THE USE OF PERSONAS IN UNDERSTANDING HEALTHY AGING: SENIOR HOUSING EXPERIENCES THROUGH IMPORTANCE PERFORMANCE ANALYSIS (IPA) AND SIMULATED PHYSICAL AGING

A Ph.D. Dissertation

by

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Ankara

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The Graduate School of Economics and Social Sciences

of

İhsan Doğramacı Bilkent University

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ŞEVKİYE MERVE TAŞOZ

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THE DEPARTMENT OF INTERIOR ARCHITECTURE AND ENVIRONMENTAL DESIGN

İHSAN DOĞRAMACI BILKENT UNIVERSITY

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September 2020

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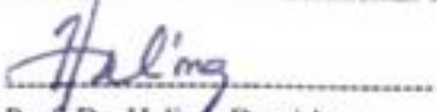

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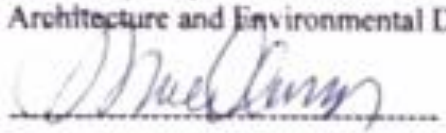

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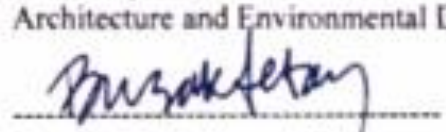

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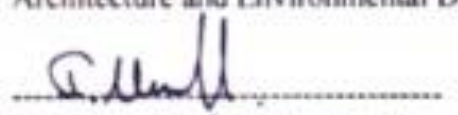

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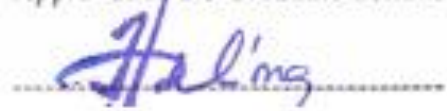

ABSTRACT

THE USE OF PERSONAS IN UNDERSTANDING HEALTHY AGING: SENIOR HOUSING EXPERIENCES THROUGH IMPORTANCE PERFORMANCE ANALYSIS (IPA) AND SIMULATED PHYSICAL AGING

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September, 2020

Accessibility is an essential interior design consideration that increases performance level and allows older people to be independent and physically active in their daily activities. Increase in performance level and a physically active later life enable healthy aging. Modelling of an accessible senior housing is a necessity of the recent design world. Accessibility of these environments should be studied from older peoples' perspective with a focus on efficient ranking methods and empathy techniques. This thesis aims to present a new method of combining aging simulation with personas through importance-performance analysis (IPA) to support basic daily living activities (BADL). Juxta-positioning of IPA findings with aging simulation findings to use it for persona method makes this thesis unique. The proposed method helps to develop a prioritized persona-based model to create accessible senior housing for healthy aging. This model is constructed based on a semantic coding system; an ontology framework. The current thesis is an attempt to deal with the complex nature of accessible design and their attributes for aging studies, which are often considered as theoretical concepts and standards. The findings of the thesis are significant for future aging studies and mobile computing researches in terms of indicating that physical capabilities of older people are associated with different requirements of accessibility attributes, which require structured knowledge and data management to diagrammatize their association with BADL. Moreover, thesis findings are also beneficial for interior designers to make human-centered interior design decisions effectively.

Keywords: Accessibility; Basic Activities of Daily Living; Ontology; Persona; Simulated Aging

ÖZET

SAĞLIKLI YAŞLANMA KAVRAMINI ANLAMADA PERSONA KULLANIMI: ÖNEM PERFOMANS ANALİZİ VE SİMÜLE EDİLMİŞ YAŞLILIK İLE YAŞLI YAŞAM EVİ DENEYİMLERİ

Taşoz, Şevkiye Merve

Doktora, İç Mimarlık ve Çevre Tasarımı Bölümü

Tez Danışmanı: Doç. Dr. Yasemin Afacan

Eylül, 2020

Erişilebilirlik, yaşlı bireylerin bağımsız yaşayabilmelerine, günlük aktivitelerinde daha aktif olabilmelerine imkân tanıyan ve performans seviyesini arttıran önemli bir tasarım unsurudur. Artan fiziksel aktivite ve performans seviyesi sağlıklı bir yaşlanma sürecine katkıda bulunur. Erişilebilir bir yaşlı yaşam evi modeli günümüzün önemli tasarım gereksinimlerindendir. Erişilebilirlik doğru metotlar ve empati teknikleri ile analiz edilmelidir ki yaşlı bireylere hitap eden bir model oluşturulabilsin. Bu tez, yaşlılık simülasyonu ile persona metodunu önem performans analizi yöntemini kullanarak birleştirmektedir. Böylece yaşlı bireyler için erişilebilir tasarım ile desteklenen günlük yaşamın temel aktiviteleri konusunda farklı bir yaklaşım sergilenmektedir. Sunulan bu yöntem, daha sonra erişilebilir yaşlı yaşam evleri tasarlayabilmek için persona metodu bazında model geliştirmekte kullanılmıştır. Bu model semantik bir kodlama sistemi olan ontolojik bir çalışma taslağı ile oluşturulmuştur. Elde edilen bu araştırma bulgularının gelecekte yapılacak olan yaşlılık çalışmalarına ve mobil bilgi işlem araştırmacılığına katkıda bulunması hedeflenmektedir. Tez bulgularına göre yaşlı bireylerin fiziksel kabiliyetlerinin farklı erişilebilirlik gereksinimleri ile ilişkisi olduğu ve bu ilişkinin anlaşılabilmesi için doğru yapılandırılmış bilgi yönetimi ile çözümlenmesi ve günlük yaşamın temel aktiviteleri ile ilişkilendirilmesi gerektiği sonucuna varılmaktadır.

Anahtar Kelimeler: Erişilebilirlik; Günlük Yaşamın Temel Aktiviteleri; Ontoloji; Persona; Simüle Edilmiş Yaşlılık

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LIST OF ABBREVIATIONS

ADL: Activities of Daily Living

BADL: Basic Activities of Daily Living

GDS: Geriatric Depression Scale

GERT: Gerontologic Test Suit

HCD: Human Centered Design

IADL: Instrumental Activities of Daily Living

ICF: International Classification of Functioning

IFA: International Federation on Aging

IOS: Inclusion of Other in the Self

IPA: Importance Performance Analysis

ISO: International Organization for Standardization

KASEV: Kadıköy Sağlık Eğitim Merkezi Vakfı

PP-B: Prioritized Persona Based

TÜRYAK: Türkiye Yaşlılık Konseyi Derneği

SPSS: Statistical Package for the Social Sciences

UN: United Nations

WHO: World Health Organization

CHAPTER 1

INTRODUCTION

According to World Health Organization (WHO, 2011), in 2025 there will be more than 1 billion people who are aged 60 or older (Marshall et al., 2004). Apparently, throughout the world, there is an increase in the number of older population, which is called 'population aging'. Population aging is one of the most significant societal transformations of our contemporary world. Population aging is a worldwide fact that is characterized by an increasing number of people who are aged 60 years or more (Junior et al., 2018). Therefore, aging is not only a personal but also a universal experience. World Health Organization (WHO) and International Classification of Functioning (ICF) compose a chronological definition for older people. According to WHO (1998), this chronological definition is as follows; people who are aged 65 years or more are considered as old. ICF (2002) defines people who are aged 60 years or more as old. Moreover, WHO (1998) also categorizes old people into the three subgroups of aging: (i) 'young old' between the ages of 65-74; (ii) 'middle old' between the ages of 75-84, and (iii) 'oldest old' 85 years old or over.

At a biological context, aging is related with the fractional accumulation of a wide variety of molecular and cellular damage. With the lapse of time, this damage leads to a gradual decrease in physiological reserves of body (WHO, 2015). While some

older people may make use of good physical and mental functioning, the others may be frail or in need of crucial support and assistance to meet their basic needs of their daily lives (WHO, 2015). Regardless of age and physical condition, all people have the right to remain integrated in their community and participate actively in society, to share their knowledge and life experiences with other generations, to seek and develop opportunities and facilities, to serve as volunteers in fields that are appropriate to their interests and capabilities, to form movements or associations, to access educational, cultural and training programs, to live in environments that are safe, comfortable and adaptable to personal preferences and varied physical and mental capacities (IFA,1990). Evidently health status of older people and their healthy aging varies because health-related biological changes are strongly affected by physical environment as well as by the behaviors of the individuals (Dias et al., 2019). In this study, the main focus is person- environment relationship of the aging process in terms of healthy aging (aging well).

When, healthy aging is taken into consideration, person and physical environment relationship becomes very crucial. According to WHO (2015), there are five key domains of functional ability that are important for older people's health status: first domain is to be independent and meeting their basic needs; second domain is to learn, grow and make decisions; third domain is to be mobile and active; the fourth main domain is to be social and to build and maintain relationships, and the last domain is to feel useful and to be able to contribute. These domains are significant to both enable older people to do the basic living activities in their housing environments, and allow them to age in a healthy and safe way. To achieve healthy aging and its related domains, promoting physical activity through human centered design (HCD) considerations in housing environments and enhancing accessibility of those environments are very crucial (King et al., 2017). In this study, HCD approaches will be considered in terms of promoting healthy aging through increased level of physical activities among older people.

Although there are a lot of studies on accessible housing environments and daily living activities of older people, designers are still struggling to empathize towards

physical activity patterns of older people. Designers are also struggling on determining the importance rankings of home features to address the relationships between the most important and the most satisfactory feature in terms of accessible design for older people (Keates, 2015). According to Keates (2015) “It is often hard to prioritize which issues are the most important to fix and, occasionally, which ones may actually harm the overall usability and accessibility of the product” (p. 398). “While these strategies may help designers in broadening the potential audience their design can accommodate, they offer little assistance in prioritizing issues” (Bianchin & Heylighen 2018, p.7). Therefore, accessibility of housing environments should be studied from older people’s perspective with a focus on ranking methods and specialized empathy techniques.

1.1. Aim of the Study

The four main aims of this study are: (i) exploring how to match older people satisfactions with their importance rankings of senior housing features in terms of accessibility through Importance Performance Analysis (IPA) tool; (ii) developing empathy toward simulating these priorities rankings that older people face in their daily living activities through simulated physical aging tool and persona method; (iii) integrate these living needs as a central driver of accessible design process through the use of personas, and (iv) presenting an accessible senior housing model for interior architects through a semantic modeling framework: ontology. Figure 1 illustrated these main aims.

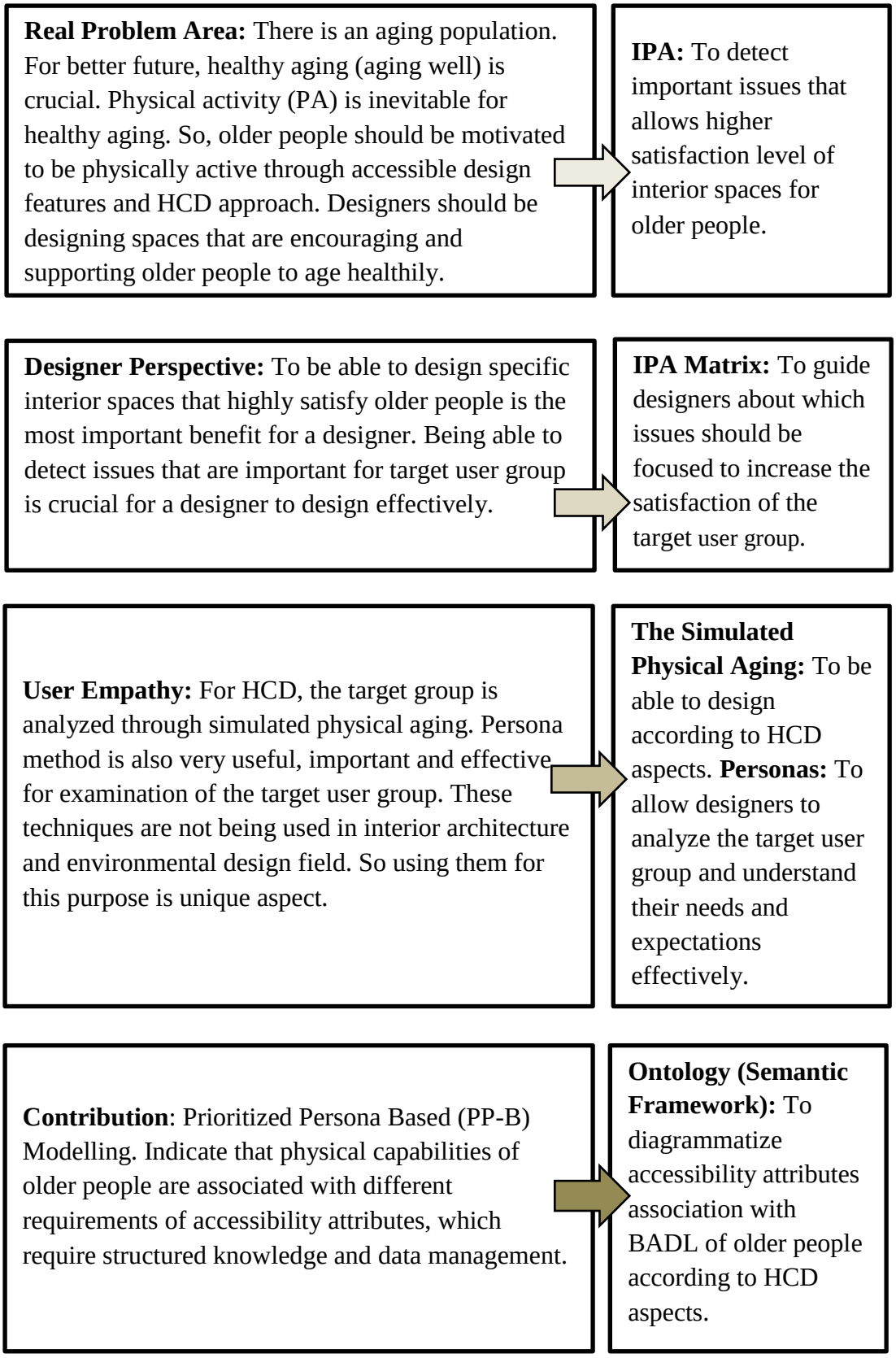

Figure 1. Diagram for the Main Aims of this Study

1.2. General Structure of the Thesis

This thesis consists of nine chapters. After an introductory first chapter, the following two chapters review related literature. In the second chapter, basic definitions and concepts related to aging and healthy aging are examined. HCD is explained and persona method is introduced relatedly. In addition, the second chapter explores simulated physical aging's significance for empathizing older people in order to examine person-environment relationship. The third chapter comprises information about the importance of physical activities of daily living for healthy aging. Also measurements criteria of physical activity level are explained in detail. This chapter also, explains about coping with activities of daily living (ADL) in accessible housing environment and effective details for institutional senior housing are added. The fourth chapter describes the study with its research questions, hypotheses and methodology. The methodology of the study also involves detailed information on the participants and the study setting, procedures and instruments of the study. The fifth chapter presents findings quantitative findings from IPA, qualitative findings and their correlations. The sixth chapter explains the developed personas for aging simulation. Also analysis of personas and their relationship with simulation results are discussed in this chapter. In seventh chapter is the discussion part exists. The eighth chapter includes presentation of prioritized persona based (PP-B) accessible design model that is obtained through semantic modelling framework: ontology. This ontological framework is used by coding accessibility attributes and domains that are obtained by the initial phases of the study through juxta-positioning of IPA and simulation analysis also using persona method. Ninth chapter is the conclusion. Exemplary visual and written materials including survey questionnaire related to literature and study procedure are included in the appendices.

CHAPTER 2

HEALTHY AGING AND THE BUILT ENVIRONMENT

Aging and human development are complex processes that results in a variety of changes on the living organism over time (Cannon, 2015). Aging is associated with the increased vulnerability to accidents or diseases. However, aging is not a disease by itself (Cannon, 2015). In assessing the health status of an older person, it is significant to consider specific diseases that older people may be experiencing by also considering how these diseases interact and influence on trajectories of functioning. However, functioning is determined not just by assessing physical and mental capacities but also by the interactions with the environments that people inhabit across their lives. Functional ability is made up of the intrinsic capacity of the individual, relevant environmental characteristics and the interactions between the individual and these characteristics (WHO, 2015). Moreover, the environmental influences on health in older age may take many forms, including the policies that affect people, the economic status, norms, the physical characteristics of the natural and built environments, and the social participations and networks (Arking, 1999). Consequently, being 'healthy' for older people varies because the health related biological changes are strongly affected by the environment and social behaviors of the individuals (Arking, 1999). Since the important portion of the population is aging, to have a sustainable future, healthy aging is a crucial issue. Healthy aging is "the process of developing and maintaining the functional ability that enables

wellbeing in old age" (WHO, 2015). The physiological and homeostatic changes are largely inevitable in aging process. Healthy aging is dependent mainly on three aspects: physical capacities, mental capacities and lastly, environmental influences (which could be home, community and society) (WHO, 2015). Thus, healthy aging is affected by our experiences, environmental exposures and social behaviors. As a result, healthy aging is "a lifelong process of optimizing opportunities for improving and preserving health and physical, social, and mental wellness, independence, quality of life, and enhancing successful life-course transitions" (Healthy Canadians, 2002). Physical activity is one of the key ingredients for healthy aging. In their living environments older people should be able to be physically active to maintain their health status. There is strong scientific evidence that regular physical activity results in major and extensive health benefits for people aged 65 and older (King et al., 2017).

The relationship between older people and the design of their built environment becomes significant for healthy aging. The built environments, especially home environments, encourage older people to be physically active and allow healthy aging accordingly. Older people should have accessible domestic environments for their mental health, physical activities, social life, and independence in their daily living. Accessibility and home environment have important impacts on older people's well-being since they are highly effective on provoking feelings such as; feeling secure, feeling oriented, feeling independent, feeling socially included. Empirical studies showed that the positive relations between older people and housing environment has significant effects on healthy aging (Bamzar, 2019; Chaudhury et al., 2016; Hees, Horstmanc & Jans, 2017; Oswald et al., 2007; Seah et al., 2019). It is a basic human necessity to have equitable access and be able to participate in the environment without restrictions or discrimination (Calder et al., 2018). Furthermore, accessibility is an important issue that increases the satisfaction level by allowing older people to be independent and physically active in their daily activities (Bamzar, 2019; Rantanen, 2013). However, inaccessibility of the buildings, such as inaccessible access routes and kitchen and bathroom facilities etc., are the common obstacles that older people encounter, and can present barriers to participate in daily living activities. So, from the environmental design point of view, reaching

an accessible home is right of every older person for healthy aging (Bamzar, 2019; Hockey, Phillips & Walford, 2013).

2.1. Human Centered Design (HCD) Approaches for Healthy Aging

According to United Nations (UN, 2000), every individual without any exclusion, has the right to lead a healthy life and right to reach the related determinants of health, such as food and nutrition, housing, access to safe and potable water and adequate sanitation, safe, comfortable and healthy working conditions and a healthy and accessible environment. Hence, if societies are cohesive, peaceful, equitable, secure and accessible for older people, this will be beneficial for all generations. If older people participate actively in society and if they remain integrated to their community, they will be more useful for their society and they will not feel that they are left behind (IFA, 1999). When healthy aging is considered, older people should be encouraged to participate in real life actions. Older people might be people, who have discernable impairments, but have a strong ambition to remain independent and to contribute to the community (Huppert, 2003). Furthermore, it is a crucial aspect for our future to provide environments that are usable to the greatest number of individuals, regardless of their functional abilities (Evcil, 2012; ISO, 2001). However, older people are usually excluded and precluded by inappropriate design issues (Canadian Human Rights Commission, 2006). A HCD approach can play an important part in enabling older people to remain physically and mentally active and independent individuals.

HCD is a design approach that aims to allow useful, usable, pleasurable and meaningful products, services or building environments for user groups. According to HCD approach, design should consider the target users as an individual, possessing individual abilities, experiences, expectations, limitations, capabilities and human characteristics. This way a service, product or design will be capable of being used by people with the wide range of abilities, within the wide range of situations reaching most and potential end-users (Wilkinson & Angeli, 2014). The main

principle of HCD is to describe how to gain and apply knowledge about human beings and their interaction with their environments and to design products or services that meet target user group's needs and expectations. Figure 2 illustrates the importance of HCD for reaching the target user group. By HCD satisfied users are expected to be obtained (Hekkert & Dijk, 2011). In the contemporary design world, human centeredness is a core quality of design. HCD is built up into a field of expertise of its own. As a result of this new of professionals, human-factors experts, usability and accessibility researchers and designers, user experience specialists are being part of design world (Bijl-Brouwer & Dorst, 2017).

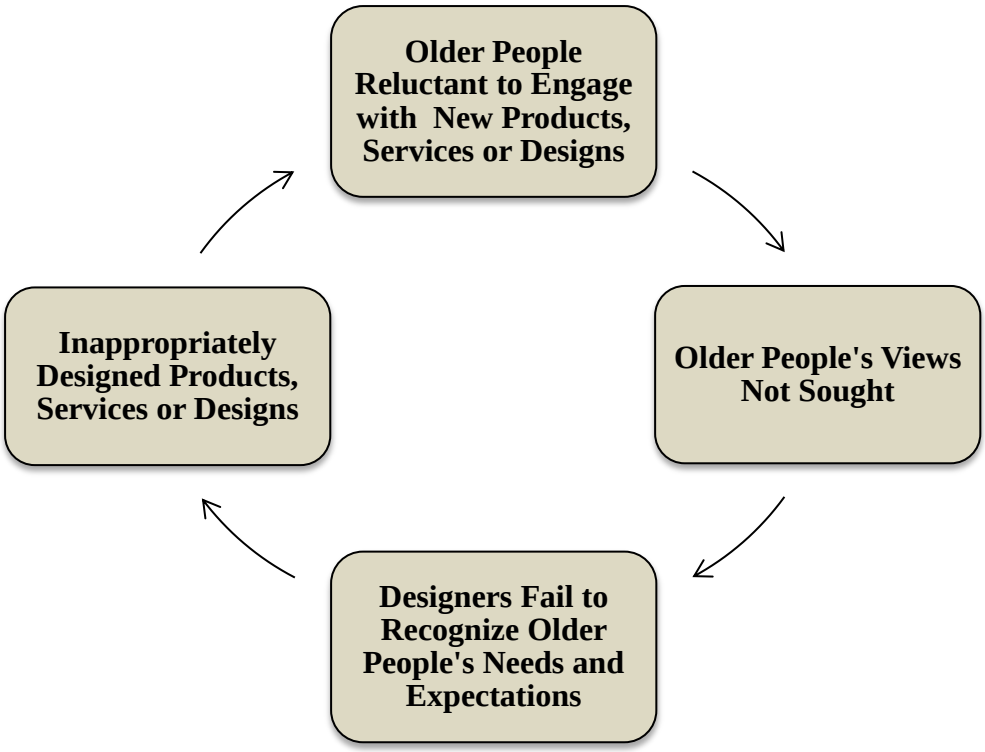

Figure 2. Cycle of Design for Older People without HCD Approach (Adapted from Wilkinson & Angeli, 2014)

So, especially in the last decade because of the growing population of older adults and disabled people, there is a significant need for products, services and environments to be developed in a holistic way that they do not exclude, but instead reflect more accurately the variety of demands of today's users (Huppert, 2003). There are moral, sustainable, professional and economic reasons why designers should be aware of a HCD approach. Morally, designers as part of society should be seeking to remove barriers and obstacles that create disabling environments. From a

sustainability point of view, there is a strong argument to create communities that encourage participation regardless of age, gender or circumstance (Casserley & Ormerod, 2003). Economically, HCD argues that increasing the numbers of people able to use the design expands the market share and increases business profitability (Casserley & Ormerod, 2003).

Rethinking environmental design in a human centered way requires a change in mind set within design practice. Many techniques were used for HCD in different fields. Observations, interviews, tasks, prototyping, personas, cognitive mapping, data journalism are some of the techniques that were used for HCD (Alazanez-Cortes et al., 2017). In interior architecture and environmental design field, the use of personas for HCD is not common; so it is a unique aspect to use personas as a HCD technique in this specific field. Furthermore, simulated physical aging is also an effective technique for HCD. Recently, new simulation tools are introduced and these tools have being used for HCD. Applying techniques like; the use of simulated physical aging and persona, allows designers to gain nuanced and diversified insight into the experience of future users. This insight allows also maintaining a human centered approach throughout the design process (Van der Linden, Dong & Heylighen 2018). Special solutions and assistive devices towards increasing accessibility and inclusivity could not be sufficient within the mainstream of this design movement. A better understanding of environmental design should be given for more personalized and adapted space. To maintain quality and safety, each older person is unique, and should be actively involved in that environment activity patterns (Huisman et al., 2012). Moreover, this HCD approach, driven by the needs of both users and designers, helped to extract more visual cues, patterns of behavior, and design opportunities (Willis, 2018). Compared to other traditional approached, HCD approach has more potential to overcome physical and emotional comfort and needs, which were integral to the research and design (Willis, 2018).

2.2. Use of Personas

When people design, build or create a product or a service, their aim is to obtain a useful, accessible and appreciated design that can address the target user group. As mentioned before this is the key principle of HCD. However in real life, it is an important challenge to design, build or create a product or a service that can meet the needs, expectations and desires of target user group. To deliver on the promise and the benefits of HCD, designers should find creative and efficient ways to use accurate information about real users to be able to have appealing and effective design for target user group (Puritt & Adlin, 2006). Anvari et al. (2017) defined persona as "archetypical user of a product or service" and consider persona use an effective method in HCD studies (Anvari et al., 2017, p.324). In this study, the method of 'persona design' is considered as an alternative method for representing healthy aging.

The verdict of 'personas' was created by Allan Cooper in 1999 (Cooper, 1999). "Personas are fictitious, specific, concrete representations of target users. Personas put a face on the user- a memorable, engaging and actionable image that serves as a design target" (Puritt & Adlin, 2006, p.11). A persona is not a real person; it is an abstraction of a real person. However a name and a picture are selected for the fictional representative of the real user who shares common characteristics, needs and expectations (Miaskiewiez & Kozar, 2011). In persona methodology, personas that are created to represent real target user group is described in narrative form for to make persona seem like a real person and to provide a strong story that reflects the needs, expectations and desires of real target users so that designers could focus on the product accordingly (Miaskiewiez & Kozar, 2011). In the narration, descriptions of the persona should exists including; likes, dislikes, occupation, life style etc. This allows creating an image in mind (Cooper, 1999; Grudin & Pruitt, 2002). Persona's specific needs and personal goals should be described in detail to allow designers to consider critical design decisions relatedly (Pruitt & Adlin, 2006).

Persona use was considered as a useful method in HCD field because of its various benefits. One of the significant benefits is that it provides improved communication about the target user group within the design group (Cooper, 1999; Cooper& Reimann, 2002; Grudin & Pruitt, 2002; LeRouge et al., 2011; Ma & LeRouge, 2007). Another positive impact of personas is that, creating personas allows designers to focus on the needs, expectations and desires of the target users more effectively (Cooper, 1999; Grudin & Pruitt, 2002; LeRouge et al., 2011; Long, 2009; Ma & LeRouge, 2007; Pruitt & Adlin, 2006). Personas are also beneficial to reflect diverse opinions, needs, expectations and desires of real target user groups (Cooper & Reimann, 2002; Grudin & Pruitt, 2002). Personas also allows improved identification with users (Ma & LeRouge, 2007) and also by the use of persona method, after product development process the need for making changes will be reduced and this will consume time for the designers and design groups (Cooper, 1999). Various studies that mentioned benefits of persona methods are listed in Table 1.

Table 1 Benefits of persona use within the literature

Literature Source	Specified Benefits of Personas Method
Cooper (1999)	-Increasing focus on the target user group and their needs, expectations and desires. -Enhancing effective communication about target user group. - Reducing the need for making changes after product development process.
Cooper and Reimann (2002)	-Building consensus and commitment to design field. -Testing design's effectiveness. -Defining the product's feature characteristics. -Enhanced communication within the design group members. -Helping related actions such as marketing strategies.
Grudin and Pruitt (2002)	-Enhancing a focus on target user group and work contexts. -Exploration of target user groups to diverse contexts. -Making assumption about target user groups needs desires and expectations. -Providing effective communication about target user group. -Focusing on a specific audience.
Pruitt and Adlin (2006)	-Making assumption about target user group's needs and desires -Narrowing the target users -Leading to better and more suitable design solutions. -Enhancing the motivation within the design team. -Building empathy for the target user groups.
Ma and LeRouge (2007)	-Enhancing effective communication about target user group. -Enhancing the identification with the target user group. -Increasing the focus on target user group's needs.
Long (2009)	-Providing better focus on the target user group during the development process. -Leading to human-centered design by focusing on target user group's needs. -Guiding the decision making process.
LeRouge et al. (2011)	-Placing the target user at the focal of the design. -Focusing early on target users and their tasks. -Measuring usability empirically. -Designing iteratively so a product is designed, evaluated and modified with real users or experts continuously.

As listed in Table 1, there are various studies that provided a set of persona profiles for HCD. However, there are few studies on personas that provide a set of information on capabilities and the activities of daily living (Goodman-Deane et al.,

2018). Therefore, questions arise as to how one can create personas based on the interior physical performance of older users or provide information on their BADL within the context of the healthy aging process. This study was an initial attempt to deal with the complex nature of accessible interior design and it's attributes within studies, which are often considered theoretical concepts and standards. Although there are accessibility standards, they are in the form of indicators derived from numerical values of human considerations (lacking information on qualitative data or data), which correlate the importance, performance and satisfaction ratings of older adults (Heylighen, Linden and Steenwinkel, 2017). However, accessible interior design requires the consideration of human diversity, social inclusion and right to equal participation in every aspect of society. A major challenge in accessible design is the difficulty that comes with considering these human differences and conflicting claims (Heylighen, Linden and Steenwinkel, 2017). Although it may be logical in theory, it is not realistic in practice. Accessible design is potentially achievable "if overall usability for the worst off is maximized" (Bianchin and Heylighen, 2018, p. 62). The complexity of accessibility in interior design lies in this paradox.

To sum up, design process should consider the target user groups. Experiences, individual aptitudes, characteristics, abilities and limitations, desires and expectations of all potential users should be considered during the design process. With this approach, an end product will be capable of being used by users with the widest possible range of abilities, needs, desires and expectations (Wilkinson & Angeli, 2014). However, many design products fail to consider the consumer needs, desires and expectations as the focus of their process (Gulliksen et al., 2003). Personas are effective methods to be used in design field to provide better understanding a wide range of target user group's needs, desires and expectations. There are many benefits of using personas methodology. However there should be consciousness of how to apply this method effectively (Vincent & Blandford, 2014).

2.2.1. Creating Suitable Personas

When creating a persona adding important information content is one of the most important aspects. The right type of information should be coded to be able to analyze and determine whether each persona would be able to use the product, service or design efficiently. The second most important thing when creating a persona is; personas must be based on quantitative data about the target population. The third most important issue when creating personas is the representativeness (Goodman-Deane et al., 2018). "Each persona needs to represent a group of people in the population with sufficient accuracy for the assessment. It needs to be close enough to all members of the group that it is possible to say with some certainty that if the persona can use the product, then the embers of the group will be able to as well." (Goodman-Deane et al., 2018, p.2). The number of personas is significant point in terms of representativeness. If the persona number is too large, then doing an assessment through these personas becomes unmanageable. As a result, persona number should be small enough to keep the whole set in mind and manage the information efficiently (Goodman-Deane et al., 2018). Table 2 illustrates different ways of persona developments in four different literature sources in detail.

Table 2 Persona development examples related with healthy aging studies in different literature sources

Literature Source	Subject/Aim	Instrument	Personas
Marshall et al. (2010)	- Aim is to assess exclusion and identify problems and solutions through tasks.	-HADRIAN method. -Uses description of 100 real people.	- Persona profiles include detailed data on capabilities, preferences and experiences with the range of daily activities.
Reeder et al. (2011)	-Aim is to propose approaches for "holistic personas" to understand diverse older people and their circumstances.	-Personas are created through cluster analysis of data from a small study of people who are aged 85 and over. -21 "oldest- old" people used for cluster analysis.	-Presents two personas with fictional descriptions with a quantitative basis. -Personas include information on age, education, health conditions, experience with computers and social support. However, the rating scales used are not specific enough to facilitate product assessment.
Wöckl et al. (2012)	-Aim is to describe the diversity among eight European countries for the project Cure-Elderly-Personas.	- Personas created according to survey data of 12,500 older people in different European countries through partitional clustering. Capabilities are not defined specifically. Most of the capabilities were not included in the initial cluster analysis which means that it is unclear how well they represent the cluster as a whole.	-Created thirty personas to represent the diversity among older people in Europe. -Personas included wide range of information such as health status, limitations in Activities of Daily Living (ADL), economic status, social activities and range of capabilities etc.
Burkett and Jones (2016)	-Descriptions of real users are done instead of fictional users based on interviews on 'baby boomers' to understand how they see the idea of healthy aging. -Aging is described as systematic event but not a personal event.	-Persona profiles includes systematic categories such as; family, housing, income, social network etc. -The descriptions are qualitative and aim to hand the designers a holistic view of the person's background and situation.	-Personas are not effective to assess usability since they do not include any information about capabilities.

To sum up, creating a plan and limiting the research scope to a target user group's tasks is an important issue in persona development, since it allows staying focused. A good way to initialize the study is, to consider the target users goals, as well as the tasks that the user group wants to complete while meeting those goals. Definition of the research plan and research questions around those goals is a crucial step of the persona development. During the data gathering and categorization methods like affinity diagraming could be used. After gathering the data, analyzing the data with appropriate statistical method is inevitable for suitable persona development process. As a result of these steps, the data obtained could be used to understand the target user group and create suitable personas accordingly (Lior, 2013). In this study, persona development procedure starts with obtaining the right type of information about the target user group through surveys. So personas of this study are fictional, however, they are based on observations on real target user groups and surveys' analysis of the real target user groups. Personas in this study include information on, age, health status, social activities, life experiences, interests, psychological wellbeing and range of capabilities. The descriptions are qualitative and focus on giving the designer a holistic vision on the target user group. However important aspects are detected after quantitative analysis of survey with IPA tool. These important aspects are analyzed and grouped by affinity diagrams. Affinity diagramming method is used to state the important aspects and characteristic features of the target user group and to be able to make the categorization of the listed features. After affinity diagramming of personas, they are ready for the tasks that are created for simulated physical aging method. All personas are stated as independent older people on basic activities of daily living (BADL). Also, all personas are stated as not indicative of depression. The aim of creating personas for this study is to assess exclusion and identify problems and solutions for healthy aging through HCD. See Figure 3 for the main procedure of persona development.

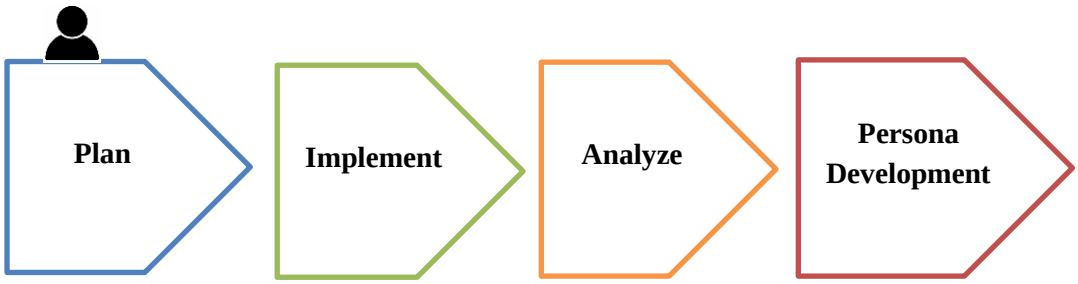

Figure 3. Main Process of Persona Development (Adapted from Lior, 2013)

2.2.2. Task Creation Procedure

After persona development, a task list should be created. A list of tasks should be stated for each persona group. The task list should comprise all the tasks that the target users are expected to perform and experience with the product, service or design. Tasks should be created according to specification and categorization of the tasks related with target user group's capabilities (Lior, 2013). Figure 4 represents the main process of creating tasks for simulation.

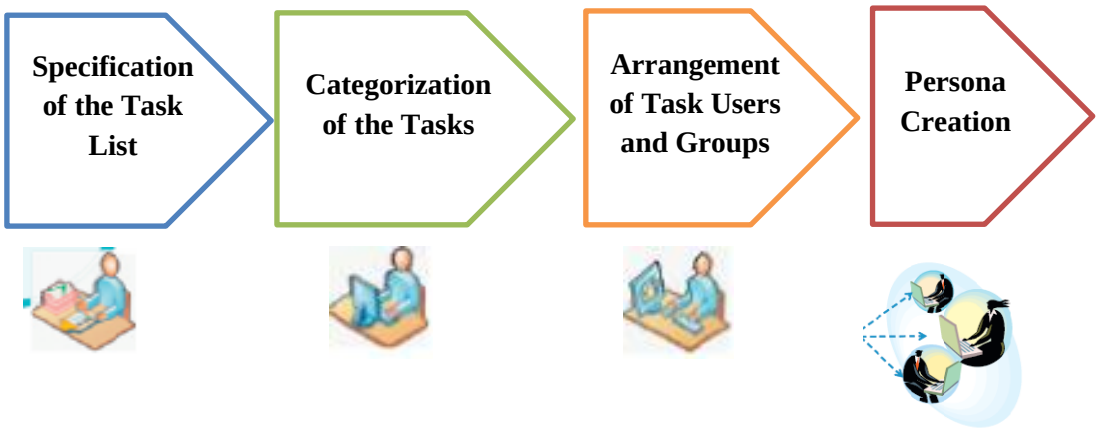

Figure 4. Main Process of Creating Tasks for Simulation (Adapted from Lior, 2013)

2.2.3. Using the Personas for Evaluation

After creating personas, they can be used for evaluation through creating different tasks for certain product, service or design. Personas capabilities should be compared with demands of the task steps to be able to understand whether they could be able to complete the stated tasks. If a persona could not complete a related task, it means that the group that this persona represents would not be able to complete the task either. This means that the product, service or design should be reconsidered for more efficiency to reach target user group (Goodman-Deane et al., 2018). According to Goodman-Deane et al. (2018) there are important steps for suitable persona creation (p.3). These steps are as follows;

i. The personas need to include the right type of information to be able to understand whether each persona would be able to use the product, service or design.
ii. Personas should be named for building better understanding of the situation of the target user group.
iii. Capabilities of each persona should be stated in detail.
iv. There are other qualitative factors that influence target user group such as health status, life experiences, social activities, interests, psychological wellbeing so these issues should also be included in the personas as well.
v. The personas must be based on quantitative aspects about the target users to be able to know approximately how many people in a selected user population are represented by each persona.
vi. Each persona should be able to represent a group of people in the target population with efficient accuracy for the assessment.
vii. Number of personas should not be large since large numbers makes the assessment unmanageable and it will be difficult for design team to keep the whole set in mind.
viii. Representativeness of the personas is the most crucial concern for persona creation.
ix. Evaluation of tasks can be done after creating suitable personas.

x. If a persona cannot complete a task, it means that the group this persona represents will not be able to complete that task either.

2.3. Simulated Physical Aging for Promoting Empathy towards Healthy Aging

Depending on the increase in the number of older people population, the need for specialized design for older people increased. In this case, it is significant to have empathy on older people's thoughts, expectations and their experiences with goods, services, products and building environments. However, many designers are not be aware of the challenges and difficulties that older people experience while using the goods, services, products or building environments (Lavallière et al., 2017). In terms of HCD; designers should not ignore older people while designing. To be able to design for older people, designers should be able to empathy on older people by the help of knowledge about older people and by the help of self-observations (Cardoso & Clarkson, 2012).

As a result of the significance of empathizing in design field, a design approach called empathic design was developed to ensure a creative consciousness for the specific target users (Postma et al., 2012). Through the years, several design approaches have emerged to support user-friendly products and environments such as universal design, inclusive design, trans-generational design and HCD (Demirbilek & Demirkan, 2004; Farage et al., 2012; Vermeulen et al., 2013; Woudhuysen, 1993). Among the approaches, empathic design is a design approach that ensures a creative consciousness for specific target users and their daily lives (Postma et al., 2012). It also enables designers to feel for the users in consideration of their special needs (Postma, Lauche & Stappers, 2009). Pastalan (1977) pioneered an empathic model in the early 1970s that places more emphasis on the users of the designed spaces and transforms the subjective knowledge of human behavior into objective and scientific knowledge. Empathic design focuses on target user group's necessities, life styles, everyday life experiences, ambitions and emotions (Mattelmäki, Vaajakallio & Koskinen, 2014). Empathic design approach has four

main principles. These principles are: (i) balancing rationality and emotions, (ii) making deductions about target users and their possible futures, (iii) involving the target users in the design process, and (iv) having expert contribution in design process (Postma et al., 2012). As a result, empathic design can be helpful for HCD.

Recently, designers are aware of the importance of empathic design in HCD. To close the gap between designers and older people, an empathic tool was developed which as the age simulation suit (Lavallière et al., 2017). Recently, simulation suits are common in the fields of health services, educational studies and gerontological (older people) studies. Moreover, the simulation suit was firstly used, by automobile companies. Automobile companies used simulation suits to improve vehicle design for older people, so that they can provide better service for older users as well (Lavallière et al., 2017).

Eventually by wearing a simulation suit, it is possible to understand life from other person's perspective and to experience similar challenges that enable human centered approach in design for specific user groups like older people (Eymard, Crawford & Keller 2010; Farmer & Bruce, 2010.) The simulation suit allows simulating the effects of aging for improving the design process for specific groups as a contribution to HCD.

Simulation suits are used for physical aging simulations to empathize with the activities of older people while designing for them (Lavallière et al., 2017). Simulation suits including, gloves, goggles, whole body suits, restrict the movements of the person who wears it, and aims to evoke, through a combination of affects and sensations, the experiences of a person having difficulties while performing certain physical tasks. These kinds of simulations serve the purpose to develop awareness of the variability of users. Simulation suits also, allow designers to feel empathy and they are beneficial since they help to shape the design process accordingly.

Simulations are open ended prototypes that present both possibilities and limitations into design field. Possibilities are; simulations invite creative and collaborative renderings of user experiences by working as a ‘flexible medium of interpersonal interaction and a tool for discovery, insight and test’ (Schrage, 2013, p. 19). On the other hand, there are some limitations. These limitations are because they expose the fragility of simulation and the partial character of any effort to mediate bodies in design (Kullman, 2016).

For academic institutions, many companies produce simulation suits for enhancing issues related with design work. Simulation suits also allow forms of ‘empathy training’ in the fields like medicine, occupational therapy and cognate areas. These simulations suits produced for academic studies, mostly, include the German simulation suit, which is named; GERT (GERontologic Test Simulation Suit). There are many other products belonging to different companies (Kullman, 2016). All these products are distributed worldwide and have different types of accessories and exchangeable parts, which can be combined to generate a range of bodily effects (Moll, 2018). One of the most desired advantages of these simulations that are mentioned by most commercial manufacturers is the ease whereby professionals can ‘wear’ the experiences (Kullman, 2016).

CHAPTER 3

THE IMPORTANCE OF PHYSICAL ACTIVITIES (PA) OF DAILY LIVING FOR HEALTHY AGING

Physical activity (PA) is mainly defined as a body movement that is produced by skeletal muscles. Furthermore, physical activity does not only involve energy, but also it involves balance and strength training, that are highly related with the motor system of human beings (i.e., balance, coordination, muscle strength, etc.). Physical activities are essential for older people to improve healthy aging (aging well). However, physical activity levels decrease with age (Buchner, 2012). According to WHO (2013), around 3.2 million deaths per year are related with physical inactivity. Consequently, all adults should be physically active. Evidently older people, who participate in any amount of physical activity, benefit from some health benefits accordingly (Buchner, 2012). As a result, physical activity is considered as a medicine for older adults that promotes healthy aging (Taylor, 2013).

3.1. Physical Activity of Older People

Studies showed that participation in regular physical activity reduces the risk of coronary heart disease and stroke, diabetes, hypertension, colon cancer, breast cancer

and depression (Cerin et al., 2017; King et al., 2017; Perracini et al., 2017). Physical activity is not only beneficial for its positive effects on physical health, but also for its positive effects on cognitive health (Taylor, 2013). Additionally, the importance of physical activity during midlife period linked to the likelihood of healthy aging (Shin, Lee & Belyea, 2018). Physical activity is defined as any movement of the body, which requires energy expenditure (Caspersen, Powell & Christenson, 1985). WHO (2018) defines physical activity as; "any bodily movement produced by skeletal muscles that require energy expenditure including activities undertaken while working, playing, carrying out household chores, travelling, and engaging in recreational pursuits". Countries and communities must take action to provide individuals with more facilities to be active, in order to increase physical activity for healthy aging (U.S. Department of Health and Human Services; 2017). Physical activity could be undertaken in many different ways: walking, cycling, sports and active forms of recreation (for example, dance aerobics). On the other hand, physical activity could also be undertaken at work (for example, lifting, arranging objects) and around the home (for example, cleaning, carrying). Moreover, all forms of physical activity provide health benefits if undertaken regularly and of efficacious duration and intensity (U.S. Department of Health and Human Services; 2017).

There are three types of physical activities classified according to the level of intensity of the activity; low intensity, moderate intensity and vigorous intensity (WHO, 2010). According to WHO's report (2010) following activities are considered as physical activity; recreational activities, leisure-time activities, transportation activities (e.g. walking or cycling), occupational activities (i.e. work), household chores, plays, games, sports or planned exercise, in the context of daily, family, and community activities. WHO (2010) states that people should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week, or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity. Also the aerobic activity should be performed in bouts of at least 10 minutes

duration. However for people who are aged 65 or more, if there is any mobility problem, they should perform physical activity to enhance balance and prevent falls on three or more days per week (WHO, 2010).

Physical activity is essential for independence and wellbeing in older people in all settings and at all levels of functional capacity (Perracini et al., 2017). According to studies active participation in physical activities of daily living in older ages, allow enhanced physical function, enhanced muscle strength, enhanced gait and balance (Toots et al., 2016). However the activity participation levels of people tends to decrease as people age; older people generally have lower exercise capacities than younger people. Therefore, they need a physical activity plan that is of decreased intensity and amount (WHO, 2018). Physical activity is also essential to maintain social health as well as physical and mental health (WHO, 2018). On this case, accessible environment is one of the key issues that encourage older people to engage in recommended physical activities to feel more independent and self-esteemed to participate in accessible socializing environments. In this study, the focus group is the older people, and the physical activities that are going to be considered are related with their activities of daily living (ADL).

3.2 Activities of Daily Living (ADL)

Research has revealed that an increase in overall activity is related to with happiness and higher degree of independence in activities of daily living (ADL) where the level of activity is crucial (Menec, 2003). Recently, assessment of the functional state of older people is mainly based on the performance of activities of daily living which are divided into two categories. The first category is the basic activities of daily living (BADL), consisting of daily self-care tasks related to survival. The second category is; instrumental activities of daily living (IADLs), involving tasks for maintaining life in the community or supporting life in the society (Dias et al., 2019).

BADL indicate the tasks related to self-care within the daily routine, such as eating, bathing and functional mobility (Mahoney & Barthel, 1965). According to Horgas, Wilms & Baltes (1998), BADL are considered as the basic content of a successful and healthy life (Horgas, Wilms & Baltes, 1998). Furthermore, participation on BADL are varied from person to person, because those activities include personal care (Lin, Shih & Ku, 2019). IADL refer to the tasks that are not necessary for fundamental functioning. They refer to the activities related with person's ability to live independently in a community, such as money management, medication management, shopping and meal preparation (Lawton & Brody, 1969).

3.3. Measurements Criteria of Physical Activity Level

The physical activity level is measured either by subjective or objective method. Subjective method are tools such as observation, physical activity questionnaires, etc., and objective method are tools such as using monitoring devices, accelerometers and pedometers etc. (Committee on Physical Activity, Health, Transportation and Land Use, 2005). There are many different studies that use different physical activity questionnaires in the literature (King et al., 2017; Pereira et al., 2018; Perracini et al., 2017; Taylor, 2013). Also, there are many other studies that use monitoring devices like; accelerometer which is a monitoring device that measures the intensity of an activity or pedometer which is a monitoring device that counts steps and measures distance (Committee on Physical Activity, Health, Transportation and Land Use, 2005).

Since 1955, most hospitals are using a simple index of independence test to score the ability of a patient with muscular or musculoskeletal disorders to test their abilities to take care of themselves (Mahoney & Barthel, 1965). In this index values assigned to each element are based on time and amount of actual physical assistance that is required in daily life activities. Even if the person needs minimal assistance, full credit is not given for that certain daily life activity. Environmental conditions have an effect on the score as well. If a person need special requirements; which means that the home environment should be designed with more accessibility concern, such

as wider door opening for walker users, wider maneuvering spaces in corridors or grab bar installation on bathroom units etc. than these should be provided to this person to score full credit in the index. This index is called Barthel Index of Activities of Daily Living. This index includes 10 basic activities of daily living; feeding, control of bowel, control of bladder, dressing (includes shoes and fasteners), ascending and descending stairs, bathing, getting on and off toilet, mobility, personal grooming (combing hair, brushing teeth etc.) and transfer (Mahoney & Barthel, 1965).

3.4. Coping with Activities of Daily Living (ADL) In Accessible Senior Housing Environment

In our contemporary world, home is a significant place for human experience that every individual engages with it in everyday life. Home has a lot of purpose for its occupants; "Home is many things; it is a container of wellbeing, a place of security, a space where social life, leisure and recreation place" (Stretton, 1976, p 250). Housing environment is also a part of a self-identity that reflects its occupant's memories, ideas, hobbies, aesthetic manners and characteristic issues which is built up over time (Stretton, 1976). Furthermore, housing environment is inevitably linked to the social and cultural background of a person (Oswald et al., 2007). Housing is a significant typology that includes subjective evaluations, goals, values, cognition and emotions (Oswald et al., 2007). A home and the sense of 'being at home' involves far more than occupying a sheltering and accommodating physical structure so home and housing are different aspects. The process of transforming a housing environment into a home is complex and it is composed of different stages. This process involves making a space (a physical structure that has no meaning) into a place (a locus of lived experience burden with meaning) (Rowles, 2013).

Older people spend more time in their housing environment, either home or institutional living, with settled habits and daily routines. Older people have more difficulties on adapting to new living conditions and they feel themselves dissatisfied

on new housing issues (Iwarsson et al., 2007; Rowles & Bernard, 2013). Moreover, older people value their memories and they feel dissatisfied in home environment, where they could not locate their memories (Nygren et al., 2007). For this case, to express home attachment of older people there is an issue called 'aging in place'. WHO defines aging in place as "meeting the desire and ability of people, through the provision of appropriate level of services and assistance, to remain living relatively independently in the community in his or her current home or an appropriate level of housing" (WHO, 2004, p. 9). The ability of older people to age in place is closely related with housing conditions and structural aspects of housing. Aging in place studies tends to focus on the quality of housing, suitability, physical characteristics and access (Greenfield, 2012). Studies showed that older people who have lived longer in their home environments because they are accessible, have more favorable experience compared to older people who are changing their home environment frequently because of its inaccessible features, such as stairs, long corridor and inaccessible bathrooms (Irwin, Lawton & Wohlwill, 1984).

The majority of basic daily activities of older people are undertaken in the immediate surroundings of the house and neighborhood (Temelova & Dvorakova, 2012). Consequently, for older people who are physically and socially active for healthy aging, a homely environment with accessible design issues should be provided. There are different housing environment alternatives for older peoples such as individual or family housing, assisted living, senior cohousing communities and institutional senior housing (Rowles, 2013). All forms of housing can be designed with accessibility issues and homely atmosphere can be created. In this study, institutional senior housing will be studied in terms of accessible design in ADL since accessibility is a key issue for daily living considering healthy aging.

3.4.1. Accessible Housing Environment

A living environment that is comfortable and accessible supports and enables wellbeing and independence. This is same for older people housing as well as houses for other generations (Vasara, 2015). According to Handy et al. (2002), people are more active in accessible built environments and being active both physically and socially is beneficial for health. Accessibility in general describes the ability to participate in activities, obtain opportunities or interact with others within an environment (Rooney et al., 2017). Home accessibility is the extent to which the physical environment of home supports the autonomy of users in their daily activities (Nygren et al., 2007). It is an important prerequisite for the elderly to be able to maintain control and independence in their lives. "Unsuccessful adaptations of homes, living in homes with physical barriers and lack of correct housing decisions in later life will result in serious health and social consequences, such as falls and dependence on others to perform daily activities" (Afacan, 2018, p.347).
According to Iwarsson and Stahl (2003) accessibility is based on two components: (i) the personal component or an individual's functional capacity, (ii) the environmental component or the barriers in relation to available standards. Accessibility is mainly for satisfying all users by addressing accessibility expectations and needs. Furthermore, this study considers human centered accessibility in housing environments. Rather than addressing every-one's accessibility expectations, human centered accessibility means how accessibility is distributed across relevant users. Either in homes or in institutional housing environments, human centered accessibility could be achieved by creating conditions to choose where conflicting claims arise about the accessibility priorities (Afacan, 2008).

3.4.2. Institutional Senior Houses

Older people who live alone in an individual home may be comfortable however, he or she can feel lonely and socially isolated which prevent healthy aging (Michael, Green & Farquhar, 2006). However, even if living lonely is a problem for older people, researches show that older people who have children and grandchildren

generally do not desire to live with them either (Harper & Bayer, 2000). Since older people do not have the same interests with younger family members and since they are not in the same era of life they cannot socialize efficiently in family environment. According to contemporary researches, older people are eager to spend time and socialize with people who are at the same age group instead of their younger family members (Glass & Plaats, 2013). As a result of this individual homes or family homes even if they are enhanced with assisted living (smart home technologies); older people are more encouraged to live in institutional senior housing or cohousing (Glass & Plaats, 2013).

Institutional senior housing is a type of housing where older people live in an institution where they can obtain physiological support, medical support or social support. Even if there are some problems related with creating 'homely atmosphere' for many institutional senior housing, it can be achieved by designing with accessible design features and older people's interests and valued furnishings and belongings (Rowles, 2018). In this study institutional senior house case will be analyzed in terms of physical activity facilitation through accessible design features for healthy aging.

"Environmental factors as well as viewing accessibility as a relation between a person and the environment are important in determining an individual's degree of independent living and in defining the status of people with disabilities in society" (Iwarsson & Stahl, 2003, p.57). There is an increasing demand for accessibility issues since it allows healthy environment through enhanced person environment relationship and encourages people to be physically active in their daily life activities by providing access, safety and comfort. The significance of accessibility issues is not only covered by architects and designers but also by engineers, occupational therapists and other health care professionals and researchers. To be able to implement client solutions successfully, knowledge on person and environment relationships should be fully covered, not only theoretically but also practically (Iwarsson & Stahl, 2003). In this study, a senior housing case with its entrance and lobby area, bedroom, bathroom, circulation areas (corridor spaces), dining hall,

staircases and activity rooms will be examined in terms of accessible design for HCD approach to facilitate healthy aging.

CHAPTER 4

METHODOLOGY

4.1. Research Questions and Hypotheses of the Study

The study has the following four research questions:

RQ1. What are the correlations between older people's importance and satisfaction rankings of accessible senior housing features?

RQ2. Does simulated physical aging positively influence to assess accessibility performance of senior housing design?

RQ3. Does persona design allows designers a more increased level of inclusion of otherness compared to the simulated physical aging?

The study hypotheses are as follows;

H1. There is a strong correlation between high priority importance ranking of an accessibility feature and high priority satisfaction ranking of this feature.

H2. Simulated physical aging positively influence to assess accessibility performance of senior housing design.

H3: Simulated physical aging and personas highlights more accessibility concerns than older people's rankings.

H4. There are statistically significant inclusion of otherness differences between simulated physical aging and persona design in terms of assessing accessibility of senior housing.

4.2. Participants of the Study

There are 30 survey participants. The participants were chosen voluntarily. 20 participants are female and 10 participants are male. Since the senior house is for retired teachers, all participants are university graduates. The youngest participant is 75 years old, which is categorized as ‘middle old’ and the oldest participant is 88 years old, which is categorized as ‘oldest old’ according to World Health Organization (WHO, 1998). Their mean age value is 81.6. Moreover, 26 participants are widow, i.e. their spouses are passed away and 2 of the participants were single, i.e. they were never married before. Also, 2 of the participants are still married; however they mentioned that their spouses are struggling with Alzheimer’s disease. Table 3 listed demographic characteristics of the participants.

Table 3 Demographic information of the participants

Characteristics	N	% Percentage
Gender		
Female	20	66.7
Male	10	33.3
Age		
65-74	0	0.0
75-84	21	70.0
85+	9	30.0
Education		
University Graduate	30	100
Marital Status		
Single	2	6.7
Married	2	6.7
Divorced	0	0.0
Widow	26	86.7

4.3. Setting: Tuzla KASEV Senior Housing

M.E.B Kadıköy Sağlık Eğitim Merkezi Vakfı (KASEV) is chosen for the study. KASEV senior housing was established in 1986 as a civil society organization, with the aim of providing health services, health education, social services and elderly healthcare. The senior housing mostly serves for the retired teachers. The senior housing welcomes both older people who are healthy and also older people who are in need of healthcare.

This senior housing building which is located in Tuzla has been a housing environment for older people since 1997. The senior housing building is a 6-story cohouse, where older people can have their own suite (a room with a bathroom and a balcony) so that they can decorate according to their pleasure and comfort. However, safety appliances are added by the senior housing administration staff to each room

(safety bars, bathroom safety units etc.). All of the rooms have Marmara Sea view. There are 135 rooms in the senior housing building. Moreover, there are also the following common areas; public living rooms, activity rooms, conference space, garden gazebo, lobby, library, etc. There is also a dining hall and a cafeteria, which serves only for senior housing residents. These common areas are spaces, where older people can socialize either with other residents of the senior housing or with senior housing staff including, administrative staff, nurses, psychologists, and care takers. Visitors are allowed during the scheduled visiting hours in the common areas. So, common areas are the areas, where senior housing residents could socialize and participate in activities; such as playing card games, singing, attending senior yoga activities, watching films, attending seminars etc. The senior housing also arranges off-campus activities; such as field trips, picnics, music recitals etc. so that older people can be active, social and amused. Figure 5 shows a view of the senior housing environment. Figure 6 illustrates the interior spaces of KASEV senior housing environment through elevation view.

Figure 5. KASEV Senior Housing (Photograph is retrieved from https://www.kasev.org)

Figure 6. Elevation View Illustrates the Interior Spaces of KASEV Senior Housing Environment

The reasons why KASEV senior housing was chosen as the setting of this study could be explained as follows: Firstly, as reported by the managers of the senior housing, all the physical and social services of KASEV senior housing are based on an inclusive-philosophy that all people should age well (happily and healthy) no matter at what age they are. As a result, the senior housing members are active individuals not only physically but also socially and emotionally. Secondly, in Turkey, in 2008, International certificate of ISO in the area of older people care is only given to KASEV. The senior housing institution also established a civil association called TÜRYAK (Türkiye Yaşlılık Konseyi Derneği) in Ankara. This association is working on health, health education, social services, older people research, aging well and healthcare problems related with older people since 2003. Also in 2008 'Turkey Elderly Platform' is established by KASEV senior housing institution in Ankara with the collaboration of Akyurt Foundation, which is also a

civil association for social services. Moreover, KASEV senior housing is a civil society organization that has the motto as; not to get retired from life. With this motto the senior housing institution aims to serve older people with accoutered facilities and interactive activities for older people's active conduction of life. Since 2004, this senior housing was also working with a modernization mission for more accessible and accoutered facilities for older people. They are conducting projects and researches in this field actively. See Appendix A for the images of KASEV.

4.4. Procedure of the Study

The study was conducted in eight stages. The first stage is obtaining ethics approval from İhsan Doğramacı Bilkent University's Ethics Committee. Related documents were sent to the Ethics Committee and approval was obtained (See Appendix B). The second stage is the permission stage. For conduction of this study in KASEV Senior Housing, a permission request was sent to KASEV officials, from İhsan Doğramacı Bilkent University, Interior Architecture and Environmental Design Department head office. KASEV officials are enlightened about the study. Moreover, KASEV officials were informed about the Ethics Committee approval. KASEV officials are very sensitive on their residents and they would like to be sure that the questions of the survey are not offending any participants and also not violating any privacy issues. As a result they asked for a sample survey questionnaire. Survey questionnaire was sent to KASEV officials. KASEV officials analyzed the questions and they approved it. After then, an official permission was obtained from the KASEV officials. See Figure 7, for workflow diagram of the eight seven stages of the study.

First Stage: Approval

- Approval forms were sent to İhsan Doğramacı Bilkent University's Ethics Committee.
- Official approval was obtained from İhsan Doğramacı Bilkent University's Ethics Committee.

Second Stage: Permission

- Approval from İhsan Doğramacı Bilkent University's Ethics Committee was also sent to KASEV officials.
- Official permission was obtained from the KASEV staff.

Third Stage: Observations and Walkthroughs

- Investigation of the current physical situation of the KASEV building.

Fourth Stage: Pilot Study

- Initial data collection & analysis (questionnaire conduction to 15 participants).

Fifth Stage: Data Gathering

- Conduction of the accessibility questionnaire in public lounges and living spaces in KASEV building for the main study.
- Residents, who are willing to participate voluntarily, were informed about the content of the study.
- Accessibility definition was stated before the questionnaire conduction.

Sixth Stage: Findings

- Evaluation of the accessibility questionnaire through IPA.

Seventh Stage: Persona Development and Aging Simulation

- Through IPA and affinity method, personas are created.
- Through personas simulation tasks are created.
- Age simulation through GERT simulation suit will be conducted on both experts and architecture students.

Eighth Stage: Modeling Stage

Figure 7. Workflow Diagram of the Stages of the Study

The third stage of the study is the observations and walkthroughs by the author to investigate the current physical situation of the KASEV building. During the observations and walkthroughs, a KASEV staff accompanied for the author. This companionship was very helpful in obtaining information about the housing environment and its residents, since this staff is a person who lives in the institution with the residents. The staff informed that the first floor is for residents who have mental disorders such as Alzheimer. Other floors are for independently living residents. The study was not conducted on the first floor area, because independently living older people are the focus group of the study.

The fourth stage is the pilot study; pilot study survey questionnaire was conducted with 15 participants. Initial data collection and data analysis were done in this stage. This stage is very helpful to understand the principals of IPA and to understand 'building-residents' relationship. According to the pilot study, survey questionnaire is revised. Before the pilot study, survey questionnaire is not grouped according to BADL; instead subspaces of KASEV senior housing building, constituted the survey questionnaire groups. After the pilot study, survey questionnaire is revised and grouped according to basic daily life activities that are stated by Barthel Index, since our study focuses on BADL of older people to investigate its relationship with healthy aging (aging well). Also, during the pilot study, it was clear that the focus group should not be only narrowed as 'independent individuals' but also it should be more narrowed as 'independent individuals who are not indicative of depression'. Through the literature research, Geriatric Depression Scale (GDS) was examined and it is decided to be conducted to be able to specify residents who are not indicative of depression. As a result of this, the study focus group is narrowed and became more accurate to conduct this study.

The fifth stage is the conduction of the final version of the survey questionnaire in public living rooms of KASEV building. Residents, who are willing to participate voluntarily, are informed about the content of the study. Accessible design is one of the main issues of the survey, so it is very important that residents know the term 'accessibility'. As a result, they are briefly informed about the definition of the term

accessibility; accessibility allows all people to be a part of social life independently without any barriers, even if they have varied needs. Moreover, the survey participants were also informed about the definition of *satisfaction*; this term indicates the degree to which they are satisfied with their ability to access and then carry out the designated function. The author asked the questions to 30 participants. After conducting the survey questionnaire, study moves on to the sixth stage, which is: the evaluation stage of the questionnaire through the IPA and the development of IPA matrix. This stage is explained in detail in the following sub-section. The seventh stage is the persona design and simulation stage. GERT Simulation Suit is the tool for the simulation process. Furthermore, according to the IPA findings, personas are created to designate tasks for simulation analysis. This stage is also explained in detail in the following sub-section. Aging simulation and the eighth stage will be aimed for future step of the study deals with developing accessibility guidelines and the proposal of an accessible senior housing model.

4.5. The Instruments

The study used five survey instruments to gather the data. First instrument is the Geriatric Depression Scale (GDS). Depression is common in older ages. However depression is not a natural part of aging. Depression is often treated with prompt recognition and appropriate treatment. However, if depression is not treated it may cause many health problems. So, depression may cause decreased quality of life, delayed recovery from medical illness or surgeries, increased health care utilization and it may even cause suicide. As a result for healthy aging, people should not be indicative of depression. Decisiveness of depression is tested through GDS, which consists of 15 questions (Blazer, 2003; McKenzie & Harvath, 2016; Yesavage et al., 1983). GDS was developed in 1983 by Yesavage et al (Yesavage et al, 1983). This scale consists of self-reported, easy to answer questions for older people. The scale questions are only answered with ‘yes’ or ‘no’. One point is given to each answer that suggests depression and zero point is given for the other answers, and final score is accepted as the depression score. In this study short form of GDS is used and it consists of 15 questions (See Appendix C).

Second instrument is the Barthel Index, which is a scale for testing independency in BADL (See Appendix D). This index includes 10 BADL items; feeding, control of bowel, control of bladder, dressing (includes shoes and fasteners), ascending/descending stairs, bathing, getting on/off toilet, mobility, transfer and personal grooming (Mahoney & Barthel, 1965). For this study, survey questions are grouped according to these items of BADL. In Barthel Index, there are 10 BADL. This study used an adapted version of Barthel Index with 8 BADL items: feeding, dressing, ascending/descending stairs, bathing, getting on/ off toilet, mobility, transfer and personal grooming. Moreover, these 8 items are grouped under 5 headings such as; (i) walking: mobility in between interior spaces, (ii) bathing and toilet usage, (iii) feeding: eating and drinking, (iv) personal care and dressing, (v) transfer: movement without balance lost.

Third instrument is the accessibility survey. The accessibility survey was developed based on the Barthel Index for BADL and the literature review as mentioned in Chapter 3 (See Appendix E). The survey is composed of four parts. The first part (Part A) is about the demographic data. The second part (Part B) includes five questions according to the five-point Likert scale, where participants rated both their accessibility agreement and independency levels on daily life activities regarding KASEV senior housing. The first question is aimed to analyze the participant's general assessment on accessibility of the senior housing. The second question is about the importance level given to the accessibility of a general senior housing. The third question is about self-assessment of the independency level on daily life activities in the senior housing. The fourth question is about the relationship between independency level on daily life activities and the accessibility of the senior housing environment. And the fifth question is about stating the most accessible part of the senior housing: (i) entrance and lobby, (ii) individual suits, (iii) bathroom, (iv) dining hall, (v) public living rooms, (vi) conference hall, (vii) corridor areas, (viii) vertical circulation elements (staircases and elevators). At the third part (Part C) and fourth part (Part D) of the survey, the participants rated their importance and performance levels based on the modified Barthel Index regarding the following architectural spaces of the senior housing; entrance, vertical circulation systems, bathrooms and toilet, dining hall and common living rooms.

To organize the data obtained by the survey affinity diagram is used as fourth instrument. The affinity diagram is the common and basic method to organize the data that is obtained. It assists the arrangements of the findings into a hierarchy that reveals common aspects across all users. How to organize the hierarchy of the obtained data is crucial for success. The affinity diagram mainly aims to elaborate the scope of the problem and present to the design team's focus with a basic hierarchical diagramming (Holtzblatt & Beyer, 2017). Moreover, affinity diagramming method also helps to define the key issues and requirements about the design problem and the target users. The affinity diagram can be considered as an initial model that has a purpose of allowing design team to facilitate the data that is obtained for a design process. The affinity diagramming might be needed for the constitution of other models as well. Affinity diagramming is also very useful to group the characteristics when creating personas (Holtzblatt & Beyer, 2017).

Fifth instrument is the Inclusion of Other in the Self (IOS) Scale by Aron et al. IOS is a scale that aims to allow better understanding on the perception of the task evaluators, i.e. how close they feel with older people who are living in the senior housing environment (Aron, Aron, & Smollan, 1992). In this study, IOS scale is used in order to measure the perceived closeness between task evaluators and older people who are living in the senior housing environment. (See Appendix F for the IOS scale test).

The last instrument in this study is GERontologic Test Simulation Suit (GERT) is used for task scenarios. GERT suit is selected for this thesis study as an apparatus, since it offers the opportunity to experience the impairments of older people by even younger people. The age simulation suit GERT suit consists of a set of separate components. By the interactions of the components of GERT suit, sensory and motoric skills of older people can be experienced efficiently. These are the reasons why this suit is beneficial for developing products and services for older people (Groza, Sebesi & Mandru, 2017). Figure 8 illustrates the components of GERT suit and the components. The age related impairments that can be tested by this simulation suit are as follows; (i) opacity of the eye lens, (ii) narrowing of the visual

field, (iii) high-frequency hearing loss, (iv) head mobility restrictions, (v) joint stiffness, (vi) loss of strength, (vii) reduced grip ability, (viii) reduced coordination skills. The suit enables young subjects to experience the physical limitations of older adults with respect to vision, audition, mobility, balance, grip ability and strength (Zijlstra et al., 2016).

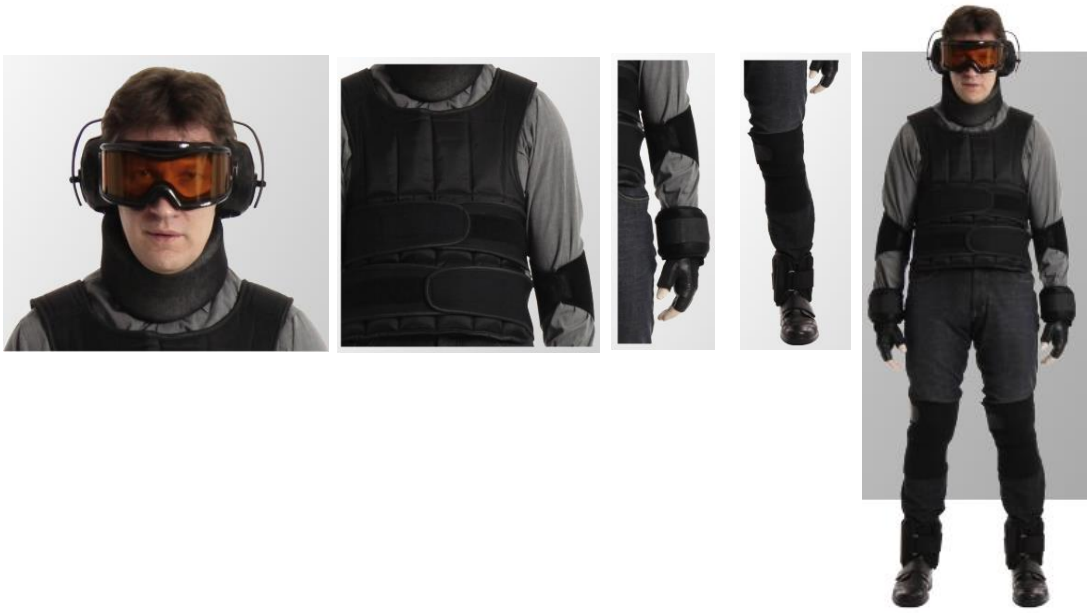

Figure 8. Components of GERT Age Simulation Suit (Retrieved from http://www.age-simulation-suit.com/download/Age_simulation_suit.pdf)

The GERT suit is referenced by many authorized research institutes such as; Network Aging Research NAR and Institute of Gerontology IfG, Heidelberg University (Germany); De Montfort Univerity, Leicester (UK); Wexham Park Hospital, Berkshire; Laboratories, Maidenhead (UK) etc. (Groza, Sebesi & Mandru, 2017). The instant aging suit GERT is easily being purchased by public authorities, institutions and companies. GERT suit is not available for private persons (Groza, Sebesi & Mandru, 2017). The purchase of GERT suit for this study was supported by the grant of Science Academy's Young Scientist Award Program 2017 (BAGEP) received by Assoc. Prof. Dr. Yasemin Afacan. Figure 9 illustrates the relationship between the stages of the study and their related data collection instruments.

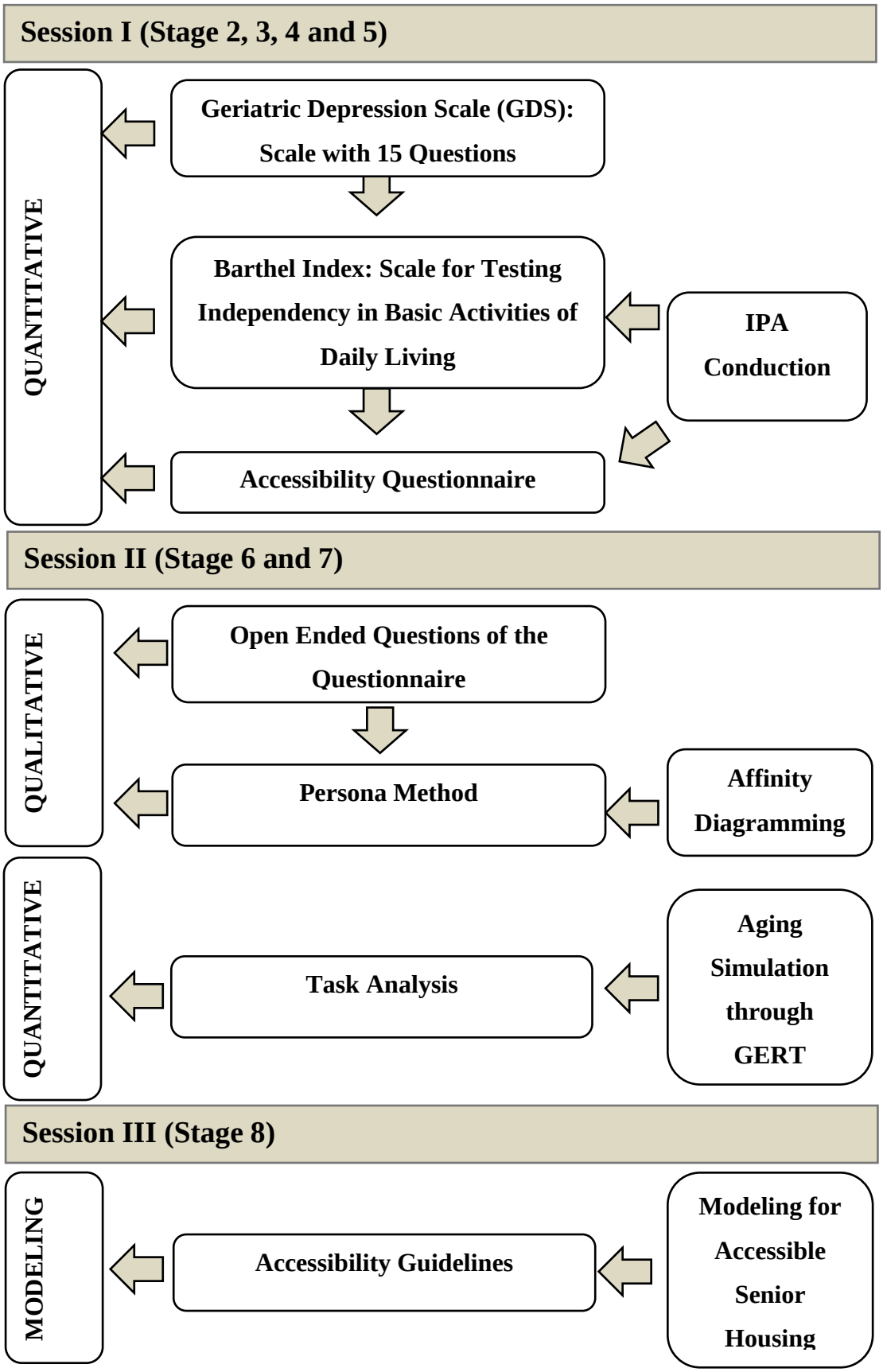

Figure 9. The Relationship between the Stages of the Study and Their Related Data Collecting Instruments

CHAPTER 5

FINDINGS

5.1. Quantitative Findings

Quantitative findings of this study are analyzed in two categories; descriptive results and IPA results in the following sub sections. To analyze the obtained data from questionnaires, the Statistical Package for the Social Sciences (SPSS) 17.0 was used and demographic results and correlation diagrams were constructed accordingly. IPA results are illustrated as IPA matrix that is prepared by using Microsoft Excel.

5.1.1. Descriptive Results

In the survey, duration of the residency of the participants were as follows; 11 participants were living in the senior housing for 1 year, 3 participants for 1 year and 6 months, 9 participants for 2 years, 6 participants for 3 years. Only 1 participant was living in the senior housing for 4 years. All of the participants stated that they do not have any impairments or treatment processes including, orthopedic, visual and audial impairments. However, 2 of the participants stated that they feel safer when they use

walker even if they do not need a walker, to walk independently. They mentioned that they feel the need of using a walker especially at the night time, when many people are not on the public areas. These two participants, also, stated that they feel safer and better, when there is someone to assist them, especially when they are sleepy or ill. Even if the participants stated that they do not have any impairments or contemporary treatment process for any impairment, the Barthel Index of Activities of Daily Living was also applied to test the independency of each participant. Participants who are considered as 'independent' according to the Barthel Index were incorporated to the study. As a result, all participants are considered as independent in their daily life activities. It should be also noted that at the beginning of the survey, based on the Geriatric Depression Scale (GDS), 15 questions were asked to each participant to test their depression scale. All, 30 participants were not indicative of depression as well. So, all survey participants are considered as independent individuals and they are not indicative of depression. Additionally, 26 of the participants stated that they would recommend the senior housing to their relatives and friends and 4 participants stated that they would not recommend the senior housing to any of their friends or relatives. First participant, who did not recommend the senior housing, expressed that she is used to live in more luxurious living environments. The other participant would like to live in a senior housing, which is located in the city center; he mentions that Taksim or Ortaköy location is his ideal location for living, since there are many touristic spaces and there are many facilities. Third participant who did not recommend the senior housing, stated that she would like to live in a senior housing where there are smart building systems such as automatic control of lighting systems, automatic control of curtain systems, audial systems etc. Last participant mentioned that she did not feel homely in the senior housing environment. Most of the participants, who stated that they would recommend the senior housing to their relatives and friends, mentioned that they would do so, since they feel peaceful, comfortable, safe and socially active in the senior housing.

5.1.2. Importance Performance Analysis (IPA) Results

IPA was developed mostly to enhance tourism and economy field researches. However, in this study IPA is used in the context of architectural design discipline. The reason, why this method is chosen for this study, is because the importance and satisfaction rankings obtained by the IPA could fill the gap of prioritizing user data needs in the design field. IPA could allow designers to systematize design issues from the older people's perspective. This thesis contributes to the design knowledge with the application of IPA, through which senior housing design and facilities could be rethought in terms of accessibility rankings of older users.

As seen in Table 4, 13 participants considered bathroom as the most important space within the senior house. It is the highest percentage in the Table. This means that 43.3 % of the participants considered bathroom area as the most important area of the senior housing in terms of accessibility. So bathroom area should be reconsidered carefully for a holistic HCD approach. Bedroom is ranked as the second highest important space. Eight participants (26.7% of the participants) considered bedroom as the most important area of the senior housing in terms of accessibility. Six participants considered public living rooms as the third most important area of the senior housing. Two participants considered entrance (lobby) area as the most important area within the senior house. Only, 1 participant considered corridor area as the most important area within the senior house. None of the participants considered dining hall, conference hall or vertical circulation as important areas within the senior housing. In the open ended questions in part B (Question B6: related with ideas about person environment relationship and healthy aging and Question B7: related with participants point of view about their experiences, ideas and recommendations about accessibility of the senior housing), some participants mentioned that dining hall is very significant for them, but in overall rankings they preferred to state bathroom area or bedroom area as the most important area within the senior house. See Table 4, for the rankings of questionnaire part B according to participants. Also see Table 5, for percentages of the most important areas of the senior housing in terms of accessibility according to participants.

Table 4 Rankings of questionnaire part B according to participants

Part B: Question 1 *General Assessment on Accessibility of the Senior Housing Environment*	**N**	**% Percentage**
Not Satisfied	0	0.0
Poorly Satisfied	5	16.7
Average	10	33.3
Satisfied	8	26.7
Very Satisfied	7	23.3
Part B: Question 2 *Importance Level of Accessibility of the Senior Housing Environment*	**N**	**% Percentage**
Not Important	0	0.0
Poorly Important	0	0.0
Average	0	0.0
Important	5	16.7
Very Important	25	83.3
Part B: Question 3 *Self-Assessment of Independency Level on Daily Life Activities within the Senior Housing Environment*	**N**	**% Percentage**
Very Poor	0	0.0
Poor	1	3.3
Average	12	40.0
Well	6	20.0
Very Well	11	36.7
Part B: Question 4 *The Relationship Between Independency Level on Daily Life Activities and the Accessibility of The Senior Housing Environment*	**N**	**% Percentage**
Not Accessible	0	0.0
Poorly Accessible	3	10.0
Average	10	33.3
Accessible	9	30.0
Very Accessible	8	26.7

Table 5 Percentages of the most important areas of the senior housing in terms of accessibility according to participants

Senior Housing Areas	N	% Percentage
Entrance (Lobby)	2	6.7
Bedroom	8	26.7
Bathroom	13	43.3
Dining Hall	0	0.0
Public Living Rooms	6	20.0
Conference Hall	0	0.0
Corridor Areas	1	3.3
Vertical Circulation Elements	0	0.0

According to IPA, mean values should be taken in to consideration before creating the IPA matrix. Table 7 listed all the mean values obtained from the third and fourth part of the accessibility questionnaire. The mean values under 1.5 (including 1.5) and values above 4.5 (including 4.5) are not analyzed because of floor and ceiling effect. If mean values are between 1.5 and 4.5 for both part C and Part D, they are considered for the analysis, and the IPA matrix is constituted accordingly. According to the mean values, the following 13 common questions from both part C and D, are selected to construct the IPA matrix; Q3, Q7, Q15, Q16, Q20, Q24, Q25, Q26, Q28, Q29, Q30, Q31, Q34. Figure 10 illustrates the IPA implementation process in detail. See Table 6 for mean values of each question for Part C and Part D.

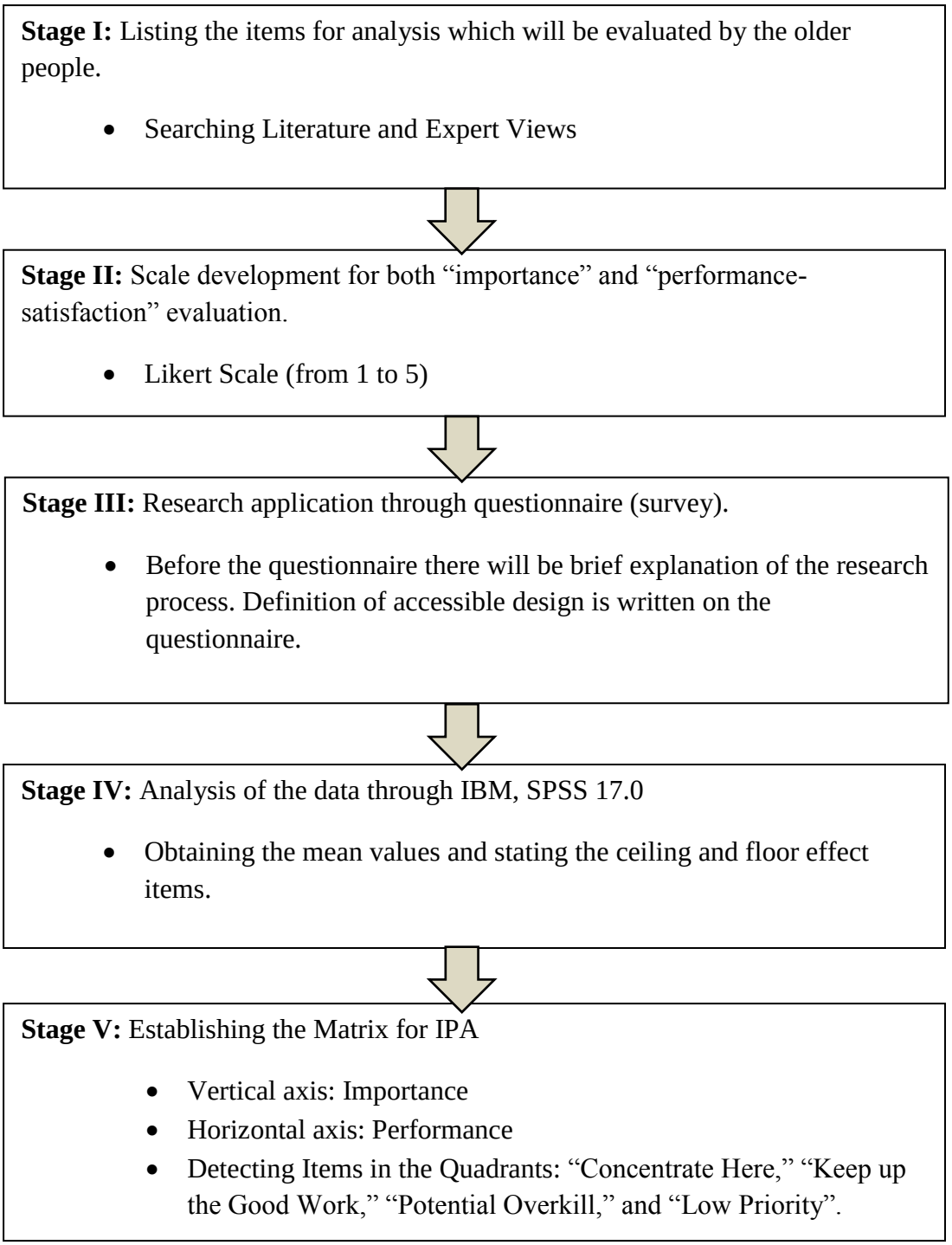

Figure 10. IPA Implementation Process

Table 6 Context and the mean values of common items of questions from part c and part d of the questionnaire

Question Number	Question Context	Part C Mean Values	Part D Mean Values
QC&QD 3	Legible and unobstructed route to the main entrance area.	4.1	3.4
QC&QD 7	Vertical circulation elements safety and comfort; appropriate balustrade and handrail design.	4.4	4.4
QC&QD 15	Efficient color design of interior spaces for better visual comfort and for better mobility accordingly.	4.3	3.6
QC&QD 16	Appropriate daylight and artificial light design for safe mobility within an interior environment.	4.3	3.7
QC&QD 20	Bathroom doors that opens outwards or that opens by sliding for accessible design.	4.2	3.1
QC&QD 24	Bathroom doors', cabinets' and drawers' flexible design for both left and right hand users.	4.4	3.8
QC&QD 25	Efficient dimensions of dining hall for accessible design (maneuvering space etc.)	4.4	3.4
QC&QD 26	Efficient design of dining tables of dining hall for comfortable and accessible dining activities.	4.4	3.1
QC&QD 28	Kitchenware that requires low physical effort (tea cups with handles) for safe and comfortable dining activities.	3.8	3.4
QC&QD 29	Locating personal care mirrors on correct height considering area of vision better visual comfort.	4.3	3.6
QC&QD 30	Personal care furniture's drawers and doors that require low physical effort for safe and comfortable usage.	4.4	3.1
QC&QD 31	Seating unit integration to dressing areas for safe and comfortable dressing.	4.4	2.5
QC&QD 34	All furniture's safe and comfortable design that prevents balance lost while sitting down/ standing up or lying down/ getting up.	4.5	2.9
Total Mean Values		4.3	3.4

Importance and satisfaction (performance) data were plotted against one another on a two dimensional grid (Tarrant & Smith, 2002). The overall mean values of performance defined the origin for *y* axis and the overall mean values of importance defined the origin for *x* axis. Then, the four quadrants existed and the related data was distributed into one of four quadrants: 'Concentrate Here', 'Keep up the Good Work', 'Potential Overkill', and 'Low Priority' (Abalo, Varela & Manzano, 2007).

According to IPA results, questions 7, 15 and 24 were located in the Quadrant 1 that means 'Keep up the Good Work'. These three items are satisfying the residents of the senior housing. These two items are strong items that are pillar of the organization. The question 7 is about; vertical circulation elements safety and comfort; appropriate balustrade and handrail design. The question 15 is about; efficient color design of interior spaces for better visual comfort and for better mobility accordingly. The question 24 is related with bathroom doors', cabinets' and drawers' flexible design for both left and right hand users. Since these three items were on the first quadrant, it means that they are important items for residents of the senior housing. Furthermore, at the same time it means that, the participants were also satisfied with their performance on these three items. These three items were introduced to develop an understanding of the safety, legibility and flexibility issues in designing accessible circulation elements and handles of doors, cabinets and drawers. Senior residents considered it important that they were able to maintain certain degrees of comfort in their BADLs. The accessibility possibilities of the physical environment in senior housing could be referred to as 'satisfaction in performance'. Four quadrants and the associated items are plotted in the IPA matrix illustrated in Figure 11.

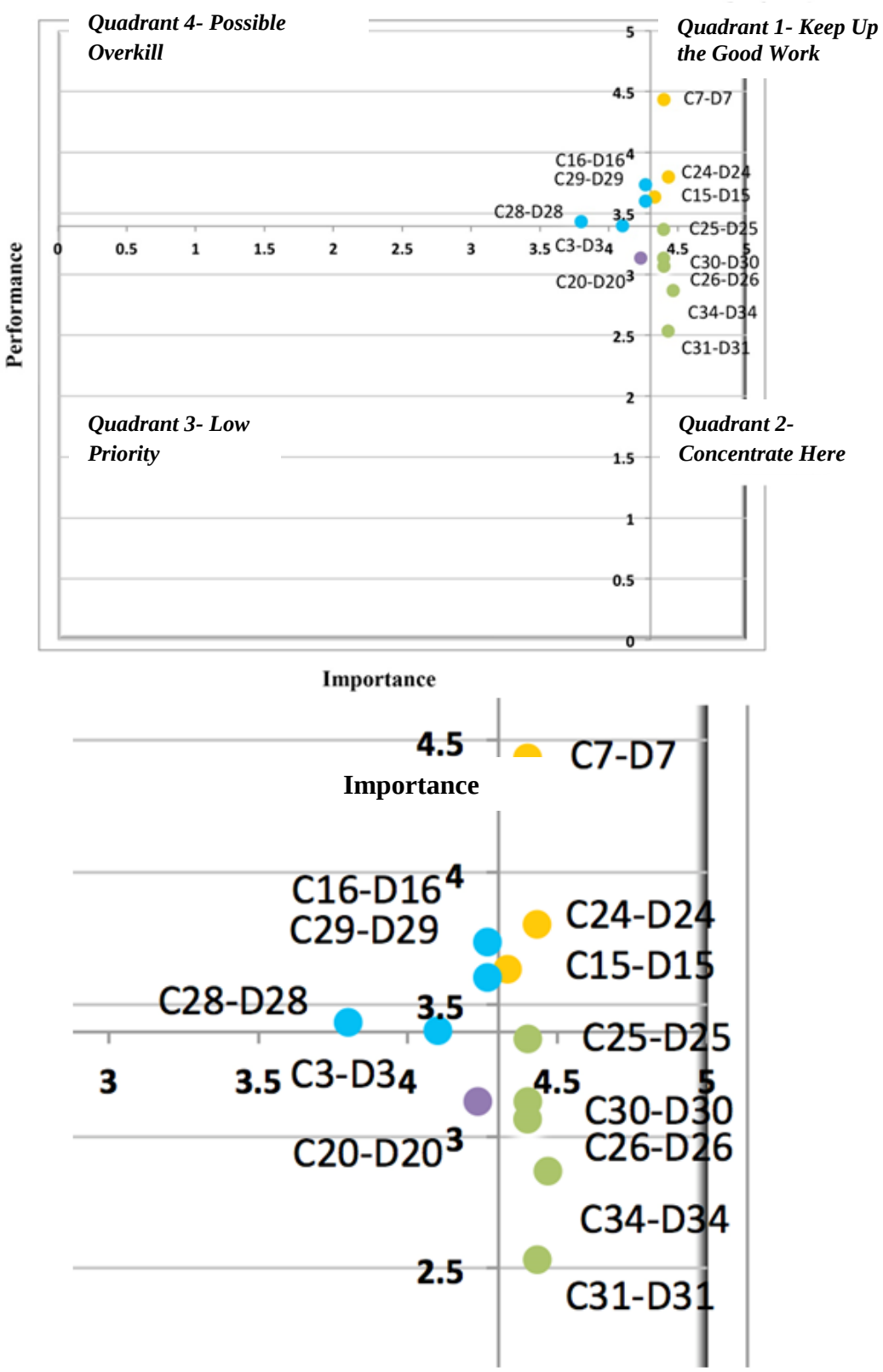

Figure 11. (a) IPA Graph with the Four Quadrants; (b) a Close up View of the Items

All items that fall into Quadrant 2, 'Concentrate Here', are related with the satisfaction of the residents. In the Quadrant 2, there are 5 items; question 25, 26, 30, 31& 34. Question 25 is related with efficient dimensions of dining hall for accessible design (maneuvering space etc.). Question 26 is related with efficient design of dining tables of dining hall for comfortable and accessible dining activities. Question 30 is related with personal care furniture's drawers and doors that require low physical effort for safe and comfortable usage. Question 31 is related with seating unit integration to dressing areas for safe and comfortable dressing. Last question in Quadrant 2 is the question 34. Question 34 is related with all furniture's safe and comfortable design that prevents balance lost while sitting down/ standing up or lying down/ getting up. The items in this quadrant emphasize the significance of dining activity. Compared to the other facilities, there was an urgent need in the critical analysis of approach, reach and manipulation in the dining hall. Moreover, to carry out the dressing activity, comfortable seating played a key role in the low accessibility performance of senior housing (See Figure 11).

All items that fall into Quadrant 3, 'Low Priority' are not important and pose no threat to the organizations. In this analysis, only question 20 is in the quadrant 3. Question 20 is related with bathroom doors that opens outwards or that opens by sliding for accessible design. To maximize accessibility, outward opening bathroom doors could have low priority level compared to other accessibility attributes in senior housing. Such a priority categorization could indicate to build environment professionals how accessibility is addressed in relation to interior design. Deciding which attributes are not important could encourage designers to go beyond minimum accessibility standards (See Figure 11).

Questions; 3, 16, 28& 29 are in Quadrant 4. Quadrant 4 means that there is 'Potential Overkill' in the items that are located in this quadrant after IPA analysis. These items are related with the issues that should be enhanced to increase satisfaction levels of the residents. Consequently, even if the senior housing residents consider these items in Quadrant 4 as not important, actually if the service is enhanced they will be more satisfied. So, these items should be enhanced to increase

satisfaction of the residents and provide better living environment. Question 3 is related with legible and unobstructed route to the main entrance area. Question 16 is related with appropriate daylight and artificial light design for safe mobility within an interior environment. Question 28 is about kitchenware that requires low physical effort (tea cups with handles) for safe and comfortable dining activities. Question 29 is related with locating personal care mirrors on correct height considering area of vision better visual comfort. As mentioned, accessible interior design requires in-depth insight into attributes in order to put more emphasis on some attributes and/or to eliminate them. By determining the attributes that are in the potential 'overkill' quadrant, designers can possibly reconsider the misfit between what is really needed in practice to design accessible interiors and what is currently available in theoretical sources (See Figure 11).

5.2. Qualitative Findings

The sixth and seventh questions are open ended questions. The sixth question is related with ideas about person environment relationship and healthy aging. The related ideas for this question are grouped under three main issues; safety, comfort and accessibility. Some answers that are related with the safety issues are as follows:

"Even if I am an independent person, when I am walking at night times, I feel the need to use a walker. It makes me feel safe. I am precautious since I fear to fall and become a dependent person". (Participant, #18)

"When people are aging, they are more eager to feel safe and comfortable, as a result housing environment should be able to be comfortable and safe for healthy aging." (Participant, #18)

Some answers that are related with the comfort issues are as follows:

"My privacy is the most important issue for me, so my personal space and my personal space's accessible design issues are inevitably important for me. I would be dissatisfied and I would feel uncomfortable if staff comes to my personal space

frequently. So privacy issues are very significant for healthy aging." (Participant, #5)

"I feel the need to have a better designed areas, to spend enjoyable time with my visitors; my family especially my granddaughters. I feel dissatisfied an uncomfortable when my granddaughters get bored during their visit." (Participant, #14)

"When people are aging, they are more eager to feel safe and comfortable, as a result housing environment should be able to be comfortable and safe for healthy aging." (Participant, #18)

Some answers that are related with the accessibility issues are as follows:

"I enjoy walking in the exterior environment with my friends, since I need fresh air and walking as a physical activity. Especially when the weather is nice and sunny I enjoy walking in the garden area. However, this institution's outdoor environment is mostly serving as parking lot, if there is a design in that area especially for walking, residents will be able to walk more and they will enjoy sunny weather. I think it is significant for our physical and social health. My doctor mentions that most suitable physical activity for people who are in their older ages is; walking." (Participant # 1)

"Cooking is my hobby. However, in this institution meals are served by the staff. I would be more happy and healthy if I would be able to cook my own food in my own kitchen that is designed for my capabilities."(Participant, #3)

"Accessible design is significant for healthy aging, however in my opinion; in older ages socializing is very crucial as well. If the interior environment is accessible but if I cannot socialize and attend social activities that institution arranges, I would not be satisfied and I would not recommend this institution to my relatives and friends." (Participant, #4)

"Accessible design is important for me, at the same time aesthetical appearance of furniture is very significant for me. I do not enjoy using modern furniture in my living environment. In this institution all furniture are donated furniture and they are

not modern designs, they remind me my young ages so I admire the furniture." (Participant, #8)

"Accessibility of a living space and aging should be directly proportional, when age increase, accessibility considerations should also increase." (Participant, #20)

"When people are aging, they fear to be dependent on others, so environmental qualities should be efficient enough to minimize the dependency." (Participant, #22)

The seventh question is the part where the participants express their point of view, experiences, ideas and recommendations about accessibility of the senior housing. The related ideas for this question are grouped under three main issues; safety, comfort and accessibility. Some answers that are related with the safety issues are as follows:

"Variation of the social and physical activities should be increased; residents have different hobbies and interests." (Participant #3)

"To be able to have health support 7/24, is a great opportunity that makes me feel better. When I am around people who are ready to help me, I feel more self-confident and that makes me more active both physically and socially. It is like a mental relief for me." (Participant #5)

Some answers that are related with the comfort issues are as follows:

"This senior house's furniture's are donated furniture, I like how they look, however they should also be ergonomically designed furniture as well. Some of this furniture increases my back pains so I carry my pillow with me when I use the public living rooms." (Participant, #8)

"One of my favorite activities in this institution is; drinking Turkish coffee in public living rooms with my friends and visitors and reading newspapers and discussing news." (Participant #10)

"When I am getting older, I feel that my joints (especially knees) are getting affected because of aging the most, so that all furniture design should be considered accordingly." (Participant, # 22)

Some answers that are related with the accessibility issues are as follows:

"Accessible design makes me feel safer and more self-confident accordingly." (Participant #2)

"I enjoy my balcony since there is a sea view. I am satisfied with the size of the balcony, however instead of plastic outdoor furniture, ergonomic furniture integration is crucial. Also there should be a garden gazebo as well, we have a garden in this institution but mostly we can use it as a parking lot." (Participant #6)

"Bathing is very significant for me, when I bath, I would like to fill a bucket instead of using shower head, also seating unit integration is inevitable for me, so bath tub or shower area should be in efficient sizes." (Participant, #7)

"Social activities are very significant for me especially the ones with my family members, thus public spaces should be qualified enough to enjoy socializing hours." (Participant, # 14)

"Sometimes I get confused about which floor I am in; sometimes I am at wrong floor level, trying to open another resident's suite, to avoid this confusion color codes can be helpful." (Participant #18)

"Saving energy is very significant for me as well as accessibility; sustainability should also be in the design criteria of an architect." (Participant, #28)

5.3. Correlations between Quantitative and Qualitative Data

Part A is the first part of the survey questionnaire of this study. This part is about the demographic data related with participants. In part A, it is clear that, participants who were living in this senior house for a longer time are the residents, who are satisfied

with the senior house more. Pearson's correlation value is; 0.789 which indicate that correlation between the duration of residency and the recommending the senior house to others is strong. So, there is significant strong correlation in this case. As a result, duration of residency and satisfaction levels is associated with each other. There are only 4 people among 30 participants who do not recommend the senior house to their relatives or friends. One of them was living in the senior house for 6 months only, 1 of these participants were living in the senior house for 1 year and 2 months and 2 of these participants were living in the senior house for 1 years and 4 months.

The second part; Part B includes five questions according to the five-point Likert scale, where participants rated both their accessibility agreement and independency levels on daily life activities regarding KASEV senior housing. Since the data is ordinal, to asses association of the questions of Part B, Spearman's correlation is used. There is a strong correlation between the first and the third questions of Part B. Part B first question is about general assessment on accessibility of the senior housing environment and part B, third question is about self-assessment of independency level on daily life activities within the senior housing environment. Spearman's correlation value is 0.741. This value indicates that there is a significant correlation among the first and the third questions of Part B. As a result people who are satisfied with the general accessibility of the senior housing environment of the senior house, they are also satisfied with the self-assessment of independency level on daily life activities within the senior housing environment. So, accessibility and independency in daily life activities are strongly correlated. They should be assessed crucially for healthy aging and HCD. There is also a strong correlation between Part B third question which is about self-assessment of independency level on daily life activities within the senior housing environment and part B, fourth question which is about the relationship between independency level on daily life activities and the accessibility of the senior housing environment. Spearman's correlation value is 0.715. This value indicates that there is a significant correlation. There are no other strong correlations between part B questions. Part C and Part D of this study are analyzed by using IPA tool as mentioned in the previous chapter.

After analyzing Part C and D with IPA to be able to juxtapose IPA findings with personas affinity diagramming is used as mentioned previously in Chapter 2. The qualitative data analysis revealed six categories that are obtained by the affinity diagramming method. An affinity diagram is considered as a useful method for analyzing qualitative data including participant responses from an interview or a survey (Holtzblatt, Wendell & Wood, 2005).

Affinity diagramming method for this thesis study includes the following steps according to the guidelines of Holtzblatt, Wendell and Wood (2005);

i. Consider the data from each participant and pull out key points (e.g., participant comments, observations, expectations, suggestions, and design ideas).
ii. Note each key issue individually on an index card or sticky note (There might be a need to indicate other things on the cards like the participant number, task, or site related with the study).
iii. Shuffled all the notes or cards to avoid any pre-existing order and placed each note or card on a wall or whiteboard inconveniently.
iv. Group the similar findings or concepts physically (on the wall or whiteboard) to identify themes or trends in the data.
v. Code the data with an open mind and structure the relationships emerges from the data without preconceiving.
vi. Label the obtained data for each group.
vii. Consider common issues related with the obtained comments and their relationship between each other.

According to affinity diagramming, there were the following six categories and their relevant attributes: (i) Safety – handle bars, seating unit and safe vertical circulation; (ii) Comfort – dining area furniture, personal care furniture, ergonomics of balcony and public area; (iii) Accessibility– appropriate size and space in the dining area, bathroom units, and legible routes as well as color coding in way finding; (iv) Aesthetics – furniture; (v) Socialization – independence, family times; and (vi) Privacy – respect for personal space and daily routines. Figure 12 illustrates the

overview of the categories and subcategories of factors affecting older people's importance and satisfaction criteria of a senior housing environment. Figure 13 illustrates six categories that are grouped as a result of affinity diagramming process. The qualitative data is obtained through open ended questions of survey questionnaire. This figure presents qualitative findings as keywords grouped and listed with affinity diagramming.

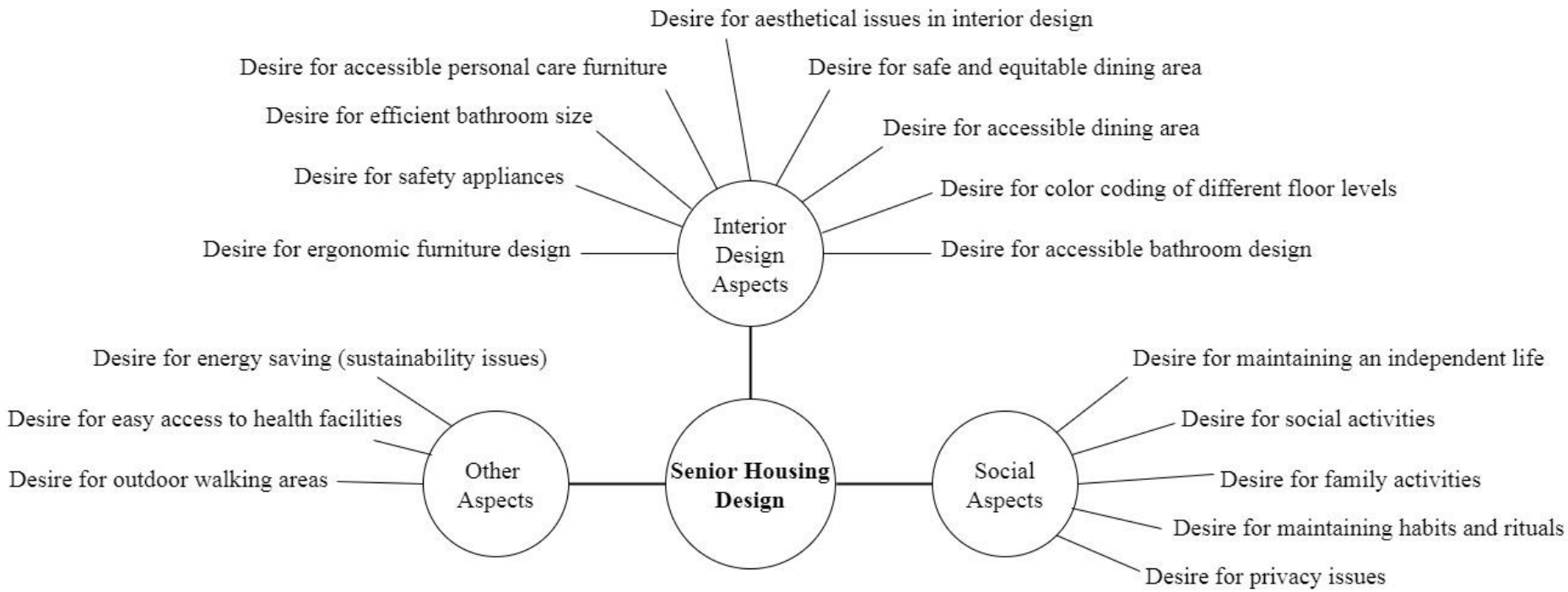

Figure 12. Overview of the categories and subcategories of factors affecting older people's importance and satisfaction criteria of a senior housing environment

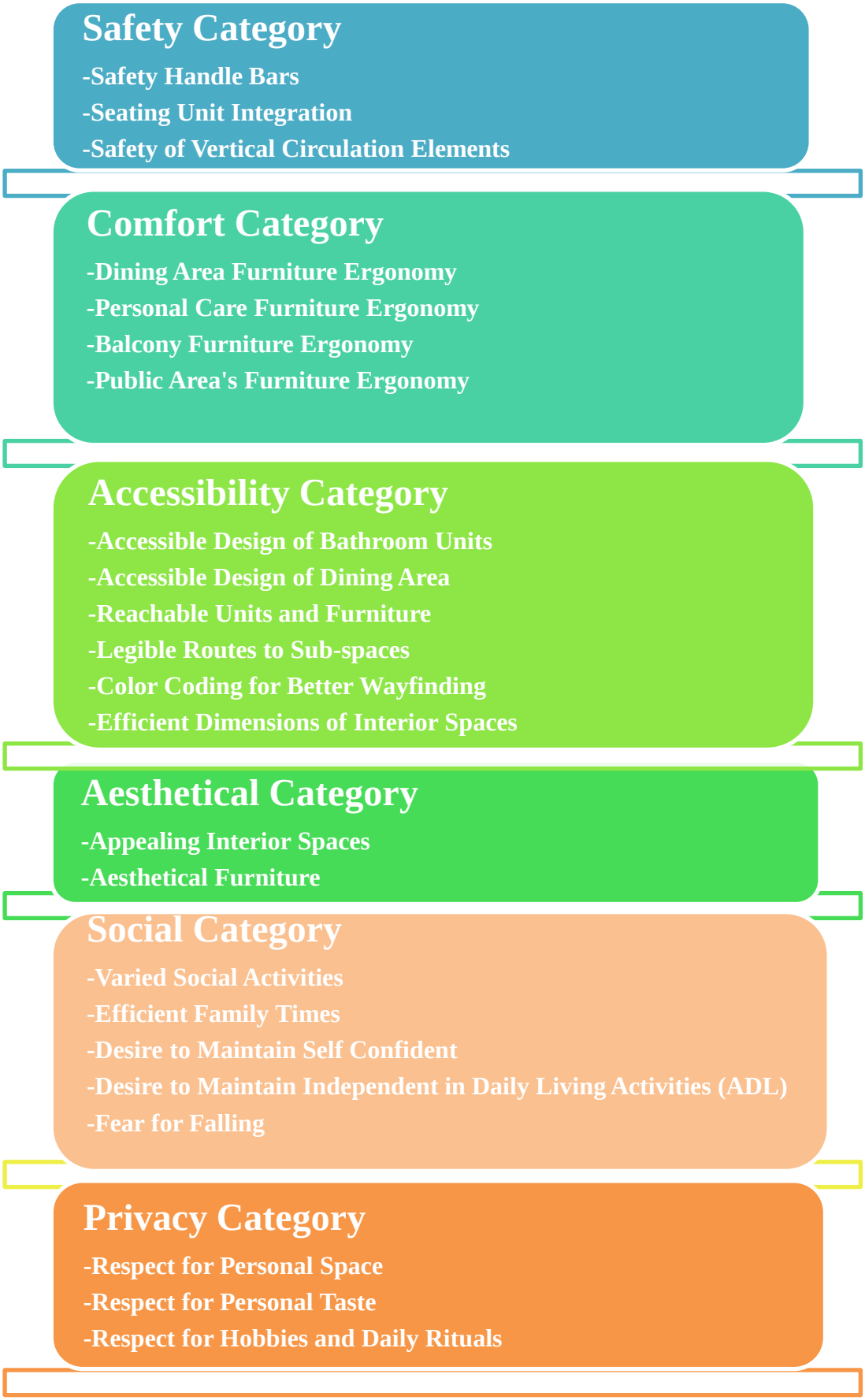

Figure 13. Affinity Diagram for Qualitative Findings

Lastly, the six categories from qualitative data and thirteen items obtained from the IPA matrix juxtaposed to correlate the qualitative and quantitative data. The following three key senior housing categories are developed: Safety; comfort and accessibility. Aesthetical, social and privacy issues are eliminated because the study focus does not include any background for these issues as a result the study's survey questionnaire does not include any items about these issues as well. The survey questionnaire includes accessibility, safety and comfort issues to focus on. As a result these three categories are considered for the study. Figure 14 illustrates the qualitative data match with the IPA items. In the next chapter, these matching are coded for persona development as stated in Chapter 2.

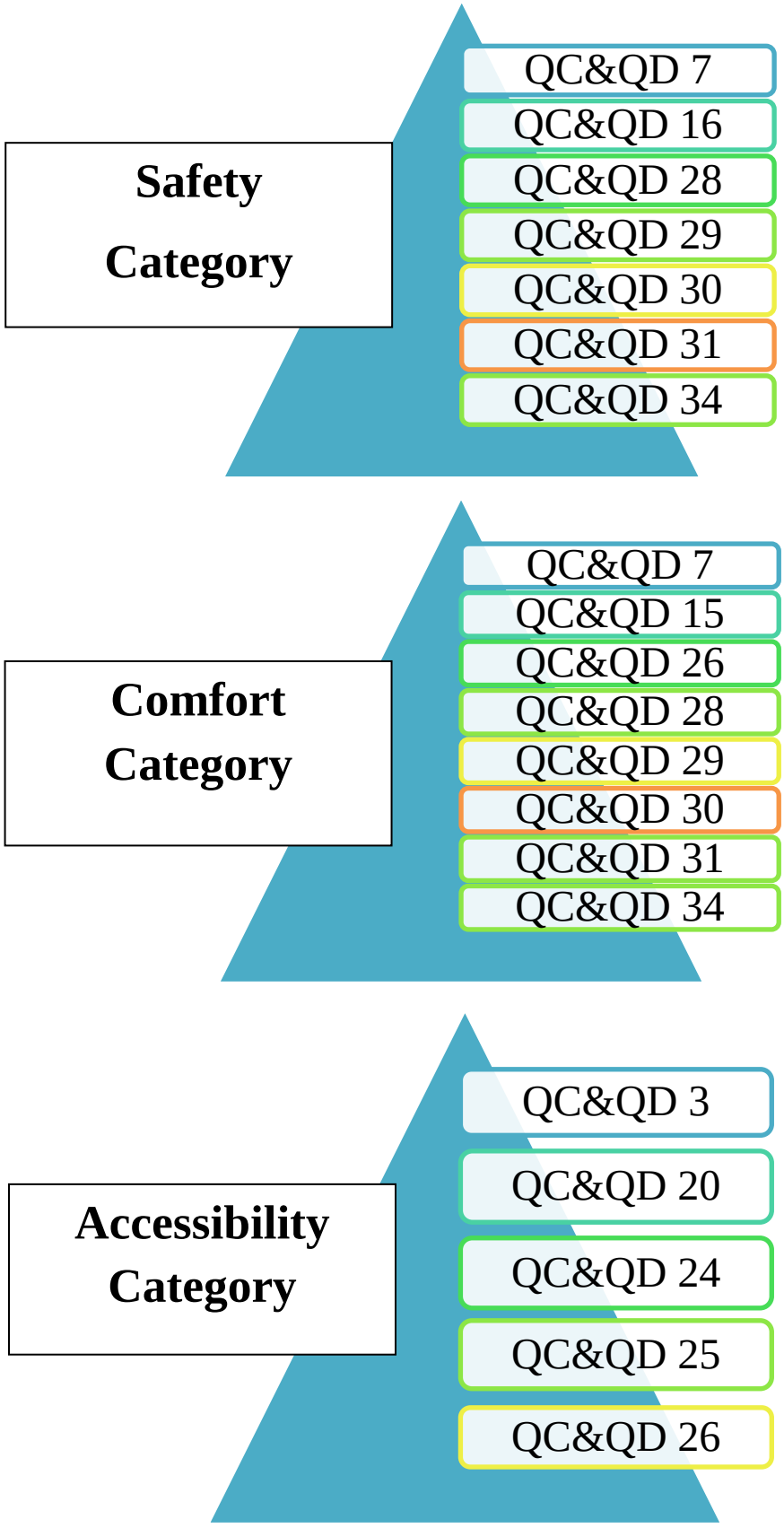

Figure 14. Three Key Senior Housing Categories Showing How Qualitative Data Match with the IPA Items

CHAPTER 6

PERSONA DEVELOPMENT AND AGING SIMULATION

6.1. Persona Development

Persona method in the study is used to better explain and examine the complexity of the target user behavior and expectations to be able to empathy and design senior housing environments accordingly. Personas are created based on the three senior housing categories. To be able to create personas that reflect target users, Anvari and Tran (2013) proposed a study based on 'holistic persona'. Holistic persona is consisted of five aspects; (i) a persona should be realistic, (ii) a persona should include target user groups personality, (iii) a persona should include target user groups intelligence, (iv) knowledge and (v) cognitive process (Anvari & Tran, 2013). This study also refers to these five key aspects of 'holistic personas' to eliminate limitations related with the resemblance of real target users. Table 7 illustrates characteristics of personas that are created. Table 8 illustrates three holistic personas created for this study (See Appendix F for created personas).

Table 7 Characteristics of personas that are created for the study

	Information
Personal Background	Gender
	Age
	Profession
Health Status	Barthel Index Results
	Geriatric Depression Scale Results
	Health Problems
Life Style	Hobbies
	Interests
	Personal Background
	Family Relations
	Desires and Needs
	Housing Environment Expectations
	Most Important Aspect about a Senior
	Housing Environment: Accessibility, Safety
	Or Comfort Issues
Further Information	Image Source
	Fictional Elements

Table 8 Holistic personas and their personal traits

The Persona	Independency in BADL (Barthel Index)	Emotional Stability (Geriatric Depression Scale)	Terms Descriptive of Personality Traits
Ayşe (Osteoporosis Problem)	Independent	Not Indicative of Depression	Outgoing, strong family relationships, well groomed, eager to participate in social activities.
Osman (Posture and Hamstring Problem)	Independent	Not Indicative of Depression	Intellectual, personal space is sacred for him, his books are valuable, social.
Afife (Diabetes Problem)	Independent	Not Indicative of Depression	Well groomed, outgoing, cheerful, colorful, has long term goals, joins social groups.

Each persona corresponds to each senior housing category respectively: Ayşe corresponds to accessibility; Osman corresponds to safety; and Afife corresponds to comfort. Each persona is also shaped according to the reported health problems that limit their physical activities. There are three common health problems reported by the participants; osteoporosis, postural problems and diabetes. In the study, it is assumed that these health problems are not in the degree of effecting independency of older people in their daily life activities since participants who are independent according to Barthel Index as mentioned before.

6.2. Aging Simulation Process

Aging simulation process of this thesis includes six participants and five task scenarios that are developed according to BADL of older people.

6.2.1. Task Evaluators

For the aging simulation process, six evaluators participated voluntarily. For each persona, there are two evaluators to simulate the persona according to the defined task scenarios. All the evaluators have been in this senior housing for the first time. None of the evaluators have tried GERT suit before this study. Three of the evaluators are female and three of the evaluators are male to avoid biases related with gender. The mean age value for the simulation evaluators is 24.5. All evaluators are either architecture or interior architecture students (two evaluators are interior architecture students and four evaluators are architecture students). All evaluators are 4^{th} grade students. Therefore they are perceived as future designers. Furthermore, all of the evaluators have the knowledge and consciousness about aging related studies and HCD approach. In addition, all of the evaluators are in same age range (23 to 26 years) so, they have same fit body index which is an index for estimating body levels based on weight and height measurements. Table 9 illustrates the demographics of the evaluators.

Table 9 Demographics information of the evaluators

	Gender	Age	Profession
Evaluator 1	Female	23	Interior Architecture Student (4th Grade)
Evaluator 2	Male	24	Architecture Student (4th Grade)
Evaluator 3	Female	24	Architecture Student (4th Grade)
Evaluator 4	Male	25	Interior Architecture Student (4th Grade)
Evaluator 5	Male	25	Architecture Student (4th Grade)
Evaluator 6	Female	26	Architecture Student (4th Grade)

6.2.2. Task scenarios

Five task scenarios are developed; (i) mobility tasks, (ii) personal care tasks, (iii) bathroom tasks, (iv) dining tasks and (v) transfer tasks. These tasks are created according to the Barthel Index BADL groups. Figure 11 illustrates these tasks. Each task is associated with the corresponding components of the GERT suit and their related restrictions. Figure 15, 16, 17, 18 and 19 show the tasks and their restriction components.

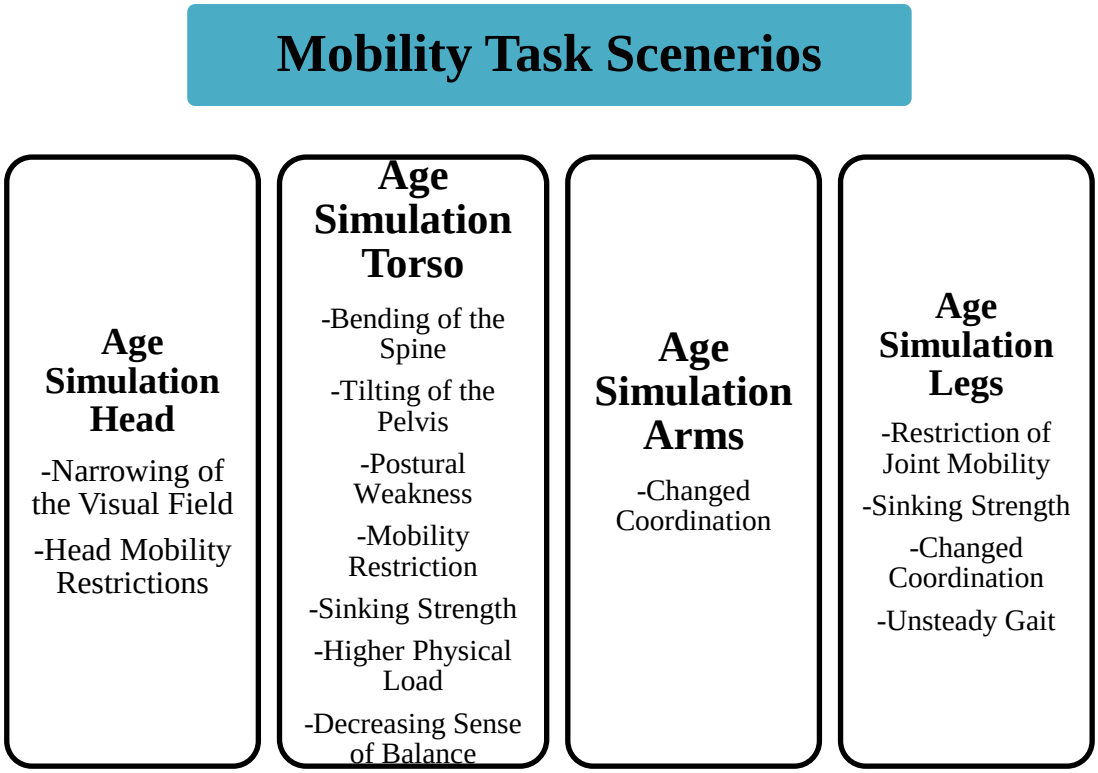

Figure 15. Mobility Task Scenarios and Its Corresponding Components of GERT Suit

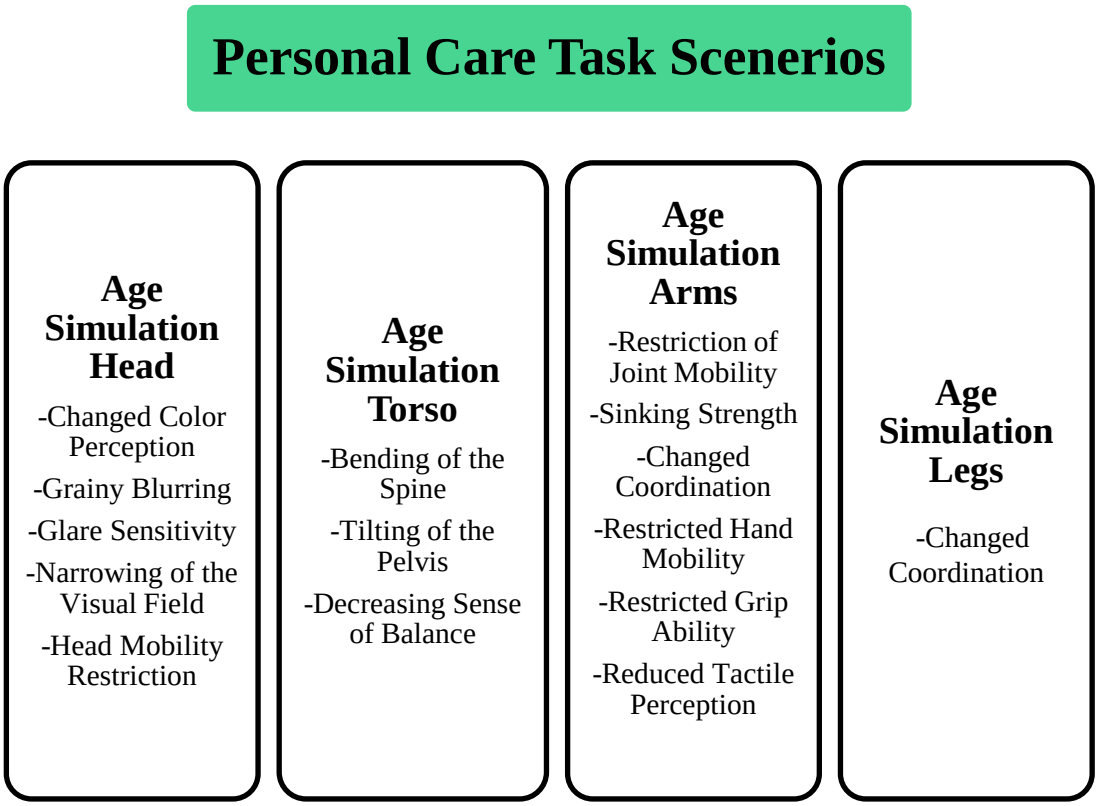

Figure 16. Personal Care Task Scenarios and Its Corresponding Components of GERT Suit

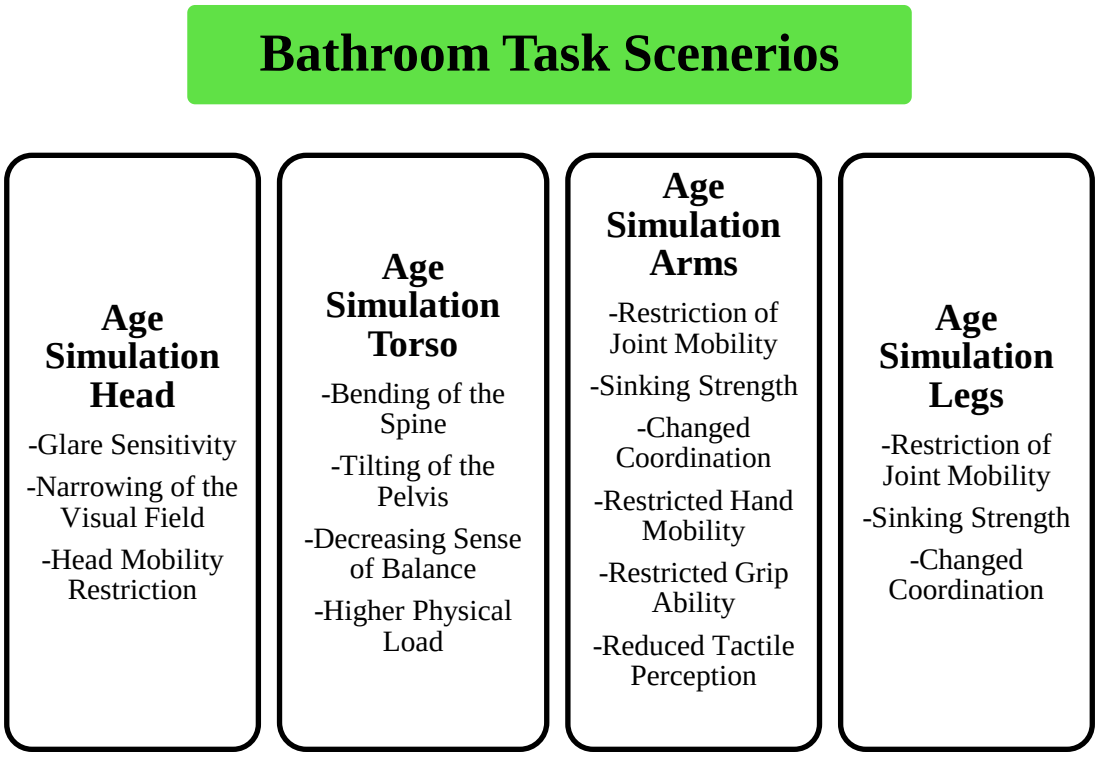

Figure 17. Bathroom Task Scenarios and Its Corresponding Components of GERT Suit

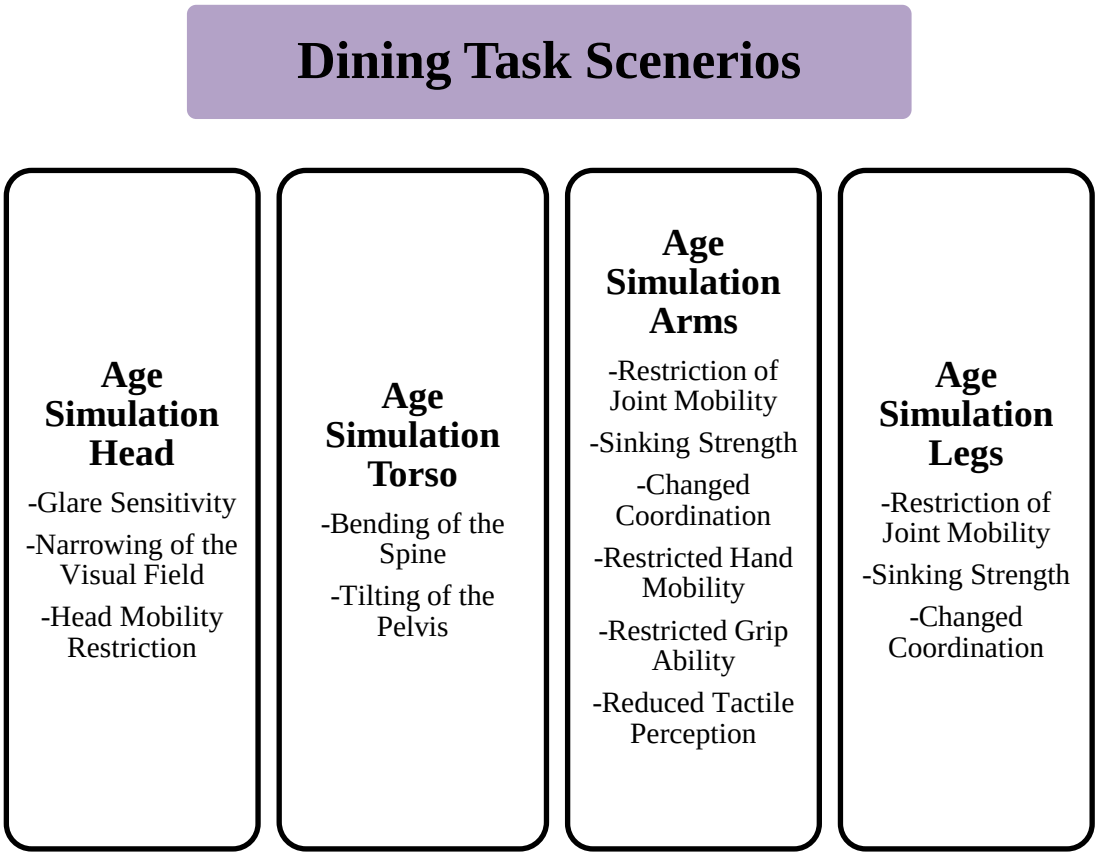

Figure 18. Dining Task Scenarios and Its Corresponding Components of GERT Suit

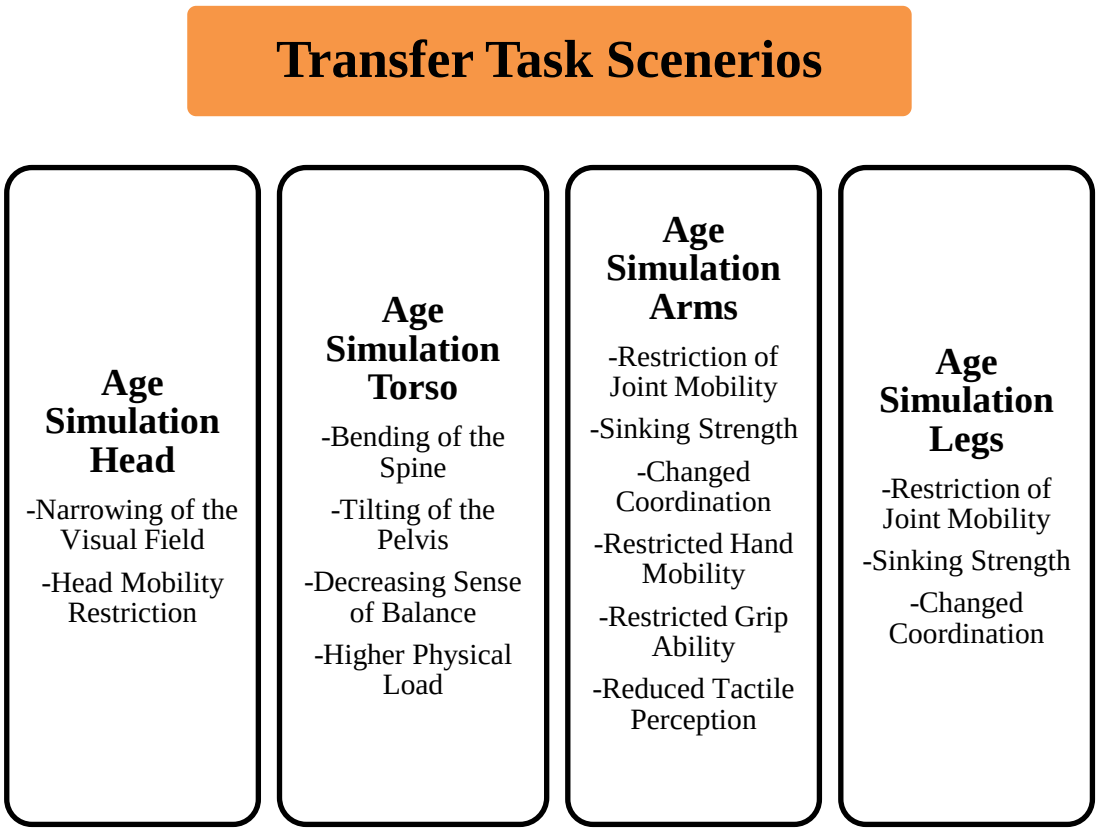

Figure 19. Transfer Task Scenarios and its Corresponding Components of GERT Suit

Table 10 illustrates the subtasks under each task scenarios that are formed according to Barthel Index. All these tasks are measured by the chronometer (in seconds). Figure 20 and 21 shows exemplary photos taken during the task conduction. Additional photos taken during each scenario are given in Appendix H.

Table 10 Tasks that will be done by using GERT suit

Mobility Tasks (MT)	Personal Care Tasks (PCT)	Bathroom Tasks (BT)	Dining Tasks (DT)	Transfer Tasks (TT)
MT1: Walking from parking lot to entrance (lobby) area.	**PCT1:**Wearing a sweater and button up.	**BT1:** Access to sink.	**DT1:** Drinking a glass of water.	**TT1:** Sitting down on chair.
MT2: Using staircase from ground floor to upper floor.	**PCT2:** Sitting and tying shoe lace.	**BT2:** Access to shower.		**TT2:** Standing up from chair.
MT3: Using staircase from upper floor to ground floor.	**PCT3:** Reaching lowest personal care furniture unit (drawer).	**BT3:** Access to toilet.		**TT3:** Lying on bed.
MT4: Walking from entrance (lobby) area to personal suites.	**PCT4:** Reaching highest personal care furniture unit (drawer).			**TT4:** Getting up from bed.

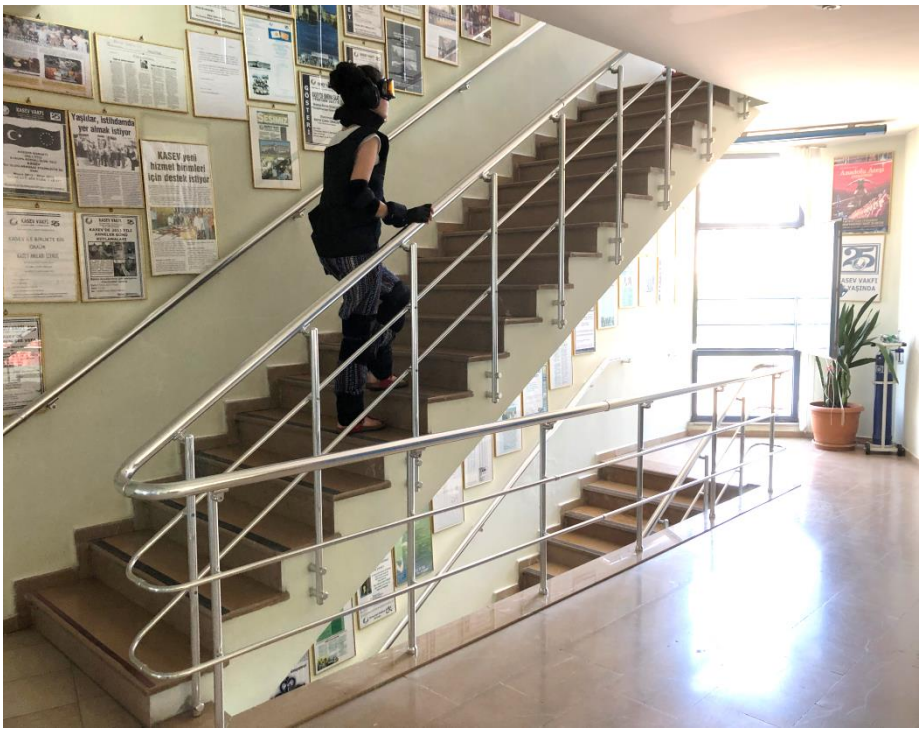

Figure 20. Using staircase from ground floor to upper floor with GERT suit (taken by the author, 2019)

Figure 21. Bathroom appliance's usage with GERT suit (taken by the author, 2019)

6.3. Simulation Findings

Simulation analysis is done with using GERT simulation suit. Five task scenarios evaluated by the evaluators.

6.3.1. Task Effectiveness

All evaluators conducted the five task scenarios in two sessions; session with GERT suit, and session without GERT suit. To overcome the learning effect, there is a one-week break between the sessions. To overcome the order effect, three randomly assigned evaluators conducted the task scenarios with GERT suit first, and later without GERT suit. The other three conducted the scenarios without GERT suit first and later with GERT suit. All evaluators conducted all task scenarios without the companion of other task evaluators to prevent biases. See Appendix I for evaluator's task experience in terms of the time efficiencies with and without GERT suit, respectively.

Ayşe is a persona who is mostly giving importance to accessibility issues in senior housing design and Osman is a persona who is mostly giving importance to safety issues in senior housing design. The third persona is Afife and she is mostly giving importance to comfort issues in senior housing design. See Appendix F.

Mobility tasks include three subtasks; mobility task 1 (MT 1), mobility task 2 (MT 2) and mobility task 3 (MT3). See Appendix I, for details of tasks, subtasks and task efficiencies (in seconds). For mobility subtasks, Osman is the persona that requires most of the time to complete the task with GERT suit and also for without GERT suit condition. This might be because Osman is the most precautious persona and he is very sensitive on safety issues and he fears of falling. See Appendix F for more information about persona Osman. Therefore persona Osman's mean values of time

in seconds are the highest in all three mobility subtasks compared to other two personas (persona Ayşe and persona Afife). During the evaluation of MT 2 which is using the staircase upwards and MT 3 which is using the staircase downwards for vertical circulation, it is distinguished that MT 3 requires more time compared to MT 2 with GERT suit. However, for without GERT suit condition MT 2 requires more time compared to MT 3. This situation is expressed by some of the evaluators. This oppositeness was experienced by the evaluators as well. Some of the evaluators explained this situation through their experiences. Evaluator 3 mentioned that, *normally it is more difficult to use the staircase to reach upper levels (upstairs) is more difficult however with GERT suit the evaluator experienced that using the staircase to lower level is much more difficult because of physical restrictions of GERT suit and it causes fear of falling as well*.

Personal care tasks are comprised of four subtasks; personal care task 1 (PCT 1), personal care task 2 (PCT 2), personal care task 3 (PCT 3), personal care task 4 (PCT 4). See Appendix I, for details of tasks, subtasks and task efficiencies (in seconds). For persona Afife comfort issues are essential for senior housing design. Moreover; persona Afife thinks appearance of a person is very important so she expresses that personal care activities are critical for motivation and promoting healthy aging (See Appendix F). As a result persona Afife has the highest mean values for task efficiency for PCT 1, PCT 3 and PCT 4 for both with GERT suit and without GERT suit conditions. PCT 2 is about sitting and tying a shoe lace, this activity is related with balance, joint mobility, coordination skills and grip ability (See Figure 12) and since persona Osman is the most precautious persona and since he fears of falling (See Appendix F) he consumed the highest time (in seconds) for this task for both suit conditions (with GERT suit and without GERT suit) as well. Even if this task is a personal care task persona Afife consumed the lowest mean value for time for both suit conditions (with GERT suit and without GERT suit) among other persona groups. This might be because this activity is mainly about balance and tying a shoe lace is not directly about the appearance. For this task, Evaluator 5 expressed that; *if there is any furniture near the seating unit such as coffee table etc. it would be very difficult to tie the shoe lace since with GERT suit because of the restrictions people need more space to move*. Furthermore, PCT 3 which is about reaching lowest parts

of personal care furniture, this activity is also related mostly with balance, joint mobility, coordination skills and grip ability (See Figure 12) and since persona Osman is the most precautious persona and since he fears of falling (See Appendix F) he consumed the highest time for this task scenario with GERT suit as well.

Bathroom tasks are comprised of three subtasks; bathroom task 1 (BT 1), bathroom task 2 (BT 2) and bathroom task 3 (BT 3). See Appendix I, for details of tasks, subtasks and task efficiencies (in seconds). Since persona Osman is the most precautious persona and since he fears of falling he consumed the highest time for these bathroom tasks. See Appendix F for personas in detail. Other two personas who are the representatives of accessibility and comfort, means values of time are slightly different. So; there is not a significant difference. So accessibility and comfort issues should also be considered significantly for bathroom designs of senior housing environments for better satisfaction as can be detected from IPA results in Chapter 5.1.2 as well.

Dining task scenario includes one task which is dining task 1 (DT 1) which is drinking a glass of water. See Appendix I, for details of tasks, subtasks and task efficiencies (in seconds). Mean values of time for different persona groups are slightly different for both suit conditions (with GERT suit and without GERT suit). Evaluator 6 expressed that, *it is very difficult to grab the glass because of grip restrictions of GERT suit but also it is very difficult to drink the last drops of water because of neck restrictions.*

Lastly transfer tasks are consisted of four subtasks; transfer task 1 (TT 1), transfer task 2 (TT 2), transfer task 3 (TT 3) and transfer task 4 (TT 4). See Appendix I, for details of tasks, subtasks and task efficiencies (in seconds). Persona Osman consumed the highest mean values of time for both suit conditions (with GERT suit and without GERT suit) for all four transfer subtasks. This might be because Osman is the most precautious persona and since he fears of falling. See Figure 22 for mean values of time in seconds for each persona and each task scenario with GERT suit.

See Figure 23 for mean values of time in seconds for each persona and each task scenario without GERT suit.

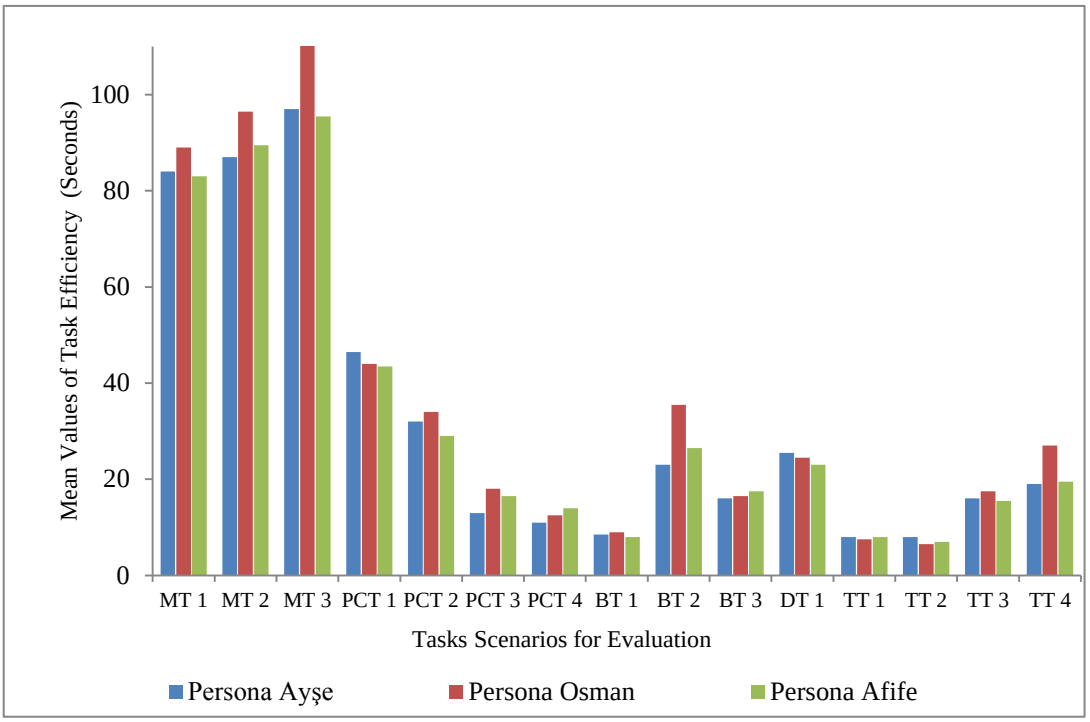

Figure 22. Mean values of time in seconds for each persona and each task scenario with GERT suit

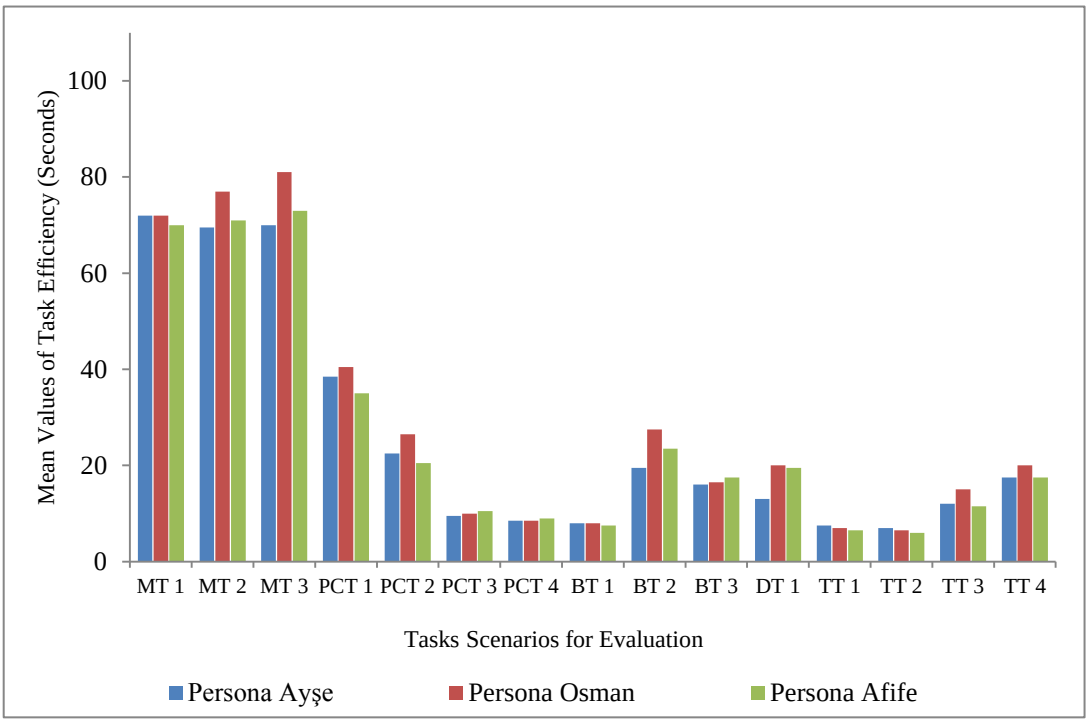

Figure 23. Mean values of time in seconds for each persona and each task scenario without GERT suit

The majority of the task evaluators experienced a decline in performance of the task scenarios while wearing the simulation suit (GERT). None of the task evaluators experienced any improvement in task performance after wearing the simulation suit (GERT). Only in the following three tasks some of the task evaluators experienced no change: Bathroom Task 1 (BT1) - three task evaluators did not experience any change; Transfer Task 1 (TT1) - three task evaluators did not experienced any change, and Transfer Task 2 (TT2) - four task evaluators did not experienced any change. Bathroom Task 1 is access to sink; Transfer Task 1 is, sitting down on a seat and Transfer Task 2 is, standing up from chair. Not experiencing any change while using GERT suit and while not using GERT suit, might be because of these activities are not time consuming activities so that the simulation suit is not accurately tested for these three activities in seconds with a chronometer. However since these activities are some of the main BADL's (Mahoney & Barthel, 1965), they should not be ignored for any studies that are related with accessible housing design. Instead the effects of handle bars, non-slip floor and wall surfaces etc. kind of qualities of design should be discussed for accessibility of these three main activities. Table 11 illustrated the mean, minimum and maximum values of the efficiency times for each task that are simulated with GERT suit and without GERT suit. Table 12 presents overall mean values of efficiencies of times for each task for each persona with GERT suit and without GERT suit. See Appendix I, for efficiencies of times for each sub-task for each persona with GERT suit and without GERT suit conditions.

Table 11 Mean values of sub-tasks with GERT suit

Task Number	with GERT Suit			without GERT Suit		
	Min. Value	Max. Value	Mean	Min. Value	Max. Value	Mean
MT 1	78	90	85.3	70	74	71.7
MT 2	86	97	91	69	78	72.5
MT 3	95	102	97.8	68	82	74.2
PCT 1	42	50	46	32	44	38.0
PCT 2	28	36	31	20	30	23.2
PCT3	12	22	15.8	9	11	10
PCT 4	10	15	12.5	8	9	8.6
BT 1	8	10	8.5	7	8	7.8
BT 2	22	37	28.3	19	28	26.2
BT 3	15	18	16.7	11	17	13.2
DT 1	20	31	24.3	17	28	20.7
TT 1	6	10	7.8	6	8	7
TT 2	6	9	7.2	6	7	6.5
TT 3	14	20	16.3	10	18	12.8
TT 4	18	28	21.8	17	20	18.3

Table 12 Mean values of tasks with and without GERT suit for each persona

	with GERT Suit			without GERT Suit		
	Persona Ayşe	**Persona Osman**	**Persona Afife**	**Persona Ayşe**	**Persona Osman**	**Persona Afife**
Mean Value for Mobility Tasks	89.3	95.5	89.3	70.5	76.5	71.7
Mean Value for Personal Care Tasks	25.5	27.1	26.7	19.7	18.0	18.7
Mean Value for Bathroom Tasks	15.8	20.3	17.3	13.5	16.6	14.3
Mean Value for Dining Task	25.5	24.5	23.0	22.5	20.0	19.5
Mean Value for Transfer Tasks	12.7	13.9	14.6	11.0	12.1	10.4

The results of the simulation indicate how wearing GERT suit affected task evaluators who are young adults who are aged 23 to 26. Wearing the GERT suit resulted in a simulation of overall reduction in mobility and physical capabilities. These results are consistent with the literature related with physical capacities of older people. Perracini et al. (2017) express the importance adopting activity levels and types according to different capabilities of older people for healthy aging. When older people cannot do the recommended amounts of physical activity due to health conditions, they should be as physically active as their abilities and capabilities allow them to be. Also muscle strengthening activities, involving major muscle groups is one of the crucial issues for being able to stay physically active even if there are some declines in physical capabilities. Maintenance of balance, strength, flexibility,

exercise capacity, healthy bones, muscles, and joints is essential for physical activities and also for healthy aging accordingly (Perracini et al., 2017). As a result, experiencing these overall reductions in physical capabilities allow evaluators to understand the important issues related with physical activities in a senior housing for older people. Also, results of using GERT suit show the importance of physical activities for maintaining physical capabilities as well. Moreover, the results of simulation analysis show the importance of senior housing design for promoting physical activities for healthy aging. The findings of this study are contributive in terms of listing main BADL according to Barthel Index and analyzing them with and without GERT suit. BADL are the most important activities of older people since they spend most of their time in home and since they should be efficiently active in these activities for maintaining their independency and for healthy aging.

6.3.2 Task Effectiveness Differences among the Personas

Since this thesis study has three samples for persona groups, ANOVA was conducted to test whether there are any significant differences between the samples in terms of task effectiveness among the personas without causing Type I errors. ANOVA compares the amount of variations between the samples with the amount of variation within each sample. ANOVA was conducted on the three personas that the evaluators are representing (Group 1: persona Ayşe, Group2: persona Osman Group 3: persona Afife). After determining which samples are significantly different through ANOVA, Post Hoc comparisons are also implemented to be able to discover whether there are significant differences between the means of any two samples (personas) that are being compared for the thesis. According to ANOVA results; MT 2 for both with and without GERT suit conditions, BT 2 for both with and without GERT suit conditions and for TT 4 for both with and without GERT suit conditions there are significant mean value differences. This indicated that for these stated tasks at least one of these persona groups has a mean that is not equal to others so there is a significant difference. For MT 3, there is not any significant mean value difference for without GERT suit condition. Because of this, for MT 3 is there is no significant difference between two different suit conditions (with GERT suit condition p=0.043

and without GERT suit condition p=0.112). Results of ANOVA is as follows; MT 2 significance value for with GERT suit condition is 0.005 and significance value for without GERT suit situation is 0.017; BT 2 significance value for with GERT suit condition is 0.015 and significance value for without GERT suit situation is 0.022; TT 4 significance value for with GERT suit condition is 0.030 and significance value for without GERT suit situation is 0.035.

To be able to detect which of the groups and how many of them differs Scheffe test is applied. Scheffe test is selected for Post Hoc comparison, since it examines subgroups formed by various combinations of the samples, rather than just pairwise comparisons. For MT 2 with GERT suit condition and without GERT suit condition), MT 3 (with GERT suit condition), BT 2 (with GERT suit condition and without GERT suit condition), TT 4 with (GERT suit condition and without GERT suit condition) there are significant differences between the means of Ayşe and Osman; Afife and Osman since the significance values are under 0.05. Table 13 illustrates ANOVA Test for Task Scenarios with GERT Suit and without GERT Suit.

Table 13 ANOVA test for task scenarios with and without GERT suit

	with GERT suit		without GERT suit	
	F Value	**Significance Value**	**F Value**	**Significance Value**
Mobility Task 1	1.033	0.456	1.400	0.372
Mobility Task 2	48.500	0.005	21.000	0.017
Mobility Task 3	10.778	0.043	4.965	0.112
Mobility Task Overall	2.897	0.197	2.582	0.223
Personal Care Task 1	0.433	0.683	0.560	0.621
Personal Care Task 2	2.586	0.222	2.196	0.259
Personal Care Task 3	0.530	0.635	0.500	0.650
Personal Care Task 4	3.000	0.192	0.500	0.650
Personal Care Task Overall	0.521	0.639	2.296	0.248
Bathroom Task 1	0.600	0.604	1.000	0.465
Bathroom Task 2	22.682	0.015	17.455	0.022

Table 13 Continues

Bathroom Task 3	0.700	0.563	0.576	0.614
Bathroom Task Overall	3.870	0.148	0.762	0.540
Dining Task	0.238	0.801	0.151	0.866
Transfer Task 1	0.059	0.944	1.500	0.354
Transfer Task 2	0.778	0.534	1.500	0.354
Transfer Task 3	0.310	0.755	0.705	0.561
Transfer Task 4	14.176	0.030	12.500	0.035
Transfer Task Overall	0.620	0.595	1.764	0.312

To be able to make an inference from two samples; with GERT suit and without GERT suit conditions, independent samples t-test is applied. According to this analysis, PCT Overall (F=0.890, t=1.701, p=0.096, at 0.05 level), BT 1 (F=3.769, t=1.754, p=0.110, at 0.05 level), BT 2 (F=1.576, t=1.685, p=0.123, at 0.05 level), BT Overall (F=0.459, t=1.110, p=0.275, at 0.05 level), and TT4 (F=8.344, t=1.935, p=0.082, at 0.05 level), there are significant differences between with and without GERT suit conditions since the null hypothesis which is 'the two population means are equal' is not rejected. So, for PCT Overall, BT 1, BT 2, BT Overall and TT 4 equal variances assumed by conducting independent samples t-test Table 15 illustrates independent samples t-test for with GERT suit and without GERT suit conditions.

Table 14 Independent samples t-Test for with and without GERT suit conditions

		Levene's Test for Equality of Variances		t-test for equality of means				
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**
MT 1	**Equal variances assumed**	3.803	0.080	6.814	10	0.000	13.667	2.001
	Equal variances not assumed			6.814	6.841	0.000	13.667	2.001
MT 2	**Equal variances assumed**	0.406	0.538	7.829	10	0.000	18.500	2.363
	Equal variances not assumed			7.829	9.637	0.000	18.500	2.363
MT 3	**Equal variances assumed**	1.923	0.196	10.259	10	0.000	23.667	2.307
	Equal variances not assumed			10.259	7.751	0.000	23.667	2.307
MT Overall	**Equal variances assumed**	7.551	0.010	10.633	34	0.000	18.611	1.750
	Equal variances not assumed			10.633	26.956	0.000	18.611	1.750
PCT 1	**Equal variances assumed**	0.616	0.451	3.341	10	0.007	8.000	2.394
	Equal variances not assumed			3.341	9.042	0.009	8.000	2.394
PCT 2	**Equal variances assumed**	0.009	0.928	4.512	10	0.001	8.833	1.847
	Equal variances not assumed			4.512	9,506	0.001	8.833	1.847

Table 14 Continues

PCT 3	**Equal variances assumed**	17.559	0.002	3.121	10	0.011	5.833	1.869
	Equal variances not assumed			3.121	5.396	0.024	5.833	1.869
PCT 4	**Equal variances assumed**	2.855	0.122	5.452	10	0.000	3.833	0.703
	Equal variances not assumed			5.452	5.978	0.002	3.833	0.703
PCT Overall	**Equal variances assumed**	0.890	0.350	1.701	46	0.096	6.500	3.820
	Equal variances not assumed			1.701	45.376	0.096	6.500	3.820
BT 1	**Equal variances assumed**	3.769	0.081	1.754	10	0.110	0.667	0.380
	Equal variances not assumed			1.754	7.253	0.121	0.667	0.380
BT 2	**Equal variances assumed**	1.567	0.239	1.685	10	0.123	4.833	2.868
	Equal variances not assumed			1.685	8.397	0.129	4.833	2.868
BT 3	**Equal variances assumed**	0.960	0.350	3.490	10	0.006	3.500	1.003
	Equal variances not assumed			3.490	7.911	0.008	3.500	1.003
BT Overall	**Equal variances assumed**	0.459	0.503	1.110	34	0.275	3.000	2.702
	Equal variances not assumed			1.110	32.216	0.275	3.000	2.702

Table 14 Continues

DT	**Equal variances assumed**	0.005	0.943	1.670	10	0.126	3.667	2.196
	Equal variances not assumed			1.670	9.983	0.126	3.667	2.196
TT 1	**Equal variances assumed**	1.706	0.221	1.387	10	0.196	0.833	0.601
	Equal variances not assumed			1.387	7.154	0.207	0.833	0.601
TT 2	**Equal variances assumed**	2.168	0.172	1.265	10	0.235	0.667	0.527
	Equal variances not assumed			1.265	7.094	0.246	0.667	0.527
TT 3	**Equal variances assumed**	0.197	0.667	2.289	10	0.045	3.500	1.529
	Equal variances not assumed			2.289	9.283	0.047	3.500	1.529
TT 4	**Equal variances assumed**	8.344	0.016	1.935	10	0.082	3.500	1.809
	Equal variances not assumed			1.935	6.039	0.101	3.500	1.809
TT Overall	**Equal variances assumed**	2.035	0.161	1.289	46	0.204	2.208	1.712
	Equal variances not assumed			1.289	43.546	0.204	2.208	1.712

6.3.3. Perceived Closeness Differences between the Groups with and without GERT Suit

Moreover, independent samples t-test is also conducted to measure the differences between the groups (Group 1: with GERT suit and Group 2: without GERT suit) in terms of perceived closeness of the task evaluators towards older people who are living in the senior housing. In this study, as mentioned in the methodology chapter, perceived closeness was measured by Inclusion of Other in the Self (IOS) Scale by Aron et al (1992). Independent t-tests provide inferential statistics. According to the results, there is a significant mean difference between the groups (Group 1: with GERT suit and Group 2: without GERT suit) ($F=5.568$, $t=10.661$, $p=0.040$, at 0.05 level). It was shown that the group with GERT suit experienced higher perceived closeness towards older people. Therefore, GERT suit significantly enhanced perceived closeness towards older people that can result in better inspection of accessibility problems within senior housing environment for healthy aging. This study reveals that GERT simulation suit makes a contribution in explaining the correlation in older people's physical capabilities within a senior housing environment by allowing evaluators to make empathy with older people. The usage of IOS in this thesis is unique, since it allows supporting the senior housing residents in terms of HCD aspects as concerned interior architects and environmental designers. The interior architects and environmental designers with higher perceived closeness towards older people could work more effectively to explore their real physical experience and to lead the senior housing residents toward better physical experiences. The goal of this process is to widen physical experience and promoting a more complex attribution of meaning about healthy aging of older people's intentions, motivations, thoughts, and behaviors in a senior housing environment. This study proposes that these aims should be pursued also in counseling in order to promote psychological well-being for healthy aging as well. See Figure 24 for mean values for inclusion of other in the self (IOS) scale. Table 16 illustrates independent samples t-test for perceived closeness (IOS scale).

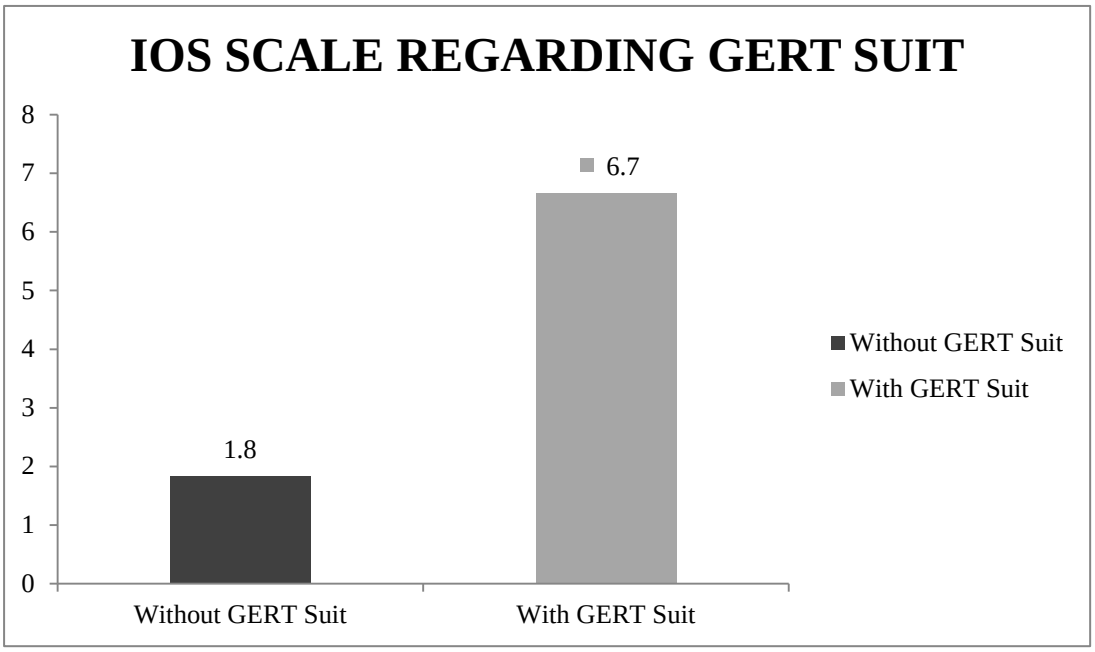

Figure 24. Mean Values for Inclusion of Other in the Self (IOS) Scale

Table 15 Independent samples t-Tests for perceived closeness (IOS Scale)

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**
IOS	**Equal variances assumed**	5.568	0.040	10.661	10	0.000	4.833	0.453
	Equal variances not assumed			10.661	7.564	0.000	4.833	0.453

CHAPTER 7

DEVELOPMENT OF PRIORITIZED PERSONA-BASED (PP-B) ACCESSIBLE SENIOR HOUSING MODEL FOR FURTHER STUDIES THROUGH SEMANTIC MODELING: ONTOLOGY

This thesis is elaborated on accessibility issues of senior housing design to motivate older people to be physically active and to promote healthy aging accordingly. It is a pioneering study to develop a PP-B accessible senior housing model. This study aims to lead interior architects and designers to make and use models for accessible senior housing as future studies. As a result, this study proposed a development process of an exemplary PP-B model to create accessible interiors in senior housing environments for healthy aging. Within the framework of the study, *prioritized* means 'ranked in order of importance to select appropriate sets, resolve conflicts between alternatives and evaluate alternative solutions'. The main aim of this senior housing model is to provide a residential setting for older people that are consonant with the target user's level of competence and needs. Moreover, developing a compatible residential setting with its target users is crucial since the environmental qualities are capable of maximizing the individual's potential (Rowles, 2018). Therefore, for a better future in a population aging era, development of a PP-B for a senior housing is essential. There is an aging friendly environment movement throughout the world, and this movement is stimulated by the World Health Organization (Buffel et al., 2012). Within this framework, the proposed model in the

study is significant to enhance the satisfaction levels of older people living in senior housing and to allow designers to have empathy for the target user groups efficiently as mentioned in Chapter 5. Figure 26 illustrates the development process of this model.

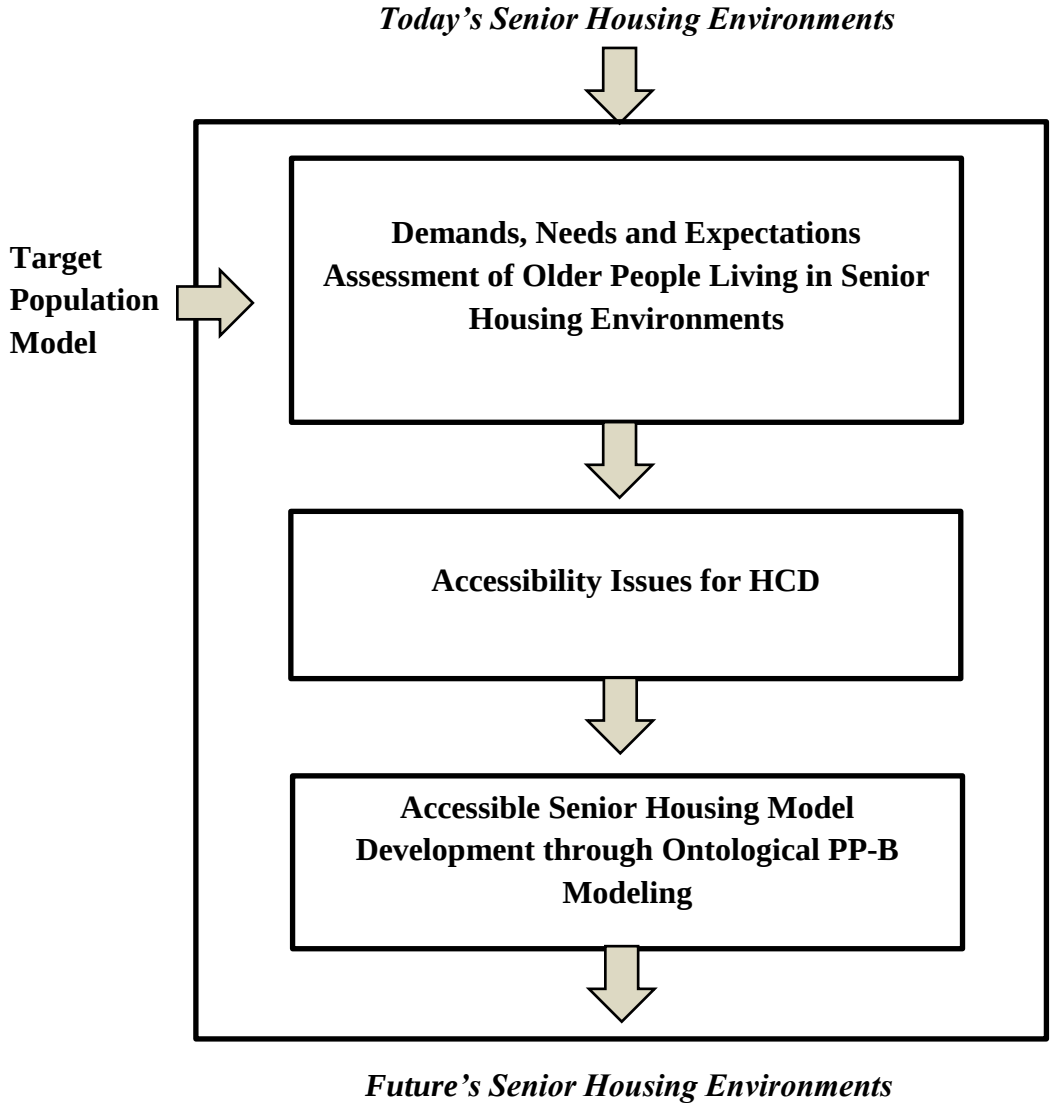

Figure 25. The Development Process of the Prioritized Persona-Based (PP-B) Senior Housing Environment Model

This thesis is not gathered by the commonly used frameworks for modeling through obtained data. The knowledge for this thesis's modeling stage is retrieved and obtained from the accumulated documentation in a human-friendly (human-centered) and productive framework; ontology. Ontology allows semantic knowledge management by conceptualizing the domains of an existing being. Ontology is an

abstract knowledge modeling, which treats the knowledge as concepts, associated attributes, and relations. Therefore it is an explicit specification of conceptualization and a formal way to define the semantics of knowledge and data (Chen & Luo, 2019).

In this thesis, for guiding future studies semantic coding is used to create a prioritized persona based (PP-B) accessible senior housing model. Semantic coding is done and personas are prioritized by affinity diagramming of IPA analysis findings. Three categories are obtained; accessibility, safety and comfort and these three categories represented by persona Ayşe, persona Osman and persona Afife. These three categories are inverted to five tasks based on the Barthel Index, since it is the mostly used index for BADL's. According to these five tasks, subtasks are formed for simulated physical aging through GERT simulation suit. Simulation analysis and the data obtained through these analyses are aimed to be used for creating a PP-B accessible senior housing model. Figure 27 illustrates the process of PP-B accessible senior housing model through semantic coding.

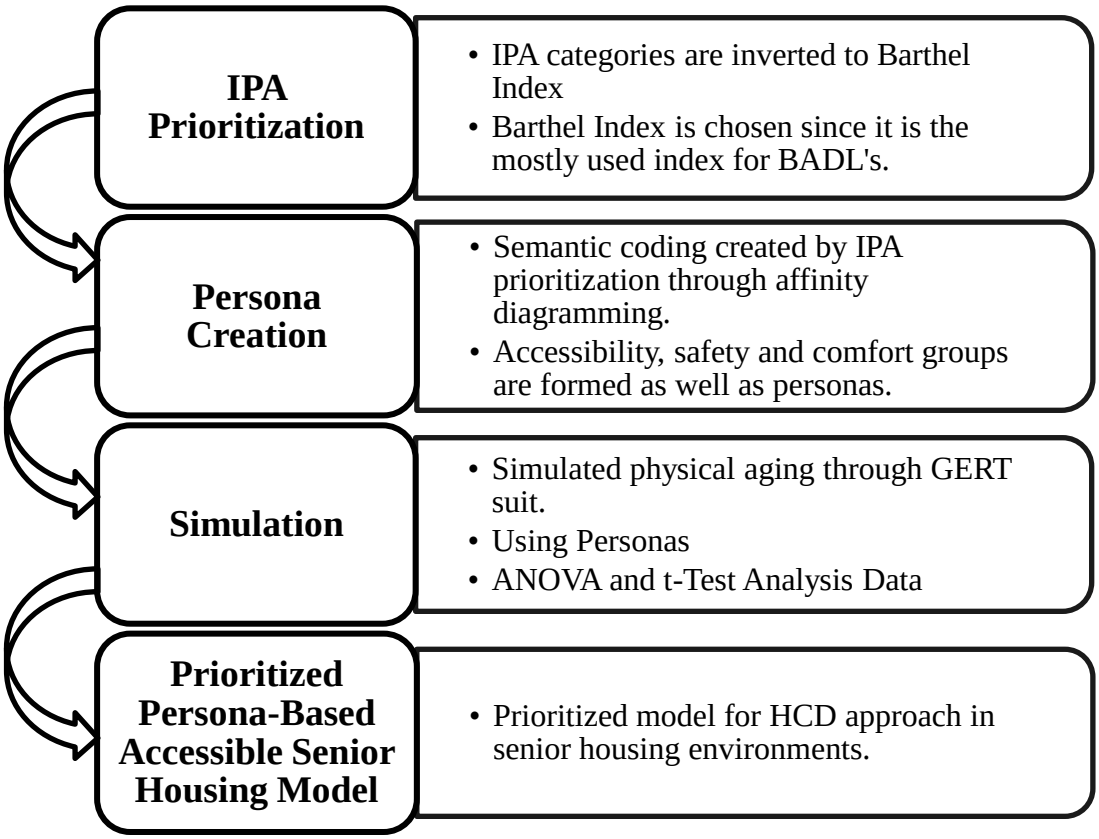

Figure 26. Semantic Coding for Prioritized Persona-Based (PP-B) Accessible Senior Housing Modeling Procedure

Ontology: the branch of metaphysics dealing with the nature of being. This framework aims to code a set of concepts and categories in a subject area or domain that shows their properties and relations between them. Ontology allows human-friendly modeling since when researchers pay much of their effort and attention to the data management to explore its value, more and more documentation has been accumulated to record the generated knowledge. Due to human's limited cognitive capacity, it is a crucial challenge. However during the ontology based modeling procedure which is a semantic based process, the literature abstracts and study results can be represented by using a consistent and clear structure, which is critical for knowledge mining (Chen & Luo, 2019). Therefore, in this thesis, ontology based modeling is used since it is a significant and efficient technique for reasoning and modeling. In the context of aging and design studies, ontology based modeling is mostly applied in pervasive computing and assisted living regarding older people housing environments, smart homes, sensor technologies and computerized cognitive rehabilitation (Afacan & Surer, 2019). Most of the ontology studies have focused on monitoring data management issues. However, data formation and annotation of knowledge domain in ontology based approaches are more time consuming and requiring expertise, especially while designing systems for older adults (Afacan & Demirkan, 2010). Since the efficiency of the knowledge support system determines the level of creativity and the quality of the design process, a suitable knowledge support system is also crucial for designing older people housing built environments for promoting healthy aging. Therefore, the developed ontology should go beyond specification of human dimensions, visualization of ergonomics data or task analysis tools. It should be done according to HCD approaches to be human friendly. This study is unique since ontology based modeling is not commonly done for older people's housing environments. Figure 28 illustrates the procedure for PP-B accessible senior housing model.

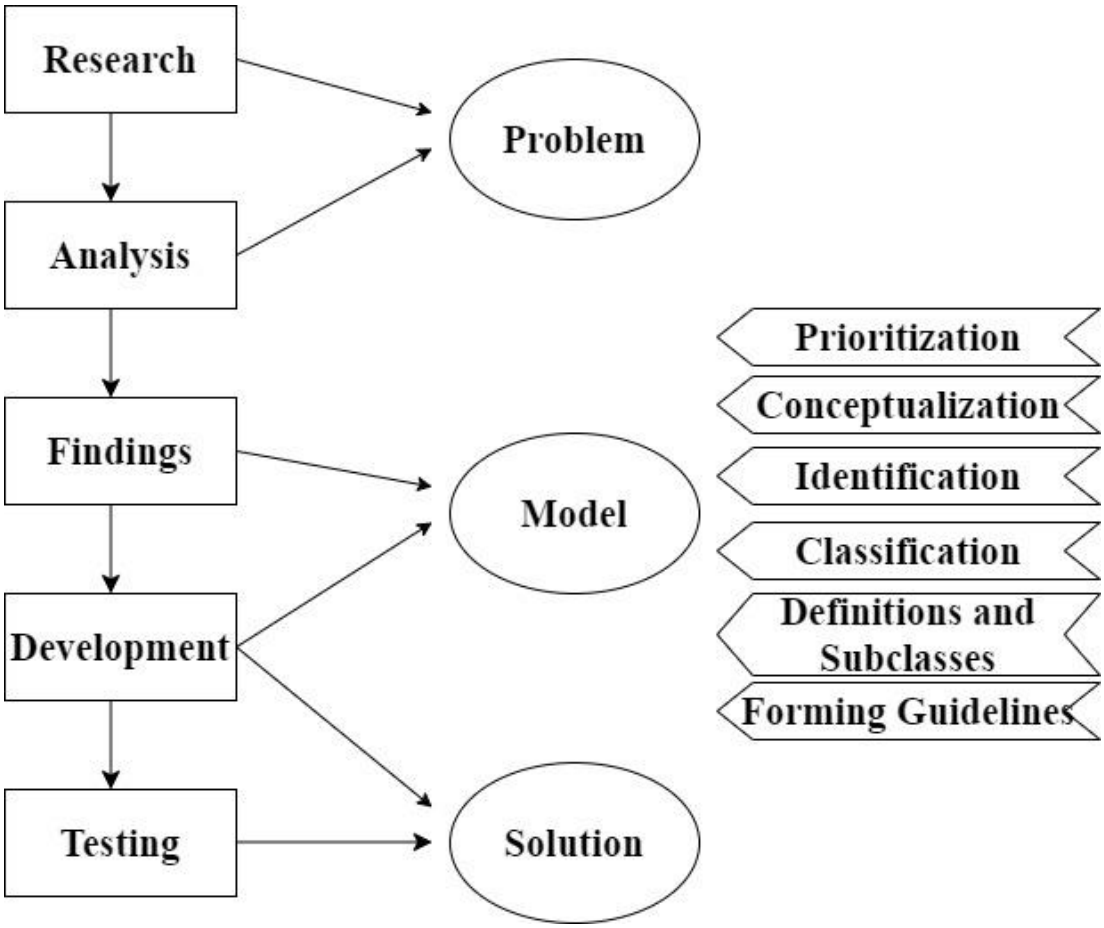

Figure 27. The Procedure for PP-B Accessible Senior Housing Model

Moreover, for PP-B accessible senior housing environment model five BADL task classes (Barthel Index classes) were identified according to accessibility issues; mobility, bathroom, personal care, dining, and transfer tasks. Figure 29 illustrates the initial understanding of the ontology domains for modeling.

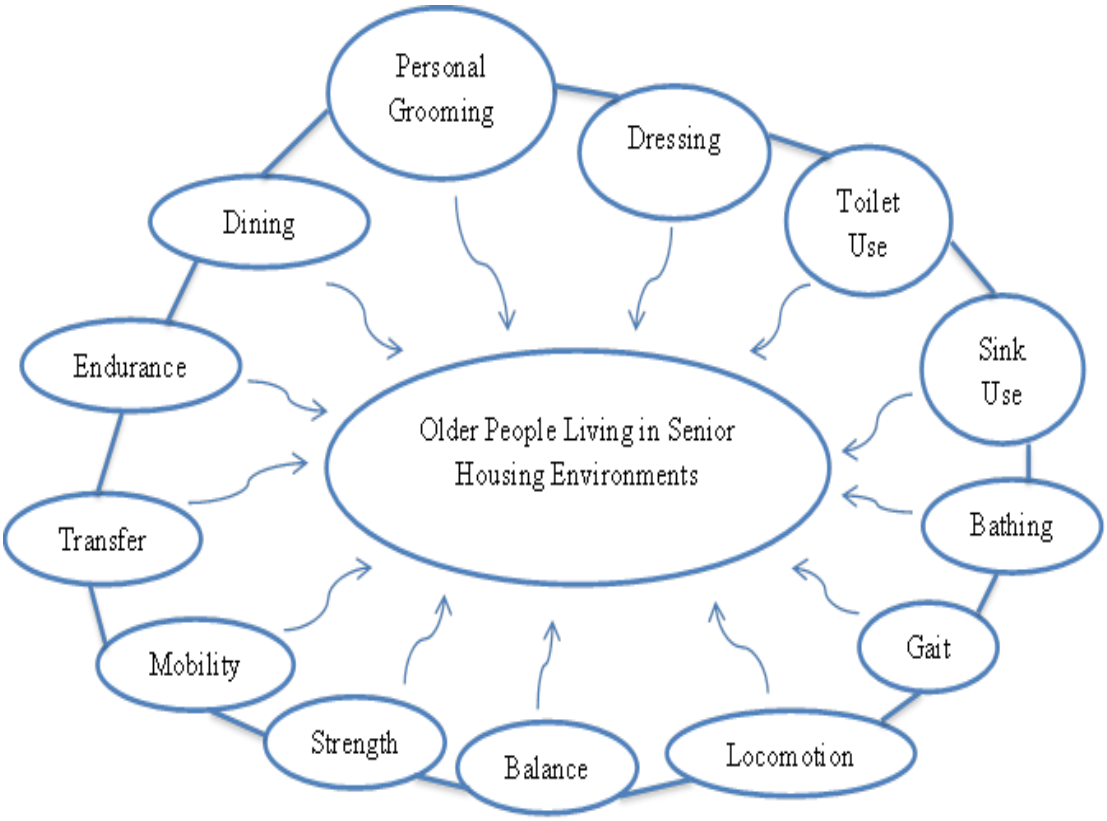

Figure 28. Initial Understanding of the Ontology Domains for Modeling

In the ontology of this study, senior housing design categories are the three main domains of the framework: safety, comfort and accessibility (Figure 14). These domains were obtained by personas created according to IPA method's findings. In this framework, there are also three classes: 'senior housing environment', 'senior housing residents (users)' and 'BADL'. All these classes have sub-classes with different object properties. For example, "Grab bars are substantial while transferring within interior spaces", is a general statement for an interior designer. The same transfer statement was also stated by KASEV residents during a survey questionnaire and observations as well, which was also presented in the framework with its related attributes. In the framework, arrows symbolize the relationships among different domains, classes and sub-classes. The relationship of 'senior housing environment' class is defined by 'need spaces of', which means that an accessible senior housing has the spaces described in the sub-classes: entrance/lobby, bedroom (suites), bathrooms etc. Moreover, the associations between the 'senior housing environment'

class and the ‘BADL’ class are defined with the terms ‘need spaces of’ and ‘need activities of’, while the associations between ‘senior housing environment’ class and ‘senior housing residents’ are defined with the terms ‘need consideration on’ and ‘need maintenance on’. As a result, for accessible senior housing, the study structured the multiple associations by ‘spaces’ class, ‘activities’ class and ‘physical capabilities’ class to find an optimum design solution. For assessing other accessible environment domains of older adults, associated classes, subclasses and accessibility categories could be gathered through an ontological framework, but a different PP-B model would be obtained with different a prioritized hierarchy. The accessibility knowledge network built upon ontologies would change if personas and activities changed. Because the modeling for this study consisted of the real-life situations of older adults, we considered all extents related with senior housing design. Figure 30 illustrates an exemplary domain for the task class of transfer. For other four domains and related subtasks and accessibility issues are gathered by same technique of ontology based modeling to obtain the prioritized model.

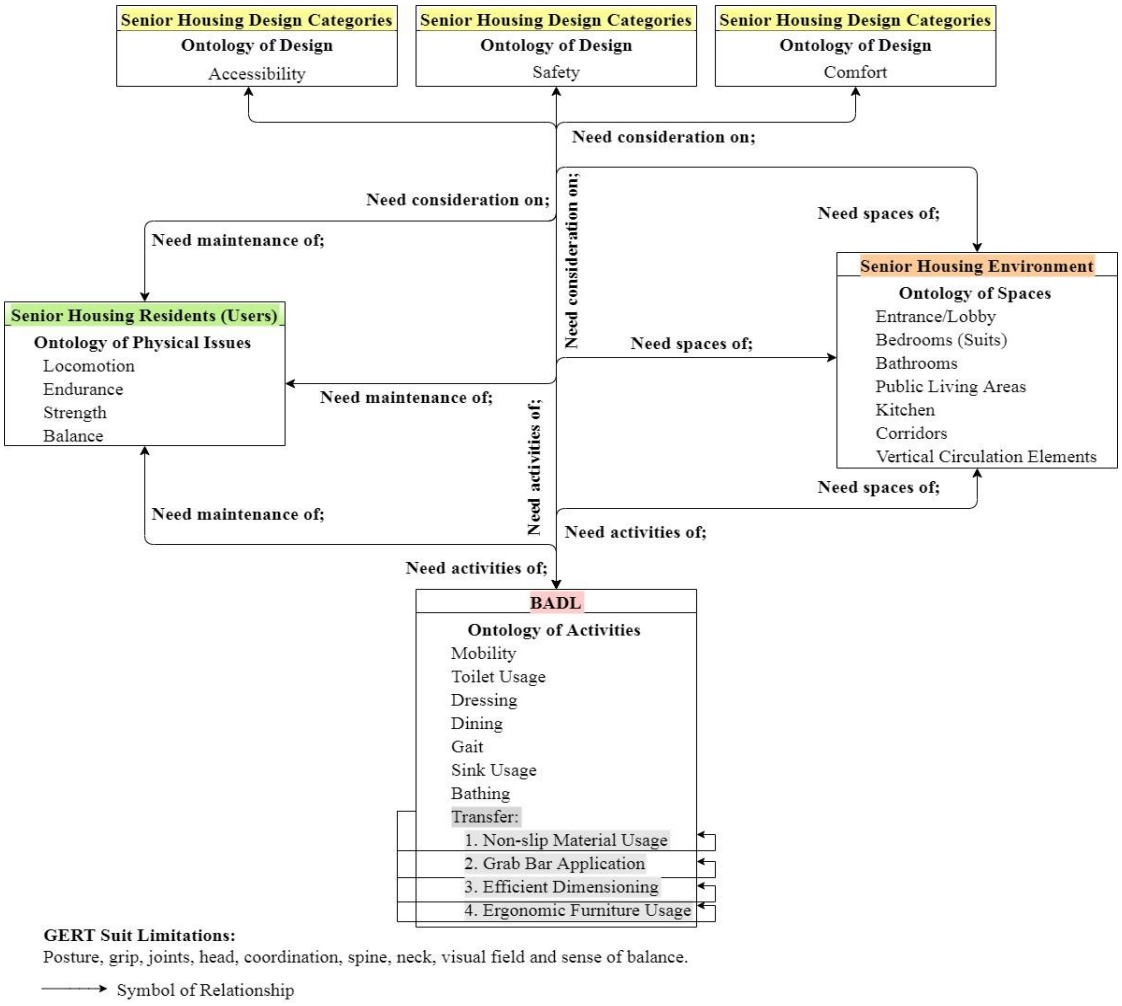

Figure 29. Exemplary Domain for the Task Class of Transfer

Odoki, Kerali, & Santorini (2001) clarify accessibility as "a function of the mobility of the individual, of the spatial location of activity opportunities relative to the starting point of the individual, and at the times at which the activities are available". As a result an accessible senior housing should be able to promote both social and physical activities efficiently for healthy aging of the residents. According to this thesis quantitative and qualitative findings' crucial accessibility factors for a senior housing that will increase satisfaction level and facilitate healthy aging are;

i. Legible and unobstructed route to the senior housing facilities.
ii. Safe and comfortable vertical circulation elements.
iii. Effective color design including color coding's of different zones of the senior housing environment.

iv. Effective fenestration systems for daylight design including control systems like, shelves, jalousies etc. for better visual comfort.
v. Effective artificial light design for safe mobility within the interior environment and for better visual comfort.
vi. Effective doors openings for accessible design.
vii. Effective furniture ergonomics and flexible design including cabinets and drawers, handles etc.
viii. Efficient dimensions of senior housing facility spaces for accessible design (maneuvering space etc.)
ix. Kitchenware that requires low physical effort (tea cups with handles) for safe and comfortable dining activities.
x. Effective safety and comfort systems for wet spaces such as handles, fire safety issues.
xi. Specific design considerations for socializing spaces so that visitors and the residents can have pleasurable and comfortable time together.
xii. Locating personal care mirrors on correct height considering area of vision better visual comfort.
xiii. Seating unit integration to dressing areas, walking areas, shower areas for safe and comfortable mobility.
xiv. All furniture's safe and comfortable design that prevents balance lost while sitting down/ standing up or lying down/ getting up.
xv. Accessible smart system's integration to the senior housing environment for extra assistance to senior housing residents.
xvi. Integration of effective communication devices to the senior housing environments spaces to increase safety and easy access to health facilities.

These issues are obtained by a semantic model; ontology based modeling which is a technique of gathering data that are obtained by the previous findings of this thesis which are; IPA, persona development process and simulation suit analysis.

CHAPTER 8

DISCUSSION

The study analyzed obtained data both qualitatively and quantitatively. To summarize the analysis process, there were three main sessions. In Session I, IPA was conducted to explore satisfaction levels of senior housing users by detecting important accessibility issues. Using IPA in the interior architecture and environmental design context is an initial effort, which highlights the scientific contribution of this study to the design and aging literature. In Session II, a persona driven approach was used, where personas were developed by correlating IPA items with the qualitative findings by using affinity diagram method and personas used with GERT suit. One of the most important limitations of Session II is; despite of its crucial contribution to this study, GERT suit only simulates the older people with respect to sensory and motor capabilities. This means that only physical capabilities were restricted while wearing GERT suit. However, when people age their physical capabilities decrease but also cognitive capabilities decrease as well. So, this study only considered physical limitations of older people. In Session III, a simulation driven approach combined with persona method allowed to make realistic empathy and experience more the physical limitations of older people who are living in the senior housing environments. These three session process and creating personas through both qualitative and quantitative data makes the study not only different from the previous persona research, but also more reliable, because prioritized

requirements through IPA matrix correlated with the data obtained by the content analysis of the most commonly stated keywords. As a result, this study suggest a higher understanding of older people's needs, capabilities, expectations and life styles ensure evaluators and researchers a new and a more realistic and accurate perspective for deduction of accessibility issues to motivate older people can be more physically active in their living environment for healthy aging.

This study emphasized the importance of increased physical performance level, independent and physically active later life allows healthy aging. Moreover, accessibility and its related attributes in senior housing interiors allow older people to be more active and as a result healthier. These issues are supported with this thesis findings and also literature review that is presented previously as well. However, recent literature often considers accessibility as basic theoretical concepts or as standards. But, accessibility of these environments should be studied from older peoples' perspective with a focus on efficient ranking methods and empathy techniques.

Recently, because of global Covid-19 issue, home stay levels increased. As a result of pandemic issues accessible home environments for older people is more crucial for health. So, there should be more studies related with this case. Pandemic issues can be considered for future studies in case of healthy aging, aging in place and accessible home environments to motivate older people to be more active.

Empathy techniques are being used in aging studies as mentioned previously in the literature review however, juxta-positioning of IPA findings with aging simulation along with persona method makes this thesis unique. According to this juxta-position this thesis presents that accessibility, safety and comfort issues are the three main aspects that are important design issues that allow older people to be satisfied with senior housing environment. Moreover, accessible, safe and comfortable senior housing environments contribute healthy aging by increasing physical activity level. These three design issues are also contributive to HCD aspects for older people

since, these three issues are crucial for older people. With the persona development and simulation analysis, this study later uses the information to create ontological model and these three design aspects; accessibility, safety and comfort attributes are integrated to this model to guide the interior architects and designers while designing senior housing environments. This thesis analyzed main studies on persona and represents it with Table 2 in Chapter 2. With this table the recent persona literature is synthesized to create more efficient persona development process according to previous studies limitations and effective strategies. So, by synthesizing recent literature persona method is used to analyze accessibility attributes through simulation process. As a result, this thesis used a narrow group of persona to represent older people to avoid confusion on group that is being represented. In this thesis, persona descriptions are done by real users and fictional users based on interviews of senior housing residents that are analyzed by IPA, personas and GERT simulation suit evaluation. So, this thesis uniquely combines real users and expert ideas (fictional users) on persona creation process to have efficient personas. Capabilities of the group that is being represented by the created personas are defined specifically. So, it is clear how well these personas represent the real group as a whole. Persona profiles includes wide range of systematic categories such as; age, health condition, education, family, social activities, hobbies, experiences of senior housing and range of capabilities etc. The rating scales used in survey questionnaire are designed specific enough to facilitate senior housing assessment. Also, in current literature, there is a lack of semantic modelling usage in design and aging studies. Ontology as a semantic modelling framework is used in this thesis to capture the attention on potential of using ontology in design and aging field to create accessible interiors that can contribute to human-centered design and healthy aging accordingly. Figure 30 illustrates the methodological map that shows literature synthesis and its relationship with literature research.

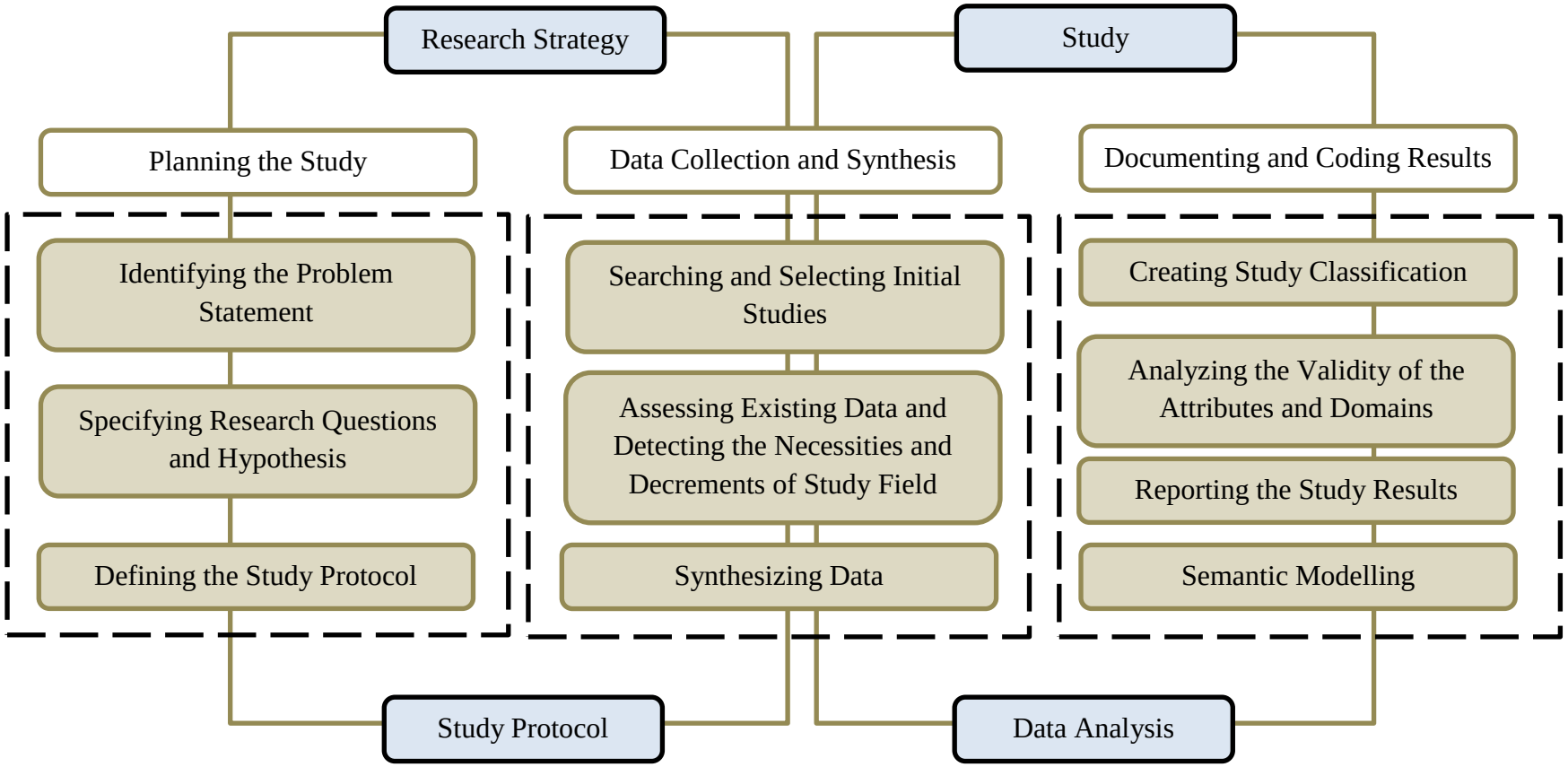

Figure 30. The Methodological Map

CHAPTER 9

CONCLUSION

The findings of this study suggest that perceived aspects of senior housing design are crucial to consider when developing HCD for older people to contribute to healthy aging through physical activity engagement. These aspects are also significant to create accessible senior housing model and related design interventions. The study findings present that professionals involved in senior housing design should address issues related to HCD and health efficiently. This study contributes to the literature as a study of the use of personas in understanding healthy aging: senior housing experiences IPA and simulated physical aging.

According to the IPA there are 13 design issues that are crucial to increase the satisfaction levels of the senior housing residents. These 13 issues are as follows;

i. Legible and unobstructed route to the main entrance area.
ii. Vertical circulation elements safety and comfort; appropriate balustrade and handrail design.
iii. Efficient color design of interior spaces for better visual comfort and for better mobility accordingly.

iv. Appropriate daylight and artificial light design for safe mobility within an interior environment.
v. Bathroom doors that opens outwards or that opens by sliding for accessible design.
vi. Bathroom doors', cabinets' and drawers' flexible design for both left and right hand users.
vii. Efficient dimensions of dining hall for accessible design (maneuvering space etc.)
viii. Efficient design of dining tables of dining hall for comfortable and accessible dining activities.
ix. Kitchenware that requires low physical effort (tea cups with handles) for safe and comfortable dining activities.
x. Locating personal care mirrors on correct height considering area of vision better visual comfort.
xi. Personal care furniture's drawers and doors that require low physical effort for safe and comfortable usage.
xii. Seating unit integration to dressing areas for safe and comfortable dressing.
xiii. All furniture's safe and comfortable design that prevents balance lost while sitting down/ standing up or lying down/ getting up.

As a result of these 13 issues which are related with accessible design aspects, this thesis's first hypothesis (H1); there is a strong correlation between high priority importance ranking of an accessibility feature and high priority satisfaction ranking of this feature, is supported by IPA results.

The results of this thesis study indicate that when evaluators are wearing GERT suit, they are facing more difficulties in BADL's; since they are slower and more limited by the simulation suit as mentioned detailed in Chapter 6. When the evaluators wear the suit, they experienced issues like; before GERT suit experience they would think that going up stairs is more difficult than going downstairs, however with GERT suit they experienced more difficulty when going down stairs because of the constraints and limitations of the suit. Also some of the evaluators mentioned that without GERT suit it was not clear how some of the furniture or decorative objects can be acting like an obstruction. But with the experience of GERT suit, they realized that

because of physical limitations, even if there is a side table or a coffee table near a seating unit it is very difficult to tie a shoe, they discovered that older people needs more space to move. So some of the evaluators mentioned that GERT suit allowed them to understand physical capabilities of older people better and this is very effective for them to consider accessibility issues while they are designing for older people. Evaluators considered that it is a decisive experience for their design life. By the help of GERT suit which is a simulated physical aging device, evaluators detected accessibility issues that are not highlighted by the senior housing residents survey analysis and IPA. Evaluators noticed that drinking last drops of a drink from a glass or a cup is very difficult and balance losing activity because of neck and arm limitations and postural defects. So it is crucial to have a seat while eating or drinking. They noticed the importance of vertical circulation elements accessibility and safety issues. They understand that the comfort is very significant issue that allows older people to be more motivated and feel more safe and eager to be physically active. Evaluators indicated that obstructions should be fully eliminated from a senior housing design. During the GERT suit experiences, evaluators mentioned that they experienced contraction in their joints and they feel some pain in their muscles. So they mentioned that staying active is vital and a prerequisite for healthy aging. All evaluators agreed that BADL are the activities of a daily life and to maintain independent and motivated, older people should be able to have efficient facilities in their living environments. One of the most important facilities for maintaining independency and staying active in BADL's is the HCD through accessibility. As a result the second hypothesis of this study (H2) which is; simulated physical aging positively influence to assess accessibility performance of senior housing design, and the third hypothesis (H3) which is; simulated physical aging and personas highlights more accessibility concerns than older people's rankings, are supported by this thesis as well. According to Davis (2012), older people become slower in body and mind, and the results of this thesis confirm that simulated older people of a senior housing environment are slower in BADL's and therefore take more time to complete the created tasks. However since the GERT suit does not have any system related with cognitive abilities, this thesis does not able to confirm the part about mind of older people.

Through IOS test that is fully mentioned in Chapter 6 it was shown that the group with GERT suit experienced higher perceived closeness towards older people. As a result, Hypothesis 4 (H4), 'There are statistically significant inclusion of otherness differences between simulated physical aging with persona using a simulation suit and not using a simulation suit in terms of assessing accessibility of senior housing.', was supported.

Moreover, this study is a unique study considering the four following viewpoints: (i) IPA tool is mostly used in economics and tourism related disciplines, in this study it is used to detect importance and performance related aspects of senior housing design. (ii) In this study GERT suit is used in the senior housing environment. (iii) This study evaluated accessibility issues in terms of HCD approach of a senior housing environment by persona evaluation method combined with simulated physical aging. (iv) Furthermore, this study evaluated motivational issues of accessible senior housing design on physical activity for healthy aging. Therefore, this study suggested a new methodology with IPA tool and simulated physical aging combined with holistic persona evaluation to close the gap between interior architects (environmental designers) and older people.

Findings of the study suggests that GERT suit crucially improved better perception of accessibility problems in senior housing environment and older people's needs, expectations, desires and demands. By restricting physical capabilities through GERT suit and by created personas which reflects target user group's needs, expectations, desires and demands (older people living in senior housing environment), task evaluators increased their empathy towards older people who are living in a senior housing environment. By this way, task evaluators become aware of obstacles in lives of older people who are living in senior housing environment. Accordingly, better interior design interventions are desired to reach the target user group to motivate them to be more physically active and satisfied for healthy aging through HCD. Evidently, this study refers that there are many benefits of incorporating personas into HCD process. This study also forms a basis for future research examinations of persona use in interior architecture and environmental

design field since personas have the potential to help designers achieve HCD approach.

The simulation findings also indicate that the level of perceived closeness and the physical performance difficulty both increased when GERT suit is experienced during task evaluations. Having limited capabilities and physical challenges during task performances allows better understanding of accessibility problems within senior housing environments.

Modeling of an accessible senior housing is a necessity of contemporary design world. A model for an accessible senior housing will be an exemplary aspect for senior housing design with HCD approach for promoting healthy aging. But, interior architects and environmental designers are struggling to create accessible spaces to accommodate diverse needs of older people who are living in senior housing environments, because complex structured background knowledge processing is required. In order to address the lack of literature, this study proposed user friendly ontology. The user friendly ontological approach tries to overcome the limitations in design practice by (i) providing an efficient data and knowledge management processing of older people's requirements through their active participation, and (ii) integrating their physical capabilities. The proposed ontological language enhances not only defining, composing and configuring diverse user based data for healthy aging but also retrieving these data for PP-B accessible design process for senior housing environments. The findings of the study are significant for future aging studies and mobile computing researches in terms of indicating that physical capabilities of older people who are living in senior housing environment's difficulties are associated with different requirements of accessibility attributes, and structured knowledge and data management is required to diagrammatize their association with BADL. In the future, a software application for the ontology will be developed and implemented for a prototype environment.

There are several limitations of the study. As mentioned in the literature review, aging is not a homogeneous process, according to WHO's (1998) categorization there are three sub groups; young old (65 to 74 years), middle old (75-84) and oldest old (85 years and more). However, GERT suit is not designed to refer these specific age categorizations. So, the results may be different if there would be selection of age range in the suit design. Moreover, as mentioned in the discussion part, one of the most important limitations is that the cognitive capacities of older people were not taken into consideration. In this manner, since this study mainly deals with the needs of older people in senior housing environments, utilizing the perspective of real older people in future studies would improve the reliability of the study. In future studies, comparison of personas and real target user's task analysis results could also be investigated.

Furthermore, for future studies senior cohousing environments could be done with simulated physical aging methodologies. Cohousing is a community, composed of self-contained home units and these communities are enhanced by shared facilities and services. This new collaborative housing concept is designed to develop better healthcare facilities, services and social interaction for older people (Wang & Hadjri, 2017). Since senior cohousing is one of the contemporary alternatives for senior housing environments, issues related with HCD for promoting healthy aging should be handled in future studies as well. Discussing HCD in senior cohousing environments through simulated physical aging techniques could be beneficial for the interior architecture and environmental design field as well as environmental gerontology field. Concurrently, an ontology based model for accessible design features of a cohousing environment will be an effective and a unique addition to the design field.

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APPENDICES

Appendix A- Images of KASEV Senior Housing

Appendix Figure 1: KASEV Building (Photo Taken by the Author)

Appendix Figure 2: KASEV Entrance (Photo Taken by the Author)

Appendix Figure 3: KASEV Lobby Area (Photo Taken by the Author)

Appendix Figure 4: KASEV Public Living Rooms (Photo Taken by the Author)

Appendix Figure 5: KASEV Corridors for Suites (Photo Taken by the Author)

Appendix Figure 6: KASEV Cafeteria (Photo Taken by the Author)

Appendix Figure 7: KASEV Activity Area (Photo Taken by the Author)

Appendix Figure 8: KASEV Public Living Rooms (Photo Taken by the Author)

Appendix Figure 9: KASEV Vertical Circulation Areas (Photo Taken by the Author)

Appendix Figure 10: KASEV Vertical Circulation Areas (Photo Taken by the Author)

Appendix Figure 11: KASEV Suites (Photo Taken by the Author)

Appendix Figure 12: KASEV Suites (Photo Taken by the Author)

Appendix Figure 13: KASEV Suite's Bathrooms (Photo Taken by the Author)

Appendix B- Ethics Approval

Bilkent Üniversitesi
Akademik İşler Rektör Yardımcılığı

Tarih : 21 Kasım 2018

Gönderilen : Şevkiye Merve Kaya

Tez Danışmanı : Yasemin Afacan

Gönderen : Fatma Taşkın
İnsan Araştırmaları Etik Kurulu Başkanı

Konu : *"Exploration of Senior..."* çalışması etik kurul onayı

Üniversitemiz İnsan Araştırmaları Etik Kurulu, 21 Kasım 2018 tarihli görüşme sonucu, *"Exploration of Senior Housing Experiences of Older Adults: An Experimental Study through Importance Performance Analysis (IPA) and Simulated Physical Aging."* isimli çalışmanız kapsamında yapmayı önerdiğiniz etkinlik için etik onay vermiş bulunmaktadır. Onay, ekte verilmiş olan çalışma önerisi, çalışma yürütücüleri, ve bilgilendirme formu için geçerlidir.

Bu onay, yapmayı önerdiğiniz çalışmanın genel bilim etiği açısından bir değerlendirmesine karşı gelmektedir. Çalışmanızda, kurulumuzun değerlendirmesi dışında kalabilen özel etik ve yasal sınırlamalara uymakla ayrıca yükümlüsünüz.

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Appendix C- Geriatric Depression Scale (GDS): Short Form

Choose the best answer for how you have felt over the past week:

1. Are you basically satisfied with your life? YES / NO

2. Have you dropped many of your activities and interests? YES / NO

3. Do you feel that your life is empty? YES / NO

4. Do you often get bored? YES / NO

5. Are you in good spirits most of the time? YES / NO

6. Are you afraid that something bad is going to happen to you? YES / NO

7. Do you feel happy most of the time? YES / NO

8. Do you often feel helpless? YES / NO

9. Do you prefer to stay at home, rather than going out and doing new things? YES / NO

10. Do you feel you have more problems with memory than most? YES / NO

11. Do you think it is wonderful to be alive now? YES / NO

12. Do you feel pretty worthless the way you are now? YES / NO

13. Do you feel full of energy? YES / NO

14. Do you feel that your situation is hopeless? YES / NO

15. Do you think that most people are better off than you are? YES / NO

Answers in bold indicate depression. Score 1 point for each bolded answer.

A score > 5 points is suggestive of depression.

A score ≥ 10 points is almost always indicative of depression.

A score > 5 points should warrant a follow-up comprehensive assessment.

Yesavage, J. A., Brink, T. L., Rose, T. L., Lum, O., Huang, V., & Adey, M. (1983). Development and Validation of Geriatric Depression Screening Scale: A Preliminary Report. *Journal of Psychiatric Research*, 17(1): 37-49.

Appendix D- Barthel Index for Basic Activities of Daily Living (BADL)

	ACTIVITY SCORE
FEEDING	_____
0 = unable	
5 = needs help cutting, spreading butter, etc., or requires modified diet	
10 = independent	
BATHING	_____
0 = dependent	
5 = independent (or in shower)	
GROOMING	_____
0 = needs to help with personal care	
5 = independent face/hair/teeth/shaving (implements provided)	
DRESSING	_____
0 = dependent	
5 = needs help but can do about half unaided	
10 = independent (including buttons, zips, laces, etc.)	
BOWELS	_____
0 = incontinent (or needs to be given enemas)	
5 = occasional accident	
10 = continent	
BLADDER	_____
0 = incontinent, or catheterized and unable to manage alone	
5 = occasional accident	
10 = continent	

TOILET USE _____

0 = dependent

5 = needs some help, but can do something alone

10 = independent (on and off, dressing, wiping)

TRANSFERS _____

0 = unable, no sitting balance

5 = major help (one or two people, physical), can sit

10 = minor help (verbal or physical)

15 = independent

MOBILITY (ON LEVEL SURFACES) _____

0 = immobile or < 50 yards

5 = wheelchair independent, including corners, > 50 yards

10 = walks with help of one person (verbal or physical) > 50 yards

15 = independent (but may use any aid; for example, stick) > 50 yards

STAIRS _____

0 = unable

5 = needs help (verbal, physical, carrying aid)

10 = independent

TOTAL SCORE (0–100): _____

The Barthel ADL Index: Guidelines

1. The index should be used as a record of what a patient does, not as a record of what a patient could do.

2. The main aim is to establish degree of independence from any help, physical or verbal, however minorband for whatever reason.

3. The need for supervision renders the patient not independent.

4. A patient's performance should be established using the best available evidence. Asking the patient, friends/relatives and nurses are the usual sources, but direct

observation and common sense are also important. However direct testing is not needed.

5. Usually the patient's performance over the preceding 24-48 hours is important, but occasionally longer periods will be relevant.

6. Middle categories imply that the patient supplies over 50 per cent of the effort.

7. Use of aids to be independent is allowed.

Mahoney, F. I., & Barthel, D. W. (1965). *A simple index of independence useful in scoring improvement in the rehabilitation of the chronically ill* . Baltimore: Rehabilitation Section Baltimore City Medical Society.

Appendix E- English and Turkish Versions of Survey Questionnaire Set

1. Turkish Version of Survey Questionnaire Set

Erişilebilirlik Tanımı: Erişilebilirlik, farklı gereksinimleri olan bireylerin, toplumsal yaşamın bir parçası olabilmelerine olanak tanır. Erişilebilir tasarımlar farklı gereksinimleri olan bireylerin toplum içinde davranışlarının engellenmeden veya kısıtlanmadan, bağımsız bireyler olarak yaşamlarını sürdürebilmelerine imkân sağlar.

A. KİŞİSEL BİLGİLER

A1. Yaşınız:

A2. Cinsiyetiniz:

a) Kadın b)Erkek

A3. Medeni Durumunuz:

a) Bekâr b)Evli c) Boşanmış d) Dul

A4. Engellilik Durumunuz:

a) Yok b) Ortopedik (lütfen belirtiniz c) Görme (lütfen belirtiniz) d) Duyma(lütfen belirtiniz)

A5. Ne zamandan beri Tuzla KASEV Vakfında yaşamaktasınız?

A6. Aşağıda belirtilen günlük yaşam aktivitelerinden hangilerinde yardıma ihtiyacınız vardır?

Günlük Yaşam Aktiviteleri (Barthel Dizinine Göre)	**Yardıma İhtiyaç Duymakta**	**Biraz Yardıma İhtiyaç Duymakta**	**Yardıma İhtiyaç Duymuyor**
Yürüme: Mekânlar Arası Haraketlilik			
Banyo Kullanımı: Küvet/Duş Kullanımı			
Tuvalet Kullanımı: Tuvalet Kâğıdı Kullanımı, Temizlik vb.			
Beslenme: Yeme ve İçme			
Kişisel Bakım: Saç Tarama, Diş Fırçalama, Tıraş Olma vb.			
Giyinme-Soyunma: Kıyafet Giyme, Ayakkabı Bağlama vb.			
Transfer: Denge Kaybı Yaşamadan Hareket (Oturup Kalkma vb.)			

A7. Yaşamakta olduğunuz bu tesisi başkalarına önerir misiniz? Niçin?

a)Evet b)Hayır

B. GENEL SORULAR

B1. Lütfen yaşadığınız ortamın iç mekân tasarımı açısından erişilebilirliği konusundaki genel memnuniyetinizi değerlendiriniz.

1 2 3 4 5

Az Memnun Çok Memnun

B2. Yaşadığınız ortamın erişilebilir olması sizin için ne kadar önemlidir? Lütfen düşündüğünüz oranı değerlendiriniz.

1 2 3 4 5

Hiç Önemi Yok Çok Önemli

B3. Lütfen yaşadığınız ortamdaki günlük yaşam aktivitelerini kendi başınıza (bağımsız) yapabilme performansınızı değerlendiriniz.

1 2 3 4 5

Çok Zayıf Çok İyi

B4. Günlük yaşam aktivitelerindeki bağımsız performansınızı göz önünde bulundurarak, lütfen yaşadığınız ortamın erişilebilirliğini genel olarak değerlendiriniz.

1 2 3 4 5

Hiç Erişilebilir Değil Çok Erişilebilir

B5. Erişilebilirlik açısından yaşadığınız ortamın hangi bölümü sizin için en önemlidir?

a) Giriş (Lobi)

b) Yatak Odası

c) Banyo

d) Yemek Salonu

e) Ortak Oturma Alanları

f) Konferans Salonu

g) Koridor Alanları

h) Düşey Dolaşım Elemanları (Merdiven, Asansör)

B6. Sağlıklı yaşlanma ve iç mekân tasarımı (insan-çevre) arasındaki ilişki hakkında ne düşünüyorsunuz?

B7. Yaşam alanınızın tasarımı ve erişilebilirliği hakkında eklemek istediğiniz, fikirleriniz veya tavsiyeleriniz var mıdır?

C. ÖNEM SIRALAMASI SORULARI

C. Lütfen aşağıda listelenmiş olan huzurevi tasarımı ve erişilebilirlik ile ilgili değerlendirme ölçütlerinin size göre önem sıralamasını belirtiniz.

	Hiç Önemi Yok 1	Önemsiz 2	Ne Önemli Ne Önemsiz 3	Önemli 4	Çok Önemli 5
Yürüme: Mekânlar Arası Hareketlilik					
C1. Park yerinden/otobüs durağından ana girişe yorucu olmayan bir yol sağlanması.					
C2. Ana girişe erişimde yolun korkuluk ve tutunma çubukları gibi elemanlarla desteklenmesi.					
C3. Ana girişe okunaklı bir rota sağlanması.					
C4. Ana girişe erişimde (hava karardığında) yeterli aydınlatma sağlanması.					
C5. Ana girişten iç mekânlara erişimde yorucu olmayan bir yol sağlanması.					
C6. Ana girişten iç mekânlara erişim sağlayan dolaşım alanlarının (koridor vb.) korkuluk ve tutunma çubukları gibi elemanlarla desteklenmesi.					
C7. Düşey dolaşım elemanlarının (merdiven ve asansör) korkuluk ve tutunma çubukları gibi elemanlarla desteklenmesi.					
C8. Düşey dolaşım elemanlarının (merdiven, asansör) uygun alan ve ölçülere sahip olması.					
C9. Düşey dolaşım elemanlarının (merdiven, asansör) zemin malzemelerinin kaydırmaz olması.					
C10. İç mekânlar arası erişimde yorucu olmayan geçişler sağlanması (yatak odası ve banyo yakınlığı, vb.).					
C11. İç mekân girişlerinin **e**ngelsiz olarak (merdivensiz ve eşiksiz) tasarlanmış olması.					
C12. Bir alandan diğerine geçerken, kullanılan kapı elemanlarının düşük fiziksel çaba (kulplar, açılma ve kapanma güçlüğü vb.) ile kullanılabilir olması.					
C13. Ortak oturma alanlarının uygun alan ve ölçülere sahip olması.					
C14. İç mekânların zemin malzemelerinin kaydırmaz olması.					
C15. İç mekânlardaki renk tonlarının konforlu hareket etmeye elverişli olması.					
C16. İç mekânlardaki yapay ve doğal aydınlatmaların rahat hareket etmeye elverişli olması.					
Banyo ve Tuvalet Kullanımı					
C17. Tüm tuvalet elemanları arasında (klozet, lavabo, küvet, duş teknesi vb.) rahat erişim alanı sağlanması.					

	Hiç Önemi Yok 1	Önemsiz 2	Ne Önemli Ne Önemsiz 3	Önemli 4	Çok Önemli 5
C18. Tüm tuvalet elemanlarına (klozet, lavabo, küvet, duş teknesi vb.) güvenli erişim sağlanması.					
C19. Banyoda duş/banyo erişiminin eşiksiz bir şekilde sağlanması.					
C20. Banyo kapılarının dışa açılan kapılar olarak tasarlanması.					
C21. Duş/banyo aktivitesi için yeterli alan sağlanması.					
C22. Duş/banyo aktivitesi için oturma ünitesi sağlanması.					
C23. Banyoda kullanılan tüm bataryaların rahat kullanıma uygun düşük fiziksel çaba ile kullanılabilmesi.					
C24. Banyoda kullanılan tüm kapı, dolap ve çekmece kollarının hem sağ hem sol el ile kolayca kullanılabilirliğinin sağlanması.					
Beslenme: Yeme ve İçme					
C25. Yemek salonun uygun alan ve ölçülere sahip (manevra alanları vb.) tasarlanmış olması.					
C26. Masaların konforlu oturuma imkân verecek şekilde tasarlanması.					
C27. Sandalyelerin konforlu oturuma imkân verecek şekilde tasarlanması (Bel desteği, diz mesafesi, sağ ve sol kol dayama, uygun ölçülerde tasarım vb.).					
C28. Mutfak gereçlerinin düşük fiziksel çaba ile kullanımı (Kulplu bardak tercih edilmesi vb.).					
Kişisel Bakım ve Giyinme					
C29. Kişisel bakım aynalarının görüş açısına uygun yükseklikte yerleştirilmiş olması.					
C30. Kişisel çekmece ve dolapların düşük fiziksel çaba ile kullanılabilir olması.					
C31. Ayakkabı, kıyafet vb. giyinirken kullanılabilecek konforlu oturma alan tasarlanması.					
Transfer: Denge Kaybı Yaşamadan Hareket					
C32. Tüm mekânların mobilyalarının konforlu kullanıma izin verecek şekilde tasarlanmış olması.					
C33. Tüm mekân mobilyalarına oturum, uzanım ve erişme aktivitelerinin tutunma çubukları ile kazaların en aza indirgenmesi.					
C34. Tüm mekân mobilyalarına oturum, uzanım ve erişme aktivitelerinin denge kaybını en aza indirgeyecek şekilde tasarlanmış olması.					
C35. Tüm mekân mobilyalarına oturum, uzanım ve erişme aktivitelerinin uygun alan ve ölçülere sahip olması.					

D. MEMNUNİYET DERECESİ SORULARI

D. Lütfen aşağıda listelenmiş olan huzurevi tasarımı ve erişilebilirlik ile ilgili değerlendirme ölçütlerinin size göre memnuniyet derecesini belirtiniz.

	Çok Az Memnun 1	Az Memnun 2	Ne Memnun Ne Değil 3	Memnunum 4	Çok Memnunum 5	Mevcut Değil 6
Yürüme: Mekânlar Arası Hareketlilik						
D1. Park yerinden/otobüs durağından ana girişe yorucu olmayan bir yol sağlanması.						
D2. Ana girişe erişimde yolun korkuluk ve tutunma çubukları gibi elemanlarla desteklenmesi.						
D3. Ana girişe okunaklı bir rota sağlanması.						
D4. Ana girişe erişimde (hava karardığında) yeterli aydınlatma sağlanması.						
D5. Ana girişten iç mekânlara erişimde yorucu olmayan bir yol sağlanması.						
D6. Ana girişten iç mekânlara erişim sağlayan dolaşım alanlarının (koridor vb.) korkuluk ve tutunma çubukları gibi elemanlarla desteklenmesi.						
D7. Düşey dolaşım elemanlarının (merdiven ve asansör) korkuluk ve tutunma çubukları gibi elemanlarla desteklenmesi.						
D8. Düşey dolaşım elemanlarının (merdiven, asansör) uygun alan ve ölçülere sahip olması.						
D9. Düşey dolaşım elemanlarının (merdiven, asansör) zemin malzemelerinin kaydırmaz olması.						
D10. İç mekânlar arası erişimde yorucu olmayan geçişler sağlanması (yatak odası ve banyo yakınlığı, vb.).						
D11. İç mekân girişlerinin **e**ngelsiz olarak (merdivensiz ve eşiksiz) tasarlanmış olması.						
D12. Bir alandan diğerine geçerken, kullanılan kapı elemanlarının düşük fiziksel çaba (kulplar, açılma ve kapanma güçlüğü vb.) ile kullanılabilir olması.						
D13. Ortak oturma alanlarının uygun alan ve ölçülere sahip olması.						
D14. İç mekânların zemin malzemelerinin kaydırmaz olması.						
D15. İç mekânlardaki renk tonlarının konforlu hareket etmeye elverişli olması.						
D16. İç mekânlardaki yapay ve doğal aydınlatmaların rahat hareket etmeye elverişli olması.						
Banyo ve Tuvalet Kullanımı						
D17. Tüm tuvalet elemanları arasında (klozet, lavabo, küvet, duş teknesi vb.) rahat erişim alanı sağlanması.						

	Çok Az Memnun 1	Az Memnun 2	Ne Memnun Ne Değil 3	Önemli 4	Çok Önemli 5	Mevcut Değil 6
D18. Tüm tuvalet elemanlarına (klozet, lavabo, küvet, duş teknesi vb.) güvenli erişim sağlanması.						
D19. Banyoda duş/banyo erişiminin eşiksiz bir şekilde sağlanması.						
D20. Banyo kapılarının dışa açılan kapılar olarak tasarlanması.						
D21. Duş/banyo aktivitesi için yeterli alan sağlanması.						
D22. Duş/banyo aktivitesi için oturma ünitesi sağlanması.						
D23. Banyoda kullanılan tüm bataryaların rahat kullanıma uygun düşük fiziksel çaba ile kullanılabilmesi.						
D24. Banyoda kullanılan tüm kapı, dolap ve çekmece kollarının hem sağ hem sol el ile kolayca kullanılabilirliğinin sağlanması.						
Beslenme: Yeme ve İçme						
D25. Yemek salonun uygun alan ve ölçülere sahip (manevra alanları vb.) tasarlanmış olması.						
D26. Masaların konforlu oturuma imkân verecek şekilde tasarlanması.						
D27. Sandalyelerin konforlu oturuma imkân verecek şekilde tasarlanması (Bel desteği, diz mesafesi, sağ ve sol kol dayama, uygun ölçülerde tasarım vb.).						
D28. Mutfak gereçlerinin düşük fiziksel çaba ile kullanımı (Kulplu bardak tercih edilmesi vb.).						
Kişisel Bakım ve Giyinme						
D29. Kişisel bakım aynalarının görüş açısına uygun yükseklikte yerleştirilmiş olması.						
D30. Kişisel çekmece ve dolapların düşük fiziksel çaba ile kullanılabilir olması.						
D31. Ayakkabı, kıyafet vb. giyinirken kullanılabilecek konforlu oturma alan tasarlanması.						
Transfer: Denge Kaybı Yaşamadan Hareket						
D32. Tüm mekânların mobilyalarının konforlu kullanıma izin verecek şekilde tasarlanmış olması.						
D33. Tüm mekân mobilyalarına oturum, uzanım ve erişme aktivitelerinin tutunma çubukları ile kazaların en aza indirgenmesi.						
D34. Tüm mekân mobilyalarına oturum, uzanım ve erişme aktivitelerinin denge kaybını en aza indirgeyecek şekilde tasarlanmış olması.						
D35. Tüm mekân mobilyalarına oturum, uzanım ve erişme aktivitelerinin uygun alan ve ölçülere sahip olması.						

2. English Version of Survey Questionnaire Set

Definition of Accessibility: Accessibility allows all people to be a part of social life independently without any barriers, even if they have varied needs.

A. PERSONAL INFORMATION

A1. Age:

A2. Gender:

a) Female b) Male

A3. Marital Status:

a) Single b) Married c) Divorced d) Widow

A4. Impairment Status:

a) Not Existing b) Orthopedic (please state) c) Sight (please state) d) Hearing (please state)

A5. For how long have you been living in Tuzla KASEV senior housing?

A6. Do you need help or assistance in any of the basic activities of daily living (BADL) that are stated in the table below?

Basic Activities of Daily Living (According to Barthel Index)	Need Assistance	Need Some Assistance	Do not Need any Assistance
Mobility: Walking within the Interior Spaces			
Bathroom Usage: Bathtub/Shower Usage			
Toilet Usage: Toilet Paper Usage, Cleaning etc.			
Dining: Eating and Drinking			
Personal Care: Combing Hair, Brushing Teeth, Shaving etc.			
Dressing: Wearing Clothes, Tying Shoe Lace, Zipping etc.			
Transfer: Moving without Balance Lost			

A7. Would you recommend this senior housing to other people? Why?

a) Yes b) No

B. GENERAL QUESTIONS

B1. Please evaluate your satisfaction level related with the interior space design of the senior housing environment according to accessibility features.

1 2 3 4 5

Least Satisfied Highly Satisfied

B2. How important for you to live in an accessible senior housing environment? Please rank the importance level.

1 2 3 4 5

Not Important Very Important

B3. Please rate your overall independency in basic activities of Daily living (BADL) in terms of performance.

1 2 3 4 5

Poor Very Well

B4. Please rate the accessibility features of the senior housing environment while considering your performance in basic activities of daily living (BADL).

1 2 3 4 5

Not Accessible Very Accessible

B5. Please state which interior space is the most important in terms of accessibility features of senior housing environment.

a) Entrance (Lobby)

b) Bedroom

c) Bathroom

d) Dining Hall

e) Public Living Rooms

f) Conference Hall

g) Corridor Areas

h) Vertical Circulation Elements (Staircases, Elevators)

B6. What do you think about healthy aging and accessible senior housing design (person-environment) relationship?

B7. Would you like to add your comments and advices about accessible interior spaces of senior housing environments?

C. IMPORTANCE RANKING QUESTIONS

C. Please state the importance rankings of senior housing environments in terms of accessibility issues.

	Not Important at All 1	Not Important 2	Neutral 3	Important 4	Very Important 5
Mobility: Mobility within Spaces					
C1. Unobstructed and unconstrained route to the main entrance from the parking lot area.					
C2. Provision of adequate handrails in main entrance route.					
C3. Legible route to the main entrance/lobby.					
C4. Adequate lighting design in the main entrance route					
C5. Unobstructed and unconstrained route to the interior spaces from main entrance.					
C6. Provision of adequate handrails and balustrades in circulation areas such as corridors.					
C7. Provision of adequate handrails and balustrades in vertical circulation elements such as staircases and elevators.					
C8. Adequate dimensions of vertical circulation elements such as staircases and elevators.					
C9. Non-slippery floor surfaces in vertical circulation elements such as staircases and elevators.					
C10. Unobstructed and unconstrained routes in between interior spaces (e.g. distance between bedroom and bathroom)					
C11. Unobstructed entrances of interior spaces (e.g. doors without sill).					
C12. Ease of operation for interior doors (e.g. door fixtures that are operable and easy to grab).					
C13. Adequate space and dimensions of public living rooms.					
C14. Non-slippery floor surfaces in interior spaces.					
C15. Colour tones in the interior are comfortable to move.					
C16. Adequate interior illumination.					
Bathroom and Toilet Use					
C17. Provision of a comfortable approach zone for each sanitary ware.					

	1 Not Important at All	2 Not Important	3 Neutral	4 Important	5 Very Important
C18. Provision of a safe approach zone for each sanitary ware (handle bars, signs, phone).					
C19. Unobstructed and unconstrained bathtub/shower access (e.g. bathtub/shower without a high step).					
C20. Outward opening bathroom doors.					
C21. Provision of sufficient bathtub/shower space.					
C22. Provision of adequate seating unit in bathtub/shower space.					
C23. Furniture and fixtures that is operable and easy to grab.					
C24. Easy use of all door, cabinet and drawer handles used in the bathroom with both right and left hand.					
Dining: Eating and Drinking					
C25. Design of dining hall with appropriate space and dimensions.					
C26. Provision of a comfortable approach zone for dining tables.					
C27. Provision of a comfortable seating units (e.g. seating units with back support, arm support etc.).					
C28. Use of kitchen utensils with low physical effort.					
Personal Care and Dressing					
C29. Bathroom mirrors at appropriate heights.					
C30. Personal drawers and cupboards with low physical effort.					
C31. Design of comfortable seating area when dressing.					
Transfer: Moving without Balance Lost					
C32. Comfortable furniture design for all interior spaces.					
C33. Provision of safety bars and handles for safe furniture usage to decrease accident risks.					
C34. Ease of reach and access to furniture.					
C35. Provision of a comfortable approach zone for all furniture to decrease the risk of fall.					

D. SATISFACTION RANKING QUESTIONS

D. Please state the satisfaction rankings of senior housing environments in terms of accessibility issues.

	Least Satisfied 1	Less Satisfied 2	Neutral 3	Satisfied 4	Very Satisfied 5	It Does Not Exists 6
Mobility: Mobility within Spaces						
D1. Unobstructed and unconstrained route to the main entrance from the parking lot area.						
D2. Provision of adequate handrails in main entrance route.						
D3. Legible route to the main entrance/lobby.						
D4. Adequate lighting design in the main entrance route						
D5. Unobstructed and unconstrained route to the interior spaces from main entrance to interior spaces.						
D6. Provision of adequate handrails and balustrades in circulation areas such as corridors.						
D7. Provision of adequate handrails and balustrades in vertical circulation elements such as staircases and elevators.						
D8. Adequate dimensions of vertical circulation elements such as staircases and elevators.						
D9. Non-slippery floor surfaces in vertical circulation elements such as staircases and elevators.						
D10. Unobstructed and unconstrained routes in between interior spaces (e.g. distance between bedroom and bathroom)						
D11. Unobstructed entrances of interior spaces (e.g. doors without sill).						
D12. Ease of operation for interior doors (e.g. door fixtures that are operable and easy to grab).						
D13. Adequate space and dimensions of public living rooms.						
D14. Non-slippery floor surfaces in interior spaces.						
D15. Colour tones in the interior are comfortable to move						
D16. Adequate interior illumination.						
Bathroom and Toilet Use						
D17. Provision of a comfortable approach zone for each sanitary ware.						

	Least Satisfied 1	Less Satisfied 2	Neutral 3	Satisfied 4	Very Satisfied 5	It Does Not Exists 6
D18. Provision of a safe approach zone for each sanitary ware (handle bars, signs, phone).						
D19. Unobstructed and unconstrained bathtub/shower access (e.g. bathtub/shower without a high step).						
D20. Outward opening bathroom doors.						
D21. Provision of sufficient bathtub/shower space.						
D22. Provision of adequate seating unit in bathtub/shower space.						
D23. Furniture and fixtures that is operable and easy to grab.						
D24. Easy use of all door, cabinet and drawer handles used in the bathroom with both right and left hand.						
Dining: Eating and Drinking						
D25. Design of dining hall with appropriate space and dimensions.						
D26. Provision of a comfortable approach zone for dining tables.						
D27. Provision of a comfortable seating units (e.g. seating units with back support, arm support etc.).						
D28. Use of kitchen utensils with low physical effort.						
Personal Care and Dressing						
D29. Bathroom mirrors at appropriate heights.						
D30. Personal drawers and cupboards with low physical effort.						
D31. Design of comfortable seating area when dressing.						
Transfer: Moving without Balance Lost						
D32. Comfortable furniture design for all interior spaces.						
D33. Provision of safety bars and handles for safe furniture usage to decrease accident risks.						
D34. Ease of reach and access to furniture.						
D35. Provision of a comfortable approach zone for all furniture to decrease the risk of fall.						

Appendix F- Personas of the Study

AYŞE

Female, 83, Retired Teacher, Accessibility Issues within a Senior Housing Environment is Crucial for Her

Health Issues: Independent in Daily Living Activities (Barthel Index), Not Indicative of Depression (Geriatric Depression Scale), Osteoporosis Problem

Life Style:

Ayşe has been an active woman both physically and socially. Ayşe is eager to live an active life in this era of her life as well. She is enthusiastic to participate in social activities especially. She values her previous life style and she would not like to change her life style and taste. She shows this compassion of her younger ages fashion in her taste of furniture as well. She feels better when the furniture looks like her younger ages furniture. While she is criticizing an interior space, furniture's, appearance is as important as comfort for her. Ayşe feels very confident and happy when her family visits her frequently. She values the time that she spends with her granddaughters. She expresses her times with her granddaughters as "best therapy ever".

Housing Expectations:

Ayşe considers her osteoporosis problem as one of the main health issue for her. And her doctors recommend her to be physically active. Ayşe states that she can be more active if she can have better visual comfort; she mentions that she is not encouraged to be active if there is not qualified design that supports her visual comfort. She mentions that artificial lighting design, color contrasts within interior spaces and

integration of daylight are very significant since these issues support her visual comfort.

Ayşe misses her old furniture, so she adores furniture looks like her younger ages furniture. She enjoys spending time with her granddaughters the most. So, place that she spends her time with granddaughters are very sacred for her. She feels upset if her granddaughters are bored or uncomfortable because the lack of design.

Bathroom area design and accessibility of bathroom units is the most important design issue for her. She enjoys her bathroom activities. She considers herself as an old fashioned woman and also she mentions that it is impossible for her to change her daily life habits. One of the most essential habits that she cannot disclaim is using the bathroom cabin with a bucket. She says that she hates using shower head. Instead she fills a bucket. She sets the water temperature to the optimum level by using a bucket. Also she states that shower head is too rigorous but she likes to have less severe water. Moreover, Ayşe spends long time when she is bathing and she feels the need to have efficient space in bath cabin for bucket, storage of soaps and shampoo and seating unit. Efficient clearance in the bath cabin is inevitable aspect in bathroom design according to Ayşe.

Ayşe fears to be a dependent woman. She fears falling since some of her friends suffer injuries related with falling. So she tries to be physically active and she tries to eat healthily. She tries to attend senior housing activities like, senior yoga, music chorus groups, handcraft activities, field trips etc. to be active both socially and physically.

OSMAN

Male, 85, Retired Teacher, Safety Issues within a Senior Housing Environment is Crucial for Him

Health Issues: Independent in Daily Living Activities (Barthel Index), Not Indicative of Depression (Geriatric Depression Scale), Hamstring Problem

Life Style: Osman is a retired literature studies teacher. He says that he is satisfied with his life. He likes reading books and newspapers. He is eager to read newly released books even if classic books are very valuable for him. His bookcase is important furniture for his living space. One of his favorite activities is; drinking Turkish coffee in public living rooms with his friends and visitors and reading newspapers and discussing news after the breakfast time. He has been an active person throughout his adulthood, being a teacher makes him feel proud of himself. He fears to be a dependent person when he gets older. As a result of this fear, he is very precautious on his daily life activities. Even if he is an independent person, when he is walking at night times, he feels the need to use a walker. It makes him feel safer. He likes social activities, especially when authors visit the institution because of cultural activities like book signing activities, autograph sessions etc. he becomes very happy. He says that when the institution declares that an author's visit he can even sleep because of his excitement. He likes other activities that are arranged by the institution, however sometimes he just likes to be alone in his suit. Sometimes reading his books and taking notes related with the content of the book is more appealing to him. He also mentions that his memory is very strong because of reading books.

Housing Expectations:

According to Osman, accessibility of a living space and aging should be directly proportional, when age increase, accessibility considerations should also increase. Osman has posture problem. He says that when he is getting older, he feel that his joints (especially knees) are getting affected by aging the most, so that all furniture design should be considered accordingly. Since he thinks that his knees are very fragile, sometimes he feels the need to carry a walker to feel safer even if he is able to walk without any support. Osman also thinks that postural balance is an important issue and his doctor recommended him to be physically active. His suite is in third floor he can easily access to his suite through elevators. But sometimes he uses public spaces in other floor levels. If he is only one floor away from his suite and if he feels energetic he prefers to use staircases to be able to physically active. Since staircase is supported with efficient balustrade and handrail design on both sides and since the risers of the staircases is suitable (in terms of height) for him, he feels safe. However he mentions that sometimes he gets confused about which floor he is in, he says that; sometimes he is at wrong floor level, trying to open another resident's suite. To avoid this confusion color codes for different floor levels can be helpful. Osman thinks that, when people are aging, they are more eager to feel safe and comfortable, as a result housing environment should be able to be comfortable and safe for healthy aging. Comfortable and safe design is not only avoids falls but it also motives people to be physically active. Also when a person feels safe and comfortable, mental health will be maintained as well.

AFİFE

Female, 80, Retired Teacher, Comfort Issues within a Senior Housing Environment is Crucial for Her

Health Issues: Independent in Daily Living Activities (Barthel Index), Not Indicative of Depression (Geriatric Depression Scale), Posture Problem

Life Style:

Afife is a retired mathematics teacher. She gives importance to personal care and how she looks is very important for her. She likes wearing colorful glasses. She says that when she wears colorful clothes and when she wears a lipstick she feels more self-confident and she says that she feels more energetic and motivated. She has different perfumes and she uses them before she gets out of her suite. Smelling good is significant issue for her. Her clothes are very valuable for her. She washes some clothes using staffs support (staff uses common washing machine area for resident's clothing). However some of her clothes are very important for her. Even if staff washes her clothes and brings them back even ironing them. She prefers to wash some of her clothes by herself without using washing machine. She says that some clothing should be washed by gentle soaps for better maintenance. Personal care is very important but not only in terms of clothing and make up. She thinks that healthy eating habits and physical activity is really significant for her. Afife says that cooking her hobby. However, in this institution meals are served by the staff. She states that she would be more happy and healthy if she would be able to cook her own food.

Housing Expectations:

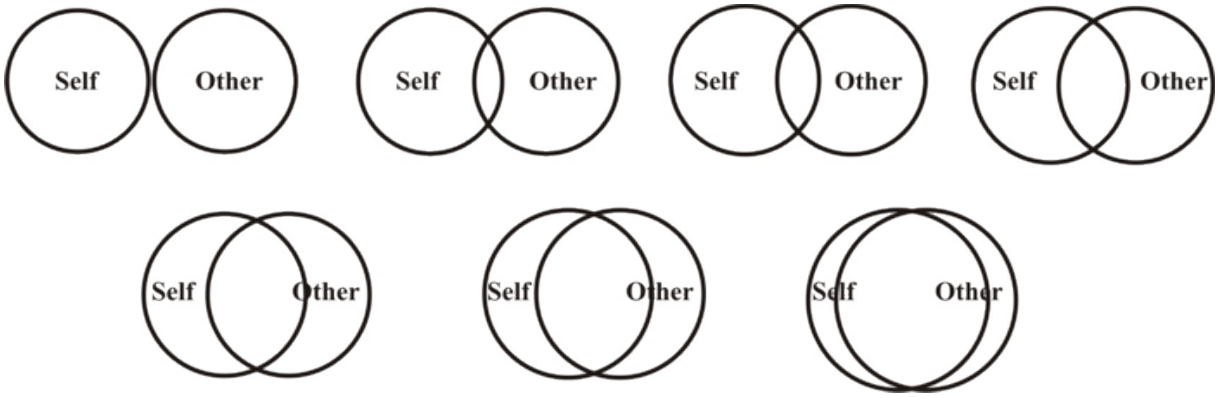
Afife has diabetes problem. As a result eating healthy food is crucial for her. She has a special diet. Afife thinks that there should be a kitchen available for residents to cook. She states that sometimes there are cooking related social activities and she enjoys them. She says that she mentioned this idea to institution staff but they said that they do not think it is safe. She still thinks that with accessible design and fire safety issues integration, there can be a kitchen available for residents.

Physical activities are very crucial activities for Afife. She likes being physically active. Afife says that sometimes she thinks she could not be physically active enough and to be able to more actives she takes walks. She says that she enjoy walking in the exterior environment with her friends. She enjoys physical activity when it is in outdoors especially when the weather is nice and sunny, because she thinks fresh air is healthy for her. However, she states that institution's outdoor environment is mostly serving as parking lot, if there is a design in that area especially for walking, residents will be able to walk more and they will enjoy sunny weather. She thinks it is significant for her physical and social health. She says that her doctor mentions that most suitable physical activity for people who are in their older ages is; walking. Also Afife thinks that frequency of social and physical activities should be increased. Also she thinks that there should be more variations in activities. She says that she attends senior yoga and she attends cooking activities but especially cooking related activities are rare.

Personal care furniture's accessibility and efficient storage area for personal care materials are inevitable for her. She likes mirrors and she says that she cannot do without tall dressing mirror. Also seating unit is crucial for her when she is dressing so she can get support from it while she is dressing.

Appendix G- Inclusion of Other in the Self (IOS) Scale

Instructions: Please circle the picture that best describes your current relationship with your romantic partner.



To score this scale, researchers record the number of the pair (1 to 7) the respondent selected.

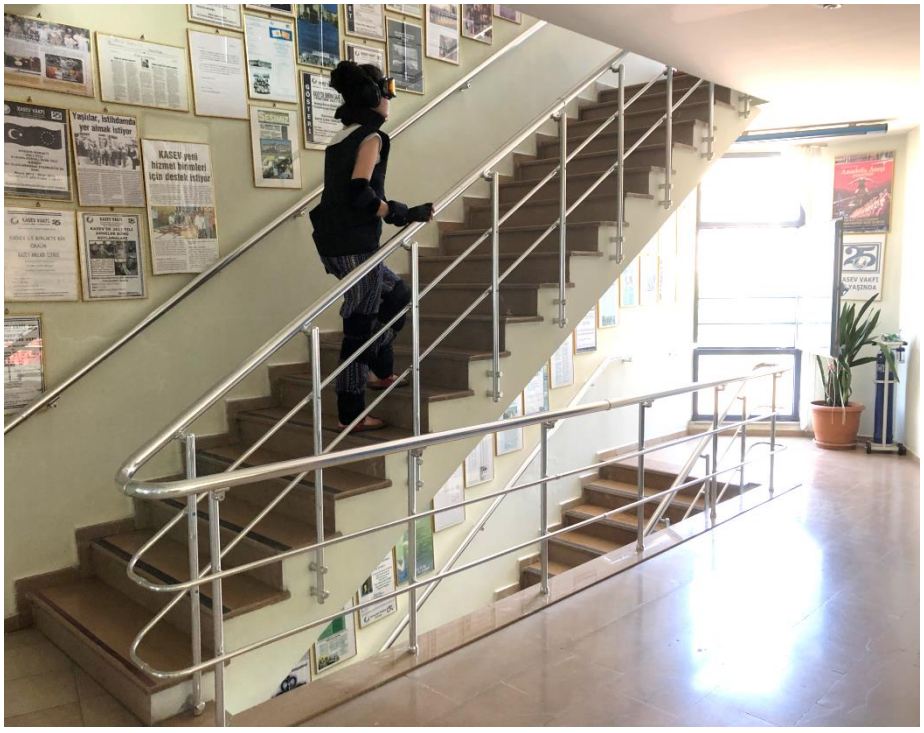
RESPONSE FORMAT

Respondents choose a pair of circles from seven with different degrees of overlap. 1 = no overlap; 2 = little overlap; 3 = some overlap; 4 = equal overlap; 5 = strong overlap; 6 = very strong overlap; 7 = most overlap.

Aron, A., Aron, E. N., & Smollan, D. (1992). Inclusion of Other in the Self Scale and the structure of interpersonal closeness. *Journal of Personality and Social Psychology*, 63(4): 596-612.

Appendix H- Images of Simulation Process

Appendix Figure 1: Mobility Task 1- Walking From Parking Lot to Entrance Area (Photo Taken by the Author)



Appendix Figure 2: Mobility Task 2- Using Staircase from Ground Floor to Upper Floor (Photo Taken by the Author)

Appendix Figure 3: Mobility Task 3- Using Staircase from Upper Floor to Ground Floor (Photo Taken by the Author)

Appendix Figure 4: Mobility Task 4- Walking From Entrance Area to Personal Suites (Photo Taken by the Author)

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Appendix Figure 5: Personal Care Task 1- Wearing a Sweater and Button up (Photo Taken by the Author)

Appendix Figure 6: Personal Care Task 2- Sitting and Tying Shoe Lace (Photo Taken by the Author)

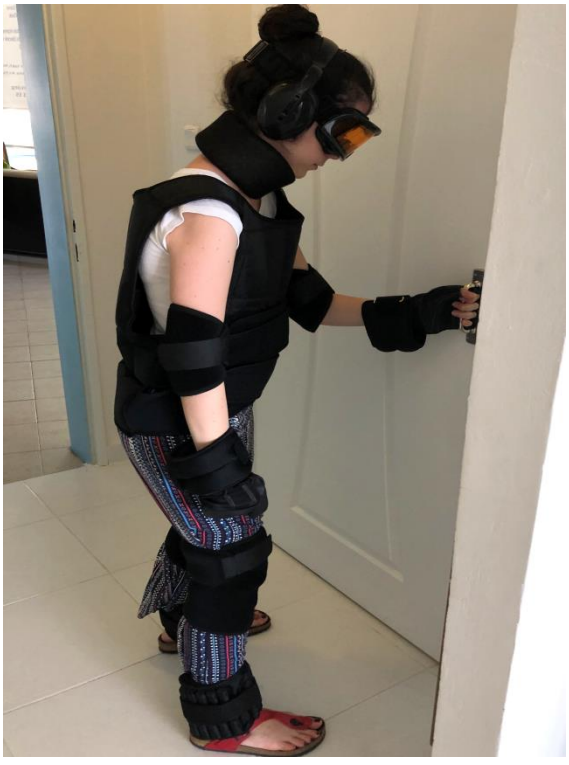
Appendix Figure 7: Personal Care Task 3- Reaching Lowest Personal Care Furniture Unit (Photo Taken by the Author)

Appendix Figure 8: Personal Care Task 4- Reaching Highest Personal Care Furniture Unit (Photo Taken by the Author**)**

Appendix Figure 9: Personal Care Task 5- Combing Hair (Photo Taken by the Author**)**

Appendix Figure 10: Bathroom Task 1- Brushing Teeth (Photo Taken by the Author**)**

Appendix Figure 11: Bathroom Task 2- Access to Shower (Photo Taken by the Author**)**



Appendix Figure 12: Bathroom Task 3- Access to Toilet (Photo Taken by the Author**)**

Appendix Figure 13: Dining Task 1- Drinking a Glass of Water (Photo Taken by the Author**)**

Appendix Figure 14: Transfer Task 1- Sitting Down on Chair (Photo Taken by the Author)

Appendix Figure 15: Transfer Task 2 – Standing Up from Chair (Photo Taken by the Author)

Appendix Figure 16: Transfer Task 3 – Reaching an Object (Photo Taken by the Author)

Appendix Figure 17: Transfer Task 4 – Lying on Bed (Photo Taken by the Author)

Appendix Figure 18: Transfer Task 5 – Standing Up from Bed (Photo Taken by the Author)

Appendix I- Tables of Task Procedure and Findings

Table 1: Data for Evaluation with GERT Suit

With GERT Simulation Suit	**Persona Ayşe Evaluator #1 (23 years old)**	**Persona Ayşe Evaluator #2 (24 years old)**	**Persona Osman Evaluator #3 (24 years old)**	**Persona Osman Evaluator #4 (25 years old)**	**Persona Afife Evaluator #5 (25 years old)**	**Persona Afife Evaluator #6 (26 years old)**
MT1: Walking from parking lot to entrance (lobby) area (approximately 15m).	82 seconds	86 seconds	90 seconds	88 seconds	78 seconds	88 seconds
MT2: Using staircase from ground floor to upper floor (38 treads with a landing).	86 seconds	88 seconds	96 seconds	97 seconds	90 seconds	89 seconds
MT3: Using staircase from upper floor to ground floor (38 treads with a landing).	96 seconds	98 seconds	102 seconds	100 seconds	95 seconds	96 seconds
PCT1: Wearing a sweater and button up (wool sweater has three buttons).	43 seconds	45 seconds	46 seconds	42 seconds	45 seconds	50 seconds

Table 1 Continues

PCT2: Sitting and tying shoe lace.	33 seconds	30 seconds	36 seconds	32 seconds	28 seconds	30 seconds
PCT3: Reaching lowest personal care furniture unit and getting a napkin (from drawer, cabinet etc.).	12 seconds	14 seconds	14 seconds	22 seconds	12 seconds	21 seconds
PCT4: Reaching highest personal care furniture unit and getting a napkin (from shelf, cabinet etc.).	10 seconds	12 seconds	13 seconds	12 seconds	15 seconds	13 seconds
BT1: Access to sink (turning on basin and turning of).	8 seconds	9 seconds	8 seconds	10 seconds	8 seconds	8 seconds
BT2: Access to shower (getting in to shower, turning on/off basin, reaching shampoo unit.)	24 seconds	22 seconds	34 seconds	37 seconds	25 seconds	28 seconds

Table 1 Continues

BT3: Access to toilet (sitting down and standing up).	16 seconds	16 seconds	18 seconds	15 seconds	18 seconds	17 seconds
DT: Drinking a glass of water (200ml plastic glass full of water).	20 seconds	31 seconds	24 seconds	25 seconds	24 seconds	22 seconds
TT1: Sitting down on chair.	8 seconds	8 seconds	7 seconds	8 seconds	6 seconds	10 seconds
TT2: Standing up from chair.	9 seconds	7 seconds	6 seconds	7 seconds	6 seconds	8 seconds
TT3: Lying on bed.	14 seconds	18 seconds	20 seconds	15 seconds	16 seconds	15 seconds
TT4: Getting up from bed.	18 seconds	20 seconds	26 seconds	28 seconds	18 seconds	21 seconds

Table 2: Data for Evaluation without GERT Suit

Without GERT Simulation Suit	Persona Ayşe Evaluator #1 (23 years old)	Persona Ayşe Evaluator #2 (24 years old)	Persona Osman Evaluator #3 (24 years old)	Persona Osman Evaluator #4 (25 years old)	Persona Afife Evaluator #5 (25 years old)	Persona Afife Evaluator #6 (26 years old)
MT1: Walking from parking lot to entrance (lobby) area (approximately 15m).	74 seconds	70 seconds	72 seconds	74 seconds	70 seconds	70 seconds
MT2: Using staircase from ground floor to upper floor (38 treads with a landing).	70 seconds	69 seconds	76 seconds	78 seconds	72 seconds	70 seconds
MT3: Using staircase from upper floor to ground floor (38 treads with a landing).	72 seconds	68 seconds	82 seconds	77 seconds	75 seconds	71 seconds
PCT1: Wearing a sweater and button up (wool sweater has three buttons).	33 seconds	44 seconds	42 seconds	39 seconds	38 seconds	32 seconds

Table 2 Continues

PCT2: Sitting and tying shoe lace.	23 seconds	22 seconds	23 seconds	30 seconds	21 seconds	20 seconds
PCT3: Reaching lowest personal care furniture unit and getting a napkin (from drawer, cabinet etc.).	9 seconds	10 seconds	11 seconds	9 seconds	10 seconds	11 seconds
PCT4: Reaching highest personal care furniture unit and getting a napkin (from shelf, cabinet etc.).	9 seconds	8 seconds	8 seconds	9 seconds	9 seconds	9 seconds
BT1: Access to sink (turning on basin and turning of).	8 seconds	8 seconds	8 seconds	8 seconds	7seconds	8 seconds
BT2: Access to shower (getting in to shower, turning on/off basin, reaching shampoo unit.)	20 seconds	19 seconds	27 seconds	28 seconds	22 seconds	25 seconds

Table 2 Continues

BT3: Access to toilet (sitting down and standing up).	12 seconds	14 seconds	17 seconds	12 seconds	11 seconds	13 seconds
DT: Drinking a glass of water (200ml plastic glass full of water).	17 seconds	28 seconds	20 seconds	20 seconds	18 seconds	21 seconds
TT1: Sitting down on chair.	7 seconds	8 seconds	7 seconds	7 seconds	6 seconds	7 seconds
TT2: Standing up from chair.	7 seconds	7 seconds	6 seconds	7 seconds	6 seconds	6 seconds
TT3: Lying on bed.	10 seconds	14 seconds	18 seconds	12 seconds	10 seconds	13 seconds
TT4: Getting up from bed.	17 seconds	18 seconds	20 seconds	20 seconds	17 seconds	18 seconds