about other contextual or subjective characteristics

shown in the literature to be influential of the likelihood of housing adjustment occurring (Oswald, et. al., 2006; Oswald, Hieber, Wahl & Mollenkopf, 2005; Oswald & Wahl, 2004; Wahl & Weisman, 2003)

1.2 Aging In Place and Adequacy of Housing Stock

Within society, there is a general trend towards linking housing and quality of life, particularly for persons in later life (Gitlin, 2003). The physical home represents autonomy and independence, both of which are perceived to be lost within institutional care settings (Gitlin, 2003; Wiles, 2005). Research suggests that individuals think more about where they want to live as they age, but the overwhelming majority expresses a desire to remain in their current home (Leeson, 2006).

This "propensity to age in place" is common, as continuity and familiarity with home environments can serve to maintain a sense of overall wellbeing (Lawton, 1990; Oswald & Wahl, 2004). An AARP study that examined attachment to community and home environments among a sample of Americans over the age of 50, found that 95% of those age 75+ expressed a desire to age in place and remain in their current home for as long of a time period as possible (Kochera & Straight, 2005). Another study that surveyed baby boomers aged 45-64 found that four-fifths expressed a wish to not move from their current residence (Koppen, 2009). The reasons behind individual preferences to not move include feelings of independence and control, feelings of safety and security, being near family, and feelings of familiarity with neighborhood and community surroundings (Wagnild, 2001).

However, this tenacious strength of place attachment and the security it provides may hinder openness for making housing adjustments, particularly in later life (Hays,

2002). The overwhelming majority of older adults believe that their homes will meet their physical needs as they grow older, as indicated by 98 percent of respondents aged 75+ in AARP's *Beyond 50.05 Study* (Waldrop & Stern, 2003). Previous research has revealed that older adults consistently underestimate risk of home injuries (Wells & Evans, 1996). Iwarsson & Wilson (2006) found that despite identification of physical barriers in 100% of the homes studied, 96% of the respondents were content with their current home and 35% believed their homes were accessible to meet potential future needs. Similar findings were gathered in a study of baby boomers (age 45-64), a third of who believed their home would present no challenges to them in the future (Koppen, 2009). Wagnild (2001) surveyed persons age 55+ about future housing preferences and asked them to identify barriers that might interfere with actualization of aging in place. Approximately half of the sample (47%) was unable to identify any possible barriers in their homes, and among this subgroup 75 percent indicated no plan to make future residential moves.

In general, older adults appear to be relatively unaware of the importance of housing characteristics and that adaptations can serve to alleviate difficulties in daily functioning they may encounter in later life (Pynoos, 1993). An underestimation of the challenges presented by home environments by older adults is attributed to an "over-familiarization" and strong, subjective feelings of attachment that accompany lengthy tenure in homes (Oswald & Wahl, 2004). A large proportion of older adults do not spend time considering possible future needs for environmental adaptations or determining a plan of action that would address potential mismatched encounters they may have with home settings in the future. Among a subsample of respondents who planned to remain in their homes throughout their later lives, one-third (32%) had no plans or had not thought

about how to facilitate their wishes and 23 percent did not answer the question (Wagnild, 2001). Wister (1989) examined if and what proactive residential adaptations individuals, age 74 and older, considered making in the future. Eighty-four percent of the respondents reported they spent no time or very little time thinking about future changes they might need to make to the environment. The most common reasons why, among those who spent no time contemplating future changes, included contentment with present circumstances (43%), a preference to live "day by day" (17%), or simply because they did not like to think about it (10%).

Consideration of the physical environment as a contributing factor of housing adjustment choices is essential because most conventional housing does not offer supportive disability and handicap accessibility features. Housing designed for healthy and able bodied customers, referred to as "Peter Pan Housing" (Pynoos, Sabata & Choi, 2005), is customary even though one study has projected that by 2050 a newly built single family home has a 60 percent probability of housing at least one disabled person at some point in time (Smith, Rayer & Smith, 2007). An AARP study found that although the availability of a bedroom on the first floor of a home is fairly common (87%), half of respondents did not have a bathroom available on the main level, 62 percent needed to navigate steps to enter their home, and 58 percent did not have doorways wide enough for wheelchair passage (Waldrop & Stern, 2003). These accessibility deficits, common in homes, are linked in the literature to falls, disability and negative health outcomes among the elderly population (Watzke & Kemp, 1992).

1.3 Conceptual Model

The primary goal of environmental gerontology research is to understand the many facets of the dynamic relationship between people and surrounding physical environments as a means to optimize quality of life in later life (Wahl & Weisman, 2003; Wahl, 2003). The foundational premise of this research domain is that a range of behaviors and actions are demanded by these environmental contexts (Faletti, 1984) which must be successfully met in order to sustain an independent lifestyle (Wahl & Lang, 2004). These environmental characteristics are viewed to be influential in defining the nature of the exchange between persons and their surroundings (Faletti, 1984). Persons and their environments both constantly change over time and continual adjustments and action must be taken to maintain a balanced transaction between the two domains (Lawton & Nahemow, 1973).

The influence of environmental demands on the continuation of an independent lifestyle becomes more prominent in later life because of the many physical changes common during this life stage. This saliency is accentuated by the increasing proportion of time older people spend in home settings requiring them to perform a greater number of activities within this context (Gitlin, 2003; Oswald & Wahl, 2004). As aging persons experience decreased physical health and strength, they may encounter greater difficulty in continuing to successfully meet the demands placed on them by their environmental contexts (Faletti, 1984; Lawton & Nahemow, 1973; Lawton, 1990). The Ecology Theory of Aging (ETA), introduced by Lawton & Nahemow (1973), conceptualizes this interaction, emphasizing the dynamic and adaptive nature of the processes involved. An underlying assertion of ETA is that exploration of the interconnectedness between

individuals and environments is an integral component of analyses of wellbeing in later life (Gitlin, 2003).

1.3.1 The Ecological Theory of Aging

The Ecological Theory of Aging builds on Lewin's (1935) ecological equation [B = f (P,E)] which introduced the concept that behavior is a function of the person and environment. The ETA model expands this equation by incorporating the competency of persons, including both physical psychological and cognitive domains, as determinants of outcomes when interacting with environmental contexts (Lawton, 1986). The theory defines three principal concepts as a means to conceptualize the dynamic interaction between individuals and environments in later life; *Competency, Environmental Press,* and *Adaptation Level*.

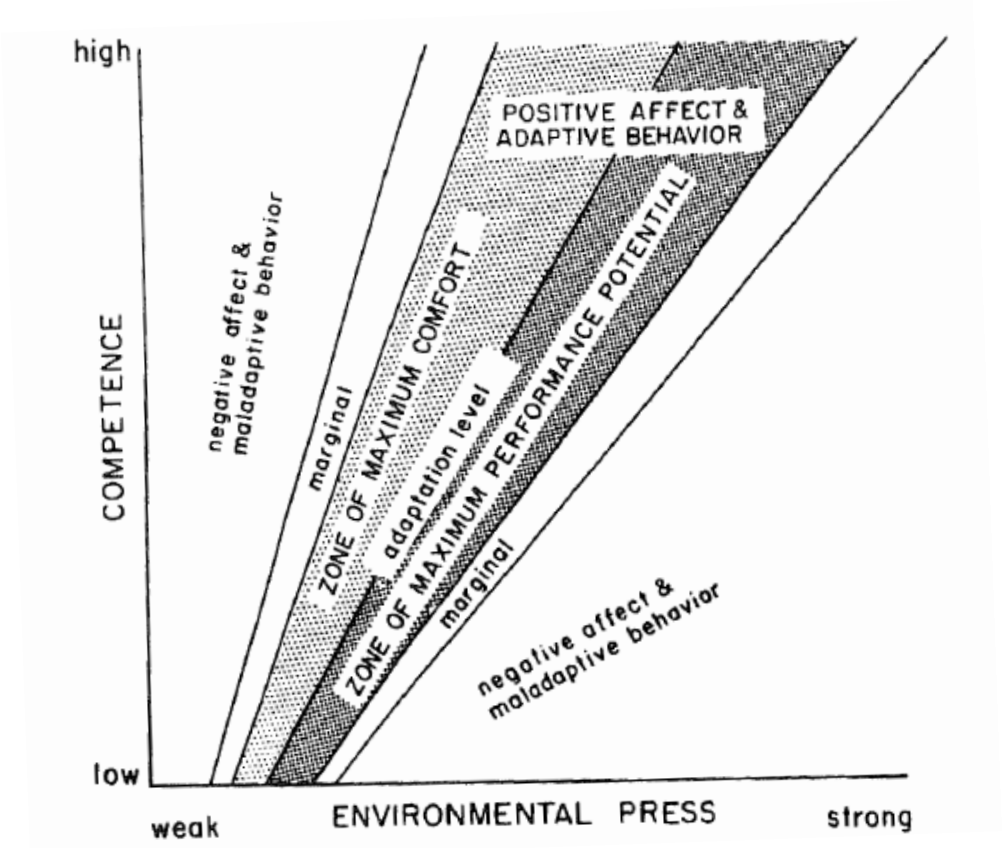

Figure 1: The Ecological Theory of Aging
Source: Lawton & Nahemow (1973)

1.3.2 Key Theoretical Concepts

Individual competence, defined by Lawton & Nahemow (1973) to be the range of abilities internal to the person, can vary across time as shifts in health and functionality occur. These internal abilities influence individual abilities in managing and interacting with surrounding physical environments (Tabbarah, Silverstein & Seeman, 2000). The concept is strengthened by characterizing competence as separate components, such as physical health, sensory capabilities, psychological wellbeing and cognitive functionality (Lawton & Nahemow, 1973). These finer distinctions between different types of

competency broaden the concept to be more representative of the complexities of human behaviors and abilities

Environmental Press, the second key concept in the ETA model, conceptualizes the environmental demands and corresponding efforts required of individuals to interact with physical environments (Lawton, 1986). Environmental press most often fluctuates according to characteristics and competencies of persons rather than intrinsic changes in the environment itself (Lawton & Nahemow, 1973), and exerts greater influence on individual behaviors as competency lessens (Lawton, 1990). However, changes in environmental press can also result from structural disrepair and other home maintenance needs that may be too costly or difficult to maintain for elder home owners (Golant, 2003; Pynoos, et. al., 2005). This deterioration of the physical structure of homes may contribute to conflict that arises between competency and the physical environment.

Adaptation Level, the third concept of the ETA Model, is the intersection of competence and environmental press where there is optimal balance in the transaction (Lawton & Nahemow, 1973). Individuals achieve AL when environmental demands match competency levels, resulting in near automatic interactions that create positive affect and physical comfort within environmental surroundings (Lawton, 1989, Lawton & Nahemow, 1973). The ideal level of a person-environment transaction occurs when the environmental demands slightly exceed that of the Adaption Level, known as the "Zone of Maximum Performance Potential" (Lawton, 1977). Resulting in stimulation, one of the three primary roles of the environment (Lawton, 1989), persons can have positive responses to being challenged to learn new skills and feel affirmed in their competencies.

Environmental demands can exceed levels of positive stimulation, and it is this intersection that leads to negative environmental press. Increased anxiety or stress outcomes are common for persons experiencing heightened levels of environmental press (Lawton, 1989). Individuals may feel a loss of control within their environment at such times, as functional abilities becomes increasingly influenced by the contextual demands surrounding them (Faletti, 1984). For highly competent individuals, a greater range of environments can be available without compromising adaptation levels to surroundings (Nahemow, 2000). Persons with lessened competency require a less demanding environmental context in order to reestablish or maintain a healthy transaction between functional abilities and surroundings (Nahemow, 2000).

A major criticism of the ETA model has been its emphasis that the environment and its demands largely determine and control behaviors of persons, while individuals have little ability to influence or control this interaction (Gitlin, 2003). The environmental docility hypothesis, a central component of the ETA model, contends that the environmental influence on behavioral outcomes increases as individual competency lessens (Lawton. 1990), increasing the potential for negative outcomes in later life (Gitlin, 2003). However, this assertion does not fully acknowledge the capabilities of all individuals to compensate and adapt to environmental conditions surrounding them (Wahl, 2003).

Lawton himself acknowledged this limitation of the theory and introduced the environmental proactivity hypothesis to highlight the active role older adults can have in influencing their environmental interactions (Lawton, 1990). Even with loss in competency experienced in later life, older adults are able to take active roles in

modifying environments (Oswald & Wahl, 2004). A supportive environment, such as a handicap accessible home, can compensate for declining functionality and lessened competency. One active choice older adults can make is to adjust their residential environment as a means to increase access to supportive features and restore a manageable balance between competency and environmental press (Wahl & Weisman, 2003).

1.3.3 Theory Contributions

The Ecology Theory of Aging has made significant contributions within the environmental gerontology research domain, a domain that is now considered an important subfield in the gerontological literature (Wahl & Weisman, 2003). Through the establishment of testable theories (Nahemow, 2000), the theory provides the conceptual framework for the majority of environmental gerontology development and research (Wahl & Weisman, 2003). The ETA model is also accredited with having both research and clinical applications (Gitlin, 2003), providing both a theoretical foundation for research and sensitivity to the interactional relationship between individuals and their physical environments for clinicians. In addition, the model is considered to be contemporary in nature (Kendig, 2003), as it conceptualizes an interaction that remains a fundamental concern across time for older adults, policy makers and researchers alike.

1.4 Proactive and Reactive Residential Adjustments

A person is considered to live in an appropriately accessible home when the interaction between their capabilities and environmental demands is well matched (Iwarsson, 2004). However, many elderly persons encounter difficulties in managing daily activities and self-care tasks within their homes because of a mismatch between

their functional abilities and the characteristics of their physical environments. Analysis of the 1995 *American Housing Survey* revealed that 14% of community-resident elderly respondents had housing-related disabilities, defined as having difficulty in using or functioning within the home or having an unmet need for a home modification (Newman, 2003). Some of the most prevalent difficulties and limitations related to housing features occur in bathrooms, kitchens and entryways, and include negotiating steps, entering or exiting the home, bathing, meal preparation, and doing housework and laundry (Gitlin, Mann, Tomit & Marcus, 2001; Iwarsson, Nygren, Oswald, Wahl & Tomson, 2006; Newman, 2003).

Despite the demonstrated preference of older adults to remain in current home environments and their confidence that they will be able to do so, housing adjustments by older people occur with regularity. The relationship between a person and their environment is dynamic, one that is constantly reassessed by individuals to determine if the housing characteristics are desirable and relevant for their current and perceived future priorities and needs (Golant, 2003, Wiles, 2005). For many, accommodative coping strategies, such as modifying goals or redefining what is considered to be problematic, are utilized to emotionally adapt to the increased negative encounters with their environment (Golant, 2011). A large proportion of older adults are found to adapt their behaviors and attitudes rather than the physical environment itself when experiencing difficulty in managing daily in-home tasks, such as opting to no longer use a second floor of a home (Golant, 2011; Longino, Bradley, Stoller & Haas, 2006; Pynoos, 1993; Wister, 1989).

However, depending upon features in the home, residential adaptations can become a necessity for older persons experiencing declining competency. Actions taken to modify or change residential environments are considered to be assimilative coping strategies (Golant, 2011). Concerns about the physical environment are found to be strong motivators of relocation within the community or into senior housing in later life (Fonad, Wahlin, Heikkila & Emami, 2006; Oswald, Schilling, Wahl & Gang, 2002; Pope & Kang, 2010).

Choice, action and change underlie the interaction between individuals and their physical environment (Ittelson, 1982). When reassessing the appropriateness of current home settings, older adults need to make choices about what actions they will or will not make regarding adaptations to their physical environment. Change is often avoided because of a perception that change is difficult and requires excessive time and energy (Slangen-de Kort, Midden & van Wagenberg, 1998). This perception may be connected with the frequency of disruptive moves in later life that are triggered by unforeseen events, such as sudden health crises or the death of a spouse (Choi, 1996, Colsher & Wallace, 1990; Pinquart, Sorensen & Peak, 2004; Pope & Kang, 2010; Speare, Avery, & Lawton, 1991).

Lack of proactive decision making to alter home environments prior to these unforeseen events can often lead to reactionary and permanent moves to more supportive housing environments. To respond reactively to negative environmental press, individuals can feel out of control because behaviors are typically determined by external forces (Lawton, 1985). The associated feelings of loss of control and dependency on others can lead to feelings of helplessness and greater difficulty in adapting and adjusting

to the demands exerted by new environments (Gignac, Cott & Badley, 2000). Bradley & Van Willigen (2010) concluded that residential adjustments triggered by negative events lead to greater levels of depression following moves; with results suggesting that the effect increases with age. Because these reactionary moves are common in later life, environmental changes are often considered to be destabilizing for people, negatively affecting physical health and functioning (Chen & Wilmoth, 2004; Findley, 1988) and psychological well-being (Golant, 2003).

However, making housing feature adjustments in later life does not necessarily need to be a destabilizing or negative experience. Even when facing declining competency, older adults can make proactive choices to alter their environmental context to maintain housing-related autonomy. Persons who make proactive residential decisions strive to change themselves or surroundings to lessen negative press of environmental contexts (Lawton, 1985) before the occurrence of a crisis or stressful event (Pope & Kang, 2010). Examples include decisions to modify existing home environments, either by opting to not use certain parts of a home (i.e. the second floor) or making structural adaptations, or by relocating to a new home (Oswald & Wahl, 2004; Oswald, et. al., 2006). Kahana, Kahana & Kercher (2003) allege that proactive decisions regarding housing will become more common as new cohorts reach retirement and experience age related physical needs. These new cohorts will have had greater exposure to health prevention initiatives, heightened awareness of the personal accountability in actualizing healthy outcomes and greater access to information because of technological developments. As a result, older adults will be increasingly aware of the personal

responsibility and role they have in positively impacting an array of outcomes throughout later life (Kahana, et. al., 2003).

If older adults take an active role in planning and preparing for their future housing needs, feelings of control are retained (Pinquart, et. al., 2004) and adapting to new environmental contexts is eased (Gignac, et. al., 2000). In addition, when older adults take a proactive role in making decisions about home adaptations, they experience greater self-respect (Lawton, 1990) and perceive greater gains than losses associated with the move (Chen, et. al., 2008). Proactive actions can serve to bolster psychological wellbeing (Pinquart, et. al., 2004). When applied to adapting and improving housing environmental features, proactivity can serve to introduce preventative measures to help ensure successful aging in place.

1.5 Residential Adjustment Options

1.5.1 Home Modifications

Home modification is a residential adjustment option that enables persons to remain in their own home even with worsening health and functionality losses. Home modifications are strategic adaptations and alterations made on the architectural and permanent physical features within and immediately outside of the house (Fange & Iwarsson, 2005; Pynoos, et. al., 2005). The overarching goal of these modifications is to promote independent living and facilitate aging in place, even with compromises in physical health and functionality (Fange & Iwarsson, 2005; Johansson, Lilja, Petersson & Borell, 2007; Pynoos, 1993; Pynoos, et. al., 2005).

Home modifications achieve this goal by lessening the environmental demands placed on individuals. Structural alterations that improve accessibility and usability of a

home for disabled persons can ease the difficulty in performing daily tasks, increase safety within the home setting by reducing the risk of falls, and delay need for personal care services or institutionalization (Pynoos & Nishita, 2003; Pynoos, 1993). Home modifications range in cost and complexity, encompassing everything from the installation of shower grab bars to architectural projects that alter the layout and accessibility of the home (Pynoos & Nishita, 200;, Pynoos, Tabbarah, Angelelli & Demiere, 1998). Inexpensive home modifications include rearranging furniture, adding additional lighting, or installing railings and grab bars. Costlier options such as the installation of ramps, widening doorways for wheelchairs, or the addition of a handicap accessible bathroom, can be cost prohibitive (Pynoos & Nishita, 2003).

Even though home modifications can enable elderly persons to successfully age in place, the proportion of older adults who live in houses with modifications is relatively small when compared to the level of disability and functional needs demonstrated by older adults. Tabbarah, et. al. (2000) found that in a nationally representative sample, only 22.9 percent of the respondents had grab bars in bathrooms, 9 percent lived in wheelchair accessible homes, and 5 percent reported having ramp access to street level. Analyses of the 1995 *American Housing Survey* revealed that approximately only half of the sample that reported having at least one household related disability (i.e. difficulty climbing stairs), lived in dwellings with at least one modification (Newman, 2003). However, research indicates that home modifications in homes do not always meet the unique requirements of those who live there, suggestive that home modification efforts need to be more tailored to individual needs (Newman, 2003; Fange & Iwarsson, 2005).

Older adults who live in houses that have undergone home modifications experience both physical and psychological benefits. Home modifications have been linked with self-perceived improvement in the ability to perform activities of daily living, instrumental activities of daily living and social or leisure activities (Petersson, Kottorp, Bergstrom & Lilja, 2009). This improvement was sustained over a 6 month period after the installation, suggestive that home modifications have a long lasting impact on aiding older adults to successfully function at home (Petersson, et. al., 2009). Studies also show that home modifications can stabilize physical health trajectories. Persons with home modifications at baseline experienced significantly lower declines in physical health at the 2-year follow up (Liu & Lapane, 2009).

Home modifications have also been found to be associated with improved psychological wellbeing among older adults. Studies that have examined outcome measures after installation of home modifications show that respondents report greater usability of homes (Fange & Iwarsson, 2005), improved self-rating of safety within the home (Petersson, Lilja, Hammel & Kottorp, 2008) and reduced perceived difficulty with managing everyday life tasks (Petersson, et. al, 2009). These positive, psychological effects can be an enabling force behind successful aging in place. Studies have found that fears about safety lead to decreased confidence and restricted activities among older adults which can contribute to increased dependence and heightened fall risk (Fuller, 2000; Tinetti & Williams, 1997).

Despite the demonstrated benefits of home modifications to achieve successful aging in place in later life and the significant increase of home modifications between 1978 and 1995 (Newman, 2003), implementation remains relatively limited. Wister

(1989) examined the prevalence of proactive thoughts and actions made by elders regarding housing and found that only 15% of the sample of older adults made modifications to their home. Although the majority of elderly people believe that home modifications do enable people to successfully age in place (Bayer & Harper, 2000), studies suggest low levels of compliance when they are encouraged by service professionals to make these adjustments (Nikolaus & Bach, 2003, Yuen & Carter, 2006).

Research has not determined a well-defined point in disability or health trajectories when older adults decide to make home modifications (Johansson, et. al. 2007). Rather, people are influenced by several factors when considering home modifications, which can facilitate or deter decisions taken by older adults and their family members. Level of awareness and knowledge about home modifications, along with the actual and perceived affordability of modifications are all directly and negatively influenced by the fragmented and poorly funded service delivery system (Pynoos, 1993).

A willingness to undertake home modifications requires older adults to be open to change their homes and adjust how they do their activities (Pynoos, et. al., 2005). For many, this willingness stems from knowledge and awareness of the benefits of home modifications. The primary reasons for making home modifications reported by older adults were all related to supporting aging in place (Bayer & Harper, 2000). Persons with greater intentions to implement home modifications were more likely to have made previous alterations to their homes or expressed belief that home modifications are beneficial and can reduce falls (Yuen & Carter, 2006). A general lack of understanding and awareness of the importance of environmental features on outcomes in later life, by

older adults and professionals alike, has hindered the advancement of home modification implementation (Pynoos, 1993).

Financial constraints are viewed to be a significant deterrent of undertaking home modifications, particularly for more costly changes such as structural adjustments (Sheets & Liebig, 2005, Tabbarah, et. al., 2000). Thirty percent of respondents in AARP's *Fixing to Stay* study indicated they were very or somewhat concerned in their ability to afford home modifications (Bayer & Harper, 2000). This same study also showed that the two most common reasons why home modifications were not made were an inability to do the work themselves and an inability to afford to pay someone else to do the work (Bayer & Harper, 2000). The majority of home modifications are paid for out of pocket, by the individual and family members (Pynoos, 1993). In general, cost of home modifications cannot be regained, as modifications rarely add market value to homes (Smith, et. al., 2003). The concern about affordability has become even more relevant because of the recent economic downturn. A recent study that examined the impact of the economic downturn on home modification implementation learned that many of the respondents had delayed taking any action because of financial affordability and concern about getting a return on the investment (Koppen, 2009).

1.5.2 Residential Relocation

Relocation is an alternative residential adjustment that older adults can consider when experiencing difficulties functioning within current home environments. Although relocation is often perceived to be an action triggered by sudden and disruptive life events (i.e. death of a spouse), it can also result from a gradual shifting of circumstances that lead to proactive relocation decisions (Wiseman & Roseman, 1979). Proactive moves

in later life require older adults to reconsider the emotional value of their housing in comparison to supportive characteristics available in alternative homes. Stated another way, the core of residential decision making in later life is the weighing and balancing of gains and losses associated with a move (Chen, et. al., 2008). Golant (2011) asserts that older adults must believe they will gain more positive outcomes when relocating for actual consideration and action to occur. Multiplex environments are formed when older adults choose to trade in emotionally favorable characteristics, such as familiarity or the space to store family heirlooms, in order to gain supportive physical features (Lawton, 1985). Older adults who make proactive decisions to move into multiplex environments may experience multiple benefits, including preservation of a sense of autonomy and active engagement with life, along with a continuation of being in control of residential decisions (Lawton, 1985).

Housing in later life can be divided into three broad categories; age-integrated housing, age-segregated senior housing and institutional settings (Clough, Leamy, Miller & Bright, 2004), each of which encompass a wide array of options. Even when relocating in later life, many people continue to prefer age-integrated housing and will seek to downsize to smaller homes or condominiums that offer the desirable household features and less home maintenance work. Moving into an age-segregated senior housing setting is another residential relocation option for moves in later life. These facilities offer disability friendly housing and a basket of services that foster social interactions, manage a range of home maintenance details, and provide emergency care. Examples of age-segregated senior housing include 55+ Communities, Continuing Care Retirement Communities (CCRCs) and Assisted Living facilities. Some age-segregated housing also

offer heavier care options, such as limited skilled nursing services or specialized dementia care units. However, institutional settings, such as nursing homes where 24-hour medical oversight or dementia supervisory programming is provided, may be more appropriate for older adults who require more extensive and/or specialized services. Although generally not a housing option that is voluntarily selected by older adults, institutional settings are an integral component of the housing network for older adults.

Although relocation is less common among older cohorts compared to those who are younger (Bayer & Harper, 2000, Blake & Simic, 2005, Borsch-Supan, 1990), residential moves in later life do occur. A recent housing study using the 2003 *American Housing Survey* data found that 16.8 percent of respondents age 75-84 and 13.5 percent of those ages 85+ reported moving in the past 5 years (Blake & Simic, 2005). Most notable among their findings is that persons who moved in late life (age 85+) and remained householders rather than moving in with an adult child or into an institutional setting, had a much greater likelihood of moving into smaller housing environments, rather than similar (12.6% vs. 2.8%) or larger settings (12.6% vs. 5.5%) (Blake & Simic, 2005). These results are suggestive that persons who move in late life, particularly among those in the oldest-old age category, downsize into smaller homes that may be easier to manage when experienced lessened competency.

Residential mobility often occurs when older adults experience negative shifts in physical health, functional capacity and activity participation. Residential relocation decisions are complex and are most often determined by multiple factors (Oswald & Rowles, 2006). A decision to move may occur when older adults determine that their activities, within the home or broader community, are severely limited due to disability

and health constraints. Chen, et. al., (2008) determined that the cumulative losses of physical, functional or social abilities combined with a triggering major event, such as a loss of a spouse, preceded residential moves. Community residing elderly people most often cited that health status changes would likely precipitate future relocation (Carpenter, et. al., 2007). Poor self-rated health has been linked with increased likelihood of moving among older adults age 75 and older, compared to those who perceive themselves to be in good health (Glaser & Grundy, 1998).

Research has clearly defined the strong relationship between increasing disability, lessening functional independence and residential moves among persons in later life (Chen, et. al., 2008; Colsher & Wallace, 1990; De Jong, Wilmoth, Angel & Cornwell, 1995; Jackson, Longino, Zimmerman & Bradsher, 1991; Newcomer, Kang, Kaye & LaPlante, 2002; Pope & Kang, 2010; Silverstein & Zablotsky, 1996; Speare, et. al., 1991). However, worsening changes in functionality and disability have been shown to be most influential on decisions to relocate in later life. Consistent research findings suggest that poor functioning older adults with similar levels of functioning at baseline and follow-up are less likely to move when compared to persons who experience a decline in functionality measures (De Jong, et. al., 1995; Jackson, et. al., 1991; Newcomer, et. al, 2002; Speare, et. al., 1991).

Although limited research has been done to specifically explore the relationship between home environmental contexts in the facilitation of residential moves among older adults (Kendig, 2003), the findings suggest that physical environmental characteristics are influential in relocation decision making. Environmental barriers were listed as reasons that might require relocation in a study that examined what concerns

older people living in the community have about possible relocation in the future (Carpenter, et. al., 2007). Statistical analysis using the *Pathways to Life Quality* longitudinal study examined the residential choices of 333 community residing adults age 60+ and the multiple factors involved (Erickson, Krout, Ewen, & Robison, 2006). The previous homes of the respondents who had moved had significantly fewer accessibility features (Erickson, et. al., 2006). In addition, respondents with more accessibility features were significantly less likely to consider making a future move (Erickson, et. al., 2006). Oswald, et. al. (2002) examined the motivations for relocation among a sample of 217 community residing elderly persons in Germany. The study found that physical environmental aspects, such as relocating into a smaller living space, were the most common motives (43%), compared to other prevalent motives related to social (21%) or physical and functionality aspects (24%). In another study, one-quarter of respondents who moved between interviews indicated some level of dissatisfaction with the physical features and poor accessibility of their prior home as motivation for relocating (Iwarsson & Wilson, 2006).

In general, relocation in later life is considered to be a stressful life event (Oswald & Wahl, 2004). Some persons resign themselves to moving because they do not have alternative options that permit them to remain safely in their current home (Smith, et. al., 2003). Others have no personal control or influence on relocation outcomes as moving decisions can be made by others for them, most often during times of health crises. The literature implies that residential relocation resulting from significant and sudden declines in health or disability conditions can lead to continued deterioration rather than enhancement of overall well-being (Chen & Wilmoth, 2004; Choi, 1996; Findley, 1988).

Sixty-five percent of elderly respondents in a study by Findley (1988) fit into the "destabilized migrant" category due to their experiencing worsening health and disability before *and* after a move.

However, relocation can be a well-planned action that stabilizes the match between individuals and their environment and promotes independence (Chen & Wilmoth, 2004; Hong & Chen, 2009; Wahl, 2003). Research suggests that the negative outcomes after relocation are not sustained long term (Bradley & Van Willigen, 2010; Chen & Wilmoth, 2004; Hong & Chen, 2009). And when the environmental fit between older adults and their surroundings is improved, health and functional status has been found to improve across time (Hong & Chen, 2009). Moving at any life stage is challenging and disruptive, but if chosen voluntarily by older adults fewer negative outcomes are experienced (Oswald & Wahl, 2004). In addition, positive relocation experiences into homes with supportive features lead to greater optimism about the potential benefits of future residential moves that may be required (Wister, 1989).
*Removed Section 1.5 from previous draft (Interaction between Individual and Environment

1.6 Research Limitations

The theoretical analysis of the interaction between the physical environment and individual competency, mostly founded on the Ecological Theory of Aging, has been examined and written about extensively (Kendig, 2003). However, less work has been done to empirically examine the theoretical assertions of the theory (Kendig, 2003; Oswald & Rowles, 2006). Because of this empirical gap, the full potential of the

Ecological Theory of Aging has not yet been fleshed out in the current literature (Kendig, 2003) and additional empirical examination is required.

Two main challenges underlie these empirical limitations within the environmental gerontology research domain. There is a need for greater precision in concept development as well as a use of more complex methodological designs in order to bring clarity in the understanding of the dynamic relationship between person and environment (Gitlin, 2003; Golant, 2003; Kendig, 2003; Oswald & Rowles, 2006; Wahl & Weisman, 2003; Wahl, et. al. 2009). These challenges must be addressed in order to further advance the empirical development and understanding of the complexities of the ecology theory of aging.

The majority of research that has examined the relationship between person and environment has been done at a cross-sectional level of analysis (Golant, 2003; Wahl, et. al., 2009), which cannot adequately incorporate the influence of temporal changes that occur between older adults and their physical environments (Golant, 2003). Because of the predominance of cross-sectional analysis in this domain, the relationships between home environmental features and disability and wellbeing outcomes in later life that have been suggested in the literature are not well developed (Wahl, et. al., 2009). Several review articles within the domain have called for the use of longitudinal research designs as a means to improve the empirical analyses of the personal environment interaction (Gitlin, et. al., 2001; Golant, 2003; Oswald & Rowles, 2006; Oswald & Wahl, 2004; Wahl, et. al., 2009). The use of longitudinal studies to examine the interactions and relationships between people and their environmental contexts introduces greater

sensitivity to the influence of change in addition to also strengthening understanding of the complexities of the relationships.

The second major challenge is the need for clarity in the definition of the key concepts of the Ecological Theory of Aging and the development of measurement tools that more effectively measure these concepts. Because of the complex breadth of the theory's concepts, the constructs of the ecological theory of aging have been challenging to operationalize and are currently without standard operational definitions or measurement tools (Wahl, et. al., 2009). For example, competency has been defined as broadly as inclusive of a range of personal aspects, social networks, and adaptability of physical environments (Slangen-Kort, et. al., 1998), and as restrictive as ADL dependence, life satisfaction and perceived health (Iwarsson, Horstmann & Slaug, 2007). Another study operationalized person-environment fit with a variable measuring accessibility that the researchers viewed to encompass both the personal competency and environmental characteristics (Iwarsson, et. al, 2006). As a result of this diversity in the literature, measures lack consistency and findings across studies are incomparable (Wahl, et. al., 2009). This hinders advancement of knowledge about the intricate relationship between person and environment that researchers attempt to explain through empirical application of the theory (Wahl &.Weisman, 2003). Efforts must be made to further develop the key theoretical constructs in order to aid the development of more concrete and reliable empirical techniques.

Improved empirical measurement of the fit between person and environment unique to the individual is an important subcomponent of the call for conceptual clarity in the environmental gerontology research domain. The tendency for researchers to treat

elderly respondents as a homogenous group also contributes to the dearth of knowledge about the interaction between person and environment in later life. The underlying assumption is often that environmental barriers are similarly challenging for all older adults, which consequently has led to little development in distinguishing between differing levels of environmental press experienced according to individual levels of competency (Gitlin, 2003). Although this assumption simplifies methodological development, it fails to recognize that older adults are a heterogeneous group with much variance in functional abilities, health and disability trajectories (Golant, 2003; Iwarsson, et. al., 2007). An environmental hazard for one person may not represent the same challenge or hazard to another person who is coping with a different set of competency losses. There is a need for research to develop measures that are more telling of what types of housing features are most supportive or problematic for older adults depending on individual competency (Gitlin, 2003; Iwarsson, et. al., 2007; Wahl, et. al., 2009) and how these nuances influence residential adjustment outcomes.

1.7 Research Questions and Aims

This research sought to expand the environmental gerontology literature by examining the intersection of the built environment and person-environment fit on housing adjustments made in later life. The analyses were divided into two distinct research aims. The first group of analyses examined the influence of the built environment on making subsequent housing adjustments of differing types. The second research aim considered the built environment features of homes that older adults move into when relocating in later life and what characterized persons who relocate into homes

that offered additional supportive environmental features in comparison to previous residences.

The study expanded the literature with two exploratory methodological techniques aimed to bring additional clarity to the theoretical constructs of competency and person-environment fit. In an effort to introduce a more comprehensive operational definition of competency, factor analysis was used to derive factors that represent physical health, functioning and cognition. In addition, a person-environment misfit variable was included in these analyses. The misfit variable, a count of unique combinations of specific environmental features and specific competency variables (i.e. multi-floor living space and history of falls), was an exploratory attempt to operationalize person-environmental fit and ascertain if increasing environmental demand is indicative of housing adjustment outcomes.

1.7.1 Built Environment and Subsequent Residential Adjustments

The first research aim examined three research questions. These questions sought to clarify and expand understanding about the influence of person-environment fit and characteristics of the built environment on the likelihood of making subsequent residential adjustments in later life. Each of the research questions in each group of analyses analyzed the impact of home environmental features on residential adjustment decisions made in later life. Physical features of respondents' homes were used as key variables to better ascertain the importance of current physical environments on housing decisions made by persons in later life.

The first research question looked broadly at residential outcomes, including housing adjustments (home modifications or relocation), no adjustment, death or nursing home admission. In the analysis, the full study sample was examined.

Research Question #1: **What is the role of physical environmental characteristics and person-environment fit on determining residential adjustments made in later life?**

Although there are many research studies that have examined the occurrence of home modifications and relocation within elderly populations, studies that emphasize the physical environmental features of the home settings as primary variables of interest are uncommon. Within the home modification literature, studies are mostly limited to analysis of falls prevention (Nikolaus & Bach, 2003), demographic comparisons of persons who reside in homes with modifications (Tabbarah, et. al., 2000), or discussion about the limited implementation of modifications due to subjective, physical or financial constraints (Pynoos & Nishita, 2003; Yuen & Carter, 2006).

Among relocation studies, few have incorporated housing and physical environmental features as key variables in the analyses. Research that examined residential relocation has focused primarily on the pathway to institutionalization or how individual subjective perceptions about home environments often deter relocation in late life (Wahl & Weisman, 2003). Past research that examined characteristics of older adults who relocated clearly demonstrated that declines in health and ADL and functional status (De Jong, et. al., 1995; Jackson, et. al., 1991; Silverstein & Zablotsky, 1996) lead to relocation in late life. The findings among the few studies that examined specific

household environmental characteristics were suggestive that these characteristics did influence residential adjustment outcomes (Choi, 2004; Erikson, et. al., 2006; Iwarsson & Wilson, 2006; Oswald, et. al., 2002). Controlling for a range of supportive environmental features in this analysis permitted additional examination of how specific supportive home characteristics intersect with housing adjustment outcomes made in later life.

The second and third research questions considered what options older adults choose when selecting to make a residential adjustment to current living environments. Again, physical features of respondents' homes were used as key control variables to examine if a predictive relationship existed between the presence or absence of supportive home characteristics and residential adjustment options selected by older adults.

Research Question #2 **– What is the role of physical environmental characteristics and person-environment fit on eliciting home modifications as opposed to relocation outcomes in later life?**

Research Question #3 **- What is the role of physical environmental characteristics and person-environment fit on whether or not older adults choose to relocate into age-segregated senior housing?**

The second analysis examined a subsample of the full analysis comprised only of those cases that had made a residential adjustment, inclusive of home modifications or

relocation. The third analysis used a different subsample that only included cases where relocation had occurred.

Three distinct types of residential adjustments were studied; home modifications, relocation to age-integrated housing, and relocation to age-segregated senior housing. The inclusion of home modifications and multiple relocation options as outcomes of interest in this study expanded the current literature by allowing for comparisons between different residential adjustments subgroups. Home modification and relocation research have been maintained as distinct domains of study within the current literature. To my knowledge, no study has looked at both implementation of home modifications and decisions to relocate when examining residential adjustments in later life. In addition to exploring the impact of the built environment and person-environment fit, this analysis examined whether or not distinct characteristics differentiated respondents who chose home modifications versus relocation.

The inclusion of two separate relocation outcome categories allowed for even greater dissection of the differences among residential adjustment subgroups. The desire to age in place (Kochera & Straight, 2005; Leeson, 2006; Wagnild, 2001) and the triggers of relocation are well established in the literature (Colsher & Wallace, 1990; De Jong, et. al., 1995; Jackson, et. al., 1991; Newcomer, et. al., 2002; Silverstein & Zablotsky, 1996; Speare, et. al., 1991), but little is known about what factors may differentiate elderly movers who elect age-segregated senior housing options from those who move into alternative age-integrated housing options. Research that has looked at relocation into retirement communities suggests health and disability declines as important precursors to relocation into senior housing, similar to findings among studies that have examined

moves into general housing (Silverstein & Zablotsky, 1996). In addition, research findings have indicated that feelings of insecurity and a desire for safer living environments trigger decisions to relocate into retirement communities (Fonad, et. al., 2006).

However, additional knowledge is needed to more fully explain what factors characterize older persons who choose senior living options instead of alternative, age-integrated housing. Supportive features are very common, if not guaranteed, in age-segregated senior housing facilities. Controlling for specific home environment characteristics prior to relocation will disentangle if these supportive features are an important consideration for older adults when opting for senior housing. An additional aim of the third analysis was to examine if other objective and measurable differences existed between people who chose one of these two alternative residential relocation options.

1.7.2 Built Environment after Relocation

In order to gain a richer understanding of how the built environment intersects with housing adjustments made in later life, it is equally important to also examine whether or not older adults opt for homes that offer additional supportive features than before. The second research aim considered the built environment features of homes that older adults move into when relocating in later life and what characterized persons who relocated into homes with additional supportive environmental features. A subsample of the full analysis sample was used, comprised only of cases that relocated. The following research questions were addressed.

***Research Question #4* – What supportive environmental features are most often obtained upon relocation in later life?**

***Research Question #5* – What characterizes respondents who move into homes that offer more supportive environmental features than previous homes?**

Due to the prevalence of cross-sectional studies within the environmental gerontology research domain, little work has been done to explore the physical environmental features of homes that people choose to move into when making later life residential transitions. Greater attention has been given to consideration of the environmental characteristics of homes that older adults currently reside in or have recently moved out of. Past research has also not examined if differences exist between respondents who make structural improvements compared to those who make no improvements when relocating.

The longitudinal approach of this study is an opportunity to examine the new home environments of respondents who relocated in comparison to characteristics of prior home settings. This comparison explored the extent to which older people selected new home environments that offered additional elder-friendly physical environmental features when relocating in later life. The one study that did look at this comparison, although limited in generalizability because of small sampling, is suggestive that older adults relocate into homes with more supportive features (Oswald, et. al., 2002). This research expanded the literature by considering if older adults alleviate environmental

housing demands when making late life residential adjustments and what characterizes those who elect to do so.

CHAPTER 2

METHODS

2.1 Data Source

The data for this research were taken from The Health and Retirement Study (HRS). The HRS is a nationally representative longitudinal survey about health, employment, economic status, and family structure of sample respondents (for detailed review, see Juster & Suzman, 1995). The HRS was an appropriate dataset to use for the proposed research questions because of two characteristics of the survey. The housing section in the survey inquires about a wide array of housing characteristics, including physical environmental design and modification features. In addition, the longitudinal design of the HRS permits examination of these housing characteristics across waves, an important expansion to the environmental gerontology research domain. The longitudinal design strengthened the findings two-fold. In addition to sensitizing the results to changes in physical health, functionality and overall competency that can influence housing adjustment outcomes in late life, it also permitted analysis of change in home environmental features following relocation.

A relatively small proportion of HRS respondents selected for this study relocated or made home modifications between waves (See Table 1). To optimize the number of

move observations in the analyses samples and strengthen the statistical power of the analytical models, the three data groups were stacked to create a final, pooled dataset comprised of T1, T2 and T3 participant data observation points. In this research, five consecutive waves of the HRS were used; 1998, 2000, 2002, 2004, and 2006. The final stacked dataset contained data from three groups, each comprised of three waves of the study (1998-2000-2002; 2000-2002-2004; 2002-2004-2006). The second wave of each data grouping (T2) served as the primary data collection point of the independent variables. The first wave of each grouping (T1) provided baseline characteristics of health and functionality that permitted analysis of the impact of negative shifts in competency between T1 and T2 on residential adjustments. The dependent variables of the analyses were measured in the third wave (T3) of each grouping. The unit of analysis for each of the analyses in the study was three-wave respondent observations.

Table 1: Housing Adjustments by Data Grouping

	T1 - T2 - T3 98-00-02 N=4,093		T1-T2-T3 00-02-04 N=4,061		T1-T2-T3 02-04-06 N=4,103		Stacked Sample N=12,257	
Housing Adjustment	# Cases	%	# Cases	%	# Cases	%	# Cases	%
Relocation	499	12.2%	414	10.2%	401	9.8%	1314	10.7%
Home Modification	256	6.3%	304	7.5%	345	8.4%	905	7.4%
Total	755	18.4%	718	17.7%	746	18.2%	2226	18.1%

Source: Health and Retirement Study, 1998 - 2006 waves

Three-wave data groups were used in constructing the dataset to sensitize the results to the influence of change in competency on housing adjustments made in later life. A single wave, cross-sectional examination of the data would not have permitted

analysis of change in competency on housing adjustments made in later life, an integral component of the person-environment fit theory conceptually underlying this research. Analysis of change in functionality on adjustment outcomes would also have needed to have been excluded from two-wave longitudinal analyses (Leland, Porell & Murphy, 2011). Including change in competency measures in a two-wave examination would have required that change in competency and the dependent outcome variable be measured in the same wave. Consequently, the timing of events would not be known, as it would be unclear if the housing adjustment or the decline in competency happened first.

The three-wave data group dataset study design did not share the limitations of cross-sectional or two-wave study designs. Because three data points were included, change in competency was measured between T1 and T2, while only the dependent variables were measured at T3. This allowed for cleaner interpretation of analysis results as it clearly separated the outcome from what influenced the outcome. However, one notable limitation of the three-wave data group study design is the inability to measure changes in health and functionality that may occur between T2 and T3 which may also impact housing adjustments made at T3. The reason to not measure change in competency between T2 and T3 was the same as the limitation noted for using a two-wave study design. As previously stated, measuring the housing adjustment outcomes at a distinct data point maintained clarity in the timing of events facilitating the interpretation of the results.

2.2 Sample Weighting and Cluster Analysis Estimation

The HRS is a nationally representative survey of cohort eligible older adults in the United States. The sample is a multi-stage probability sample with oversampling of cohort eligible persons of African American race or Hispanic ethnicity. Respondent level sampling weights were used in the analyses of this study to adjust for the oversampling of these three respondent groups. The minority of cases with zero weights that remained in the sample after sample exclusion criteria had been applied were excluded from the final data sample.

The stacked dataset containing repeated observations of individual respondents yielded large intraclass correlations within each individual cluster of respondent observations. Clustered robust standard error estimation was used to adjust the standard errors for each observation within a cluster, defined in these analyses as the household-person identification number. The VCE(cluster variable) command in STATA 10 was used in these analyses to generate standard errors that more accurately reflected the independence across cluster groups while correcting for the correlations within cluster groups.

2.3 Overall Sample

The respondent sample was then selected according to six selection criteria. Table 2 outlines the sample loss associated with imposing the sample criteria for each data grouping. First, the sample was restricted to respondents who participated in the survey at T2. Respondents new to the study at T2 were excluded from the sample because no T1 data was available to provide health and functionality history. Respondents who dropped

out of the study at T3 for reasons other than death (active attrition) were also excluded from the sample. Analysis of attrition in the HRS and AHEAD samples suggests that active attrition does not appear to be selective and is therefore statistically ignorable (Cao & Hill, 2005).

The second criterion restricted the sample to include respondents age 70 or older at T2. This age criterion was chosen to select respondents most likely to be experiencing declines in health, functionality and competency. This age restriction limited the inclusion of amenity migration moves, common among younger retirees and often motivated by reasons other than poor health, declining competency or housing environment misfit (Litwak & Longino, 1987).

A third criterion excluded respondents residing in nursing homes at T2. It was assumed that physical environmental characteristics would be minimally influential in triggering residential adjustments made by nursing home residents between T2 and T3.

The fourth criterion only selected respondents living alone or with a spouse for the analysis sample. Co-residency at T2 with persons other than a spouse, such as an adult child, is suggestive that a previous move made in response of declining functionality may have already occurred. Co-residency with persons other than a spouse indicates a readily available informal support network that may reduce the impact of home environmental features on future relocation decisions.

The fifth criterion selected one spouse/partner of a household, if the second member of the household had not been excluded with the previous criteria. In general, a change in residential arrangements is taken jointly by members of the same household.

Household level of analyses, however, would not adequately capture the individual nature of competency and person-environment interactions and the resulting influence on residential adjustment outcomes. To sensitize the results of this study to both respondent level competency and the household nature of residential adjustments, the sample was restricted to only one respondent per household. For households with more than one study participant, the respondent with the greatest generated random number was selected for the sample. Other methods of selecting the individual representing the household, including age, degree of impairment and designated study household respondent, were considered but not utilized because of potential introduction of sampling bias.

The final criterion removed respondents with zero weights, as previously discussed.

Table 2: Sample Loss Due to Selection Criteria by Data Grouping: Listed in hierarchical ordering of selection

	T1 - T2 - T3 1998-2000-2002 N=19,579		T1-T2-T3 2000-2002-2004 N=18,166		T1-T2-T3 2002-2004-2006 N=20,129	
Sample Exclusion Criteria	# Cases	%	# Cases	%	# Cases	%
Entered Study at T2/ Exited study at T3 (reasons other than death)	1,556	8.0%	1,571	8.7%	4,529*	22.5%
Age <70 at T2	11,006	56.2%	9,479	52.2%	8,344	41.5%
Nursing Home Residents at T2	403	2.1%	448	2.5%	424	2.1%
Co-Residency at T2 (not Spouse/Partner)	1,350	6.9%	1,413	7.8%	1,487	7.4%
Second Household Member (Spouse/Partner)	1,170	6.0%	1,188	6.5%	1,224	6.1%
Zero Weight	1	0.0%	6	0.0%	18	0.0%
Data Group Sample	4,093	20.9%	4,061	22.4%	4,103	20.4%
Stacked Dataset Sample	N=12,257					

*A new cohort (Early Boomers), added to the HRS sample in 2004, was ineligible for this study

2.3.1 Subsamples

Three subsamples, derived from the stacked sample described above, were created to perform additional analyses of residential change outcomes in later life.

2.3.1.1 Home Modification Subsample

The home modification subsample (n=1,921) included only relocation or home modification respondent observations between T2 and T3. This subsample was used in the second analysis to examine characteristic differences between respondents who relocated in comparison to respondents who made home modifications.

2.3.1.2 Relocation Subsample

The relocation subsample (n=1,098) used in the third analysis of the study, included only relocation respondent observations between T2 and T3. The subsample was used to compare characteristics of respondent observations of senior supportive housing relocation with observations of non-senior housing relocation.

2.3.1.3 Environmental Change Subsample

The Environmental Change Subsample (n=1,108) was also inclusive of only relocation respondent observations between T2 and T3. The subsample was used in the fourth analysis of the study to examine the characteristics of respondents who relocated into homes offering more supportive environmental features than previous housing in comparison to respondents who made no structural improvements. A third outcome category was also included to identify respondents who moved in with an adult child or other informal caregiver since such a move can also be a way older adults can choose to alleviate experiences of negative environmental demands.

2.4 Missing Data

Missing data was present in 15.0 percent (N=1,833) of the selected stacked dataset sample (N=12,257). Missing data were categorized into three variable groups: competency variables, housing environment variables, and other variables.

2.4.1 Competency Variables

Imputations were used to fill in missing data on the six competency variables used in the principal component analysis (described in Section 2.6.3.1); self-reported health, count of chronic conditions, cognition, functional limitation count, activities of daily

living limitation count, and instrumental activities of daily living limitation count. These missing cases accounted for 1 percent (n=141) at T1 and 1.8 percent (n=224) at T2 of the stacked dataset. Although missing data were minimal for each of these variables (< 0.01%), the cumulative effect of the missing data compounded its impact. The weighted component factor scores used to calculate the decline between T1-T2 analyses variables had missing data if values were missing for one or more of the six individual competency variables. These factor score competency variables were also used to generate spouse competency factor scores with spouse merges which would also have compounded the magnitude of the missing data.

Imputations were calculated utilizing the groupings of variables identified with principal component analysis (PCA) to have relatively high. PCA extracted two component factors from these six competency measures comprised of three variables each. three variables identified for each component factor were regressed and used to predict the missing values for a variable when two of the three variables had known values. In total, 92 percent (n=130) of the missing competency variable data were imputed at T1 and 93.6 percent (n=210) were imputed at T2.

2.4.2 Housing Environment Variables

The Health and Retirement Study utilizes extensive skip patterns for housing related variables. Housing environment features do not dynamically change between waves of the study and were therefore not updated at every wave. In general, only new respondents or those who indicated moving and/or making a home modification were asked to provide new information about housing characteristics. Therefore, data about

housing characteristics were collected from earlier waves of the study (HRS 92, 94, 96, 98 and AHEAD 93, 95) to hierarchically assign values for the housing environment variables for respondents who entered the study prior to 2000 (the first T2 wave of the study used in the analyses) with no updated housing environment data.

After the insertion of built housing characteristics from earlier waves, 9.9 percent (N=1,213) of the final stacked dataset had missing values on one or more of the six housing environment variables; size of home, stairs, bathroom safety fixtures, ramps, railings, wheelchair accessibility. Two categories of missing data were identified. First, 53.5 percent (n=649) of the observations with missing housing data were missing because the information was not provided in the initial entry wave and no housing adjustment was made in a subsequent year to override the housing variables skip patterns. Of these cases, two-thirds (n=434) were respondents observations entering the study in the first two HRS waves (1992 or 1994). In these two initial HRS waves, all but one of the housing environment variables were not included in the survey. Respondent observations with missing housing information at entry into the HRS study at 1992 or 1994 with no subsequent moves accounted for 35.8 percent of the total number of cases with missing values (434 out of 1,213) on one or more of the housing environment variables.

The second category of missing data, accounting for 46.5 percent (n=564) of the missing housing environment cases, was attributed to skip pattern error. Due to the complexity of the skip patterns within the HRS survey design, the housing environment variables were skipped for a notable minority of respondent observations, despite the occurrence of relocation or other housing adjustments. In these cases, housing feature

data from earlier waves, if provided, became obsolete. The majority of these respondent observations entered the study in 1992 or 1993 (n=470). These cases were excluded from the study data because data on current housing was missing.

A t-test for two independent samples was performed to compare sample mean differences between respondent observations with missing data on housing environmental features variables and observations with complete data for this subset of variables. As already mentioned, observations with missing data were more likely to have entered the study in 1992 or 1994. However observations with missing data were significantly less likely to have entered the study in 1993, even with the large number of missing cases among these respondent observations. Among respondent characteristics, observations with missing data were significantly more likely to be male or married. In addition, these observations were also more likely to be living in a smaller home with three or fewer rooms and for shorter durations. Notably, an equal proportion of respondent observations in both samples had residency tenures of two or fewer years, indicative of similar recent relocation patterns among both groups.

Cases with missing data on one or more of the housing environment variables were removed from the study sample. This method was preferred over imputation for several reasons. First, accurate imputation of housing feature variables, such as wheelchair accessibility, presents unique imputation challenges since these characteristics are not intrinsically related to demographic or health characteristics that could be used to calculate imputation values. Second, with the possibility of inaccurate imputation values, resulting bias or error could have had a greater impact on results since housing

environment variables were key, independent variables in the study analyses. Third, housing characteristic data were used to create additional variables used in the study analyses (person-environment fit; supportive feature improvements). If used, imputed data, including inaccurate imputations, would have had compounded influence on study outcomes.

2.4.3 Other Variables

Eight percent (N=971) of the stacked dataset at T2 had missing data on variables other than the housing characteristic measures. After the removal of the cases with missing data on housing environment variables, this category of missing was reduced to only 5 percent (N=620) of the stacked dataset. Five percent (n=30) were missing the dependent variable used in the first analysis, from which the subsequent dependent variables were derived.

Approximately one-half of the remaining missing cases were accounted for by only two variables; proximity of adult children and depression. Nearly one-third (n=193) had missing data only on the proximity of children variable. This pattern can be attributed to a survey error in Wave 2000 when this question was only asked of respondents who listed two or more nonresident children. Data for respondents with no children were assigned the value of not living in close proximity to a child. However, the skip pattern in Wave 2000 also skipped respondent observations with only one child. When appropriate, data were retrieved from a variable identifying if respondents had no contact with their children and assigned accordingly on the proximity variable. Missing data on the count of depressive symptoms variable alone accounted for approximately 15 percent (N=83) of

the missing data on non-housing variables. Respondent observations missing one or more of the eight variables of the CES-D scale were missing on this count variable. The remaining missing cases (N=314) were spread across the non-housing variables, including the competency decline variables.

Cases with missing data on these other variables were also excluded from the study sample. A t-test for two independent samples revealed that respondent observations with missing data on these other variables were more likely to be widowed, renters and recipients of caregiver assistance. These respondent observations were also less likely to have the highest category of income and assets or to live in homes with six or more rooms.

The final overall sample, following the removal of missing cases, equaled 10,424. Table 3 displays the final sample count following the removal of respondent observations with missing data.

Table 3: Missing Data

Stacked Data Sample after Selection	12,257
Missing Housing Environment Variables	-1,213
Missing Other Variables	-620
Analysis Sample	10,424

2.5 Dependent Variable Measures

2.5.1 Residential Adjustment – Analysis 1

The dependent variable in Analysis 1 identified respondent observations according to the type of residential adjustment made between T2 and T3. Respondent

observations were classified into one of four mutually exclusive outcome categories; (1) no residential change, (2) residential adjustment, inclusive of home modifications, relocations into independent housing and relocations into senior housing, (3) nursing home admission and (4) death.

A hierarchy was used to determine where to place the minority of respondents who answered "yes" to more than one outcome category at T3; Death, Nursing Home, Relocation Senior Housing, Relocation Independent Housing, Home Modifications. Relocation into a nursing home and death were not primary outcomes of interest in this study but were retained in the sample to minimize sample bias. Wave specific respondent information on vital status and sample status in the Tracker file was used to code death. Missing cases were filled in by use of the National Death Index variable, available starting in Wave 5 (2000).

2.5.2 Home Modification – Analysis 2

The dependent variable for the second analysis included only the respondents who reported making a home modification or relocating between T2 and T3. Study participants who reported making a home modification were compared to those who reported moving to a different home. Home modifications are defined in the HRS survey as changes made to make homes safer for older or disabled persons. The home modification question was introduced into the HRS study in wave 4 (1998).

2.5.3 Senior Living Housing – Analysis 3

The dependent variable used in the third analysis of the study differentiated between respondents who relocated into service supported age-segregated senior housing

and respondents who relocated into age-integrated housing between T2 and T3. Respondents were classified as moving into age-segregated senior housing if they indicated that their new home was part of a retirement community or other type of housing that offered special services for older or disabled adults. The HRS survey does not differentiate between different types of supportive age-segregated senior housing, such as continuing care retirement communities or assisted living facilities.

2.5.4 Environmental Improvement – Analysis 4

The dependent variable of the fourth analysis included respondents who reported moving between T2 and T3. Respondent observations were classified into one of three mutually exclusive outcome categories identifying what kind of support was gained after relocation; (1) no support changes, (2) co-residency with someone other than a spouse, (3) one or more additional supportive environmental features in comparison to previous home. A gain in supportive environmental features was identified if the total number of accessibility features at T3 was greater than at T2. Supportive environmental features included (1) one-floor living space, (2) bathroom modifications, (3) ramps, (4) railings, and (5) wheelchair accessibility. Moving in with persons other than a spouse was considered a separate outcome because co-residency can also alleviate environmental demands because of availability of informal caregiver support, even if the new home is without additional supportive features.

2.6 Main Independent Variable Measures

Three categories of variables identify the main independent variables used in the study analyses; home environment variables, person-environment fit, and competency.

2.6.1 Home Environment Variables

Past research suggests that concerns older people have about architectural features of homes contribute to thoughts about making future moves (Carpenter, et. al, 2006). Older adults who do relocate have significantly more mobility hazards and fewer accessibility features in their prior home as compared to those who do not relocate (Erickson, et. al., 2006). Modifying current homes can also compensate for lack of supportive, structural features.

The housing module of the HRS includes an array of questions that pertain to the physical environment of respondents' homes. A series of dummy variables were coded to identify characteristics of the housing environment, with (1) indicating the presence of the supportive feature. Complex skip patterns were utilized in the HRS housing module. The majority of housing variables were only answered by new HRS respondents or those who reported moving since the wave immediately preceding the interview wave. Data from earlier waves of the HRS and AHEAD studies were used to assign values missing in the current wave due to survey skip patterns. Section 2.4.2 describes in detail the skip patterns and approach used to assign values.

Size of Home was defined using the interval count variable measuring the number of rooms in respondents' homes, not including bathrooms, hallways or unfinished basements. The size of home variable was collapsed into three categorical dummy variables; three or fewer rooms, four to five rooms, or six or more rooms. The categorical coding was necessitated by a change of question format in the 1992 HRS

wave where the number of rooms variable was recorded as an interviewer observation and categorized as groups.

The literature suggests that older adults who live in homes with stairs have greater odds of relocating (Hansen & Gottschalk, 2006). Unfortunately, the HRS survey does not include a variable that defines if stairs are present in or around respondent homes. Instead, the survey identifies respondents who live in a home with single floor living space. In these analyses, the **One Floor Living Space** variable was used to operationalize whether or not respondents were required to use stairs within their home. Although this measure is the best available variable in the HRS to identify the presence of stairs, it is limited in clearly identifying the need to use stairs. Because the measure only identifies single floor living space within a home, stairs outside the dwelling are not identified. For example, a respondent could live in a one-floor apartment but may need to negotiate stairs to reach their home located on the third floor. The One Floor Living Space variable in the HRS survey was not asked in the 1992 or 1994 HRS waves. Respondents who entered the study during these waves and did not answer the questions in later waves because of relocation were coded as missing for the one floor living variable.

A series of questions in the HRS pertain to the presence of specific home accessibility features intended to make homes accessible or safer for older persons. These features include **Bathroom Safety Fixtures, Ramps, Railings** and **Wheelchair Accessibility**. Within the HRS survey, ramps and wheelchair accessibility are listed as distinct features. Dichotomous dummy variables were coded to indicate the presence of each supportive feature (1) in respondents' homes at T2. Due to survey skip patterns,

these accessibility questions were only asked of new respondents, respondents who relocated, or respondents who reported making home modifications since the previous wave. In addition, these variables were not asked in the 1992 or 1994 waves of the HRS study. Respondents who entered the study during these two waves and never relocated or reported making home modifications were coded as missing for these variables.

2.6.2 Person-Environment Fit Variable

Empirical development of environmental press, a key concept of the ETA model, has not been well developed within the literature (Kendig, 2003; Oswald & Rowles, 2006). Environmental press conceptualizes the individualized intersection between competency and the built environment, requiring measurement of the construct to identify both facets to effectively analyze each component (Wahl, et. al., 2009). A **Person-Environment Fit Measure** was included in the analysis as an exploratory method to empirically analyze the theoretical construct in a way that sensitized the measure to the level of environmental press experienced by each study participant. The P-E Fit variable is a count variable of six different combinations of specific competency variables and housing characteristics. Higher values indicated a greater number of misfits between personal competency and housing environment. The variable was capped at two-plus person-environment misfits because of the low frequency of respondents with three or more.

For each of the person-environment combinations, respondents were coded as (1) if they had the competency loss while living in an environment without the corresponding supportive accessibility feature. The P-E Fit variable is a count of the following

combinations described in detail below; One Floor Living x Low Vision; One Floor Living x Lung Condition, One Floor Living x Arthritis, One Floor Living x Falls, Inaccessible Bathroom x Difficulty Bathing, No Wheelchair Accessibility x Use of Mobility Device. The unique combinations of specific competency and specific housing characteristics used to construct the P-E Fit measure were based on literature suggestive of significant relationships between the two.

In later life, many home accidents take place on steps, and stairs are considered to be one of the riskiest environmental characteristics in homes (Archea, 1985; Gitlin, et. al., 2001; Smith, et. al., 1994). The ability to navigate stairs can become problematic for older adults experiencing a range of health problems that impact functionality and physical competency. However, stairs are considered to be one of the most common household barriers (Iwarsson, et. al, 2006). **One Floor Living x Low Vision:** Research suggests that persons with low vision have an elevated risk of accidents taking place on stairs (Archea, 1985) because of the importance of visual cues to safely navigate stairs. Respondents indicating fair, poor or legally blind visual status were considered to have low vision. **One Floor Living x Lung Condition:** The relationship between various chronic illnesses and quality of life domains, including physical functioning, were examined in a meta-analysis study by Sprangers et. al. (2000). Their study suggests that chronic lung conditions have a strong effect on the physical function domains of quality of life. Respondents who reported having a lung disease that limited their level of activity were considered to have a lung condition in this study. **One Floor Living x Arthritis:** Musculoskeletal diseases, including arthritis, have the largest overall effect on

quality of life measures (Sprangers, et. al., 2000). Respondents who reported having arthritis that limited their level of activity were classified as having arthritis. **One Floor Living x Falls**: Falls are largely attributed to multifaceted interactions between extrinsic and intrinsic factors (Pynoos, et. al., 2005). Intrinsic risk factors encompass physical health conditions and disability limitations. In contrast, extrinsic risk factors are the physical environments that surround an individual. A large proportion of falls by older adults occurs within or around the home (Yuen & Carter, 2006) and could be attributed to the presence of stairs. Respondents who reported having fallen one or more times were coded as a faller in this constructed P-E fit variable.

The accessibility of the home environment also interacts with specific competency characteristics of elderly persons. **Accessible Bathroom x Difficulty Bathing:** Research suggests that unsafe bathrooms are one of the greatest unmet needs in homes of the frail, older people (Iwarsson, et. al, 2006; Pynoos, et. al., 2005). However, it should be noted that for some cases poor bathroom accessibility may affect the ease of bathing. Respondents were classified as having difficulty bathing if they reported this difficulty in the Activities of Daily Living (ADL) question sequence. **Wheelchair Accessible x Mobility Devices:** The need to use a walker or wheelchair can interfere with abilities to easily and safely navigate around homes that are not handicap accessible. Difficulty in accessing rooms is another common accessibility challenge in later life (Gitlin, et. al., 2001). Respondents who reported using a walker or wheelchair were classified as using a mobility device.

2.6.3 Competency Variables

Competency represents a combination of a range of individually measured physical health characteristics and functional abilities, such as limitations with activities of daily living or level of cognitive function. While it is useful in some studies to examine the effect of each of these individual indicators of competency on outcomes, in this study global measures of competency were introduced to better ascertain the associations between individual competency, built environment and residential adjustments. This approach was developed on the assertion that the theoretical concept of competency is strengthened when characterized as separate components (Lawton & Nahemow, 1973). Principal component analysis (PCA), a type of factor analysis used as a variable reduction procedure (Hatcher, 1994), was utilized to identify the principal component factors that accounted for most of the variance of the observed, individual competency measures. These principal component factor scores were then used to calculate weighted sum factor scores, based on regression scoring coefficients. These weighted factor scores were used to calculate decline of functionality measures used in the first three statistical models of this research as measures of competency in the analyses.

2.6.3.1 Individual Competency Variables

Six individual competency variables that represented a range of health and functionality characteristics were included in the principal component analysis. In the literature, these competency measures, inclusive of physical health, cognitive status and physical functional abilities, were found to be related to housing adjustments. **Self-**

reported health was measured as a 5-point Likert scale, with higher scores representing poorer health. Better self-reported health is significantly related with lower odds of relocation (Hansen & Gottschalk, 2006), while the perception of poor health has been found to predict making home modifications (Mathieson, et. al., 2002). A **count of chronic health conditions** (0-6) prevalent in later life was calculated, including arthritis, cancer, diabetes, heart disease, lung disease, and stroke. Chronic conditions can impact ability for individuals to successfully function within their home environment, as suggested by the greater risk of functional status decline found to be associated with comorbidity (Stuck, et. al., 1999). In addition, home modifications were found to be associated with multiple chronic conditions (Mathieson, et. al., 2002).

The literature suggests that dementia is significantly associated with greater odds of relocating, especially into supportive housing environments (Newcomer, 2002). A **cognition scale** combining self-respondent and proxy data was developed based on the classification system used in the Aging, Demographics and Memory Study (ADAMS), a study comprised of a subsample of HRS study members age 70 or older (see Table 4). Self-respondent cognition data was retrieved from the cross-wave imputation of cognitive functioning measures data file. Higher scores on this cognition scale indicated lower cognitive functioning.

Table 4: Cognition Scale

Study Cognition Scale	Function Classification*	Self-Respondent Cognitive Score*	Proxy Cognitive Score Jorm IQCODE*
1	Normal: High	21-35	
2	Normal: Mod	17-20	1.00-3.09
3	Normal: Low	12-16	3.10-3.34
4	Borderline	9-11	3.35-3.89
5	Low	0-8	3.90-5.00

*Source: Heeringa, et. al. (2009). Aging, Demographics and Memory Study (ADAMS); Sample Design, Weighting and Analysis for ADAMS. http://hrsonline.isr.umich.edu/sitedocs/userg/ADAMSSampleWeights_Jun2009.pdf

The summary cognitive variable (0-35) included immediate and delayed word recall, serial 7 backwards count, object identification, date naming, and President and Vice President naming. Proxy reported cognition was recorded using an adapted short form of the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) developed by Jorm (1994). Proxy reported cognition data was retrieved from a series of 16 questions that inquired about respondents' change in memory during the previous two years regarding a variety of topics, such as the ability to use familiar items within the household, handling financial matters or remembering where things are stored.

Physical functioning is another important predictor of disability and increasing dependence with basic care needs that can be accentuated by poor accessibility in home environments. Housing with poor accessibility may impact older adults differently, depending on level of physical functioning limitations (Iwarsson, et. al., 2007). Defined to be a multidimensional concept within the HRS, physical functioning is measured within the survey with a series of questions that encompass three groupings of physical functioning type (Fonda & Herzog, 2004). Questions related to mobility and strength

were counted to provide a functional limitation score for individual respondents. The **count of functional limitations** (0-9) measured whether or not the respondent had difficulty walking several blocks, sitting for 2 hours, getting up from a chair, climbing stairs, stooping, extending arms, pulling/pushing large objects, lifting weights, and picking up a dime. Higher scores were indicative of greater difficulty with these functionality tasks. A **count of activities of daily living (ADL) limitations** (0-6) included whether or not the respondent had difficulty with dressing, walking, bathing, eating, getting in/out of bed, and toileting. Responses of "can't do" or "don't do" were also coded as a limitation. Higher scores were suggestive of more disability and dependence with daily care needs. Greater ADL scores have been found to predict residential mobility among older adults (Choi, 1996; Sommers & Rowell, 1992). Complex skip patterns were utilized in the HRS study to measure ADL limitations. Higher functioning respondents who had missing data because of these skip patterns were coded as having no ADL limitations. A **count of instrumental activities of daily living (IADL) limitations** (0-5) identified the level of assistance required by respondents to manage life tasks. Five common IADLs were counted, including meal preparation, shopping, using the telephone, taking medications, and managing money, with higher values suggesting greater dependence and difficulty. Responses of "can't do" or "don't do" were also coded as a limitation.

2.6.3.2 Principal Component Analysis

These six competency variables were standardized to equalize scales of each of the measured constructs, as recommended by Floyd & Widaman (1995). A stacked

dataset comprised only of the standardized competency variables was created to perform the PCA (N=22,867). This approach was used to ensure that the full range of available competency data for each respondent was used in calculating the principal component factor scores. This stacked dataset contained data information for each of the variables for each wave a respondent participated in the study. For example, a respondent who participated in three out of five waves included in this study would be represented as three different cases in the stacked dataset, with each case representing the competency variable scores for one wave of the study.

Analysis of the correlation matrix, presented in Table 5, confirmed high correlations among the six variables. The high correlations indicated that the variables measured similar constructs and the variances could be well represented with fewer principal component factor scores in the statistical analyses. The assumption was supported by the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy at 0.76. The KMO measure indicates the degree of common variance among the variables, with scores closer to 1 indicating greater commonality. Scores above 0.60 indicate that factor analysis can be an appropriate analytic approach since the extracted factors would account for a large enough proportion of the variance (Dziuban & Shirkey, 1974).

Table 5: Competency Measure Correlation Matrix

Variables	Self-Rated Health	Chronic Conditions	Functional Limitation	ADL Limitations	IADL Limitations	Cognition
Self-Rated Health	1.00					
Chronic Condition	0.40	1.00				
Functional Limitation	0.52	0.38	1.00			
ADL Limitation	0.36	0.23	0.60	1.00		
IADL Limitation	0.30	0.15	0.42	0.58	1.00	
Cognition	0.27	0.09	0.28	0.33	0.51	1.00

Principal component analysis was performed using the "factor, pcf" command in the STATA 10 statistical package. The Kaiser-Guttman criterion was applied and two extracted components were retained having met the criteria of having an eigenvalue greater than one. Eigenvalues represent the amount of variance each component accounts for and values greater than one indicate it represents the variance of more than one variable (Floyd & Widaman, 1995). The scree plot test confirmed the retention of two components. The two retained factors accounted for a cumulative 67% of the variance in the competency dataset. Individually, factor 1 accounted for 48% and factor 2 accounted for 19%.

A varimax orthogonal rotation was applied to create uncorrelated factors loadings for each variable used in the PCA analysis. Communality estimates were high, representing that a large amount of variance of each variable was accounted for by the components. Finally, scoring coefficients were produced using the regression method in

which “an optimal factor score is predicted” (DiStefano, Zhu & Mindrila, 2009, pg. 4). These scoring coefficients for each variable in the analysis were multiplied to the standardized value of each item and then summed to create component factor scores that were used to calculate declines in competency between T1-T2 entered into the statistical models. Higher factor scores were indicative of poorer competency. Factor loadings, communality estimates and scoring coefficients for each variable are presented in Table 6.

Table 6: Rotated Factor Loadings, Communalities and Scoring Coefficients

Variable	Rotated Factor Loadings			Scoring Coefficients	
	Factor 1 Cognitive	Factor 2 Physical	Communality Estimates	Factor 1 Cognitive	Factor 2 Physical
Self-Rated Health	0.27	0.73	0.61	-0.04	0.41
Chronic Conditions	-0.06	0.83	0.70	-0.26	0.56
Functional Limitations	0.47	0.68	0.68	0.09	0.32
ADL Limitations	0.70	0.39	0.65	0.30	0.07
IADL Limitations	0.85	0.14	0.75	0.46	-0.14
Cognition	0.78	-0.01	0.61	0.45	-0.21

Note: N=22,867

Each of the component factors has significant loadings (>0.65) on three variables. Factor 1 represented competency measures most influenced by cognitive abilities. The variables loaded unto this factor were Cognition, Instrumental Activities of Daily Living and Activities of Daily Living. Cognition measures cognitive status. IADL tasks are

higher level activities that require concentration and memory to successfully undertake, making them more susceptible to negative outcomes resulting from cognitive decline. Although difficulty with ADL tasks can also represent physical impairments, it is more appropriately placed as a component of cognitive functioning. In addition to physical inabilities to perform ADL tasks, severe cognitive impairment can impede with ADL functioning two-fold; with the ability to remember to do self-care or how to perform ADL self-care tasks.

Factor 2 represented competency measures most influenced by physical health, mobility and overall functionality. The three variables loaded onto factor 2 were self-reported health, count of chronic conditions and functional limitation count. Self-reported health and the number of chronic conditions are clear markers of physical health. Functional limitations was placed appropriately with the physical functionality component as these tasks, such as climbing stairs or walking several blocks, are more quickly limited due to physical health conditions than cognitive declines.

2.6.3.3 Competency Factor Score Decline Variables

The component factor scores representative of competency were used to calculate negative declines in competency between T1-T2 for use in the analyses models. Two competency decline variables were created; **Cognitive Decline** and **Physical Decline.** The literature consistently suggests that negative changes in disability and functional limitations have greater impact on residential adjustment outcomes than baseline limitations (De Jong, et. al, 1995, Jackson, et. al., 1991, Newcomer, et. al., 2002, Sabia, 2008). Respondent observations were identified as having a negative decline in

competency (1) if component factor scores at T2 were worse than at T1. A threshold decline of greater than one standard deviation of the distribution of the amount of change between factor scores at T1 and T2 was implemented as a way to select respondent observations with trajectories of declines in health and functionality in comparison to those of a more temporary nature.

2.6.3.4 Competency and the Fourth Analysis

For the fourth analysis, it was more informative to examine how declines in specific health and functionality measures affected the outcome variable of interest than to use the principal component factor defined competency decline measures used in the first three analyses. For each of the six individual competency variables identified in Section 2.6.3.1, a dummy variable was created that identified if a respondent had worsening health or poorer functioning at T2 when compared to T1.

2.6.3.5 Other Competency Variables

As discussed in Section 2.6.3, principal component analysis (PCA) was performed to reduce the number of competency variables in the models while retaining the variance within the individual competency variables. However, two competency measures did not meet the correlation criteria for inclusion in the PCA model upon initial data examination. These two variables were entered individually into the statistical models. **Depression** is measured in the HRS with an 8-item abbreviated version of the Center for Epidemiologic Studies Depression Scale (CES-D) that was introduced to the study in AHEAD 1993 (Steffick, 2000). In this study, depression was calculated by counting, for each respondent, how many of the eight depressive symptoms respondents

answered “yes”. Positively worded questions were reverse coded prior to counting. A count variable (range 0-8) was entered into the analyses, with higher values representing greater levels of depression. The literature also shows that the home environment can be a risk factor for **Falls** (Nikolaus & Bach, 2003, Yuen & Carter, 2006) and making adjustments to the home environment is one strategy available to older adults to reduce fall risk. Falls were measured as a dichotomous variable, with (1) indicating the occurrence of one or more falls between T1 and T2.

2.7 Control Variable Measures

2.7.1 Housing Characteristic Variables

The relationship between home ownership status and residential mobility among older adults is well supported in the literature, with home ownership significantly deterring the actuality of housing mobility (De Jong, et. al., 1995; Longino, et. al., 1991; Sommers & Rowell, 1992; Speare, et. al., 1991). Home ownership or renter status was specified in this study with a **Renter Status** dummy variable. On questions pertaining to home ownership status, respondents who answered “rent”, “live rent free with relative or friend” or “other” were specified as renters (1).

The number of years people reside in their current home is also influential on how likely they are to relocate. It is documented in the literature that residential adjustments occur less frequently among those who have resided for longer tenures in current homes (De Jong, et. al., 1995; Hansen & Gottschalk, 2006; Longino, et. al., 1991; Sommers & Rowell, 1992; Speare, et. al., 1991). **Residency Tenure** was operationalized in the analyses as three categorical dummy variables; 0-2 years, 3-6 years, or 7+ years. The

categorical variable, 0-2 years, also represents the occurrence of relocation between T1 and T2. Older adults who have not made recent move(s) were found to have a lower likelihood of making a housing adjustment (Sabia, 2008).

Extensive skip patterns for questions about residency tenure were utilized in the HRS study. The length of residence question, "What year did you move into current home?" was only asked of new respondents and those who had moved since the previous wave. Values for data missing in the current wave due to such skip patterns were assigned from homeowner respondent data according to purchase year of current home, available for 1998-2006 waves. Additional data values were gathered from across all earlier waves of the study (HRS 1992, 1994, 1996 and AHEAD 1993, 1995) about the year moved into current home.

A notable question format change occurred in AHEAD 93 when respondents were asked more generally if they had lived in the current home for more than 10 years. This shift in question formatting required capping the residency tenure variable at 7+ years, the highest definitive year count available for the 2000 wave, the first T2 data point used in the analyses. Capping the duration of residency is supported in the literature. The *cumulative residential stability* theory states "the longer [a person] resides somewhere, the lower [their] prospects of leaving" (Morrison, 1967, pg. 554). According this this theory, a negative relationship between residential migration and mobility is suggested the longer a person lives at their residence. Research examining this concept has found that the likelihood of residential migration was significantly reduced after respondents had lived in their homes for longer than six years (Land, 1969; Morrison, 1967).

Data were first hierarchically coded, working backwards from 1998. Figure 2 visually portrays the coding scheme used to code the 1998 residency tenure variable. The 1998 housing tenure variable was then used to fill in residency tenure data for subsequent waves (Waves 2000-2006) of the study when the survey question about residency tenure was not updated. For the minority of respondents who reported moving in one wave but indicated lengthier tenures, the residency tenure variable was adjusted to match the recent moving status.

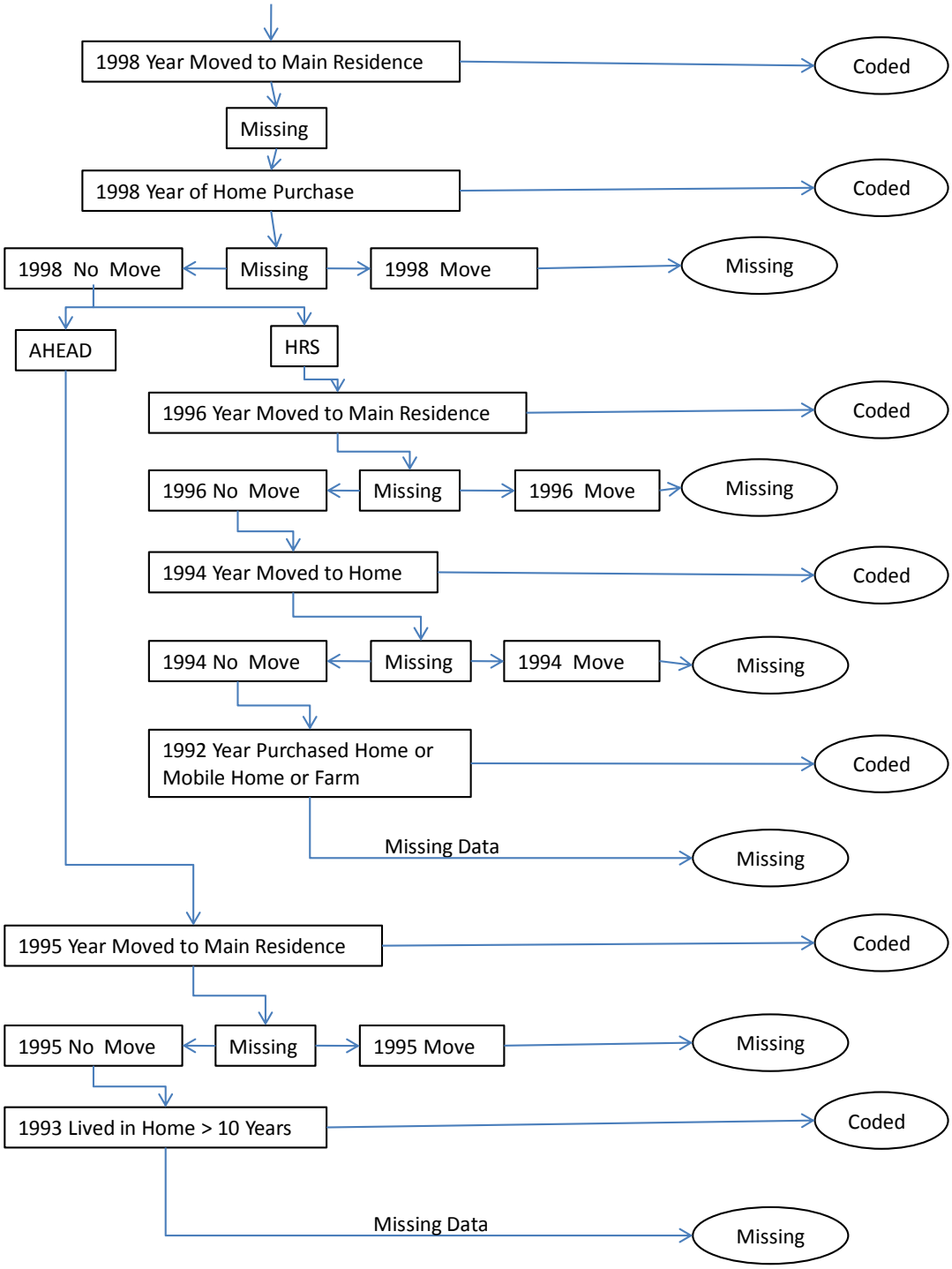

Figure 2: Residency Tenure Coding Schematic

Engagement and interaction with the broader environmental context, including neighborhood safety or public transportation accessibility, also influences residential decisions taken in later life. Limited information about these broader environmental contexts was provided in the HRS survey. As a result, this study examined the impact of only two such contexts on relocation outcomes in later life. The self-reported physical **Condition of Home** was collapsed into a dummy variable. Respondents reporting that their home was in excellent or very good condition were coded as "1". Those who indicated that their home was in good, fair or poor condition were coded as "0". Respondent perception of N**eighborhood Safety** was coded as a dummy variable. Respondents who perceived neighborhood safety to be excellent or very good were coded as "1".

A dummy variable was created to identify if respondents lived in a retirement community or any other type of housing that offered supportive services for older or disabled adults at T2. This variable was used as a control variable in the third analysis of the research in which the outcome of interest was whether or not respondents moved into senior housing at T3.

2.7.2 Social Support Variables

For older adults with declining competency, a spouse can provide vital support and assistance with everyday activities and enable them to remain in their homes when encountering challenges with physical environmental features. The **Marital Status** of respondents was measured at T2 and coded as four categorical dummy variables; married, divorced or separated, widowed, or never married. Literature suggests that

recent widowhood triggers residential adjustments (Chevan, 1995; Hansen & Gottschalk, 2006; Speare & Goldscheider, 1985), with moves into adaptive housing most salient (Bloem, 2008). **Recent Widowhood** was indicated with a dummy variable identifying respondents as recently widowed if they were married at T1 and widowed at T2.

Proximity to Children impacts the amount of assistance adult children can provide aging parents and is considered to be a motivation for making assistance moves when competency and health declines (Litwak & Longino, 1987). Adult children have been found to have significant influence on residential relocation decisions (Chen, et. al., 2008). Living a greater distance from adult children in late life increased the odds of relocating nearer their children (De Jong, et. al., 1995; van Diepen & Mulder, 2009), particularly when older adults have functional declines (Rogerson, Burr & Lin, 1997). Greater proximity to children was also associated with higher likelihood of moving into retirement communities (Silverstein & Zablotsky, 1996). This dummy variable identified respondents who lived within ten miles of one or more of their children at T2.

Supportive assistance provided by informal or formal caregivers is an important social support available to older adults. The services provided to older adults in their homes by family member caregivers or paid personnel can compensate for losses in competency. This support enables elderly adults to remain in their current home environment, even without supportive features. Low frequency distributions of variables separately classifying formal and informal caregiving required the caregiving support variables be combined Respondents were classified as a **Caregiving Recipient** if in-

home care was provided by a spouse, paid or unpaid relatives or nonrelatives, or a person with an organizational affiliation.

2.7.3 Spouse Competency

For married individuals who live with a spouse, residential adjustment decision making may be influenced by the competency of the spouse. Spouse merges were performed on the component factor competency scores (See Section 2.6.3) to create measures of spouse competency at T1 and T2. These factor scores were than used to define **Spouse Cognitive Decline** and **Spouse Physical Decline** measures between T1-T2 for the analyses. The same threshold decline used for respondent observations (>1 SD) was utilized for the spouse competency decline variables. For these spouse variables, unmarried respondents were coded as "0".

Because the principal component factor defined competency decline measures were not used in the fourth analysis, an alternative measure was used to sensitize the model to spouse competency. For this analysis, a spouse merge was performed to create a **Spouse Person-Environment Fit** variable.

2.7.4 Socio-Economic Status and Demographic Variables

Socio-Economic status was measured using education, household income and household wealth variables. **Education** was coded as an interval variable indicating the number of years of schooling completed. Household income and wealth also influences housing adjustments made in later life. Greater income and net worth are suggestive of greater financial security and the availability of greater choice when considering housing adjustments. The literature shows mixed findings on the interaction between financial

wealth and residential adjustment outcomes. The financial cost of home modifications is considered to be a major deterrent in the implementation of home modifications (Pynoos, 1993). However, financially well-off elders were found to be less likely to make home modifications (Mathieson, 2002). Higher income was found to be associated with moves into retirement communities (Silverstein & Zablotsky, 1996). But respondents with greater asset wealth and incomes have been found to have a lower probability of relocating (Hansen & Gottschalk, 2006; Sabia, 2008).

In response to these mixed findings, an innovative household measure of financial resources was implemented in this study as an alternative approach to including wealth measures in statistical models. A **Household Measure of Financial Resources**, inclusive of household income and net worth, was created to sensitize the results to the combined influence of income and assets on residential transitions. Many older adults can be rich in assets and poor in income, leading to more viable housing options for them than for older adults who are poor in both income and assets. Considering financial resources as separate variables of influence on residential outcomes may not adequately measure how finances intersect with housing decisions taken in later life.

Household Income and Net Worth data was retrieved from the HRS Imputation files. Household net worth values encompassed total household assets, inclusive of second home property values. The data was divided into equal quintile categories, distributed according to the total weighted sample prior to sample selection. Income or assets in the lowest 20^{th} percentile were considered to be income or asset "poor". Income or assets above the 20^{th} percentile were classified as income or asset "higher". Four

categorical dummy variables were created; (1) income poor/asset poor, (2) income poor/asset higher, (3) income higher/asset poor, (4) income higher/asset higher.

Demographic variables were included in the analyses as control variables. **Age** was coded as an interval variable. **Gender** was coded as a dummy variable with male as the reference category. **Race/Ethnicity** was coded as dummy variable, specifying non-Hispanic White respondents from those of Hispanic ethnicity, African American race or other race. **Proxy status** was indicated with a dummy variable to identify respondent observations completed by proxies.

CHAPTER 3

RESIDENTIAL ADJUSTMENTS AND THE BUILT ENVIRONMENT

The environmental gerontology research domain has sought to explain the influence of the built environment on the successful continuation of independent lifestyles despite the many physical changes that occur in later life. Theoretically defined as environmental press (Lawton & Nahemow, 1973), the intersection between individual competency and environmental contexts can become increasingly relevant as people advance in age and experience decreased physical health, mobility or cognitive functionality. Homes can either serve as preventative resources or facilitators of worsening downward trajectories of health and functionality (Oswald & Wahl, 2004). As a result, older people may encounter increasing difficulty in meeting the demands of environmental contexts (Faletti, 1984) if homes do not offer adequate supportive features.

The majority of older adults believe their current homes will meet future physical needs (Waldrop & Stern, 2003). Other research, however, reveals that a concern about features of the physical environment of a current home is a strong motivator for relocating in later life (Fonad, et. al, 2006; Oswald, et. al., 2002). This finding lends support for the assertion that the relationship between person and environment is a dynamic one requiring regular reassessment (Golant, 2003). Residential adjustments,

either through relocation or home modifications, can restore balance between individual competency and environment demands, if useful supportive features are introduced.

The following analyses considered the influence of the built environment on the likelihood of making subsequent housing adjustments of differing types while controlling for the individual levels of competency, environmental press and various background variables. The three analyses are a multi-stage examination of the relevance of the built environment and person-environment fit on multiple housing adjustment outcomes; home modifications, senior housing relocation, and independent housing relocation. The first analysis, inclusive of the entire study sample, compared the likelihood of making one of these three residential adjustment outcomes compared to making no adjustment, being admitted to a nursing home or death. The second analysis targeted the distinctions between home modifications and relocation and included only respondent observations for which a housing adjustment had occurred. The analysis examined how the built environment and person-environment fit influenced the likelihood of choosing to make a home modification over relocation. To explore if the built environment and person-environment fit influenced the likelihood of relocating into senior housing facilities, the third analysis only included respondent observations that had made a residential move.

3.1 Sample Descriptives

The sample descriptives of the control variables from the main study sample used in the three analyses are outlined in Table 7**.** The main independent variables are described for each of the samples used in the different statistical models in the respective analysis subsection.

3.1.1 Control Variable Descriptives

Women made up the majority of the sample, with men only accounting for 40 percent of the sample. The average age was 78 years. The race/ethnicity of the sample was predominantly represented by non-Hispanic whites. A notable minority, 6 percent, required proxy assistance to complete the surveys. Completion of high school (12 years) was the mean level of education. Two-thirds of the sample had household income and assets above the twentieth percentile, compared to only 13 percent with income and assets in the lowest quintile.

Survey respondents received social support from a variety of sources. Only 42 percent of the sample was married, while widowhood accounted for 46 percent. Five percent of the sample was also classified as being recently widowed within the two years prior to the survey wave. Just over half of the respondents (55%) lived within close proximity to one or more adult children. One-fifth of the sample received some type of formal or informal caregiving assistance within the home. Eight percent of the sample had spouses with a decline in cognitive functioning between T1 and T2. In comparison, 11 percent had spouses with physical declines in competency.

Table 7: Sample Descriptives - Control Variables

Variables	Mean	Percent	SD
Demographics & Socio-Economic			
Male		39.6%	0.49
Age[a]	78.02		5.80
Race/Ethnicity - Non-Hisp		89.2%	0.31
White			
Proxy Respondent		6.4%	0.25
Education[b]	12.01		3.22
Household Wealth			
Low Income, Low Assets*		13.3%	0.34
Low Income, Higher Assets		16.1%	0.37
Higher Income, Low Assets		5.9%	0.24
Higher Income, Higher		64.7%	0.48
Assets			
Social Support Characteristics			
Marital Status			
Married*		41.6%	0.49
Divorced/Separated		9.2%	0.29
Widowed		45.9%	0.50
Never Married		3.3%	0.18
Recent Widowhood		5.1%	0.22
Child Proximity		55.0%	0.50
Caregiving Recipient		20.7%	0.40
Spouse Competency			
Sp Cognitive Factor Decline (T1-T2)		8.0%	0.27
Sp Physical Factor Decline (T1-T2)		10.8%	0.31
Other Housing Characteristics			
Renter		26.0%	0.44
Residency Tenure			
0-2 Years		16.9%	0.37
3-6 Years		23.6%	0.42
7+ Years*		59.5%	0.49
Good Condition of Home		64.2%	0.48
Safe Neighborhood		69.3%	0.46

Notes: n=10,424; All Calculations are weighted; *Categorical Reference Category;
Value Range: [a]70-104 years; [b] 0-17 yrs

The majority of the respondents were home owners, with renters only accounting for 26 percent of the sample. More than half of the sample had lived in their home for seven or more years (60%), in comparison to 17 percent who reported recently moving into their current home within the previous two years. In general, two thirds of the sample lived in neighborhoods they considered to be safe and in homes they perceived to be in excellent or very good condition, 69 percent and 64 percent respectively.

3.2 Analysis 1: Housing Adjustment, Nursing Home Admission and Death Analysis

The first analysis examined the likelihood of making a housing adjustment, being admitted to a nursing home or dying compared to no change occurring in residence. The following research question was explored.

> ***Research Question #1:*** **What is the role of physical environmental characteristics and person-environment fit on determining residential adjustments made in later life?**

3.2.1 Dependent Variable

The dependent variable in the analysis identified respondent observations according to the type of residential adjustment made between T2 and T3. Survey respondents were classified into one of four mutually exclusive outcome categories; (1) no residential change, (2) residential adjustment, inclusive of home modifications, relocation into independent housing and relocation into senior housing, (3) nursing home admission and (4) death. Approximately one-fifth of the sample made a residential adjustment between T2 and T3. Table 8 displays the frequency distribution of the residential adjustment dependent variable used in the first analysis.

Table 8: Residential Adjustment Dependent Variable

	Percent	N (unweighted)
No Residential Change	68.2%	7,052
Housing Adjustment	18.5%	1,921
Nursing Home Admission	3.6%	387
Death	9.7%	1,064

n = 10,424; Percentage calculation on weighted data

A hierarchy was used to determine where to place the minority of respondents who answered "yes" to more than one outcome category at T3; Death, Nursing Home, Relocation Senior Housing, Relocation Independent Housing, Home Modifications. Relocation into a nursing home and death were not primary outcomes of interest in this study but were retained in the sample to minimize sample bias. Nursing home admissions were kept as a separate category from other adjustments because of the different triggers that underlie institutional moves. Moves into nursing homes often result from sudden health crises and are rarely made voluntarily. Respondents were classified as moving into a nursing home at T3 if they lived in a long term care nursing facility that provided nursing supervision and personal care assistance. To code the death outcome, wave specific respondent data on vital status and sample status in the Tracker file were used. Missing cases were filled in by use of the National Death Index variable, available starting in Wave 5 (2000). It is noted that the HRS survey design does not allow for information to be gathered about possible residential adjustments after T2 that may have preceded the death recorded at T3.

3.2.2 Sample Descriptives - Main Independent Variables

The sample descriptives of the main independent variables used in the first analysis are described in Table 9. Approximately half of the sample lived in larger homes with six or more rooms, compared to only 12 percent living in smaller homes of only three or fewer rooms. A third of the sample had bathroom safety features which are generally less expensive, easily installed home modifications. Fifteen percent had railings in homes purposed to aiding older or disabled people. Only 10 percent of the sample had ramps or otherwise wheelchair accessible homes. Four-fifths of the sample lived in homes in which living space was available on one floor. The average number of person-environment misfits was .23 on a range of 0 to 2 or more. The person-environment misfit variable identified the level of environmental press and is a count of six different combinations of specific competency variables and housing environment characteristics.

Table 9: Sample Descriptives - Main Independent Variables

Variables	Mean	Percent	SD
Housing Environment Features			
Size of Home			
Number of Rooms: < 3 rooms		12.4%	0.33
Number of Rooms: 4-5 rooms		40.0%	0.49
Number of Rooms: 6+ rooms*		47.6%	0.50
Bathroom Safety Fixtures		32.6%	0.47
Railings		14.8%	0.36
Ramps		10.3%	0.30
Wheelchair Accessibility		10.0%	0.30
One Floor Living Space		82.0%	0.38
Person-Environment Misfit a	0.23		0.52
Competency			
Cognitive Factor Decline (T1-T2)		13.2%	0.34
Physical Factor Decline (T1-T2)		17.9%	0.38
Fall(s)		31.5%	0.46
Depression: CES-D Count b	1.45		1.90

Notes: n=10,424; all calculations are weighted; *Categorical Reference Category;
Value Range: a 0-2+; b 0 - 8 symptoms

Thirteen percent of the sample experienced a negative threshold decline in cognitive functioning and 18 percent had a negative threshold decline in physical functioning between T1 and T2. Approximately one-third of the sample had fallen one or more times in the previous two years. Depression rates were low among the sample, with the average number of depressive symptoms at 1.45 out of 8.

3.2.3 Statistical Method

A multinomial logistic regression model on weighted respondent observations was estimated using the *mlogit* procedure in STATA 10. As described in Section 2.2, the VCE(cluster variable) command was also used to generate robust standard errors corrected for the correlations within the clusters present in the dataset. Individual

respondents were classified as clusters, defined according to the household-person identification number. The overall sample (n=10,424) was used in Analysis 1.

3.2.4 Results

The results of the multinomial logistic regression are presented in Table 10. The following sections present the findings for each of the housing adjustment outcome categories, in reference to the base category of no occurrence of a residential adjustment type.

3.2.4.1 Housing Adjustment Outcome Results

Results suggest that the influence of the built housing environment on late life residential adjustments depends on the type of supportive feature. Respondents with reported bathroom safety fixtures had 36 percent greater relative risk of relocating or making additional home modifications over making no residential changes relative to otherwise similar sample members without such features. Those living in homes with railings had 20 percent greater relative risk. However, wheelchair accessible homes lowered the relative risk of making a housing adjustment by 34 percent.

The analysis also provided empirical support of the underlying assertion of the person-environment theory that physical home environments and individual competency are interconnected. The results showed that increasing misfit between individual and home environment, indicative of experiences of heightened environmental demand, increased the probability of making a housing adjustment. With each additional person-environment misfit, the relative risk of making a housing adjustment over no residential change increased by 18 percent.

Worsening physical competency was also found to be an important predictor of housing adjustments made in later life. A threshold decline in physical health between T1-T2 led to a 16 percent increased the relative risk of relocating or modifying a home compared to no residential change. Falling also influenced the relative risk of housing adjustments in later life. Respondents who reported one or more falls between T1 and T2 had 18 percent greater relative risk of moving or modifying a home over undergoing no residential change relative to otherwise similar without a fall history.

Housing characteristics other than the supportive built environment also influenced housing adjustments made in later life. Renters had 21 percent greater relative risk of a housing adjustment over no residential change relative to otherwise similar homeowners. In addition, short lengths of residency tenure in current homes (0-2 years), also suggestive of a recent move, increased the relative risk of a housing adjustment by 101 percent over no housing changes, relative to respondents with residency tenures of seven or more years.

Several social support characteristics were also found to affect housing adjustment outcomes. Widowhood and never being married lessened the relative risk of making a housing adjustment over no residential change by 21 percent and 36 percent respectively relative to otherwise similar married respondents. Being the recipient of in-home formal or informal caregiving increased relative risk of housing adjustments over no changes by 46 percent.

Among the demographic and socio-economic measures in the model, only the overall household wealth measure was found to influence residential outcomes.

Respondents with low income with higher asset levels had 29 percent greater relative risk of relocating or modifying the home over making no residential changes relative to otherwise similar survey participants with low income and low assets.

Table 10: Relative Risk Ratios of Housing Adjustments, Nursing Home Admission or Death

	Housing Adjustment Relocate or Home Mod [1]			Nursing Home [1]			Death [1]		
	RRR	95% CI		RRR	95% CI		RRR	95% CI	
Housing Environment Features									
Size of Home[2]									
Number of Rooms: ≤ 3 rooms	1.098	0.870	1.388	2.141***	1.411	3.249	1.333†	1.000	1.776
Number of Rooms: 4-5 rooms	1.017	0.889	1.163	1.178	0.865	1.606	1.080	0.902	1.293
Bathroom Safety Fixtures	1.363***	1.196	1.552	1.264†	0.959	1.667	1.283**	1.086	1.515
Railings	1.196*	1.008	1.421	0.954	0.681	1.337	1.071	0.870	1.320
Ramps	0.919	0.742	1.138	1.172	0.828	1.659	1.081	0.858	1.363
Wheelchair Accessibility	0.665***	0.533	0.829	1.035	0.706	1.517	0.897	0.697	1.155
One Floor Living Space	1.155	0.959	1.393	1.080	0.685	1.703	1.677***	1.274	2.208
Person-Environment Misfit	1.184*	1.027	1.364	1.306*	1.003	1.701	1.612***	1.380	1.883
Competency									
Cognition Decline Trajectory	1.145	0.953	1.375	2.044***	1.528	2.734	1.663***	1.375	2.011
Physical Decline Trajectory	1.156*	1.006	1.329	1.037	0.758	1.418	1.236*	1.032	1.481
Fall	1.180**	1.043	1.336	1.115	0.872	1.427	1.166†	0.996	1.367
Depression: CES-D Count	1.016	0.984	1.049	1.054***	0.988	1.125	1.103***	1.061	1.147

Notes: n=10,424; † p < .10, *p < .05; ** p <.01; *** p< .001; RRR=Relative Risk Ratio; CI = Confidence Interval
Model Fit: Std. Err. Adjusted for 5,217 clusters; Wald chi2(99) = 1344.46 (p < .001); Pseudo R-squared = 0.0880
Reference Categories: [1] No Housing Adjustment [2] 6+ rooms

	Housing Adjustment Relocate or Home Mod [1]			Nursing Home [1]			Death [1]		
	RRR	95% CI		RRR	95% CI		RRR	95% CI	
Demographics and Socio-Economic									
Male	0.964	0.850	1.094	1.145	0.872	1.505	1.691***	1.418	2.016
Age	1.011†	1.000	1.023	1.109***	1.087	1.132	1.076***	1.061	1.091
Race/Ethnicity - Non-Hisp White	1.088	0.900	1.315	1.550*	1.047	2.295	0.996	0.796	1.247
Proxy Respondent	1.098	0.843	1.432	1.985**	1.254	3.142	2.394***	1.834	3.126
Years of Education	1.021†	0.999	1.044	1.027	0.986	1.071	1.011	0.986	1.037
Household Wealth[3]									
Low Income, Higher Assets	1.290*	1.004	1.657	0.863	0.557	1.339	1.115	0.834	1.491
Higher Income, Low Assets	1.126	0.853	1.487	1.362	0.850	2.182	1.110	0.785	1.569
Higher Income, Higher Assets	1.007	0.797	1.272	0.768	0.504	1.170	0.932	0.701	1.239
Social Support Characteristics									
Marital Status[4]									
Divorced/Separated	1.019	0.811	1.281	1.891*	1.092	3.276	1.454*	1.064	1.988
Widowed	0.792**	0.670	0.935	1.806**	1.212	2.691	0.991	0.784	1.252
Never Married	0.641*	0.432	0.952	2.387*	1.228	4.639	1.537†	0.953	2.479
Recent Widowhood	0.950	0.730	1.237	1.192	0.757	1.876	0.700†	0.489	1.001
Child Proximity	0.902†	0.802	1.014	0.805†	0.632	1.025	0.909	0.779	1.061
Caregiving Recipient	1.461***	1.239	1.723	2.985***	2.174	4.099	2.273***	1.887	2.737
Spouse Competency									
Spouse Cognitive Factor Decline	0.929	0.759	1.138	1.378	0.847	2.242	0.872	0.654	1.164
Spouse Physical Factor Decline	1.176†	0.984	1.405	0.840	0.501	1.410	0.848	0.653	1.101
Other Housing Characteristics									
Renter	1.209*	1.003	1.458	1.131	0.805	1.589	1.051	0.840	1.315
Residency Tenure[5]									
0-2 Years	2.007***	1.725	2.334	1.576**	1.153	2.153	1.306*	1.058	1.614
3-6 Years	1.071	0.919	1.249	1.031	0.725	1.466	1.221†	0.992	1.503
Good Condition of Home	0.972	0.849	1.113	1.044	0.792	1.375	0.992	0.829	1.186
Safe Neighborhood	1.115	0.970	1.283	1.063	0.799	1.414	0.913	0.764	1.092

Notes: n=10,424; † p < .10, *p < .05; ** p <.01; *** p< .001; RRR=Relative Risk Ratio; CI = Confidence Interval
Model Fit: Std. Err. Adjusted for 5,217 clusters; Wald chi2(99) = 1344.46 (p < .001); Pseudo R-squared = 0.0880
Reference Categories: [1] No Housing Adjustment; [3] Low Income, Low Assets; [4] Married; [5] 7+ years

3.2.4.2 Nursing Home Outcome Results

Housing features were found to have minimal effect on the relative risk of being admitted to a nursing home over making no residential changes. Only size of home was found to increase relative risk of nursing home admission. Respondents living in homes with three or fewer rooms had 114 percent greater relative risk of admission into a nursing home relative to otherwise similar respondents living in larger homes of seven or more rooms. Person-environment misfit, representative of poor health and functioning combined with an inadequately supportive housing environment, was also found to increase the risk of nursing home admission by 31 percent, compared to respondents making no housing adjustment.

A decline in cognitive functioning was positively related to greater relative risk of nursing home admission over making no residential adjustment. These respondents had 104 percent greater relative risk of entering a nursing home over no residential change, relative to otherwise similar members of the sample without a decline in cognitive function. Greater levels of depression also elevated risk of nursing home admission, with the relative risk of admission increasing by 5 percent with each additional depressive symptom.

Only one non-supportive housing characteristic was related to nursing home admissions. Sample participants with residency tenure in the current home of two or fewer years had 58 percent greater risk of being admitted into a nursing home over no housing adjustments, relative to those with residency tenures of seven or more years.

Two social support measures were found to positively influence nursing home admissions. Marital status was found to be strongly related to this type of residential change. All non-married marital status categories had greater relative risk of entering a nursing home relative to otherwise similar married respondent observations. Divorced or separated respondents had 89 percent greater risk. Widowed respondents had 81 percent greater risk. Never married respondents had 139 percent greater risk. In addition to marital status, requiring caregiving services also influenced risk of entering a nursing home. Recipients of informal or formal caregiving support services had 198 percent greater relative risk of entering a nursing home over no residential change, compared to otherwise similar respondents who did not receive such supportive services.

Advancing age also increased risk of nursing home admission. With each additional year, the relative risk of being admitted to a nursing home over no residential adjustments increased by 11 percent. Race and ethnicity were also found to affect residential outcomes. Non-Hispanic white respondents had 55 percent higher relative risk of entering a nursing home over no housing adjustment, compared to otherwise similar respondents of non-Hispanic black, Hispanic or other race and ethnicity. In addition, sample participants requiring proxy assistance with completing the survey had 98 percent greater relative risk of nursing home admission.

3.2.4.3 Death Outcome Results

The relationship between housing environment features and death suggests that certain household features may be more common in homes older adults move into when on a downward trajectory of physical health. Results showed that death is often preceded

by a recent move. Briefer residency tenures of less than two years, representative of a recent move, were found to increase the risk of death by 31%, compared to otherwise similar respondents living in a home for seven or more years. Respondents living in homes with bathroom safety features had 28 percent greater relative risk of death relative and residing in homes with one-floor living space led to 68 percent greater risk of death.

Person-environment misfit that also identified poor physical functioning positively predicted a death outcome, with each additional misfit increasing the risk of death increased by 61 percent. As expected, worsening cognitive factor scores and physical factor scores increased the relative risk of death compared to otherwise similar respondents with stable or improving competency. Sample members with worsening cognitive factor scores had 66 percent greater risk of death while a similar decline of physical factor scores led to 24 percent greater expected risk of death. Depression in later life was also found to predict death. With each additional depression symptom, the relative risk of death increased by 10%.

Of the social support measures included in the analysis, marital status and receipt of in-home services by caregivers were shown to be related to death. Divorced or separated respondents had 45 percent greater risk of dying over having made no residential change relative to otherwise similar married respondents. Those who received informal or formal caregiving services in the home had 127 percent greater relative risk of dying compared to otherwise similar respondents who did not require caregiving assistance.

Additionally, age and gender were found to be related to death occurring over no residential change. With each increasing year of age, the expected risk of death increased by 8 percent. The empirical results also showed that males had 69 percent greater relative risk of dying than otherwise similar females. The third demographic measure related to greater expected risk of death was proxy status. Respondents for whom proxies completed the survey had 139 percent greater relative risk of dying, relative to otherwise similar self-completion respondents.

3.2.5 Discussion

3.2.5.1 Housing Environment

The empirical results suggest that actions taken with the built housing environment are associated with subsequent non-institutional housing adjustments. This empirical finding lends support to previous research indicating that concern about physical environment characteristics is a common motivation for residential relocation (Iwarsson & Wilson, 2006). Wheelchair accessibility, a home feature of a more structural nature, was found to reduce or perhaps even offset the need to make future housing adjustments. This finding provides empirical underpinnings for the assertion that supportive built features can be an integral component of the infrastructure that allows aging persons to safely age in place, even when experiencing increasing impairment (Pynoos & Nishita, 2003; Wahl & Weisman, 2003). In comparison, bathroom safety features and railings in a home increased risk of making a housing adjustment within the following two years. Similar to findings by Yuen & Carter (2006), these results showed that the installation of home modifications, commonly used after persons begin to

experience physical and functional declines, was an important predictor of subsequent housing adjustments.

The analysis revealed empirical evidence of the Ecological Theory of Aging's premise that individuals and environments are interconnected (Lawton & Nahemow, 1973). The results showed that person-environment misfit, a variable introduced in this research as an exploratory measure of environmental press, positively predicted housing adjustments in later life as the level of environmental demand intensified. In addition, the predictive relationship found between person-environment misfit, nursing home admission and death suggests that the theoretical construct of environmental press also has an influential interaction with other later life adjustment outcomes. The model controlled for worsening health and functionality, which indicated that the person-environment misfit variable measured something beyond just physical or cognitive status. Although it cannot be concluded that unsupportive housing environments cause these alternative adjustment outcomes, it can be asserted that the combination of such features and poorer functionality may represent worsening trajectories that lead to nursing home admission or death.

The model also suggests that size of home has an important role in predicting residential adjustment outcomes. It is apparent that residing in smaller residences comprised of three or fewer rooms was a significant precursor for admission into a nursing home and a moderately significant predictor of death. Similarly, residing in homes with bathroom safety features or one-floor living space was significantly related to death outcomes. These three environmental features may be more commonplace in

homes that older adults move into after making need-triggered housing adjustments due to downward physical or cognitive health trajectories. Older adults with longer residency tenures in homes without these features, for whom a need-triggered move was not yet required, may represent a cohort subgroup that is more robust in health and general wellbeing

3.2.5.2 Competency

Individual competency was predictive of housing adjustments, nursing home admission and death outcomes. As expected, worsening cognitive or physical competency predicted death as an outcome. However, notable differences emerged between how cognitive and physical competencies interacted with housing adjustment and nursing home admission outcomes. A worsening physical competency factor score, a measure encompassing self-reported health, chronic health conditions, and functional mobility and strength, was positively related to the likelihood of relocation or home modifications, adding additional empirical evidence to the already well documented relationship between health, functionality and residential outcomes (Colsher & Wallace, 1990; De Jong, et. al, 1995; Newcomer, et. al, 2002; Silverstein & Zablotsky, 1996; Speare, et. al., 1991). However, a decline in physical competency factor score was not predictive of nursing home admission. This result suggested that admissions into nursing homes triggered by physical health needs more often occurred in response to sudden health changes and may be less predicted from a decline in competency measure.

Interestingly, the influence of cognitive loss and difficulties with related ADL and IADL living tasks, as represented by the decline in cognitive competency factor scores,

was found to have an opposite interaction with housing adjustments and nursing home admission. Unlike physical competency, the decline of cognitive functionality across time was predictive of nursing home admissions but not residential relocation or home modifications. This suggests that cognitive limitations may lead to fewer environmental demands at the onset because of the less physical nature of these declines, resulting in less need for non-institutional residential adjustments. In addition, once the limitations related to cognitive competency reach a level where additional support is required, it may be at a level that nursing home care is better equipped to provide.

3.2.5.3 Other Housing Characteristics

The results suggest that all three adjustment outcomes, including residential adjustments, were predicted by short durations of residency and recent moves. If recent moves into homes with certain types of supportive features are indicative of worsening health, the findings which suggest that certain environmental features predict death and nursing home admission are supported. However, it is necessary to consider both positive and negative interpretations of this finding as discussed in more detail in Section 5.1.3.1. Negatively, it suggests that housing adjustments are stressful and destabilizing for older adults, leading to the need for additional adjustments so shortly after a previous residential change. However, positively it could be indicative of a learned experience that residential adjustments can lead to positive outcomes and a way to maintain housing autonomy in advancing age.

Home ownership status only predicted relocation or home modification adjustments in the model. Not surprisingly, the results indicate that older adults who rent

were more likely to make an adjustment. This supports previous research findings that suggest home ownership significantly deterred the actuality of moving (De Jong, et. al., 1995; Longino, et. al., 1991; Sommers & Rowell, 1992; Speare, et. al., 1991).

3.2.5.4 Social Support Characteristics

Informal or formal caregiving assistance was a predictor of greater risk of making each type of adjustment analyzed in the model. One explanation of the relationship found in this model is that caregiving services are an indicator of compromised physical and/or cognitive functionality. This suggests that older adults who require caregiver support are on a downward trajectory that eventually requires additional supportive services provided outside of current home environments.

The empirical results also indicated that marital status strongly affected residential adjustments made in later life. Widowhood and never married status had inverse relationships on housing adjustments and nursing home admission. Both statuses had lower probabilities of moving or making a home modification compared to those who were married. However, widowhood and never being married were both strong predictors of nursing home admission. In addition, divorced persons also were found to have a greater risk of nursing home admission compared to married counterparts. These findings suggest that non-institutional housing adjustments were more often made when support from a spouse (both financial and psychological) was available.

Proximity to children was also found to be an important deterrent of subsequent residential adjustments or nursing home admission at the 0.10 statistical significance level. This supported previous research that indicated that adult children influenced

residential adjustments of older adults (Chen, et. al., 2008), but highlights that proximity of children was clearly associated with whether this influence increased or decreased residential adjustment. This finding lent additional empirical support to the concept of assistance migrant, as theorized by Litwak & Longino (1987), in which moves taken in later life can be motivated by a goal to be closer to kin networks, It also built upon prior research that found living in proximity to children reduced the relative risk of relocating (De Jong, et. al., 1994; van Diepen & Mulder, 2009). In addition, it suggested that family caregivers living in close proximity to older adults serve as integral replacements of institutional long term care services by allowing for postponement of nursing home admission. This builds empirical support of the importance of recognizing informal caregiving and the economic value of family caregivers within the long term care sector (Gibson & Houser, 2007).

3.2.5.5 Demographics and Socio-Economic Status

The demographic empirical findings supported what is already well documented in the research. As older adults advance in age, the risk of moving into a nursing home or dying increased. Males, compared to women, were also more likely to die. In addition, race and ethnicity contributed to nursing home admission. Being non-Hispanic white increased the risk of nursing home admission. Alternatively stated, this suggested that older adults of minority race or ethnicity were less likely to enter nursing homes.

The innovative household measure of financial resources used in the model produced telling results, compared to models run with separate income and asset measures. When entered separately into the model, neither assets nor household income

predicted residential outcomes, giving an impression that financial resources were insignificant in late life housing adjustments. The household measure of combined financial resources, representative of both assets and income, revealed that financial resources do play an important role in subsequent residential adjustments. The findings suggested that availability of financial assets can offset the limitations imposed by low income when considering housing alternatives such as relocation or home modifications. The results supported the hypothesis that residential adjustments made in later life are influenced by the combination of financial resources and that asset wealth can provide low income elders with a wider range of housing options in later life. This alternative approach to controlling for household assets and income requires additional exploration within the literature.

3.3 Analysis 2: Home Modification and Relocation

Home modifications and relocation are two types of housing adjustments that older adults can consider when seeking more supportive features in living environments. As described in Section 1.5, previous research has examined the likelihood of making each of these residential adjustment types. But to my knowledge, no studies have been published that have analyzed the characteristics that differentiate older adults who choose to make one type of residential adjustment over the other. By bridging the home modification and relocation literature, this analysis not only added to past research within each of these research domains but also highlighted the important distinctions about what characterizes individuals who make different types of residential adjustment choices in later life. In addition, the analysis examined the influence of environmental context and person-environment fit on choice of residential adjustment type. The environmental emphasis of the analysis added additional empirical exploration of how the physical structure of homes intersects with housing adjustment decisions in later life. The following research question was analyzed using a selected subsample of the main study sample.

Research Question #2 **– What is the role of physical environmental characteristics and person-environment fit on eliciting home modifications as opposed to relocation outcomes in later life?**

3.3.1 Dependent Variable

The dependent variable for the second analysis included only the sample respondents from the main study sample that reported making a home modification or relocating between T2 and T3. Home modifications were defined in the HRS survey as changes made to make homes safer for older or disabled persons. The home modification question was introduced into the HRS study in Wave 4 (1998). Respondents who had relocated were used as the reference group to which those who reported making home modifications to a current home were compared. The home modification dependent variable was selected from the housing adjustment variable used in the first analysis and the same classification hierarchy applied. The minority of respondents who reported making a home modification and relocating were assigned as moving for this analysis. Table 11 displays the frequency distribution of the home modification dependent variable.

Table 11: Home Modification Dependent Variable

	Percent	N (unweighted)
Home Modification	41.1%	796
Residential Relocation	58.9%	1125

n = 1,921; Percentage calculation on weighted data

3.3.2 Sample Descriptives – Main Independent Variables

The main independent variables sample descriptives used in the second analysis are listed in Table 12. Approximately 15 percent of the sample lived in homes of three or fewer rooms and slightly less than half lived in larger homes consisting of six or more rooms. Nearly 40 percent of the sample already had bathroom safety features in the home

at T2, and approximately one-fifth had railings in the home. Fewer respondents had ramps or other wheelchair accessibility features, 10 percent and 9 percent respectively. One floor living space was common in the sample, with 83 percent reporting this supportive accommodation in the home. The average number of person-environment misfits, which measured the number of combinations of specific competency limitations and unsupportive household features, was .25 on a range of 0 to 2 or more.

Table 12: Home Modifications Sample Descriptives: Main Independent Variables

Variables	Mean	Percent	SD
Housing Environment Features			
Size of Home			
Number of Rooms: < 3 rooms		13.4%	0.34
Number of Rooms: 4-5 rooms		40.9%	0.49
Number of Rooms: 6+ rooms*		45.7%	0.50
Bathroom Safety Fixtures		38.6%	0.49
Railings		16.8%	0.37
Ramps		10.3%	0.30
Wheelchair Accessibility		8.7%	0.28
One Floor Living Space		82.9%	0.38
Person-Environment Misfit[a]	0.25		0.55
Competency			
Cognitive Factor Decline (T1-T2)		13.6%	0.34
Physical Factor Decline (T1-T2)		19.7%	0.40
Fall(s)		35.0%	0.48
Depression: CES-D Count[b]	1.48		1.88

Notes: n=1,921; *Categorical Reference Category; Value Range: [a] 0-2+; [b] 0 - 8 symptoms

A larger proportion of the sample had a negative decline in physical competency factor scores than cognitive competency factor scores, 20 percent and 14 percent respectively. Recent fall history had occurred for more than one-third of the sample. The average number of depressive symptoms was 1.48 out of 8.

3.3.3 Statistical Method

A logistic regression model on weighted respondent observations was estimated using the *logistic* procedure in STATA 10. As described in Section 2.2, the VCE(cluster variable) command was used to generate robust standard errors corrected for the correlations within the clusters present in the dataset. Individual respondents were classified as clusters, defined according to the household-person identification number. The home modification subsample of the overall sample was comprised of 1,921 respondent observations.

3.3.4 Results

The results of the logistic regression analysis are presented in Table 13. Relocation into a different home at T3 served as the reference category.

3.3.4.1 Housing Environment and Person-Environment Fit

Two supportive housing features present in homes at T2 predicted greater expected odds of making additional home modifications over relocating compared to otherwise similar respondents without these features. Bathroom safety features increased odds by 62 percent, while railings increased odds by 54 percent. This finding supported previous research revealing that older adults who had already made home modifications had greater intentions of making additional modifications (Yuen & Carter, 2006). It would seem that the installation of bathroom safety features and railings, which are relatively inexpensive and easy to install, can be an important first step in choosing to continuing to modify homes to improve environmental fit. It is important, however, to note that the model did not identify what type of home modifications were made at T3.

Because of the ease of availability and installation of home modifications such as bathroom safety features and railings, it is possible that the additional home modification introduced at T3 was simply an additional bathroom grab bar or similar supportive feature.

Table 13: Expected Odds of Home Modifications compared to Relocation

	OR	95% CI	
Housing Environment Features			
Size of Home[1]			
Number of Rooms: ≤ 3 rooms	0.660†	0.413	1.054
Number of Rooms: 4-5 rooms	0.847	0.655	1.095
Bathroom Safety Fixtures	1.619***	1.281	2.045
Railings	1.535**	1.133	2.080
Ramps	0.996	0.682	1.453
Wheelchair Accessibility	0.841	0.554	1.277
No Stairs	0.815	0.582	1.140
Person-Environment Fit	1.234†	0.968	1.571
Competency			
Cognition Decline Trajectory	0.866	0.621	1.206
Physical Decline Trajectory	0.939	0.710	1.242
Fall	1.033	0.810	1.319
Depression: CES-D Count	0.926*	0.864	0.994
Demographics and Socio-Economic			
Male	0.894	0.696	1.149
Age	0.998	0.976	1.021
Race/Ethnicity - Non-Hisp White	1.144	0.785	1.668
Proxy Respondent	0.616†	0.372	1.023
Years of Education	0.947**	0.909	0.986
Household Wealth[2]			
Low Income, Higher Assets	0.814	0.476	1.394
Higher Income, Low Assets	0.767	0.439	1.342
Higher Income, Higher Assets	0.629†	0.376	1.051
Social Support Characteristics			
Marital Status[3]			
Divorced/Separated	0.661†	0.421	1.040
Widowed	0.509***	0.364	0.711
Never Married	0.422†	0.173	1.027
Recent Widowhood	0.690	0.397	1.200
Child Proximity	1.459**	1.168	1.823
Caregiving Recipient	1.701***	1.269	2.281
Spouse Competency			
Spouse Cognitive Factor Decline	0.777	0.532	1.137
Spouse Physical Factor Decline	0.933	0.671	1.296
Other Housing Characteristics			
Renter	0.522**	0.360	0.758
Residency Tenure[4]			
0-2 Years	0.232***	0.167	0.321
3-6 Years	0.799	0.599	1.067
Good Condition of Home	0.913	0.700	1.193
Safe Neighborhood	1.001	0.765	1.310

Notes: n=1,921; † p < .10, *p < .05; ** p <.01; *** p< .001; OR=Odds Ratio; CI = Confidence Interval

Model Fit: Std. Err. Adjusted for 1,576 clusters; Wald chi2(33) = 250.58 (p < .001); Pseudo R-squared = 0.1425

Reference Categories: 1 6+ rooms; 2 Low Income, Low Assets; 3 Married; 4 7+ years

The exploratory person-environment misfit variable was found to significantly increase the expected odds of making home modifications at the 0.10 statistical significance level. Each additional person-environment misfit increased the expected odds of making a home modification over relocating by 23 percent. Although compliance with home modification recommendations is relatively low (Nikolaus & Bach, 2003; Yuen & Carter, 2006), the finding highlighted that altering a current home was preferred when difficulties arise with functioning in home settings. The finding supported the well documented preference among older adults to age in place (Lawton, 1990; Kochera & Straight, 2005; Oswald & Wahl, 2004), while adding the knowledge that even with negative environmental demands, aging in place was more often chosen.

3.3.4.2 Competency

Individual competency measures were not strong predictors of making home modifications compared to relocating. Only depression had a significant role, with each additional depressive symptom lessening the expected odds of home modifications by 7 percent. Stated inversely, the results showed that with each additional symptom, respondents had 8 percent greater expected odds of moving than modifying a home. The results suggested that older adults with more depressive symptoms favor relocation. This may be partially attributed to the depression variable picking up some of the effects of other variables in the model associated with depression (i.e. widowhood). The positive predictive relationship between depression and relocation may also suggest that depressed older adults are more often encouraged by their adult children or other

caregivers to move in hopes that mental health be improved through socialization and stimulation offered in many senior living housing facilities.

3.3.4.3 Other Housing Characteristics

Among the other housing characteristics, both renters and recent movers had lower expected odds of making home modifications to current dwellings. Compared to otherwise similar homeowners, renters had 48 percent lower expected odds of electing to implement home modifications than moving. The finding was anticipated, since renters typically have little authority to make structural changes to their home or to the building in which they live. Those who recommend home modifications should be sensitive to the home ownership status of clients because of the limitations it could impose on the compliance of older adults.

Respondents with residency tenure of less than two years, also representative of recent relocation, had 77 percent lower expected odds of making any home modifications than moving compared to otherwise similar respondents in the sample with tenures of seven or more years. The results indicated that recent relocation was more likely to predict subsequent relocation, and that home modifications were more often opted for by older adults who had not yet made residential moves during later life. The finding suggesting that older adults who had not recently moved were more likely to make home modifications can be attributed to the preference to age in place (Kochera & Straight, 2005) and a general inertia and resistance to moving because of familiarity and attachment to a long established home (Hays, 2002).

As described in more detail in Section 5.1.3.1, the positive predictive relationship found between recent moves and subsequent relocation can be interpreted both positively and negatively. Although relocating again after an initial move can, on one hand, be interpreted to be indicative of moving stress that only compounds poor health and functionality, positive interpretations are also important considerations.

3.3.4.4 Social Support

The empirical results found strong predictive relationships between social support variables and expected odds of home modifications. Compared to married respondents, all other marital status outcomes had statistically significantly lower expected odds of making home modifications. The results showed that not living with a spouse lessened the odds of making home modifications from 34 to 58 percent, compared to otherwise similar married respondents. Home modifications appeared to be residential adjustments chosen by married elders, while those who were divorced/separated, never married or widowed had greater odds of relocating.

The results suggested, however, that it may be the supportive and assistive role of spouses, not the marital status, which increased the odds of making modifications. Other persons who had supportive roles in the lives of older adults were also found to have positive predictive relationship with the expected odds of making home modifications, including nearby adult children and formal or informal caregivers. Living within proximity of at least one child or receiving assistance from formal or informal caregivers increased the expected odds of home modifications by 46 percent and 70 percent respectively. In general, the social support results suggest increased odds of making home

modifications when other supportive people are present in the lives of older adults, including spouses, family members or formal caregivers. These findings suggest that home modifications were more likely to be installed when there are other people in older adults' lives who encouraged acceptance of the modification, assisted with the installment of the modification, or even persistently insisted on the need for the modification.

3.3.4.5 Demographics and Socio-Economic Status

The innovative household measure of financial resources used in the model produced telling results, providing additional empirical support for the hypothesis that residential adjustments made in later life are influenced by a combination of household income and assets. Financial constraints are often considered to be major deterrents to the implementation of home modifications (Sheets & Liebig, 2005; Tabbarah, et. al., 2000). However, similar to previous research (Mathieson, 2002), the results indicated that higher levels of household financial resources actually lessened the expected odds of making home modifications by 37 percent, compared to respondents with the lowest amounts of financial resources. This indicated that home modifications, despite the concerns of being cost-prohibitive, may be the more affordable housing adjustment available to older adults in later life in comparison to moving. Inversely stated, the results found that older adults with the highest levels of both income and assets had 59 percent greater odds of relocating than making home modifications. The findings imply that older adults with limited financial wealth, inclusive of both income and assets, may face greater obstacles in locating affordable housing alternatives which reduces odds of relocating.

3.4 Analysis 3: Age-Integrated Senior Housing

When making non-institutional moves in later life, older adults can choose between two categories of housing; age-integrated housing or age-segregated senior housing. While some people prefer to remain integrated into the larger community and seek housing with additional supportive features in general neighborhoods, others choose to move into age-specific senior living communities. These communities, such as continuing care retirement communities or assisted living facilities, offer disability-friendly housing and a basket of services that foster social interactions, manage a range of home maintenance details, and provide personal care, health services and emergency care.

Previous research, described in more detail in Section 1.5.2 has examined a wide range of triggers of relocation in later life, with some studies looking specifically at what precedes moves into retirement community housing. However, less is known about what differentiates elderly movers who choose age-segregated senior housing from those who elect to remain integrated into the larger community and move into general, age-integrated housing. Research that has explored these differences, using non-movers as the reference category, found that living alone and increasing disability increased the likelihood of moving into retirement communities (Silverstein & Zablotsky, 1996). With age-segregated senior housing facilities becoming an increasingly common housing option, additional exploration of what characterizes older adults who move into these facilities is critical to better understand what drives the popularity of the senior housing market. While research has found that financial resources are a critical determinant

(Silverstein & Zablotsky, 1996), further research that distinguishes between these two housing options can highlight what other telling characteristics exist that make age-segregated senior housing appealing or unattractive to older adults.

This analysis examined the differences between older adults who choose one of these two housing options when relocating. Decisions to make residential adjustments can help restore a manageable balance between individual competency and environmental demands (Wahl & Weisman, 2003). This analysis specifically explored if unsupportive environmental features and poor person-environment fit in prior homes influenced the probability of older adults choosing supportive, age-segregated senior housing options where environmental demands can be more readily relieved. The following research question was examined using a selected subsample of the main study sample.

***Research Question #3* - What is the role of physical environmental characteristics and person-environment fit on whether or not older adults choose to relocate into age-segregated senior housing?**

3.4.1 Dependent Variable

The dependent variable used in the third analysis of the study only included respondent observations from the main study sample that reported moving between T2 and T3. The variable differentiated between respondents who relocated into age-segregated senior housing and respondents who relocated into age-integrated housing.

Respondents were classified as moving into age-segregated senior housing if they indicated that the home moved into was part of a retirement community or other type of housing that offered special services for older or disabled adults. Table 14 displays the frequency distribution of the relocation dependent variable.

Table 14: Relocation Dependent Variable

	Percent	N (unweighted)
Senior Housing	28.5%	311
Independent Housing	71.5%	787

n = 1,098
Note: Percentage calculation on weighted data

3.4.2 Main Independent Variables

The main independent variables sample descriptives used in the third analysis are listed in Table 15. Two-fifths of the relocation subsample lived in larger homes of six or more rooms, compared to less than one-fifth who resided in small homes of three or fewer rooms. Bathroom safety features were present in the homes of one-third of the sample participants. Only 9 percent of the sample had wheelchair accessible homes at T2 and approximately 10 percent of the sample had railings or ramps in the home. More than four-fifths of the sample indicated having homes with available one-floor living space. The average number of person-environment misfits was 0.20 on a range of 0 – 2.

Table 15: Relocation Sample Descriptives: Main Independent Variables

Variables	Mean	Percent	SD
Housing Environment Features			
Size of Home			
Number of Rooms: < 3 rooms		16.3%	0.37
Number of Rooms: 4-5 rooms		43.4%	0.50
Number of Rooms: 6+ rooms*		40.3%	0.49
Bathroom Safety Fixtures		35.0%	0.48
Railings		14.0%	0.35
Ramps		9.9%	0.30
Wheelchair Accessibility		8.9%	0.28
One Floor Living Space		86.4%	0.34
Person-Environment Fit[a]	0.20		0.50
Competency			
Cognitive Factor Decline (T1-T2)		13.4%	0.34
Physical Factor Decline (T1-T2)		20.0%	0.40
Fall(s)		33.4%	0.47
Depression: CES-D Count[b]	1.56		1.92
Retirement Community Resident		13.9%	0.35

Notes: n=1,921; *Categorical Reference Category; Value Range: [a] 0-2+; [b] 0 - 8 symptoms

Declines in cognitive factor scores were less predominant in the sample than declines in physical functioning factor scores, 13 percent and 20 percent respectively. One-third of the sample reported having a fall history. Depression scores were relatively low in the subsample, with the average depression symptom count of 1.56 out of 8.

3.4.3 Control Variables

An additional control variable was introduced in the third analysis to control for if respondents lived in an age-integrated senior housing at T2, accounting for 14 percent of the analysis sample. Because of missing data on this variable, 27 additional cases were removed from the analysis.

In addition, two control variables used in the first and second analyses were not included in this third analysis. Neighborhood safety and the physical condition of the home were not conceptually determined to be differentiating predictors of the probability of moving into age-segregated senior living housing upon relocation and were therefore removed from the model.

3.4.4 Statistical Method

A logistic regression model on weighted observations was estimated using the *logistic* procedure in STATA 10. As described in Section 2.2, the VCE(cluster variable) command was used to generate robust standard errors corrected for the correlations within the clusters present in the dataset. Individual respondents were classified as clusters, defined according to the household-person identification number. The relocation subsample of the overall sample was comprised of 1,098 respondent observations.

3.4.5 Results

The results of the logistic regression analysis are presented in Table 16. Relocation into general, age-integrated housing served as the reference category to which respondent observations that moved into senior housing facilities were compared.

3.4.5.1 Housing Environment and Person-Environment Fit

The empirical results indicated that housing environment features and person-environment fit had little influence on whether or not older adults who relocated chose to move into age-segregated senior living housing facilities. Only bathroom safety features were found to have a statistically significant relationship, increasing the expected odds of moving into a service supported senior living facility by 60 percent. In general, the

findings among these main independent housing environment variables suggested that even though moving in later life does appear to be influenced by a need to attain more supportive living environments (as found in Analysis 1), the decision to move into a supportive age-segregated senior community is motivated by other priorities. While senior housing complexes can offer a wide range of supportive environmental features, the results indicated that age-integrated housing located within the broader community can also be found to meet the supportive environmental needs of older adults.

Table 16: Expected Odds of Age-Segregated Senior Housing Relocation compared to Other Relocation Types

	OR	95% CI	
Housing Environment Features			
Size of Home[1]			
Number of Rooms: ≤ 3 rooms	1.036	0.544	1.971
Number of Rooms: 4-5 rooms	0.976	0.669	1.424
Bathroom Safety Fixtures	1.600**	1.152	2.221
Railings	0.879	0.536	1.442
Ramps	1.234	0.727	2.097
Wheelchair Accessibility	0.948	0.510	1.762
No Stairs	0.822	0.491	1.379
Person-Environment Fit	1.157	0.804	1.665
Competency			
Cognition Decline Trajectory	1.202	0.740	1.951
Physical Decline Trajectory	1.174	0.810	1.702
Fall	1.013	0.724	1.418
Depression: CES-D Count	1.039	0.958	1.127
Demographics and Socio-Economic			
Male	1.003	0.710	1.417
Age	1.059***	1.028	1.091
Race/Ethnicity - Non-Hisp White	1.042	0.593	1.830
Proxy Respondent	0.647	0.280	1.498
Years of Education	1.044	0.988	1.104
Household Wealth[2]			
Low Income, Low Assets	0.633	0.351	1.142
Low Income, Higher Assets	0.614†	0.365	1.031
Higher Income, Low Assets	0.917	0.487	1.729
Social Support Characteristics			
Marital Status[3]			
Divorced/Separated	1.301	0.719	2.356
Widowed	1.642*	1.015	2.657
Never Married	2.011	0.772	5.238
Recent Widowhood	0.711	0.378	1.339
Child Proximity	1.108	0.814	1.508
Caregiving Recipient	0.955	0.610	1.496
Spouse Competency			
Spouse Cognitive Factor Decline	1.778*	1.035	3.053
Spouse Physical Factor Decline	1.881*	1.133	3.124
Other Housing Characteristics			
Renter	1.465†	0.946	2.268
Age-Segregated Senior Housing T2	3.564***	2.182	5.822
Residency Tenure[4]			
0-2 Years	0.540**	0.368	0.792
3-6 Years	0.681†	0.440	1.055

Notes: n=1,098; † p < .10, *p < .05; ** p <.01; *** p< .001; OR=Odds Ratio; CI = Confidence Interval
Model Fit: Std. Err. Adjusted for 980 clusters; Wald chi2(32) = 121.32 (p < .001); Pseudo R-squared = 0.1139
Reference Categories: [1] 6+ rooms; [2] Higher Income, Higher Assets; [3] Married; [4] 7+ years

3.4.5.2 Other Housing Characteristics

Age-segregated senior housing moves were strongly predicted by other housing characteristics. Not surprisingly, older adults who relocated at T3 who already lived in a senior housing community at T2 had 256 percent greater expected odds of living in age-segregated senior housing after moving. As some types of senior housing communities offer a continuum of housing options on one campus with different available supportive services, moves occurring after an older adult had already transitioned into such a facility would most likely be within the same organizational complex.

Those who relocated who had rented a home at T2 were also found to have greater expected odds of moving into an age-segregated housing setting than otherwise similar homeowners, at the 0.10 significance level. Renter respondents had 46 percent greater odds of moving into senior housing, compared to otherwise similar homeowner respondents. In general, age-segregated senior housing options are rental contracts with some requiring large financial payments with little or no investment return options. The results suggested that homeowners may be more resistant towards the financial or contractual arrangements of such facilities compared to older adults who previously rented. Although the results do not clearly define if respondents rent or purchase a home at T3, the results could possibly indicate that homeowners who move may elect to buy a new home rather than enter into a rental contract under the authority of a senior housing complex.

Age-segregated senior housing moves were also well predicted by length of residency tenure in prior homes. Respondents who had recently moved and lived in a

home for less than two years had 46 percent lower expected odds of moving into a senior housing community compared to otherwise similar sample participants who had lived in a home for seven or more years. Likewise, respondents with residency tenures of three to six years had 32 percent lower expected odds at the 0.10 significance level. Older adults who had made more recent moves but yet need to move again, suggestive of more reactionary moves, had lower odds of moving into age-segregated senior housing.

3.4.5.3 Spouse Competency

Although individual decline in physical and cognitive factor scores did not predict the odds of moving into an age-segregated community among respondents who had relocated at T3, spouse declines in functionality were significantly predictive. Respondents with spouses having declines in cognitive factor scores had 78 percent increased expected odds of relocating into a senior housing facility than general age-integrated housing compared to otherwise similar respondents who had spouses with stable or improving cognitive abilities. Similarly, spouses with declines in physical factor scores increased expected odds of relocating into senior housing by 88 percent. In addition to the findings in previous retirement community research that found that respondent declines in ADL and health predicted moves into retirement communities (Silverstein & Zablotsky, 1996), this finding suggested that spouse health and functionality also contributes to decisions made regarding moves into service supported age-segregated senior housing.

3.4.5.4 Social Support Variables

The social support variables suggested that moves into service supported age-segregated communities can be driven by wishes to be in less isolating living arrangements. Widowed respondents had 64 percent greater expected odds of moving into a senior housing facility than other types of housing, compared to otherwise similar married respondents. Since the other marital status variables of divorce/separated and never married did not significantly predict odds of relocation into senior housing, the widowhood finding indicates that older adults who had been married and accustomed to regular social interaction at home may have stronger preferences for age-segregated senior housing options as a way to regain social outlets in their everyday lives.

3.4.5.5 Demographics and Socio-Economic Status

With advancing age, older adults are increasingly more inclined to elect to move into senior housing when relocating in later life. Each additional year of life increased the odds of senior housing relocation by 6 percent. This result was anticipated, as the basket of supportive services offered in senior housing facilities would naturally become more attractive as age advances and awareness increases about health and functionality limitations and needs.

Household financial resources were also shown to have a significant role in what housing options older adults choose when relocating in later life. Similar to findings by Silverstein & Zablotsky (1996) that indicated that moves into retirement communities were associated with higher income, the empirical results of this analysis also found a positive predictive association between financial wealth and age-segregated senior

housing relocation. Respondents with overall household financial of income in the lowest quintile but assets in the higher four quintiles had a 39 percent lower expected odds of relocating to a senior housing facility than otherwise similar respondents with higher levels of income and assets. The findings reveal that for age-segregated senior housing facilities to be affordable for older adults, both adequate household income and net assets are required.

CHAPTER 4

BUILT ENVIRONMENT AFTER RELOCATION

The intersection between the built environment and housing adjustments in later life is two-faceted. On one side, it is important to identify if and how supportive environmental characteristics and person-environment fit influence the probability of making subsequent housing adjustments, as examined in the first three analyses of this study. However, in order to gain a fuller understanding of the relationship between supportive physical features and moves made in later life relocation, it is also necessary to explore the characteristics of the homes older adults move into and what describes persons who elect to make housing accessibility improvements when relocating. This second component of analysis about the built environment in later life, examined in this chapter, can reveal through relocation actions how aware people are about the importance of the interaction between functionality, disability and supportive contexts.

The preference of older adults to age in place is well documented within gerontology research (Kochera & Straight, 2005; Leeson, 2006; Oswald & Wahl, 2004). As described in more detail in Section 1.2, the overwhelming majority of those with intentions to age in place also indicate the belief that current home environments will

meet the evolving physical needs that accompany advancing age (Iwarsson & Wilson, 2006; Waldrop & Stern, 2003). Research studies have found that older adults are often unable to identify potential household barriers (Wagnild, 2001), and spend little time considering what environmental adaptations might be useful or beneficial to facilitate continued independence despite disability or health limitations (Wister, 1989).

In general, these findings suggest a tendency for older adults to underestimate the importance of housing characteristics in alleviating difficulties in daily functioning, as contended by Pynoos (1993). It is therefore useful to analyze the supportive characteristics of homes older adults choose to move into as a way to ascertain whether or not accessibility and environmental contexts are prioritized by older adults who relocate. Residential moves into homes with more supportive features can restore balance between individual competency and environment press (Wahl & Weisman, 2003), leading to improved quality of life and greater resiliency in coping with disability. But if people are relatively unaware of the supportive nature of the built environment, as indicated by prior research findings, consideration of these characteristics may not be prioritized when exploring housing alternatives.

Little research within the environmental gerontology domain has sought to explain the physical environments of homes older adults move into, a consequence of the prevalence of cross-sectional studies and emphasis on the triggers of relocation. The one study that did look at comparisons between prior home and new home environments suggested that older adults do relocate into homes with more supportive features (Oswald, et. al., 2002). Using a nationally representative dataset, this two-part analysis

aimed to address this gap in the environmental gerontology domain and examined the environmental characteristics of new homes of the survey respondents who had relocated. A descriptive analysis of supportive features in new homes, in comparison to prior home characteristics, was performed to learn what environmental improvements were most commonly obtained when relocating in later life. The second part of the analysis examined the distinguishing characteristics of survey respondents who relocated into homes with more supportive features to identify what characterized older adults who appear to prioritize the alleviation of environmental demands when choosing a new home. The following research questions were analyzed using a selected subsample of the main study sample.

Research Question #4 **– What supportive environmental features are most often obtained upon relocation in later life?**

Research Question #5 **- What characterizes respondents who move into homes that offer more supportive environmental features than previous homes?**

4.1 Dependent Variable

The dependent variable in this analysis only included respondent observations from the main study sample that had relocated between T2 and T3. These cases were classified into one of three mutually exclusive categories identifying what type of support was gained after relocation; (1) no support change, (2) co-residency with someone other

than a spouse, (3) one or more additional supportive environmental features in comparison to prior home. Respondent observations that relocated without making any supportive changes in living arrangements or environment served as the reference category. A hierarchy was used to place the minority of respondents who moved into co-residency living arrangements and made environmental accessibility gains at T3. These respondents were defined as "co-reside" since living with informal caregivers was viewed to be a greater level of support. Approximately one-half of the sample relocated into home settings without any additional available support and one-third moved into homes with a greater number of accessibility features. Table 17 displays the frequency distribution of the dependent variable used in this analysis.

Table 17: Relocation Support Dependent Variable

	Percent	N (unweighted)
Relocate: No Support Change	49.1%	550
Relocate: Co-reside	14.6%	168
Relocate: 1+ Env Improvements	36.2%	390

n = 1,108
Note: Percentage calculation on weighted data

Co-residency was classified as support seeking relocation. Co-residency with an adult child can also serve as a means for older adults to gain the necessary support to compensate for disabilities and health limitations experienced in prior home settings. The informal support available when co-residing can alleviate environmental demands and many of the difficulties in managing daily needs, even if the caregiver's home does not offer any additional supportive housing features. Respondents who moved into the home of an adult child or another person other than a spouse at T3 were categorized as a

separate outcome for the analysis. Respondents who co-resided with someone other than a spouse at T2 were selected out of the sample at the initial sample selection (see Section 2.3).

Respondent observations were classified as making environmental improvements if the total count of supportive environmental features in the new residence at T3 was greater than the number present in the previous home lived in at T2. The count of supportive environmental features included (1) one floor living space, (2) bathroom modifications, (3) ramps, (4) railings, and (5) wheelchair accessibility. Two assumptions were made when calculating the difference in the sum total of accessibility features at T2 and T3. One assumption was that all accessibility features were considered equal. The second assumption underlying the sum approach was that an increase in the number of features represented improvement in accessibility for a respondent.

However, several limitations of this approach must be noted. Not all features provide equal levels of support. In addition, a greater number of supportive environmental features does not necessarily equate with better accessibility because of the unique and individualized experience between every individual and their environment. For example, a person who uses a wheelchair may live in a home with several accessibility features, but if that home does not have adequate wheelchair accessibility, the person may still encounter negative environmental press. Even with these acknowledged limitations, these assumptions were made to allow for clearer interpretation of the analysis results. The assumption that a positive change in the total number of supportive features between T2 and T3 was representative of improvement in

accessibility of the home allowed for certain identification of respondents who moved into more accessible homes at T3. Secondly, interpretation of the findings was also conceptually more intuitive when defining a gain in supportive environment to be equal to a positive change in the total count score. Because of the identification of these limitations of this coding approach, an alternative coding of accessibility improvement was considered for this analysis. A sensitivity analysis was performed using this alternative coding. This alternative coding and results of the sensitivity analysis are discussed in more detail in Appendix B.

4.2 Sample Descriptives

The sample descriptives of the relocation sample used for this analysis are listed in Table 18. The average number of person-environment misfits was .19 on a scale of 0 to 2 or more. The person-environment misfit variable identified the level of environmental press and is a count of six different combinations of specific competency variables and housing environment characteristics. The average number of person-environmental misfits of spouses was only .09. This value, however, is underestimated due to the unmarried respondents in the sample which were coded as zero for this variable. When a subsample of only married respondents was selected (n=394), the spouse person environment misfit count increased to .25 with a standard deviation of .57. The average number of the five environmental supportive features counted in respondents' homes at T2 was 1.48 out of three or more.

The worsening health and functionality variables identified respondents with a decline between T1 and T2 for each of these measures. Approximately one-fifth of the

sample had one or more chronic conditions at T2 than at T1. Almost 30 percent felt as if their health had worsened, as indicated on the self-reported health measure. Worsening mobility and strength, as measured by the functional limitation variable, was the most common decline affecting 41 percent of the sample. In comparison, only 14 percent experienced an increase in the number of limitations with activities of daily living. Similarly, limitations with instrumental activities of daily living increased for 17 percent of the sample. Cognitive functioning declines were noted for 21 percent of the sample. One-third of the sample had fallen one or more times between T1 and T2. The average number of depressive symptoms was 1.58 on a range of 0-8 symptoms.

Table 18: Sample Descriptives

Variables	Mean	Percent	SD
Person-Environment Misfit[a]	.19		.48
Spouse Person-Environment Misfit[a]	.09		.36
Count of Supportive Env Features[b]	1.48		.85
Worsening Health and Functionality			
Chronic Conditions		19.2%	.39
Self-Rated Health		28.3%	.45
Functional Limitations		41.1%	.49
ADL Count		14.2%	.35
IADL Count		16.6%	.37
Cognition		20.9%	.41
Fall(s)		33.4%	.47
Depression: CES-D Count[c]	1.58		1.94
Renter		37.6%	.48
Residency tenure			
0-2 Years		36.0%	.48
3-6 Years		20.5%	.40
7+ Years*		43.5%	.50
Marital Status			
Married*		35.5%	.48
Divorced/Separated		12.7%	.33
Widowed		48.5%	.50
Never Married		3.3%	.18
Child Proximity		50.2%	.50
Caregiving Recipient		17.4%	.38
Male		35.5%	.48
Age[d]	77.78		5.62
Race/Ethnicity - Non-Hisp White		90.7%	.29
Proxy Respondent		4.9%	.22
Years of Education[e]	12.41		3.14
Household Wealth			
Low Income, Low Assets		14.6%	.35
Low Income, Higher Assets		15.5%	.36
Higher Income, Low Assets		8.0%	.27
Higher Income, Higher Assets*		61.9%	.49

Notes: n=1,108; *Categorical Reference Category;
Value Range: [a] 0-2+; [b] 0-3+; [c] 0 - 8 symptoms; [d] 70-104 years; [e] 0-17 years

Renters accounted for approximately two-fifths of the sample. Thirty-six percent of the respondents were recent movers who had moved into their prior home within the previous two years. In comparison, 44 percent of the sample had residency tenures of seven years or more.

Among the marital status variables, widowed respondents were the most prevalent, accounting for nearly half of the sample. More than one-third were married, with divorced/separated and never married respondents accounting for less than one-fifth of the sample. Other social support was available to the sample via the proximity of adult children and the receipt of informal or caregiver assistance. Fifty percent of the sample lived within ten miles of at least one adult child. Nearly one-fifth indicated receiving assistance from an informal or formal caregiver.

The sample was predominately female, with males accounting for only 35 percent of the sample. The average age was approximately 78 years. The majority of the sample, 91 percent, was non-Hispanic white. Five percent of the sample required proxy assistance in answering the survey questionnaire. The average number of years of education was slightly more than a high school level (12.41 years). The majority of the sample, 62 percent, had both higher household income and higher asset levels, while 15 percent of the sample had both low household income and assets.

4.3 Statistical Method

A univariate, descriptive analysis was performed on a subset of variables that described the proportion of the sample that moved into homes with specific household environmental improvements. A multinomial logistic regression model was estimated

using the *mlogit* procedure in STATA 10. As described in Section 2.2, the VCE(cluster variable) command was also used to generate robust standard errors corrected for the correlations within the clusters present in the dataset. Individual respondents were classified as clusters, defined according to the household-person identification number. All analyses were performed on weighted observations. The relocation subsample selected from the overall sample, described in Section 2.3, that was used in this analysis was comprised of 1,108 respondent observations in this analysis.

4.4 Descriptive Analysis Results

4.4.1 Supportive Environmental Improvements after Relocation

The first part of the analysis examined what specific supportive environmental improvements were gained by older adults when relocating among the five features included in the count of total features. Table 19 displays the percent of the sample that obtained each type of structural change after relocation. A respondent was counted as having acquired the specific accessibility only if the same feature was not present in the respondent's previous home. Bathroom safety devices were the most common accessibility improvement gained by older adults who moved. One-quarter of the sample moved out of homes without any bathroom safety devices into homes with such features, such as shower grab bars or toilet rails. Wheelchair accessibility, found in Analysis 1 (Section 3.2.4.1) to significantly reduce the odds of making subsequent housing adjustments, was gained by 17 percent of the sample after relocating. Ramps and railings were added by approximately the same proportion of the sample, 14 percent and 15

percent respectively. Ten percent of the sample was found to have moved from a multi-story living arrangement into a home with available one-floor living space.

Table 19: Supportive Environmental Improvements after Relocation

Variables	Percent	SD
One Floor Living Space	9.5%	0.29
Bathroom Safety Features	26.3%	0.44
Ramps	13.3%	0.34
Railings	14.9%	0.36
Wheelchair Accessibility	17.3%	0.38

Notes: n=1,108; all calculations are weighted

4.5 Multinomial Logistic Regression Results

The results of the multinomial logistic regression are presented in Table 20. The following sections present the findings for each of the supportive relocation outcomes in reference to the base category of the occurrence of no supportive relocation changes.

4.5.1 Supportive Environment

The findings show a significant relationship between person-environment misfit and increased odds of moving into a home that offered additional supportive environmental features. With each additional misfit, the odds of making this type of move over one where there is no gain in contextual support increased by 65 percent. Interestingly, this relationship between intensifying environmental demand and electing to improve environmental attributes when moving occurred whether the environmental press was experienced by the respondent or their spouse. The count of spouse person-environment misfits increased the expected odds of moving into a home with additional environmental supportive characteristics by 64 percent with each additional misfit. These

findings suggest that if older adults have had negative encounters with unsupportive environmental features in previous homes, either personally or via their spouse's needs, awareness increased about the importance of accessibility and leads to prioritization of obtaining such attributes when moving.

Respondents who lived in homes with supportive environmental features had lower expected odds of moving into a new home that offered a greater number of such characteristics than into a home with the same number or fewer. With each additional supportive feature in the home at T2, the expected odds lessened by 47 percent. It is noted that this finding suggests a ceiling effect. Respondents residing in homes with many supportive features at T2 have less opportunity to increase the number of these features when moving compared to respondents without any such supports at T2.

The insignificant relationship found between worsening health or functionality and relocation into supportive environmental settings is equally informative about how aware older adults are about the impact of environmental characteristics on resiliency in coping with disability and worsening health. The empirical findings suggested that worse health or increased disability, with environmental characteristics held constant, does not lead to a prioritization to improve housing accessibility when relocating. This finding provides empirical evidence of the inclination for older adults to underestimate the important role of housing characteristics on the likelihood of successfully aging in place (Pynoos, 1993) and to not reflect on what environmental adaptations might be useful or beneficial for the needs in the future (Wister, 1989).

A separate analysis without the person-environment misfit variable (results not presented) was performed to verify these insignificant findings. This was done to confirm that the person-environment misfit variable in the model had not weakened the relationship between these worsening health and functionality variables and the probability to move into homes with additional accessibility features. In this statistical model, these six variables were again not found to significantly predict relocation into homes with supportive contextual surroundings. These results confirmed that moves into more accessible homes are more likely to occur only when older adults have had personal experience with negative environmental demands in their prior home.

Although worsening health and functionality did not predict residential moves into more supportive homes, the results indicated that a history of falls did positively predict this type of relocation. Respondents who had fallen one or more times in the prior two years had 48 percent greater expected odds of opting to move into a new home in which the count of supportive features was at least one greater than in the previous home. It appears that falling also causes older adults to recognize the important role of housing features in compensating for disability and functionality limitations, similar to experiences of person-environment misfit.

Table 20: Relative Risk Ratios of Supportive Relocation Outcomes

	Relocate: Co-Reside with Someone other than Spouse[1]			Relocate: One or More Environmental Improvements[1]		
Variables	RRR	95% CI		RRR	95% CI	
Person-Environment Misfit	1.603†	0.988	2.602	1.650**	1.149	2.369
Spouse Person-Environment Misfit	1.705†	0.941	3.088	1.638*	1.003	2.675
Count of Supportive Env Features	0.706*	0.529	0.941	0.527***	0.431	0.645
Worsening Health & Functionality						
Chronic Conditions	0.707	0.388	1.289	1.214	0.829	1.777
Self-Rated Health	0.898	0.573	1.408	1.107	0.786	1.559
Functional Limitations	1.245	0.817	1.895	1.028	0.748	1.413
ADL Count	2.648**	1.401	5.003	1.419	0.852	2.362
IADL Count	0.561†	0.310	1.018	0.876	0.554	1.386
Cognition	1.106	0.660	1.852	0.899	0.624	1.295
Fall(s)	1.419	0.917	2.194	1.479*	1.075	2.035
Depression: CES-D Count	0.981	0.874	1.102	1.045	0.963	1.133
Renter	1.482	0.850	2.583	1.568*	1.030	2.388
Residency tenure						
0-2 Years[2]	0.819	0.495	1.353	1.020	0.709	1.469
3-6 Years	0.903	0.507	1.607	1.034	0.673	1.586
Marital Status						
Divorced/Separated[3]	1.814	0.842	3.912	1.062	0.600	1.877
Widowed	2.159*	1.144	4.077	1.493†	1.001	2.228
Never Married	0.696	0.200	2.423	1.737	0.682	4.424
Child Proximity	0.802	0.527	1.220	1.021	0.750	1.389
Caregiving Recipient	1.735†	0.933	3.227	1.408	0.858	2.310
Male	0.809	0.495	1.324	0.774	0.550	1.089
Age	1.037†	0.994	1.082	1.057**	1.024	1.092
Race/Ethnicity - Non-Hisp White	1.246	0.673	2.307	1.822*	1.036	3.204
Proxy Respondent	1.243	0.445	3.473	1.207	0.503	2.896
Years of Education	0.940†	0.879	1.005	1.019	0.964	1.078
Household Wealth[4]						
Low Income, Higher Assets	0.785	0.377	1.632	0.835	0.439	1.590
Higher Income, Low Assets	0.978	0.466	2.051	0.674	0.337	1.350
Higher Income, Higher Assets	0.522†	0.262	1.041	0.941	0.531	1.667

Notes: n=1,108; † p < .10, *p < .05; ** p <.01; *** p< .001; RRR=Relative Risk Ratio; CI = Confidence Interval
Model Fit: Std. Err. Adjusted for 970 clusters; Wald chi2(54) = 186.94 (p < .001); Pseudo R-squared = 0.1043
Reference Categories: [1] Relocate: No Support Changes; [2] 7+ years; [3] Married; [4] Low Income, Low Assets

Moves into more accessible homes were also predicted by renter status. Renters had 57 percent greater odds of making this type of move over one where no contextual support was gained compared to otherwise similar homeowners. This finding suggests

that renters may have less freedom to install home modifications in their previous homes prior to a move than homeowners, resulting in renters having greater odds of moving into homes with more supportive features after relocating. This assertion is supported by the findings reported in Section 3.3.4.3, in which renters were found to have significantly lower odds of making home modifications in comparison to otherwise similar homeowners.

Two demographic characteristics were found to increase the odds of moving into homes with more supportive features than prior homes. With each additional year of age, odds increased by 6 percent. In addition, non-Hispanic white respondents had 82 percent greater odds compared to otherwise similar respondents of minority race and ethnicity.

4.5.2 Co-Residency

The relationship between person-environment fit and the probability of moving in with someone other than a spouse, such as an adult child, was similar to that found among respondent who relocated into more environmentally accessible homes. With each additional person-environment misfit, the odds of moving in with someone increased by 60 percent. Likewise, each additional spouse person-environment misfit increased the odds by 71 percent, at the .10 significance level. It is implied by the findings that the experience of negative environmental press heightened awareness of the need for support to alleviate housing environment strain, but that this support was also found by moving in with informal caregivers. If available, the assistance provided by informal caregivers can possibly compensate for the difficulties in functioning within an unsupportive living environment. However, it is noted that this analysis did not distinguish whether or not

caregiver homes had additional supportive environmental attributes compared to prior homes of respondents. It is possible, however, that some adult children or other informal caregivers may choose to make structural improvements to their home to accommodate the physical needs of their aging parents.

Supportive environmental features in homes at T2 were found to reduce the odds of moving into a co-residency living arrangement when relocating. With each additional accessibility feature in the home, the expected odds of co-residing at T3 were lessened by 29 percent. One interpretation of this finding is that when older adults live in accessible homes, they encounter less negative press from their environments and may appear to have a greater resiliency and independence in functionality. This could result in older persons and their adult children not recognizing possible functional limitations and therefore not even considering the option of co-residency when looking at different relocation options.

Increasing dependence with activities of daily living (ADLs) and difficulties in managing instrumental activities of daily living (IADLs) were also predictors of the probability of respondents becoming co-residents with an adult child or another informal caregiver. For those in the sample that had more ADL limitations at T2 than at T1, the expected odds of moving in with someone increased by 165 percent, compared to otherwise similar respondent observations with the same or improved ADL dependence. Older adults with greater needs in managing basic, daily living tasks, such as bathing or dressing, can benefit from living within close proximity of an informal caregiver.

An increase in the number of instrumental activities of daily living that were difficult to independently manage, on the other hand, lessened the odds of moving in with an informal caregiver by 44 percent over making no supportive changes when relocating. IADL needs, in general, are less debilitating in day to day functioning, and are telling of a less severe decline in functionality which lessens the need for informal caregiver support. This assertion is supported by these empirical finding. Among older adults who relocated, burden associated with difficulty with managing money, preparing meals or running errand was not alleviated by moving in with adult children or another informal caregiver.

Marital status was also found to have a predictive relationship with the probability of older adults electing to move into the home of an adult child or other informal caregiver. Widowed respondents who relocated had a 116 percent increased odds of moving into a co-resident living arrangement than into a new home with no additional support, compared to otherwise similar married respondents. These results, combined with the positive predictive relationship also found with increased ADL dependence, lend additional empirical support of the similar results presented in the research by Keene & Batson (2010).

Receiving assistance from a formal or informal caregiver also predicted moving into co-resident living arrangements, with moderately significant greater expected odds of 74 percent. Increasing dependency is suggested among respondents who require support from caregivers, indicating that respondent needs may evolve to a level where more consistent care and supervision is required than caregivers are able to provide in the homes of respondents. These results likely capture the transition of informal caregivers

from providing care in the homes of the elderly person, most likely an aging parent, to providing this care and supervision within their own home. Decisions to co-reside by older adults and their informal caregivers may also be indicative of the increasing demands caregiving may place on informal caregivers in which co-residency may be perceived to lessen.

The innovative household wealth variable, an inclusive measurement of both income and assets, was found to have a moderately predictive relationship with probability of older adults relocating into the home of another person other than a spouse. Respondents with higher levels of both income and assets had 48 percent lower odds of moving into a co-residency living arrangement, compared to otherwise similar respondents with the lowest level of income and assets. Alternatively stated, the results suggest that older adults with greater financial resources and therefore greater choice in residency options may prefer to remain independent of their adult children and elect to move into other independent setting homes that meet their needs. This finding implied that net worth resources significantly impact what housing choices older adults can consider when needing or wanting to relocate.

CHAPTER 5

DISCUSSION

The majority of older adults wish to successfully age in place in their current residences (Leeson, 2006; Kochera & Straight, 2005). However, residential mobility does occur with regularity among the elderly population (Newman, 2003). One component of the environmental gerontology research domain seeks to explain this occurrence of residential mobility among older adults through the exploration of how the interaction between individual competency and the built environment influences the likelihood of housing adjustments occurring (Wahl, et. al., 2009). Residential adjustments can serve to alleviate the strain experienced by older adults living in home environments that do not support their particular needs (Wahl & Weisman, 2003). The analyses in this research sought to expand the current knowledge and highlight how personal competency and characteristics of the home environment influenced the occurrence of a range of possible housing adjustments that commonly occur in later life.

The first analysis (Section 3.2) compared persons who relocated or made a home modification to those who made no housing adjustment. The purpose of the analysis was to explore how the built environment and person-environment fit influenced the likelihood of non-institutional moves occurring in later life. In the second analysis

(Section 3.3), the analysis examined differences between older adults who decided to make home modifications in comparison to those who relocated and how person-environment fit and the built environment contributed to these outcomes. The third analysis (Section 3.4) looked at what differentiated older adults who elected to move into age-segregated senior housing communities versus housing located in age-integrated communities. It analyzed whether or not experiences of person-environment misfit resulted in greater likelihood of opting to move into senior housing marketed to meet the needs of aging persons. The fourth analysis (Chapter 4) compared the environmental support available in prior and new homes. The research examined how the intersection between competency and environmental characteristics impacted the likelihood of selecting homes that offered more accessibility when moving in later life.

5.1 Empirical Findings

5.1.1 Residential Adjustments and the Built Environment

The statistical analyses of this research provided empirical support of the Ecological Theory of Aging which asserts that individuals and environments are interconnected and that contextual features become increasingly relevant in later life (Gitlin, 2003; Lawton & Nahemow, 1973). The following sections discuss the empirical findings of the three main categories related to the interaction between person and their environment; built environment, competency and person-environment fit.

5.1.2 Built Environment

Older adults who adjusted their residential environment were found to be influenced by the characteristics of the housing environment within which they resided.

The first analysis indicated that structural accessibility features, such as wheelchair accessibility, can postpone or possibly even alleviate the need for future non-institutional residential adjustments. The findings show that housing environments designed with accessibility features, like handicap accessibility, can support elderly people in actualizing desires to age in place. However, adapting current homes to incorporate these types of structural features can be financially expensive (Pynoos & Nishita, 2003) and a major construction undertaking that many people may not be able to afford (Bayer & Harper, 2000; Sheets & Liebig, 2005; Tabbarah, et. al., 2000). The results provide empirical backing for the long-term benefits of building housing stock with universal design features from the onset as a way to support frail and vulnerable persons in later life within the community and facilitate aging in place.

Clear evidence emerged that home modifications less structural in design were a consistent positive predictor of a range of housing adjustments older adults make in later life. These supportive features, including bathroom safety fixtures and railings, represent relatively inexpensive modification options that can be readily installed by the general population. One conclusion that can be drawn from these findings is that these types of home modifications may postpone other housing adjustments on a short-term basis rather than provide the support necessary for successful, ongoing continuation of aging in place.

Alternatively, bathroom safety devices and railings may represent entry level environmental adjustments that often precede the investment in additional home modification adjustments. Personal experience with durable medical equipment and home modifications may lessen the psychological barriers that might otherwise deter people

from welcoming additional supportive environmental changes to their home. However, since the empirical model did not explicitly identify the type of modification introduced between T2 and T3, it is possible that a change was simply an additional bathroom grab bar or similar feature. In general, concerns about affordability and installation logistics are considered by older adults to be barriers to the implementation of more involved home modifications (Bayer & Harpers, 2000). The predictive relationship found between the presence of this type of supportive environmental features and greater odds of making subsequent home modifications may be representative of the affordability and accessibility of certain types of home modifications.

In addition, the research findings suggest that the use of bathroom safety home modifications, such as grab bars, may also be representative of functionality needs indicative of personal care needs. These needs typically contribute to decisions to move into supportive senior housing settings. This category of durable medical equipment products are often only used after older adults begin to experience physical and functional declines when installation of supportive features is necessary to compensate for the increasing challenge with daily living tasks. This assumption was supported by the empirical findings of the third analysis in which bathroom safety features in homes positively predicted moving into senior housing rather than other types of age-integrated housing environments. Senior housing that offers a basket of services to support evolving needs of aging individuals may be more attractive to older adults experiencing such functionality declines.

5.1.2.1 Competency

This research introduced the use of principal component analysis to operationalize competency, a key theoretical construct of the Ecological Theory of Aging. The use of principal component analysis, described in detail in Section 2.6.3, identified the underlying component factors that accounted for most of the variance present in the series of individual competency measures. The two competency domains that emerged encompassed physical and cognitive status.

The first analysis revealed that declines in physical and cognitive competency influenced subsequent residential adjustments in different ways. Physical decline, representative of increased count of chronic conditions, poorer self-reported health and lessened functional mobility and strength, was found to positively predict subsequent non-institutional residential adjustments but not institutional placement. The findings indicate that the theoretical assertion of the Ecological Theory of Aging is correct in that declines in competency destabilize the transaction between the person and their environment (Lawton & Nahemow, 1973) which contributes to subsequent housing adjustments. However, the findings did not show a relationship between non-institutional residential adjustments and cognitive decline and bring empirical clarity to how different domains of competency intersect with environmental demands. The results suggest that efforts to alleviate environmental press through non-institutional residential adjustments may be more relevant for older adults with physical limitations than negative changes in competency in areas related to cognitive abilities.

On the other hand, worsening cognitive status representative of poorer cognitive functioning, increased ADL dependence, and increased IADL dependence positively predicted institutional placements. The finding implies that residential adjustments by older adults experiencing cognitive competency decline may be postponed until level of need exceeds what can be provided within a residential home setting and requiring the more intensive support of nursing home services. Cognitive declines may lead to less problematic encounters with environmental characteristics because of the less physical nature of these losses. In addition, the finding suggests that cognitive loss inhibits the ability to engage in rational, cost benefit analysis that underlie and drive decisions made throughout life (Simon, 1956), such as non-institutional housing adjustment decisions taken in later life.

Although competency did not significantly influence the outcome of moving into senior housing, the third analysis of this research did reveal that worsening spouse competency levels significantly increased the odds of electing to move into senior housing communities. These results suggest that concern about the present or future cognitive or physical care needs of a spouse can increase the appeal of service supported senior housing facilities where assistance and support with caregiving is readily available.

5.1.2.2 Person-Environment Misfit

The person-environment misfit variable was an exploratory methodological approach introduced in this research to measure environmental press as uniquely experienced according to specific competency limitations and structural features. Across the analyses presented in this research, a clear empirical relationship was found between

person-environment fit and subsequent housing adjustments. Greater environmental misfit resulted in a higher likelihood of changes being made to the housing environment in which respondents lived. The research findings highlight that the experience of increased environmental demands specific to the level of individual competency is an important contributing facilitator of residential adjustments.

The results provide empirical underpinnings for the assertion that older adults may seek to restore balance in the transaction between themselves and their environment when making residential changes in later life (Wahl & Weisman, 2003). The findings highlight two different ways in which individuals restore stability by altering their environments. On one hand, the experience of person-environment misfit was linked with a greater likelihood of opting to modify a current home instead of moving. This findings adds to the previously well-documented preference of older adults to "age in place" (Kochera & Straight, 2005; Leeson, 2006) by highlighting that it persists even when experiencing negative environmental press. However, the fourth analysis revealed that when older adults do relocate, the personal experience of negative interactions between individual competency and unsupportive environment appeared to raise awareness of the importance of built housing features. Increasing levels of person-environment misfit, a measure that identified this interaction, were found to increase the odds of moving into homes with more accessibility features than prior homes.

5.1.3 Other Notable Findings

5.1.3.1 Residency Tenure and Recent Moves

The analyses examined in this research revealed that short residencies of two or fewer years, representative of recent moves by sample respondents, strongly predicted subsequent housing adjustments. The first analysis disclosed that recent movers had significantly greater odds of making another housing adjustment over not making such a change at the outcome wave of the study. The second analysis produced similar results. Recent movers were found to have greater odds of moving again rather than making home modifications.

Both positive and negative interpretations of the relationship between recent relocation and subsequent housing adjustments are noteworthy. Negatively, it suggests that when functionally impaired older persons relocate, a move does not stabilize worsening trajectories of health and functionality that likely triggered the earlier moves. Rather, additional non-institutional moves are precipitated because frailty and vulnerability continues to deteriorate even within a new housing setting. The predictive nature between recent and current moves contributes to the view that relocation can be a destabilizing life event (Chen & Wilmoth, 2004; Choi, 1996; Findley, 1988). This perspective underlies a common perception among older adults, whether accurate or not, that residential changes should be avoided because they are disruptive, stressful, and lead to bad health outcomes (Chen & Wilmoth, 2005; Slangen-de Kort, et. al., 1998).

However, positive interpretations are useful in counteracting the negative perception that moving in later life is stressful and destabilizing. These alternative

explanations support the assertion that residential adjustments in late life can be a positive action taken by older adults (Chen & Wilmoth, 2004; Hong & Chen, 2009; Wahl, 2003), even if followed up by another change shortly thereafter. For example, a recent move could be a learning experience for older adults in which they learn that residential adjustments are not very stressful and can lead to some benefits. This analysis of gains and losses associated with a move can facilitate another subsequent residential adjustment shortly thereafter, as this evaluation continues even after a move occurs (Chen, et. al., 2008). This experience may lessen psychological resistance to subsequent housing changes, as stated by Wister (1989), and can explain the empirical findings in this research. This interpretation is supported by previous research findings showing that persons who had made previous home modifications to their home had greater intentions to make more changes in the future (Yuen & Carter, 2006).

The relationship between recent moves and subsequent housing adjustments can also be viewed as empirical support of the benefits of making proactive, planned residential decisions in later life. This type of proactive move has been found in previous research to lead to fewer negative outcomes than reactionary moves (Oswald & Wahl, 2004; Pinquart, et. al., 2004). Although these data cannot disentangle motivation and level of personal control that precedes relocation, it is necessary to consider the possibility that future housing adjustments can also be in response to positive experiences associated with well-organized and planned moves that were not made in reaction to unexpected health crises. Additional moves made shortly after relocation in later life can be representative of learned behavior that moving can lead to positive outcomes or of a

desire to maintain housing decision autonomy while experiencing declines in competency and functionality.

Recent movers were also found to have a lesser likelihood of opting for senior living housing when relocating again within a short period of time, moves which can be viewed as more reactionary in nature. This outcome indicates that relocation into non-institutional retirement communities are most often made by older adults moving out of longer established homes, possibly as a first preventative later life housing transition. The results suggest that the decision to move into retirement communities, in general, may be a more proactive and planned housing move decision taken by older adults than a reactionary one.

5.1.3.2 Household Financial Resources

The innovative household measure of financial resources introduced in this research produced interesting and telling results about how financial resources interplays with housing outcomes in later life. This measure was an exploratory method to sensitize the results to the overall monetary resources available to a person. Decisions regarding housing adjustments may be better reflected by the combined influence of household income and household assets than either of these measures alone. The findings of the analyses in this study revealed that the economic component of housing decisions made in later life is better reflected by consideration of the overall wealth.

The analyses in this research clearly indicated that a combined measure of financial resources does play a significant role in determining what options older adults can realistically consider when considering making all types of housing adjustments. In

addition, this research underscores the relevancy of financial status on housing decisions made in later life and how it can limit viable residential options, a topic that has become more salient in older adults' minds due to the recent economic downturn (Koppen, 2009).

The first analysis revealed that having higher financial assets can offset the restrictions that having low income might introduce when older adults consider home modifications or relocation. Respondents in this category had significantly greater odds of making a residential adjustment over no change, compared to those with lowest levels of both income and assets. Financial resources were also significantly related with the likelihood of opting for home modifications or relocation, suggesting that less wealth can impede choice with relocation options. The second analysis found that those with highest assets and income were significantly more likely to relocate than make a home modification. Alternatively, this indicated that persons with lowest levels of both income and assets may have needed to choose the more affordable home modifications over relocation. This choice may not necessarily result from a personal preference, but possibly because of constraints imposed because of financial status.

The limitation of choice in housing options because of financial wealth became even more apparent in the third analysis of this study. Among people that moved, those with low income but otherwise higher asset resources were less likely to move into senior housing compared to those with both higher income and asset wealth. This suggests that while adequate asset resources are important for consideration of senior housing options, household income also influences what type of housing older adults can fiscally afford. Many senior housing facilities, such as continuing care retirement communities, require

both large financial payments to buy into the system and significant monthly service fees. The empirical results indicate that asset wealth alone, as provided from housing equity for example, does not necessarily make senior housing affordable for all older adults if household income is also not of an adequate level. This finding highlights the possibility that senior housing facilities can be cost prohibitive and that older adults or their family members can experience financial barriers when exploring housing alternatives.

The association found between financial resources and decisions to co-reside also highlighted the magnitude of wealth's influence on housing choices made by older people and their families. Compared to respondents with higher levels of both income and assets, those with higher income but lowest levels of asset wealth were more likely to move in with a family member or another informal caregiver when relocating in later life. The result suggests that older adults with less asset wealth resources may have fewer housing choices available to them when they relocate. This financial constraint may lead them and their families to pursue co-residency as an alternative to other housing options, such as expensive senior housing like continuing care retirement communities or personal care facilities. Alternatively stated, the results suggest that older adults with greater financial resources and therefore greater choice in residency options may prefer to remain independent of their adult children and elect to move into other independent setting homes that meet their needs.

5.2 Theoretical Contributions

The Ecological Theory of Aging has been written about extensively and has undergone critique and additional development of the model's key theoretical constructs,

as noted by Kendig (2003). Empirical development of the theoretical assertions has received less attention in the literature (Kendig, 2003, Oswald & Rowles, 2006). As previously discussed in Section 1.6, this research sought to fill in this empirical gap within the environmental gerontology domain by addressing two key empirical limitations; the need for longitudinal analyses and improved measurement of key theoretical concepts.

Cross-sectional analysis has been the predominant approach to analysis of the interaction between the individual and the environment (Golant, 2003, Wahl, et. al., 2009). This has limited the ability of analytical studies to examine the influence of the continual changes that occur in the interactions between older adults and their environments (Golant, 2003). Several environmental gerontology review articles have highlighted the need for more longitudinal research to further improve and expand what is known about the intersection between person and environment and sensitize results to the complexities of the evolving nature of the relationships examined (Gitlin, et. al., 2001; Golant, 2003; Oswald & Rowles, 2006; Oswald & Wahl, 2004; Wahl, et. al., 2009).

The four analyses presented in this dissertation were each performed on a longitudinal sample drawn from the Health and Retirement Study, a nationally representative longitudinal study. The longitudinal design of the analyses contributed to the empirical development of the environmental gerontology two-fold. The first three analyses examined how the built environment and individual competency influenced the likelihood of making subsequent residential adjustments. Due to the longitudinal design,

changes in physical and cognitive functioning variables were able to be entered into the statistical models. This sensitized the results to how changes in these different domains of functionality and health impacted housing adjustments outcomes. What this study contributed beyond what has already been reported on in other similar longitudinal studies was the use of three-wave data groupings. This approach permitted clear separation between the study outcomes of interest and the occurrence of change (as described in Section 2.1). As a result, findings were strengthened because of the clarity this approach had in delineating the sequencing of competency decline and subsequent housing adjustments.

Comparison of the accessibility available in prior homes and in the new homes older adults elect to move into was the second contribution offered by the longitudinal study design of this research. This comparison of supportive environmental features is not extensively written about in the literature. This analysis provided insight into the extent to which older adults opt to improve accessibility when moving in later life. In addition, the longitudinal nature of this analysis allowed for examination of how person-environment fit and competency declines influenced relocation decisions because of the possible alleviation of environmental strain.

The second empirical limitation this research addressed was the need for improved measurement of key theoretical concepts. One criticism of the Ecological Theory of Aging has been the complex breadth of concepts which are difficult to operationalize (Wahl, et. al., 2009). A lack of standardization in measurement has resulted from this complexity (Wahl, et. al, 2009). This inconsistency in the empirical

analysis of the ETA means that the findings across studies are incomparable, limiting the empirical advancement in the development of reliable analysis techniques and hampering the advancement of knowledge about the complex interactions between person and environment (Wahl, et. al., 2009; Wahl & Weisman, 2003). In response to these noted methodological limitations, two exploratory method techniques were introduced in this research which aimed to bring clarity to two theoretical constructs; competency and person-environment fit.

Principal component analysis was used to identify the components that accounted for most of the variance across a range of selected competency variables. Two competency domains emerged in the data; physical and cognitive competency. In the statistical models, these factor scores represented global markers of competency and replaced the individual measures of competency that have been used in previous studies. Competency is a complex and multi-faceted theoretical construct that is strengthened when characterized into separate components (Lawton & Nahemow, 1973). Replacing individual competency variables with factor scores identifying different categories of competency brought clarity to the analysis of how competency interacted with housing adjustments made in later life. The competency measures highlighted the different domains (i.e. physical competency) rather than individual competency related variables. In addition, this approach simplified the modeling of spouse competency, which better sensitized the empirical analysis to the influence of spouse competency levels on residential adjustment outcomes. As the findings suggest, physical declines in competency predicted housing adjustments while cognitive declines better predicted

institutional placement. These findings indicate that the use of factor analysis in the environmental gerontology domain may be a useful way to operationalize the complex theoretical construct of competency in empirical analyses to better facilitate interpretation and understanding of the findings.

The second exploratory methodological technique introduced in this research was the inclusion of a person-environment fit measure in the analyses statistical models in effort to better operationalize the theoretical construct of person-environment fit. This variable was a count of "misfits" between individual specific competency limitations and corresponding unsupportive housing features (i.e. wheelchair use and wheelchair inaccessible home). The individual specific nature of the misfit variable addressed the noted limitation in the domain that most studies have an underlying assumption that environmental barriers are similarly challenging for all older adults (Gitlin, 2003), and fail to recognize the heterogeneous nature of functionality limitations among older adults (Golant, 2003; Iwarsson, et. al., 2006).

The person-environment misfit variable developed in this research sought to identify the individual level of environmental demand experienced by survey participants to better identify how negative environmental press influences housing adjustments made in later life. The findings of the research indicated that a personal experience of increased environmental demands had a strong, predictive relationship with housing adjustments of various types. The research adds empirical evidence of the notion that people may strive to attain an appropriate *adaptation level*, a key concept of the Ecological Theory of Aging. Personal encounters with poor environmental fit were also found to be necessary

in order for older adults to recognize and prioritize moving into homes that offered more accessibility features. As asserted by Nahemow (2000), these results revealed that less demanding environmental contexts can by prioritized by older adults to reestablish a healthy transaction between their abilities and surroundings. This exploratory method of operationalizing the theoretical construct of environmental press may be useful in future research to empirically examine the complexities of the relationship between person and environment.

5.3 Study Limitations

The breadth of the Health and Retirement Study in content and across time makes it a rich data source for the analyses in this research in order to further develop the environmental gerontology research domain. The use of the HRS, a longitudinal and nationally representative sample, permitted generalizable, longitudinal analysis of residential adjustments made in later life. This methodological approach offered important contributions to the literature because it permitted closer examination of the complex and ever-evolving interaction between persons and their environment. However, several limitations resulting from the use of a large survey dataset must be noted and considered when interpreting the findings of this research.

First, the HRS survey design does not provide a way for researchers to clearly ascertain the timing of events that occur between waves. As a result, the analyses in this study were unable to identify if a residential adjustment preceded or followed a change in health and functionality related competency within the two-year time period between waves. Described in more detail in Section 2.1, this limitation was compensated for in

this research by the use of three-wave data groupings to establish clear sequencing of events between the timing of a change in competency and the occurrence of a residential adjustment. However, this approach still did not sensitize the empirical findings to the influence of events that may have occurred in the two years immediately preceding the outcome wave of the study. This limitation should be considered in the interpretation of the results because many residential adjustments made in later life often occur in response to sudden and unexpected events, such as the onset of a major health crisis or the death of a spouse.

A second limitation of the public HRS survey data used in this research is the limited variables in the dataset that described broader, neighborhood characteristics. Within the literature, environment is sometimes defined to be inclusive of the broader, neighborhood context within which older adults reside, examining characteristics such as proximity to health or neighborhood services, access to public transportation or neighborhood safety (Oswald, et. al., 2005). Consequently, the analyses in this research was restricted to characteristics specific to the supportive features within homes with only very general measures were included that sensitized the results to the broader, neighborhood contexts in which survey respondents lived. Since engagement and ease of interaction with the broader neighborhood context can also be influential in residential adjustment decisions, the possible influence of these broader environmental contexts need to be considered when interpreting the findings of this research. Future research that would utilize restricted access HRS data containing more detailed geographical

information would enable closer examination of the role of neighborhood characteristics on residential adjustment outcomes.

Another limitation of this research was the lack of measures in the analyses models that identify the subjective and psychological feelings respondents have regarding their current home. These emotions can inhibit older adults when considering making a residential adjustment. Golant (2011) highlighted that consideration of residential changes made in later life should be done within a holistic emotion-based framework. subcomponent of the environmental gerontology research domain emphasizes the influence of these subjective feelings on actualization of residential moves in later life. Results of these studies suggest that the emotional components underlying decisions surrounding residential adjustments, such as attachment to place, often delay or deter any actions that lead to housing related changes (Oswald, et. al., 2006; Oswald & Wahl, 2004; Wahl & Weisman, 2003).

Although the influence of subjective and emotions on residential adjustments made in later life is well documented in the literature, this research was not able to incorporate such measures because of survey limitations. Nationally representative surveys, like the HRS, are notable for their breadth of subjects, making them useful data sources for a wide range of research topics. However, the extensive scope of the HRS introduces its own limitations, especially in regards to topics that are more subjective in nature. The HRS does not include measures identifying the level of emotional attachment to current homes or feelings about the possibility of relocation. Therefore, this study was restricted to the objective, physical components that shape residential decisions made by

people in later life. When interpreting the results, consideration must be given to the underlying influence of the subjective emotions of older adults and their impact on decisions older adults make regarding future housing needs.

Survey design also impacted the measurement of supportive housing environment features, introducing a third study limitation. Because home characteristics do not dynamically change across time, the HRS only asks survey respondents housing related questions upon entry into the study or the initial wave after relocation or the occurrence of home modifications. However, this skip pattern within a large survey can result in unintended data collection error and missing data, as was found when coding the home environment variables for this research and described in detail in Section 2.4.2.

In addition, when using a large survey dataset, researchers are limited to using the available data that has been collected. Housing is not one of the primary focuses of the HRS survey, and consequently not all of the questions about housing environmental characteristics included in the dataset were optimally designed for environmental gerontology research. This limitation was observed in the absence of a measure that identified whether or not survey respondents needed to navigate stairs to get into their home. While information about the availability of one-floor living was collected and used in this study to be representative of stairs, this measure does not accurately detect survey respondents who lived in one floor living space but also needed to use stairs to enter a single-family home or reach their home in a multi-story apartment building. Therefore, analysis of the findings about one-floor living space should be done with caution since they cannot be interpreted to mean that respondents live in a stair-free home environment.

Lastly, the HRS makes minimal distinctions between the different types of age-segregated housing options now available for consideration by older adults and their families when exploring housing alternatives. Because of this limitation, the third analysis of this research needed to broadly define age-integrated senior housing to be inclusive of a wide range of housing options. Each of these noninstitutional senior housing complexes, such as continuing care retirement communities or assisted living facilities, cater to distinct subgroups of older adults with certain priorities or needs. While the benefits of using a nationally representative longitudinal dataset in this research were considered to be useful for the initial comparison of older adults who relocate (see Section 2.1), future research should make finer distinctions between age-segregated housing options when the data permits.

5.4 Future Research

One of the main contributions of this research to the literature was the introduction of an exploratory empirical measure of the theoretical construct of person-environment fit. The findings of the analyses performed in this research clearly indicate that an increasing number of "misfits", identified as a specific competency challenge combined with the absence of the corresponding supportive environmental feature, was strongly predictive of a range of housing adjustments outcomes in later life. Additional empirical exploration of the construct is called for in order to further disentangle the complex interaction between individual competency and the built environment and their combined effect on housing adjustments made in later life.

While the count variable used in these analyses provided a general identification of "misfit" for each respondent, future research should look at specific misfit combinations (i.e. wheelchair use/wheelchair inaccessible home) to better ascertain how each one may or may not trigger future residential adjustments. By identifying what combinations are most challenging for older adults and contribute to the likelihood of relocation, more targeted knowledge would be gained. This information would help clarify what supportive environmental features are most useful in facilitating aging in place, especially in the presence of specific functional declines.

The motivation behind housing adjustments in later life is another area future research should further explore. The constraints of using data from a large survey like the HRS allows for little exploration of the subjective perspectives and motivations that underlie residential adjustments. Previous research has extensively examined the emotional deterrents that older adults often experience when facing a need to relocate (Oswald, et. al., 2006; Oswald & Wahl, 2004). However, future research should also consider the subjective motivations and experiences of older adults who do actualize a residential change with an emphasis on incentives driven by feelings about built environment characteristics. The statistical findings of the models presented in this research suggest that awareness of and concern about the built housing environment contribute to residential adjustments taken in later life, similar to research findings by Fonad, et. al. (2006) and Oswald, et. al. (2002). Future research that would take into account these motivations would bring additional clarification about how persons

perceive and interact with their surrounding environment when facing residential adjustments.

An important subcomponent for future research exploring the subjective motivations behind residential relocation is closer examination of why recent movers are more likely to make additional moves within relatively short periods of time. As discussed in detail in Section 5.1.3.1, this pattern can be explained by both negative and positive interpretations. Negatively, these results suggest that moves in later life are an indicator of an overall declining trajectory of health and wellbeing that moving does little to stabilize. On the other hand, subsequent moves so soon after an initial move can be indicative of a positive, learned experience that moving into better equipped houses can have many benefits and be an important way to maintain housing autonomy. These positive and negative nuances behind multiple moves made in later life and which has the strongest influence on subsequent housing moves can only be ascertained through research that explores the emotional and subjective motivations of older adults with such a relocation pattern.

Future research should also consider the impact of increasingly sophisticated assistive devices used to support and assist older adults within their homes and how these devices can promote successful aging in place. Within this study, assistive devices included in the statistical models were limited to the more traditional devices, such as grab bars or shower chairs, which are incorporated into the HRS survey. However, with the technological advances in today's era, assistive devices that incorporate computer technology are becoming more predominant. With the aging of baby boomers, older

adults will become more adept with using technology and therefore more open to using these devices in their homes. Gerontechnology is a subdomain of environmental gerontology in which computer technology is utilized and developed in ways to improve the quality of life of older adults (Bouma, Fozard, Bouwhuis & Taipale, 2007). Future research that examines the prevalence of use of gerontechnology and the impact of these sophisticated devices on how older adults interact with their home environments would provide invaluable information on how person-environment fit will continue to evolve into the future.

Finally, future research should do additional examination of the innovative household measure of financial resources introduced in this research as a way to sensitize results to the combined influence of income and assets on residential adjustments made in later life. The findings of this research clearly indicated that residential adjustments made in later life are reflective of the overall financial status of a household that is not necessarily observed when income and assets are entered separately in models. The approach used in the analyses of this research was an exploratory approach to measuring economic resources. Additional research is necessary to more clearly decipher the optimal distinguishing separation between low income and assets and otherwise higher levels of income and assets as a way to better understand the economic undertones of late life residential adjustments.

In this research, an equal quintile approach was used to identify the lowest category of both income and asset. Alternative definitions of household financial wealth should be explored. For example, the federal poverty income level and an asset poverty

standard that has been defined by Haveman & Wolff (2005) could be used to identify if these measurements of lowest income and assets better distinguish households with lowest financial resources and produce stronger findings. This research has revealed to be one of the dominant factors which influences what housing choices older adults have when contemplating residential relocation. Additional research would lead to deeper knowledge of how housing adjustments made in later life are influenced by household financial resources.

5.5 Policy Implications

The preference of people to be able to age in place as they grow older is well documented in the literature (Leeson, 2006; Oswald & Wahl, 2004). The need for accessible homes will increase as the elderly population proportionally expands. Projections suggest that by 2050 newly constructed single family homes will have a 60 percent probability of housing a disabled person and a 97 percent probability of being visited by a disabled person (Smith, et. al., 2007). This statistic emphasizes the importance of designing homes with integrated accessibility features to better meet the needs of an aging population.

Universal Design and Visitability are two public policy movements that seek to raise awareness of the importance of designing all homes to be accessible for all people, including people with disabilities. Designing homes in this way would promote successful and safe aging in place while simultaneously saving Medicaid and individual costs by delaying institutionalization (Maisel, Smith & Steinfeld, 2008). Universal design aims to promote the construction of homes that are livable for all people regardless of

physical, cognitive or sensory limitations without losing the aesthetic design that appeals to a broader, non-disabled population as well (Lynott, 2009; Salomon, 2010). Examples of universal design features include step-free entrance, multiple countertop heights, wide doorways, and wheelchair accessible shower stalls (Salomon, 2010).

Visitability, although similar in concept, aims to create a standard in which new homes are built with core accessible features to insure that homes can be visited by persons of all abilities but not necessarily livable for severely disabled persons (Lynott, 2009). A visitable house would include a zero-step entrance, wide interior doors and at least one accessible half-bathroom on the ground floor (Lynott, 2009). The Inclusive Home Design Act has been introduced multiple times in Congress since 2003 without ever being successfully passed into law, with the last introduction of the bill in 2009 (Inclusive Home Design Act, 2009). If passed, this Act would have required that all newly constructed single-family homes and townhouses receiving federal funds be built with these visibility standards (Maisel, et. al., 2008).

Some legislative action has already been taken to improve accessibility in housing. The Fair Housing Amendments Act of 1988 made it a federal requirement that all newly constructed public and private multifamily residence buildings be built to accommodate disabled persons (Department of Housing and Urban Development, 1994). However, the vast majority of older Americans do not live in homes to which this law extends and continue to live in inaccessible environments (Maisel, et. al., 2008). This research provided additional empirical support of this assertion. Only 10 percent of the sample lived in wheelchair accessible homes, 15 percent in homes with railings, and one-

third in homes with bathroom safety features. This places older adults at increased risk of needing to make a late life housing adjustment despite well-documented preferences of older adults to age in place.

The invaluable role of accessible housing in accommodating the residential needs of the aging population and successful aging in place is supported by the findings of this research. Structural modifications, such as wheelchair accessibility, were shown to be strongly predictive of lower expected odds of subsequent housing adjustments. In addition, increasing levels of negative person-environment press were found to be predictive of a range of different housing adjustments. These findings show that accessible housing matters greatly in later life stages. Modifications, especially those structural in nature, are often cost-prohibitive for people (Pynoos, 1993). This cost is an underlying reason for the high proportion of older adults living in unsupportive environments and exhibiting low compliance with home modification recommendations. It is important that policies be implemented that outline requirements for basic accessibility requirements in new constructed housing stock. Older people would benefit because the level of personal responsibility to make major structural changes to homes would be lessened during a life stage in which physical strength and energy are reduced and can severely inhibit the ability to make necessary adjustments.

There is strong empirical evidence indicating that housing environment is a key element of successful aging in place, to which this research contributes. Unfortunately, advocacy efforts by universal design and visitability organizations have not yet led to the adoption of legislation that broadens the implementation of accessibility requirements in

the construction of new housing. Two interrelated barriers contribute to this resistance of standardizing accessibility. Homebuilders oppose, believing that the costs to build accessible homes are too high for a product that they perceive the general population does not desire and would not purchase (Lynott, 2009; Maisel, et. al, 2008). Secondly, people themselves resist planning for and prioritizing future residential needs because of unrealistic expectations. In general, people underestimate future physical limitations and overestimate future abilities to function within inaccessible home environments (Maisel, et. al., 2008).

More education targeted at consumers and homebuilders is necessary to overcome these barriers in order to facilitate the passage of policies that endorse a general standard of home accessibility. At the consumer level, the findings of this research suggest that without personal experience of negative environmental press, older adults who relocate do not necessarily prioritize new homes that offer additional supportive environmental features, even if experiencing declines in health or functionality. These findings add to the evidence that older adults underestimate the importance of housing environment as a key contributor to successful aging in place (Iwarsson & Wilson, 2006; Maisel, et. al, 2008; Wagnild, 2001; Waldrop & Stern, 2003). Older adults and their families need to be better educated about the importance of supportive housing environments prior to having personal experience of person-environment misfit. Education is also necessary to raise awareness and reduce negative stigma surrounding the concept of accessible homes.

Without a larger consumer acceptance of accessibility standards, homebuilders will be unlikely to incorporate universal design and visitability features in new

construction. However, older adults have indicated a preference for accessibility features that are aesthetically appealing and well-integrated into the structure of the home (Koppen, 2009). This type of accessibility is easier to incorporate into initial housing design and therefore requires homebuilder buy-in of the concept. Education of homebuilders is therefore also critical if success is to be made in promoting a more general acceptance of standardization of accessibility. As advocated by the universal design and visitability policy organizations, accessibility features would be more cost-effective to install during initial home construction because minimal extra costs would be incorporated at this stage (Maisel, et. al., 2008). Homebuilders not only need to be educated about the importance of designing accessible homes and how to successfully market accessible housing for the general population, but also to be educated about the real costs associated with the implementation of these features (Maisel, et. al., 2008).

5.6 Conclusion

In conclusion, the findings of this research bring additional empirical evidence of the underlying assertions of the Ecological Theory of Aging. Supportive environmental characteristics and physical competency were both found to influence the likelihood of housing adjustments. However, the findings also underscore the heterogeneous nature of older adults. It was revealed that it is how these two components uniquely intersect for each individual person that has the greatest impact on subsequent housing adjustments made by older adults.

The research brings attention to the important impact housing environment has on residential adjustments made in later life. Aging in place is the preferred residential

outcome for the overwhelming majority of older adults (Kochera & Straight, 2005). However, this research highlighted the financial constraints many older people experience when needing to make residential adjustments. It is therefore important that homes be designed with better accessibility. If accessible housing would become more common, the number of older adults experiencing severe, negative encounters with their home environments would lessen. As a result, housing environments could become a preventative resource for elderly persons experiencing declines in competency associated with advancing age and better facilitating successful and safe aging in place.

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APPENDIX A

ANALYTIC APPROACHES TO MEASURING CHANGE IN HEALTH AND FUNCTIONALITY STATUS

Past research shows that individual health, functionality and overall competency influence residential adjustments made in later life. In general, negative changes in these domains appear to facilitate subsequent moves and adjustments (Jackson, et. al., 1991; Longino, et. al., 1991; Newcomer, 2002; Sabia, 2008). As need for assistance increases, housing adjustment can play an important role in helping older adults access these supportive services. In this research, measures of health and functionality were central to the analytic models to strengthen the results to better understand the interactions between individual competency and housing environment on future residential adjustments.

Three questions regarding how to measure individual competency needed to be addressed when determining the final analytical approach used in the analyses of this research. The first question centered on when to measure the occurrence of change; across two or three waves of data. The second question dealt with the necessity of including a static T2 measure of health and functionality in addition to a variable indicating a negative change. A third question considered how to identify those cases for which functionality worsened between T1-T2 that represented an overall declining trajectory of health and functionality.

The inclusion of measure of negative change in physical and cognitive factor scores was supported by prior research showing that such changes are more predictive of housing adjustments in later life than static measures collected at one single data point (De Jong, et. al., 1995; Jackson, et. al, 1991; Newcomer, et. al., 2002; Sabia, 2008). The availability of three-wave data groups within in the stacked dataset of respondent observations raised the question of when to measure the occurrence of decline. In this research, two different approaches to measure such declines were considered for the final analytic models.

The first approach considered implemented trajectory measures identifying respondents with negative decline in weighted cognitive and physical factor scores between T1-T2 and T2-T3. This approach would have sensitized the results to the unexpected and sudden nature of many health and functionality status changes that may occur between T2-T3 and trigger housing adjustments made at T3. However, the survey data does not allow for the sequencing of events between T2-T3 to be untangled and clearly delineate which event between T2-T3 occurred first; the move or the decline. It was therefore decided to use the second approach in which decline in competency factor scores was measured between T1-T2. This approach clearly separated the measurement of change from the outcome measure of housing adjustment. Similarly described by Leland, et. al. (2011), this approach kept the measurement of residential adjustment outcomes separated from the measurement of control variables while maintaining unambiguity in time ordering of events in order to aide interpretation of the results.

The second question explored the strengths and weaknesses of including two measurements of competency in the statistical models; a one-time measure of competency factor scores at T2 and a decline in competency scores measured between T1-T2. Analysis of statistical models including both measures revealed that the inclusion of a static measure weakened the strength of the models and led to unexplainable results of the decline variables relationships with residential adjustments, most notably for death and nursing home admissions. It was decided to only include measures of competency factor score declines between T1-T2 for the models used in this research. This decision was supported by research showing that biased results can occur when both baseline and change measures are included in statistical models (Glymour, Weuve, Berkman, Kawachi & Robins, 2005). This bias was especially notable when a change in the measure of interest occurs prior to a baseline measurement of that same measure (Glymour, et. al., 2005).

The third question sought to differentiate between respondent cases experiencing a temporary health or functionality decline from those for whom the decline between T1-T2 was representative of an ongoing downward trajectory of health and functionality. Models in which trajectory measures (T1-T2-T3) were used supported the assertion that trajectories rather than just a one point in time decline were significant predictors of residential adjustments. Different analytic models were examined to analyze if the use of a decline threshold strengthened statistical power and produced clearer results. It was determined that a threshold of one standard deviation of the distribution of the amount of change between factor score 1 and 2 led to the most telling results.

Table 21 displays the significant outcomes between residential adjustment outcomes and competency measures at T1 and T1-T2 for each of the measurement of competency approaches considered.

Table 21: Significant Outcomes between Residential Adjustment Outcomes and Competency Measures

	Trajectory T1-T2-T3	Decline T1-T2	Decline T1-T2	Decline T1-T2, 1/2 SD	Decline T1-T2, 1/2 SD	Decline T1-T2, 1 SD	Decline T1-T2, 1 SD
Housing Adjustment							
Cognitive Factor Score T2	↑	↑	X	↑	X	—	X
Cognitive Decline T1-T2	↑	—	—	—	—	—	—
Physical Factor Score T2	↑	↑	X	↑	X	↑	X
Physical Decline T1-T2	↑	—	—	—	—	—	↑
Nursing Home Admission							
Cognitive Factor Score T2	↑	↑	X	↑	X	↑	X
Cognitive Decline T1-T2	↑	—	↑	↑	↑	—	↑
Physical Factor Score T2	↑	↑	X	↑	X	↑	X
Physical Decline T1-T2	—	—	—	—	—	—	—
Death							
Cognitive Factor Score T2	↑	↑	X	↑	X	↑	X
Cognitive Decline T1-T2	↑	—	—	—	↑	—	↑
Physical Factor Score T2	↑	↑	X	↑	X	↑	X
Physical Decline T1-T2	↑	—	↑	—	↑	—	↑

Notes: ↑= significant increased likelihood of outcome; — = relationship not significant; X = not entered into model

APPENDIX B

BUILT ENVIRONMENT AFTER RELOCATION:

DEPENDENT VARIABLE ANALYSIS

For the fourth analysis of this research, two approaches were considered for the coding of the dependent variable category identifying whether or not respondents improved the environmental accessibility of a home when relocating. As described in Section 4.1, the approach selected for the final model summed the total number of accessibility features at T2 and T3 and used the calculated difference between the two variables to identify respondents with a greater number of supportive features in the new home at T3. The underlying assumptions, limitations and rationale for using this approach were discussed in Section 4.1.

Because of the limitations of the above approach, an alternative way to identify respondents who made accessibility improvements when relocating was considered. This two-step alternative approach first considered each of the five accessibility features and identified respondents who did not have that feature in their homes at T2 but moved into a home with that specific feature at T3. A total count of this type of accessibility gain was generated, which was then collapsed into a dummy variable that identified respondents with one or more of these supportive environment improvements. A limitation of this approach was the inability to identify respondents, for example those who might move out of a home with four accessibility features into a home with just one feature that was

not present in the prior home. This respondent would be identified as having improved environmental support, even at the loss of several other features.

The underlying assumption of this approach was that respondents make implicit choices when moving, and that accessibility gains or losses present in a new home resulted from personal preferences that represented the individual needs of that person. In the example provided above, it would need to have been assumed that the gain of one new accessibility feature would have been viewed by the respondent to be more useful and needed. This gain of one accessibility feature would therefore balance out the loss of the other accessibility features no longer present in the new home.

As both approaches to defining an improvement in accessibility required some broad assumptions which were beyond the scope of this research to empirically verify, a sensitivity analysis was performed to compare the findings and determine if one definition provided more robust results. First, a comparison of the two dependent variable distributions relative to the negative, neutral or positive change in the count of supportive environmental features was made to determine how many cases were defined differently in each of the models. The alternative coding of the dependent variable resulted in only 39 cases being moved from the "no support change" outcome category to the "1+ environmental improvement" outcome category. The results are presented in Table 22.

Table 22: Comparison of Dependent Variable Frequency Distributions

Support After Relocation: Comparison of Dependent Variables		
	Analysis DV	Alternative DV
Relocate: No Support Change	550	511
Relocate: Co-reside	168	168
Relocate: 1+ Env Improvement	390	429
Total	1108	1108

Secondly, a multinomial logistic regression model was run using the alternative dependent variable. The results are presented in Table 23. The similarity of these results compared to those presented in Section 4.5 suggests that both versions of the dependent variable produced comparable empirical results. Because the total sum count of features dependent variable was more intuitive and therefore able to be clearly interpreted, this coding was selected for the final analysis presented in Section 4.5.

Table 23: Relative Risk Ratios of Supportive Relocation Outcomes - Alternative DV

	Relocate: Co-Reside with Someone other than Spouse[1]			Relocate: One or More Environmental Improvements[1]		
Variables	RRR	95% CI		RRR	95% CI	
Person-Environment Misfit	1.961*	1.178	3.263	2.138***	1.459	3.134
Spouse Person-Environment Misfit	1.950*	1.027	3.703	1.885*	1.119	3.175
Count of Supportive Env Features	0.726*	0.544	0.970	0.592***	0.489	0.717
Worsening Health & Functionality						
Chronic Conditions	0.714	0.390	1.310	1.219	0.836	1.778
Self-Rated Health	0.833	0.529	1.312	0.955	0.682	1.338
Functional Limitations	1.304	0.856	1.987	1.118	0.822	1.519
ADL Count	2.636**	1.386	5.013	1.370	0.820	2.289
IADL Count	0.563†	0.307	1.029	0.883	0.560	1.393
Cognition	1.145	0.677	1.934	0.967	0.672	1.390
Fall(s)	1.397	0.898	2.173	1.396*	1.020	1.911
Depression: CES-D Count	0.976	0.868	1.096	1.027	0.947	1.113
Renter	1.532	0.878	2.674	1.612*	1.072	2.422
Residency tenure						
0-2 Years[2]	0.703	0.423	1.168	0.753	0.528	1.072
3-6 Years	0.850	0.473	1.526	0.935	0.614	1.426
Marital Status						
Divorced/Separated[3]	1.667	0.769	3.613	0.863	0.494	1.507
Widowed	2.116*	1.113	4.024	1.377	0.928	2.044
Never Married	0.776	0.224	2.686	2.027	0.856	4.801
Child Proximity	0.799	0.523	1.221	1.002	0.742	1.353
Caregiving Recipient	1.722†	0.911	3.253	1.357	0.828	2.225
Male	0.796	0.487	1.302	0.759	0.545	1.056
Age	1.033	0.990	1.078	1.044**	1.011	1.077
Race/Ethnicity - Non-Hisp White	1.084	0.582	2.019	1.301	0.751	2.253
Proxy Respondent	1.083	0.386	3.033	0.957	0.424	2.159
Years of Education	0.942†	0.880	1.008	1.022	0.968	1.079
Household Wealth[4]						
Low Income, Higher Assets	0.843	0.399	1.781	0.993	0.524	1.882
Higher Income, Low Assets	0.987	0.461	2.113	0.707	0.353	1.417
Higher Income, Higher Assets	0.545†	0.272	1.092	1.029	0.587	1.803

Notes: n=1,208; † p < .10, *p < .05; ** p <.01; *** p< .001; RRR=Relative Risk Ratio; CI = Confidence Interval
Model Fit: Std. Err. Adjusted for 970 clusters; Wald chi2(54) = 197.87 (p < .001); Pseudo R-squared = 0.1039
Reference Categories: [1] Relocate: No Support Changes; [2] 7+ years; [3] Married; [4] Higher Income, Higher Assets

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