INFLUENCE OF SIMULATED PHYSICAL AGEING ON HEURISTIC EVALUATION IN AIRPORT ENVIRONMENTS

The Graduate School of Economics and Social Science
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THE DEPARTMENT OF
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İHSAN DOĞRAMACI BİLKENT UNIVERSITY
ANKARA

May 2019

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Fine Arts in Interior Architecture and Environmental Design.

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ABSTRACT

INFLUENCE OF SIMULATED PHYSICAL AGEING ON HEURISTIC EVALUATION IN AIRPORT ENVIRONMENTS

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This thesis suggests a new approach for the heuristic evaluation of an airport environment by using simulated physical ageing. A task-based heuristic evaluation method was conducted with the eight evaluators who were professionally working as architects and interior architects. A real airport environment was selected as the experiment building where the evaluators performed task scenarios in line with the real airport experiences of passengers. Four evaluators wore GERT suit and four evaluators did not wear GERT suit to analyze the influence of simulated physical ageing. According to the results, the findings indicated that GERT suit enabled a better inspection of usability of an airport environment, an increased level of physical performance difficulty and enhanced empathy towards elderly people.

Keywords: Age-friendly Airports, Airport Usability, Empathic Design, Heuristic Evaluation, Simulated Physical Ageing

ÖZET

FİZİKSEL YAŞLANMA SİMÜLASYONUNUN HAVAALANI ORTAMLARINDA SEZGİSEL DEĞERLENDİRMEYE ETKİSİ

Yumuşak, İrem
Yüksek Lisans, İç Mimarlık ve Çevre Tasarımı Bölümü
Tez Danışmanı: Doç. Dr. Yasemin Afacan

Mayıs 2019

Bu çalışma, fiziksel yaşlanma simülasyonu kullanılarak, havaalanı ortamının sezgisel değerlendirilmesi için yeni bir yaklaşım önermektedir. Çalışmada göreve dayalı bir sezgisel değerlendirme yöntemi profesyonel olarak çalışan mimar ve iç mimarlardan oluşan sekiz değerlendirme uzmanı ile yürütülmüştür. Değerlendirme uzmanları görev senaryolarını, yolcuların gerçek havaalanı deneyimleri doğrultusunda, çalışma için seçilmiş gerçek bir havaalanı ortamında gerçekleştirmişlerdir. Fiziksel yaşlanma simülasyonunun etkisini analiz etmek için, dört değerlendirme uzmanı GERT simülasyon kıyafetini giymiş ve diğer dört değerlendirme uzmanı giymemiştir. Elde edilen sonuçlara göre, GERT simülasyon kıyafetinin; havaalanının kullanılabilirlik değerlendirmesinde daha iyi bir performans sağladığı, fiziksel performans zorluğunu arttırdığı ve yaşlı bireylere yönelik empatiyi iyileştirdiği gözlemlenmiştir.

Anahtar Kelimeler: Empatik Tasarım, Fiziksel Yaşlanma Simülasyonu, Havaalanı Kullanılabilirliği, Sezgisel Değerlendirme, Yaşlı Dostu Havaalanları,

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CHAPTER 1

INDTRODUCTION

1.1.Problem Statement and Aim of the Study

By extended life span, elderly people are healthier than in the past (National Academies of Sciences, Engineering, and Medicine, 2014). Thus, people, who are over the age of 60 years old, have started to become more active in their daily lives, resulting in an increase in the number of elderly travelers. The number of internationally traveling elderly people is rapidly growing and it is expected to reach from 12% to 15% by 2025 (Leggat, 2017). However, despite the active ageing trend, some ongoing medical issues and some deterioration occur in elderly lives as a part of their normal ageing process. For instance, with advancing age comes, some physical limitations are started to be observed such as muscular/skeletal limitations and sight/ hearing deteriorations (National Academies of Sciences, Engineering, and Medicine, 2014). In this context, architects and designers play key role for providing an equitable use of built environments for wide range of users including the elderly people.

By means of travelling, airports are crucial environments for both domestic and international transportation within their complex mega structures that deal with numbers of travelers (Sennott, 2004). When this complexity is combined with the ongoing physical limitations of the elderly travelers, some important challenges for aging population occur during their airport activities such as walking, standing in a queue and using check-in kiosks as well as reading signage systems and hearing announcements (Bauer, 2012; Eperon & Chappuis, 2015; Wong & Simons, 2012; Lee, Hutter, Masel, Joya, & Whitman, 2017). These challenges may cause anxiety and confusion for them (Bogicevic, Yang, Cobanoglu, Bilgihan, & Bujisic, 2016), which can lead elderly travelers to have bad airport experiences. With the aim of meeting these challenges and providing an opportunity to travel independently for them, this study explores usability problems of an airport environment with respect to needs of elderly users.

Usability is mainly defined as the ability of an entity to be used (Bevan, Carter, & Harker, 2015). It can be evaluated by usability inspections (expert based) or usability tests (user based) (Quiñones, Rusu, & Rusu, 2018). For this study, we mainly focused on usability inspections through heuristic evaluation method in order to support airport experiences of elderly travelers. Heuristic evaluation, proposed by Nielsen and Molich (1990), is a commonly used usability inspection method where evaluators evaluate a specification, product or building according to a set of well-organized design principles (Wilson, 2014). In other words, usability evaluators determine the usability problems with respect to usability heuristics. According to Hermawati and Lawson (2016), the existing studies about heuristics have been considered under three categories as: (1) application or software, (2) devices and (3) buildings. However only 3% of these studies are related to usability of buildings (Hermawati & Lawson, 2016). So, there are very rare heuristics studies in terms of usability of built environments.

On the other hand, in the recent years, an empathic tool has been developed that is called age simulation suit (Lavallière et al., 2016). This suit provides a more comprehensive opportunity to experience the physical limitations of elderly people even for younger people (Moll, n.d.). Thus, younger people can understand the needs of elderly population more by increasing empathy that can result in better design of spaces, goods and services (Lavallière et al., 2016). At this point, for our study, we aimed to benefit from simulated physical ageing during the heuristic evaluation to obtain better inspection of usability problems in terms of elderly needs.

As a result, this study is a pioneering study not only for being the first study for the heuristic evaluation of an airport environment but also it is the first study for assessing the impact of an age simulation suit for the usability evaluation of an airport environment. Within this framework, the objectives of this study are as follows:

- Analyzing the effects of age simulation suit on airport usability inspection and the performance of heuristic evaluation.
- Exploring the impact of heuristic evaluation method on airport usability.
- Identifying usability problems for elderly travelers in airport environments.

1.2.Structure of the Thesis

In order to obtain the objectives of the study, Chapter 2 presents the literature review on ageing population, age-friendly built environments, airport environments and simulated physical ageing and empathic design, respectively. In Chapter 3, the methodology of the study is introduced. Firstly, the research questions and hypotheses are presented. Then, the setting of the study is explained in order to introduce the airport environment where the data was collected. Following this, the procedure is explained regarding the five stages of the study. Lastly, instrumentation and data collection including task scenarios and GERT age simulation suit are presented. In Chapter 4, the results are reported by using both qualitative and quantitative analyses methods. After this, the results embraced deeply and discussed in the discussion part. Lastly, Chapter 5 is the conclusion chapter, where the main aspects of the thesis are summarized and some additional approaches are suggested for future studies.

CHAPTER 2

LITERATURE REVIEW

2.1. Aging Population

In the recent years, the rapid increase in elderly population has become a global phenomenon. This demographic transition has emerged due to the declined fertility, improved health and longevity and reduced death rates in later life (Moulaert & Garon, 2018). By 2017, the global number of people who are aged 60 and more is over 962 million that comprises 13% of the global population, more than twice as in 1980, when there were 382 million elderly persons worldwide (United Nations, 2017). That population is estimated to increase in almost every country during 2015-2080 (Marešová, Mohelská, & Kuča, 2015). With this inevitable increase, the global number of elderly population is expected to double by 2050 when it is predicted to reach more than two billion (United Nations, 2017).

This growth is expected to be faster in the developing regions rather than developed regions (Cui, Loo, & Lin, 2016; United Nations, 2017; WHO, 2002a) (See Figure 1). By 2050, almost 80% of the global elderly population is expected to be living in developing regions (Rowland, 2014). For instance, as a developing country, in Turkey, the percentage of people who are aged 60 and more has been reached from 5.3% to 12.2% between the years of 1950-2015 and this percentage is expected to reach more than 25% by 2050 (T.C. Aile ve Sosyal Politikalar Bakanlığı, 2016). Figure 2 illustrates this growth considering the percentage of elderly population in both the World and Turkey. Similarly, according to the obtained numbers in 2017, the number of elderly population in developing regions is expected to reach from 652 million to 1.7 billion by 2050, whereas the more developed regions are projected to reach from 310 million to 427 million by 2050 (United Nations, 2017). Besides, this growth is expected to be fastest in Africa since it is projected to increase more than threefold between 2017 and 2050. Also, Asia is projected to have a twofold increase whereas Europe is expected to grow most slowly out of six geographic regions by 2050 (United Nations, 2009; United Nations, 2017).

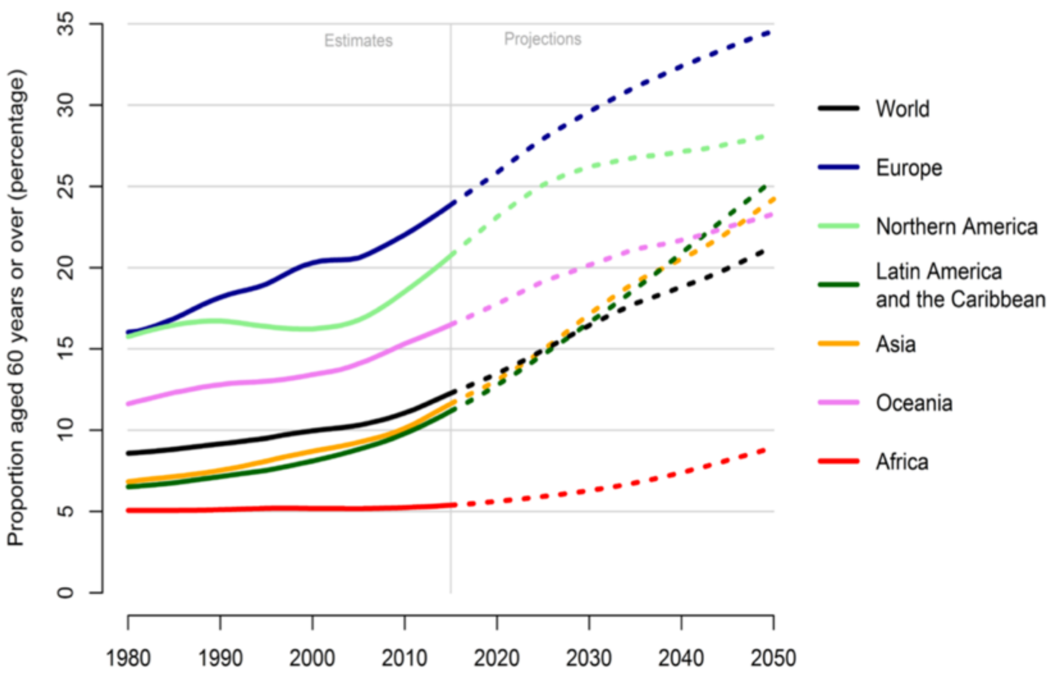

Figure 1. Percentage of elderly population by region from 1980 to 2050 (United Nations, 2017:7).

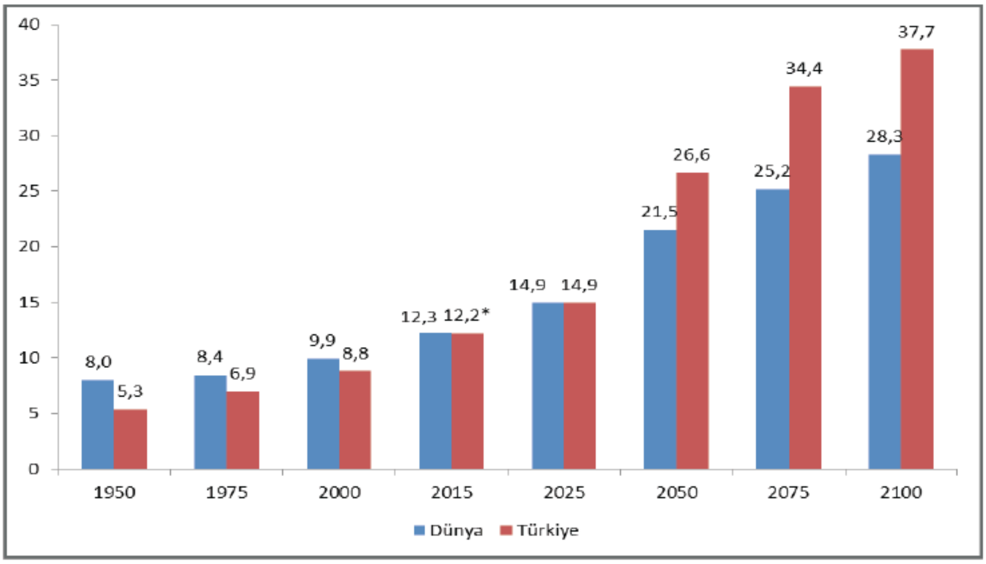

Figure 2. Percentage of elderly population in the World and Turkey from 1950 to 2100 (T.C. Aile ve Sosyal Politikalar Bakanlığı, 2016:23).

As part of this dramatic growth, elderly people have to deal with many challenges such as chronic diseases and disabilities, vision and hearing deteriorations (Lin et al., 2013), and reduced mobility (Ahacic, Parker, & Thorslund, 2000). These kinds of health problems limit the social participation of elderly population as well as result in a decrease of the quality of life in older age (Xie, An, Zheng, & Li, 2018). Moreover, as physical health reduces, elderly people become less capable to function within their surroundings, which may lead them to be more vulnerable against forces within their environments (Noreau & Boschen, 2010). Therefore, some important challenges may occur for them related to their environments. In order to meet these challenges, planners, architects, civil engineers and other groups have important missions while designing and developing built environments to address health, safety and mobility of elderly users (Kerr, Rosenberg, & Frank, 2012). In addition to design and construction process of built environment, there are also a growing number of research studies that focus on how built environment can affect multiple outcomes of the ageing process (Dujardin, Lorant, & Thomas, 2014; Danielewicz, Dorsi, & Boing, 2018; Engel et al., 2016; Kerr et al., 2012; Marquet, Hipp, & Miralles-Guasch, 2017; Rowles, Perkinson, & Barney, 2016). In this way, the necessary precautions can be taken beforehand considering the increasing proportion of elderly population.

2.1.1. What is Elderly?

Various definitions and approaches can be used to define ‘elderly’ across countries and disciplines. Most developed countries determine people over the age of 65 years as elderly or older person (National Research Council, 2001; WHO, 2002a). Likewise, in Turkey, Turkish Statistical Institute and Ministry of Family and Social Policies of Turkey define individuals who are aged 65 years and more as elderly people (TÜİK, 2017; T. C. Aile ve Sosyal Politikalara Bakanlığı, 2017). Nevertheless, United Nations accepts the age of 60 years and more as elderly (United Nations, 2017). Similarly, some developing countries accept the age of 60 years and more as the beginning of old age (Freitas, Queiroz, & Sousa, 2010). In this manner, since age of 60 and 65 years are generally the retirement age in many developed countries, the beginning of old age can be considered as both 60 and 65 years (WHO, 2002a). Similarly, there are also some researchers, who accepted the age of both 60 and 65 years as the beginning of old age as well (Roebuck 1979; Thane, 1978; Thane, 1989).

As ageing is not a homogeneous process, the age of 60 to 74 years can be referred to as ‘early elderly’ and the age of 75 years and more can be referred to as ‘late elderly’ (MacKinlay, 2017; Multani & Verma, 2007; Orimo et al., 2006). On the other hand, ageing does not only have a biological dimension, but also it embodies psychological and sociological dimensions. Hereby, it is possible to observe diversity in the characteristics and capacities between people who are at the same biological age (Rowland, 2014). For instance, in this connection, in Africa, instead of taking chronological age as a focal point of describing elderly, change in social roles is the predominant factor for elderly definition (WHO, 2002b).

2.1.2. The Significance of Active Ageing

As a result of increased life expectancy, concerns have occurred in order to improve the quality of life of elderly people, promoting healthy ageing and ensuring the elderly people to feel as part of the society (Bilbao, Almeida, & López-De-Ipiña, 2016). Accordingly, ‘active ageing’ or ‘healthy ageing’ terms have become as an area of growing importance in the recent years. Along with the increasing interest in active ageing, an urgent call emerged with the aim of providing new strategies and policies to promote active ageing with the help of research studies (Gu et al., 2019). For instance, to address this call, World Health Organization (WHO) has given priority to active ageing studies to ensure good quality of life for elderly population (Maurice, 2016). Similarly, in the recent years, active ageing concept has been covered along numbers of studies from a wide spectrum of disciplines including molecular biology (Jakovljevic, 2018; Jakovljevic et al., 2015), neurology (Kim et al., 2016; Pereira, Cipriano, Costa, Saraiva, & Martins, 2019), gerontology (Foster & Walker, 2015; Katz & Calasanti, 2015; Martinson& Berridge, 2015; Rudman, 2015), public health (Ferdows, Jensen, & Tarraf, 2017; Kendig, Browning, Thomas, & Wells, 2014; Kennedy et al., 2014; Timonen, 2016), and built environment (Buffel, Phillipson, & Scharf, 2012a; Clarke & Nieuwenhuijsen, 2009; Kerr et al., 2012; Moulaert & Garon, 2018; Xie et al., 2018).

The term active ageing was emerged by World Health Organization in the late 1990s (WHO, 2015) and it is launched in the Second World Assembly on Ageing, in Madrid in 2002 (Rowland, 2014). Even though both ‘active ageing’ and ‘healthy ageing’ terms are used constantly, the term ‘active ageing’ refers to a more inclusive meaning rather than ‘healthy ageing’ and also to the other facts in addition to health indicators (Kalachea & Kickbusch, 1997). WHO (2002a) defines healthy ageing as ensuring wellbeing by maintaining functional ability in older age. Functional ability includes health related attributes of human body that is related to autonomy, participation and wellbeing as people age (Bryant, Corbett, & Kutner, 2001; WHO, 2015). On the other hand, WHO (2002a) defines active ageing as the process of maintaining physical, social and mental well-being in the later life that can ensure a more healthy life condition to a person. Active ageing is also described as encouraging people to stay independent as long as possible during their ageing processes and also to be able to observe their contribution to the society if it is possible (European Commission, 2018). Thus, active ageing consists of life-long learning, working longer, late retirement, being active after retirement, and remaining health-supportive activities (Swedish National Institute of Public Health, 2006). Accordingly, active ageing encourages elderly people to be part of the society (Bilbao et al., 2016) and to have a capacity to be independent in the later life (Bartlett & Peel, 2005). Therefore, active ageing is the successful ageing process that is the combination of activity, health (Rowe & Kahn, 1987) and social participation.

In addition, there are also some important key aspects of active ageing: (1) autonomy, which is perceived as the ability for a person to make his/her own decision, (2) independence, that is the ability to perform daily functions without any help from others, (3) quality of life that is the perception of individuals position in life related to their goals, expectations, standards and concerns and lastly, and (4) healthy life expectancy, which is related to how long a person can expect to live without any disability (Paul, Ribeiro, & Teixeira, 2012; The Whoqol Group, 1998; WHO, 2002a).

Active ageing addresses both individual and population groups (WHO, 2002a). It enables elderly people to be aware of their capacities in physical, social and mental manner in order to maintain their quality of lives by taking part in the society (WHO, 2015). In this connection, active ageing depends on the following six groups of determinants: (1) health and social services (equitable access to quality health care within integrated, coordinated and cost effective services), (2) behavioral determinants (physical activity, eating habits, smoking and using alcohol and medications), (3) personal determinants (biology, genetics and psychological factors), (4) physical environments (safe, accessible, age-friendly and barrier free environments), (5) social determinants (education, social support, violence and abuse), and (6) economic determinants (income, social protection, employment), that are all connected with cultural and gender context (Barrio, Marsillas, Buffel, Smetcoren, & Sancho, 2018; Paul et al., 2012; WHO, 2002a; WHO, 2007). Figure 3 illustrates these six determinants. Thereby, understanding these determinants is crucial to create new strategies and policies to ensure well-being in later life.

Figure 3. The determinants of active ageing. Adapted from "Active Ageing: A Policy Framework" (WHO, 2002a).

Additionally, as one of these six determinants, physical environment plays a critical role in active ageing. As age increases, physical capabilities reduce. Thus, elderly people become less likely to deal with physical barriers and their action radius decreases, in which elderly people strongly rely on their physical environments (König, Raue, D' Ambrosio, & Coughlin, 2019). At this point, physical disabilities and environmental limitations can reduce quality of life (Mollenkopf et al., 2002;

White et al., 2010). Considering these, there are many studies that emphasize active ageing in terms of built environment. These mainly focus on neighborhood and urban scale (Buffel et al., 2012a; Cunningham & Michael, 2004; Kerr et al., 2012; Marquet et al., 2017; Michael, Green, & Farquhar, 2006b; Yen, Flood, Thompson, Anderson, & Wong, 2014). However, although these are important considerations, the micro-scale environment is also crucial during later life, because almost 80-90% percent of elderly people tend to spend their time at their homes (Klepeis et al., 2001). In this connection, Annear et al. (2014) considered both macro and micro-scale environments in terms of active ageing. Moreover, due to home environment is strongly related with quality of life (Engineer, Stenberh, & Najafı, 2018), there are also numbers of studies that only emphasize on home and residential environments (Ahrentzen & Tural, 2015; Engineer et al., 2018; Steenwinkel, Baumers, & Heylighen, 2012).

2.1.3. Person-environment Relationship in Later Life

When the process and outcome of ageing comes, constraints of a person related to his/her environment becomes as an area of interest. Thereby, with the aim of accommodating the rapid increase in elderly population, the relationship of elderly people with their environments has gained importance (Wiles et al., 2009). Studies declare that behavioral, physical and mental health, quality of live, well-being and independency of individuals are highly related to the physical environment especially in later life (Evans, 2003; Kerr et al., 2012; Satariano, 1997; Shipp & Branch, 1999). Barriers in the environment can limit physical activities and may cause anxiety, fear, stress and feeling alone for elderly people (Mitchell & Burton, 2006). In this connection, Figure 4 illustrates person-environment relationship focusing on health outcomes.

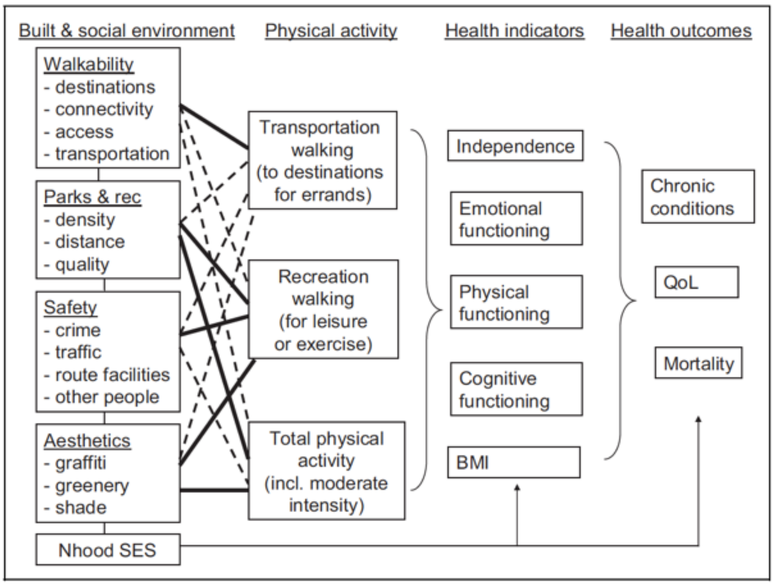

Figure 4. Theoretical framework for environment and health outcome (Kerr et al., 2012:46).

As people age, configuration and mobility of a person in a space becomes very restricted (Balfour & Kaplan, 2002). For instance, taking showers can become a very dangerous activity in older age. Even the design of a bathtub includes handrail for support, the slippery bathtub floor may become a risk factor for the unsteady body (Rowles et al., 2016). Likewise, high cabinets or heavy drawers can also become a physical barriers for houses in later life. Therefore, the design of residential areas including height and quality can significantly impact well-being of elderly residents (Evans, 2003). Similarly, outside of residents, the immediate surrounding and neighborhood can also be a physical barrier for elderly people that may cause falls and injuries (Rowles et al., 2016). For instance, poor lighting, disordered pathways or sidewalks, lack of public restrooms or seats and traffic congestions may enormously limit social interaction, functional independence (Cho, Park, & Echevarria-Cruz, 2005) and well-being of elderly people (Balfour & Kaplan, 2002; Fänge & Iwarsson, 2003). These kinds of unsafe neighborhoods are known to discourage walking in later life (Fisher, Li, Michael, & Cleveland, 2004; Michael, Beard, Choi, Farquhar, & Carlson; 2006a). On the other hand, living in neighborhoods with large sidewalks and paved streets along with wide green areas are believed to increase social participation of elderly residents (Schafer& Upenieks, 2015; Vogt et al., 2015). Accordingly, these environmental factors do not only have aesthetic and functional qualities but also they can affect behavior and socialization of elderly people (Day, 2008). Besides, the lack of structural barriers are known to be very crucial in line with increased sense of agency within the environment in later life (Boudiny, 2012). For instance, a comfortable and inviting space can attract elderly people to come and use it by developing positive feelings about the environment as well as by encouraging them to do physical activities and to be active in their social lives (Sun, Phillips, & Wong, 2018). In this connection, previous studies found that quality of life, wellbeing, life satisfaction or successful ageing are affected from accessibility, residential satisfaction, home size, housing type, heavy traffic, higher usability, exterior environment, street noise, and safety from traffic (Clarke, Nieuwenhuijsen, & Ailshire, 2010; Engel et al., 2016; Garin et al., 2014; Iwarsson, Horstmann, & Slaug, 2007; Ng, Broekman, Niti, Gwee, & Kua, 2009; Oswald et al., 2007; Oswald, Jopp, Rott, & Wahl, 2010; Parra et al., 2010).

In order to clarify the person-environment relationship, different models have been studied in the existing literature. For instance, Lawton's 'environmental press model', focuses on adaptation of an individual to his/her environment in line with his/her capacities (Lawton, 1982). As physical capacities decline with increasing age, elderly people become more likely to deal with physical barriers. Therefore, physical environments may cause an increased stress and reduced action range, which decreases quality of life in later life (König, et al., 2019). Thus, according to Lawton's model, person-environment relationship is not only related to supportive environments but also to individuals' capacities (Lawton, 1999).

Another model is developed by Wahl and Oswald (2010). They created a new framework to understand the interchange between people and environment (Wahl, Iwarsson, & Oswald, 2012). This model identifies two processes: (1) agency, which is the behavior-based and active process for adapting to an environment and (2) belonging, which is experience-based and carries the cognitive and emotional evaluation of the physical environment (König et al., 2019). According to this model, functional and cognitive abilities and personality may gain or lose importance in specific environments. Similarly, environmental resources can be utilized differently among people (Wahl et al., 2012). Therefore, according to this model, person-environment resources and demands of individuals across life span should be considered as a whole while analyzing person-environment relationship in later life. Figure 5 illustrates this relationship.

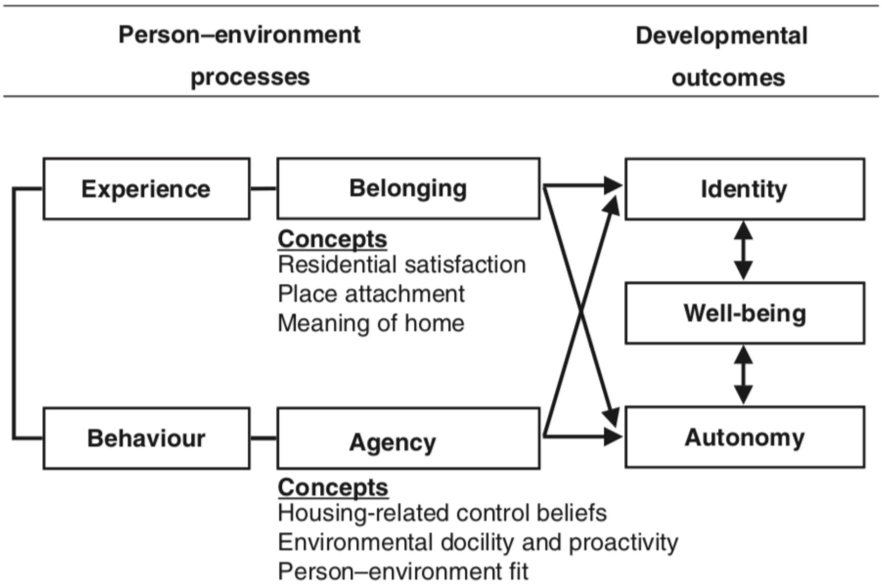

Figure 5. A model of person–environment relationship in later life. (Wahl & Oswald, 2010:114).

To sum up, considering challenges and risk factors, a growing concern occurred towards constituting age-friendly neighborhoods and communities to meet the needs of elderly population (Yen, Michael, & Perdue, 2009). In order to have a better understanding to those needs, the dimensions such as identity, well-being, autonomy and ageing-well should be considered with respect to person and environment relationship (Rowles et al., 2016). In this way, age-friendly environments can be supported thoroughly along with the aim of promoting independency, quality of life, social participation and well-being of elderly population (Beard & Petitot, 2010; Clarke & George, 2005; Clarke & Nieuwenhuijsen, 2009; Lager, Hoven, & Huigen, 2015).

2.2. Age-friendly Design of Built Environments

As discussed in the previous section, with population ageing comes, the need for composing new strategies and policies for elderly people occurred along with various health determinants in which housing and built environment have become significant landmarks (European Commission, 2012; WHO, 2002a; WHO, 2012). Built environment is a wide term that contains outdoors spaces and natural environments including parks and green areas as well as buildings with respect to theirs accessibility and locations (Clarke, Ailshire, Bader, Morenoff, & House, 2008; Menec, Means, Keating, & Parkhurst, 2011). Besides, man-made existences that form physical environment such as roads, utilities, homes and fixtures are also considered as part of built environments (Centre for Disease Control, 2010).

Recently, there is a growing number of studies that examine how built environments are related with multiple outcomes of ageing (Marquet et al., 2017). In this connection, considering the physical limitation in older age, people are tend to depend more on their environment for support and assistance, in which built environments generate more challenges for elderly population (Matlo, 2013). These challenges may occurr as a result of uneven payment, high curbs, high bus steps, lack of place to rest, short timing on traffic lights, small bus schedules and signage, and inadequate labelling of buildings (Matlo, 2013; Rowles, 1978). These structural barriers can negatively affect neighborhood walkability, ease of navigation, utilization of resources and services and social participation (Matlo, 2013). Accordingly, it is important to consider these challenges to meet the specific needs of elderly population.

Referring to these challenges, in the recent years, there have been a variety of strategies and policies regarding supportive built environments for elderly people (Steels, 2015). Accordingly, the model of 'age-friendly cities' has been launched by World Health Organization in 2004 (WHO, 2007). One year later, in 2005, Kalache launched 'age-friendly city concept' (Barrio et al., 2018). As a result of the emergence of this concept, researchers showed interest in this idea and they started to work on ageing and urbanization together (Kalache, 2016). Concordantly, age-friendly cities become an area of interest in the twenty first century (Barrio et al., 2018) and spread rapidly as a global movement (Barrio et al., 2018; Golant, 2014; Fitzgerald & Caro 2016; Lui; Everingham, Warburton, Cuthill, & Bartlett, 2009).

This concept has been studied in large and small scales. For that reason, literature includes both the terms of 'city' and 'community' (Fitzgerald & Caro 2016). WHO (2007) describes age-friendly city as promoting active ageing to increase quality of life by optimizing opportunities for health, participation and security. On the other hand, Alley et al. (2007) define age-friendly community as "a place where older people are actively involved, valued, and supported with infrastructure and services that effectively accommodate their needs" (Alley, Liebig, Pynoos, Banerjee, & Choi, 2007:4). In some studies, age-friendly concept has been covered regarding the whole cities (Barrio et al., 2018; Buffel & Phillipson, 2016; Ruza, Kim, Leung, Kam, & Ng, 2015; Steels, 2015; WHO, 2007). Nevertheless, it is also concerned with communities including physical environment, housing, social environment, health services, transportations, and information (Broome, Worrall, Fleming, & Boldy, 2013; Golant, 2014; Gough & Cassidy, 2017; Menec et al., 2011; Plouffe &

Kalache, 2011; Sun, et al., 2018). The reason that community is a form of participation through interaction with other people and using community resources; transports, shopping areas, parks, libraries or other public environments are the matter of age-friendly communities (Fitzgerald & Caro 2016). Therefore, age-friendly communities include both built and social environments to ensure living spaces with plenty of opportunities and successful living (Fitzgerald & Caro 2016).

In this connection, although participating in communities are generally conceptualized as part of social environment, it is important to consider the effect of built environment on the communities as well (Matlo, 2013; Smith, 2009). Especially, green areas and open spaces are believed to encourage elderly people to be socially active more (Menec et al., 2011). Also, walkable environments are known to encourage people for physical activity (Ding et al., 2014; Hajna et al., 2015), as well as increased independency (Clarke & George, 2005; Clarke & Nieuwenhuijsen, 2009) and social participation (Beard & Petitot, 2010; Lager et al., 2015). Likewise, places like third spaces including parks, coffee shops, community organizations and food markets are also important spaces to increase the social interaction and participation in older age (Mehta, 2007). Overall, age-friendly communities can promote physical activity (Morris, Mcauley, & Motl, 2007), social participation (Day, 2008) and greater perceived quality of life (Rantakokko et al., 2010).

2.2.1. Elements of Age-Friendly Environments

Previous studies have shown that the success of built environment is highly related to the action space of elderly people and hence their daily activities and social participation are affected (Cerin, Natal, Cauwenberg, Barnett, & Barnett, 2017; Chui, 2008; Phillips, Siu, Yeh, & Cheng, 2005; Sun et al., 2018). At this point, it is critical to create good environments with flexible and evolving characteristics in line with physical changes associated with ageing process (Beard & Petitot, 2010). In the existing literature, there are various approaches to maintain age-friendly environments starting from physical features to social relations (Buffel & Phillipson, 2016; Lui et al., 2009; Scharlach, 2012). Besides, in these studies, collaboration between local authorities, public health professionals, architects, community organizations and elderly people have also been found very important for age-friendly environments (Buffel & Phillipson, 2016; Glicksman & Ring, 2016; Garon, Paris, Laliberte, & Veil, 2016). For instance, in New York, local authorities, police and community organizations collaborated with each other and worked closely with elderly people. This collaboration ensured elderly people to feel safer and engage with their communities (Steels, 2015).

According to the study by Fitzgerald and Caro (2014), age-friendly environments require some preconditions and progress to achieve primary and secondary age-friendly features. These preconditions are composed of five elements that are: (1) population density (size and growth rate of elderly population), (2) climate and weather (may affect types of activities for elderly people), (3) topographical features (may impact transportation, housing structure and walkability), (4) social and civil organization (may affect community conditions and morale of residents), and lastly (5) health and social services (potential barriers in terms of cost, information and transportation) (Fitzgerald & Caro, 2014). Thereby, preconditions are the elements that should be considered before taking actions with respect to age-friendly environments.

In addition to these preconditions, Fitzgerald and Caro (2014) considered (1) primary features, as housing, mobility, outdoor spaces and buildings, and participation of elderly people, and (2) secondary features, as age-friendly businesses. On the other hand, WHO (2007) has a more general approach for age-friendly cities. The different domains of age-friendly environments are taken a whole, such as outdoor spaces and buildings, housing, transportation, respect and social inclusion, social participation, civic participation and community support and health services (WHO, 2007). Figure 6 illustrates these domains.

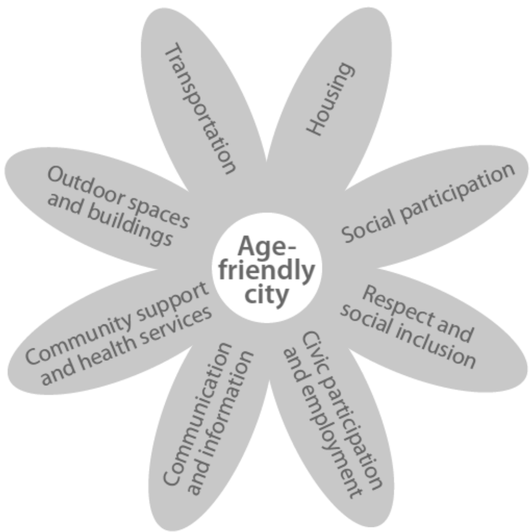

Figure 6. Domains of age-friendly cities (WHO, 2007:9).

2.2.2. Usability of Built Environments

The term usability was firstly used by Gould and Lewis in 1985 (Gould & Lewis, 1985). Later, it has been evaluated and formulated along various research studies. There are various usability definitions that have been defined by several authors and standardization organizations (Jimenez, Lozada, & Rosas, 2016). The most commonly and internationally accepted definition is done by International Organization for Standardization (Quiñones & Rusu, 2017; Rasila, Rothe, & Kerosuo, 2010). The standard ISO 9241-11 defines usability "as the extent in which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specific context of use" (ISO 9241-11, 2018).

There are some important terms when evaluating usability (Quiñones & Rusu, 2017). Quiñones and Rusu emphasize six important terms according to ISO definitions (Quiñones & Rusu, 2017). These terms are (ISO 9241-11, 2018):

> (1) *user,* person who interacts with the product, (2) *goal*, intended outcome, (3) *effectiveness,* accuracy and completeness with which users achieve specified goals, (4) *efficiency*, resources used in relation to the results achieved, (5) *satisfaction*, an extent in which user's physical, cognitive and emotional response towards use of the product and (6) *context of use*, users, tasks, equipment and physical and social environments in which a product used.

On the other hand, within the framework of the built environment, the concept of usability also came across through the history with respect to architectural qualities, functional, technical, aesthetic and economic features of built environment (Bittencourt, Pereira, & Júnior, 2015). Usability can be evaluated to understand if users can complete a task or achieve a specified goal in a particular space (Acemyan & Kortum, 2018). Environments should be convenient for user performance, behavior and need (Stokols, 1978). Therefore, to increase usability, designers should study how to optimize an environment during both before and after utilization of a space with the aim of preventing possible usability problems as well as learning from the project to use this information for the future projects (Acemyan & Kortum, 2018).

Unfortunately, in the case of architecture and interior architecture, there is a knowledge gap between designers and end users in terms of understanding real behavior of users, their needs and expectations (Ghani et al., 2016; Heylighen & Herssens, 2014). That happens mainly due to the constraints related to building operation, materials, time, budget and many other factors (Altay, 2014). Besides, in architectural design process, architects and interior architects filter the spatial experience of users with the eye by overlooking the rest of the body parts (Franck & Lepori, 2007; Heylighen & Herssens, 2014). That means architectural designs are distant from people's experience of a space (Franck & Lepori, 2007; Heylighen & Herssens, 2014) and they are mostly related to aesthetical aspects. Moreover, there is also currently a lack of tool to evaluate the design of a built environment and to analyze potential usability problems (Fink, Pak, & Battisto, 2010). The existing studies mainly consider working environments, products and ergonomic analysis in terms of universal design principles (Afacan & Erbug, 2009), philosophical and conceptual underpinnings of usability (Alexander, 2008) and usability dimensions (Rasila et al, 2010). Accordingly, considering the lack of specific methods to evaluate usability of built environment, existing usability tools can be adapted into architectural scale in order to meet the individual needs and skills (Afacan & Erburg, 2009; Alexander, 2008; Rasila et al., 2010). Bittencourt, Pereira, & Júnior (2015) suggested a model of usability, in which dimensions of usability for built environment were divided into two categories. These categories are: (1) physical/objective usability that includes orientability, environmental comfort, readability, functionality, accessibility and safety, and (2) subjective usability category that contains identity, attachment, independence, familiarity, domain, independence and sense of security. Figure 7 illustrates this relationship.

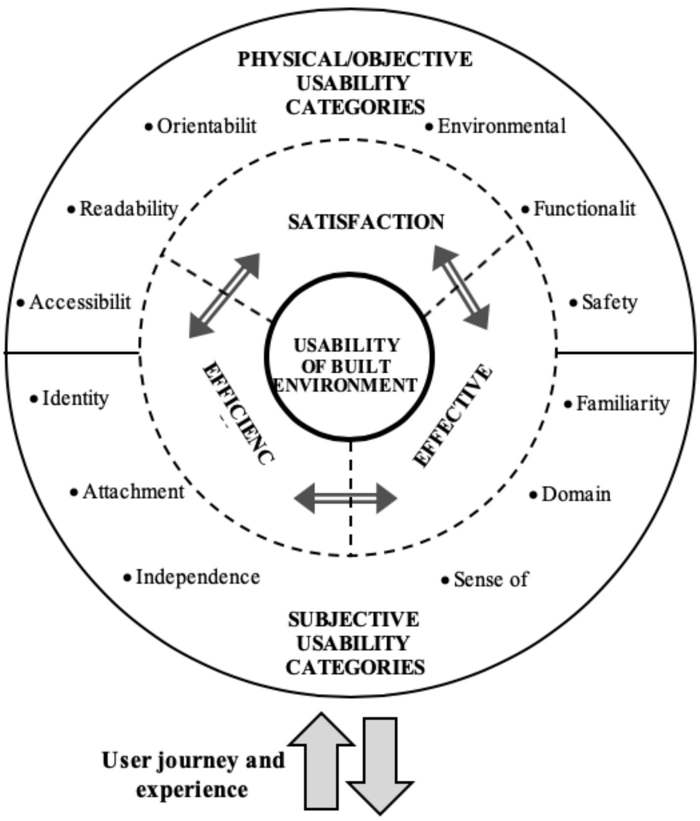

Figure 7. Usability of the built environment (drawn by the author, 2019).

In addition to the model of Bittencourt et al. (2015), Rasila et al. (2010) summarize the usability dimensions based on a study by Kerosuo, and these dimensions are divided into 11 categories (Kerosuo, 2007). In this regard, these categories include: (1) *efficiency* related to time and autonomy (Kaya, 2006); (2) *flexibility*, which is adaptable use situations and environments (Shackel, 1991); (3) *learnability* as the ability to use environment when it is used for the first time (Nielsen, 1993); (4) *memorability* as the ability to reuse the environment after some time between initial use (Nielsen, 1993); (5) *accessibility* is the ability to interact within the surrounded environment with respect to ease of moving around (Kaya, 2006), (6*) navigation* is moving around in the building (Rothe, 2007), (7) *functionality,* is the fit of an environment to the function as it is designed to serve (Rothe, 2007); (8) *atmosphere* related to sensual experiences related to smelling, hearing, feeling, and seeing (Göbel, 2015); (9) *visual design* as the identity, image and brand (Kirby & Kent, 2010); (10) interaction and feedback related to information delivered to and by user (Rasila et al., 2010), and lastly (11) *satisfaction* related to an individual usability dimension as an outcome of good usability (Nielsen, 1993). Therefore, reviewing existing usability literature, new methods and tools can be developed in order to evaluate the usability of built environment.

2.2.3. Heuristic Evaluation Method

Holzinger (2005) divides the usability evaluation methods into two as: (1) usability inspections, which are performed by evaluators, and (2) usability tests, which are carried out by users. Heuristic evaluation proposed by Nielsen and Molich (1990), has been the most commonly used usability inspection method among the existing tools (Jaspers, 2009; Jimenez et al., 2016). Heuristic evaluation is a type of usability inspection, where a team of individuals evaluates a specification, product, system, or building with respect to a list of usability or user experience principles (Nielsen & Molich, 1990). It involves three to five usability evaluators who independently inspect usability problems based on well-organized usability design principles or in other words usability heuristics (Quiñones & Rusu, 2017; Jaspers, 2009; Jimenez et al., 2016). In the literature, many usability heuristics are created as an extension or adaptation of existing heuristics. However, many studies do not explain in detail the process of developing new sets of heuristics (Quiñones et al., 2018). The existing studies about this domain can be considered under three categories: "(1) usability of application or software – 83%, (2) usability for devices – 14%, and (3) usability for buildings – 3%" (Hermawati & Lawson, 2016:35). So, there are very rare heuristics studies in terms of usability of built environments.

In the heuristic evaluation process, usability problems are analyzed regarding frequency, severity and criticality of each heuristic principle (Quiñones & Rusu, 2017). Each expert evaluates the usability of a system, product, service or building separately (Scholtz, 2005). There are three general approaches to conduct heurist evaluation. These are: (1) object-based (evaluators are asked to examine usability of an object), (2) task-based (evaluators analyzed usability problems based on given heuristics and a set of tasks) and (3) object-task hybrid (combines object-based and task-based) approaches (Wilson, 2014). The advantages of performing heuristic evaluation are: (1) less expensive in terms of time, number of evaluators and resources, (2) possible to find many problems, (3) does not involves users, (4) can be easily adapted into other studies and (5) increases awareness of common usability problems (Jaspers, 2009; Quiñones & Rusu, 2017; Quiñones et al., 2018; Scholtz, 2005; Wilson, 2014). On the other hand, the disadvantages of heuristic evaluation are: (1) evaluator effect, in which different evaluators can find different problems, (2) lack of real users, since the evaluators may not be the actual users of the system/product or building, (3) lack of clear rules while indicating 'minor' or 'major' problems, in which variety of observations can be seen between evaluators and (4) lack of problem solutions, since it addresses mainly on the usability problems (Wilson, 2014).

2.3. Airport Environments

Air travel has become a common transportation opportunity in recent years, as a result of cheaper flights and wider range of destinations (Department for Transport, 2008). So, we can say that air travel is the mode of transportation of the 21th century (Edwards, 2009). Accordingly, airports become the key environments within their complex architectural features that comprise of interconnecting systems of people, baggage, cargo and aircraft (Kazda & Caves, 2007). In addition to these systems, airports also ensure various services including shops, restaurants, cafes, entertainment and hotels (Han, Kim, & Hyun, 2014). In this sense, airports are also architectural spaces to look at and to entertain (Adey, 2008).

In the literature, airport architecture has been the pioneer of innovative design in the way of architectural design, creating images and structural solutions that have been adapted into other building types (Edwards, 2009). There are four generations of airport buildings: (1) *Early airports* (1930s-1940s) with most basic structures, (2) *second-generation airports* (1950s-1960s) with concrete runways and single-storey terminals, (3) *third-generation airports* (1970s-1980s) as complex multi-terminal places with three or four storeys and road systems, and lastly (4) *fourth-generation airports* (1990s-) as huge-scaled buildings with directly linked rail systems (Edwards, 2009). Airport architecture holds glamour, scale and technology as an artifact of growing industry (Edwards, 2009). Also, it has a greater importance in terms of reflecting values and aspiration of the society (Edwards, 2009; Zheng, 2014). Therefore, airports should be designed with specific features that represent itself and its city (Suvantola, 2018). In terms of their size and target passenger, Zheng (2014) considers airports into two categories: (1) international airports and (2) regional airports. The design of the international airports are especially important since they have varied background of passengers to consider the image of the building as a brand of the country (Zheng, 2014). Moreover, it is crucial that airport design and facilities must meet the passenger's needs, since passengers do not only pass through security control and board their flights. Instead, considering other services of airport buildings, they may have a variety of behaviors during their airport activities such as using shops, restaurants, cafes, restrooms or seating elements. Therefore, it is important that designed facilities should accommodate not only for a specific user group, but also all kinds of passenger groups and demands (Zheng, 2014).

Moreover, airport designers, engineers and specialists divide airports into two areas as *landside* and *airside* (Cravioto, 2013). There are many definitions that exist about these two terms. According to the definition of Oxford Dictionary, landside is the part of the airport building where general public has unrestricted access and airside is the part that is beyond passport and customs (Oxford Dictionary, 2019). Similar to these definitions, Collins English Dictionary defines the boundaries between landside and airside as security check, customs and passport control (Collins English Dictionary, 2019). Similarly, Cravioto (2013) claims that with respect to general civil engineering and architectural jargon, landside represents the area of the building on the side of the passengers and airside refers to the side of the planes. Concordantly, landside allows free flow of passengers, visitors, and vehicles, but airside is limited for the use of authorized personnel, aircrafts and service vehicles (Evans, 2006). Regarding all these definitions, it is important to consider the importance of the landside of the airport, because landside is the first part of the building after passengers enter the airport building. Accordingly, experiences of passengers in this area impact the overall airport usability (Livingstone, Popovic, Kraal, & Kirk, 2012).

Most of the previous studies on airports have dealt with physical attributes including ambient conditions, signage systems, lighting elements and materials. (Fodness & Murray, 2007; Goh, St, Yuan, & Wu, 2007; Jiang and Zhang, 2016; National Academies of Sciences, Engineering, and Medicine, 2011; Tam & Lam, 2004). Other studies have examined psychological attributes such as kindness of staff, passenger experience, check-in performance, safety and security, and service needs (Barros & Tomber, 2007; Chang & Chen, 2012; Enoma & Allen, 2007; Kirk, Popovic, Kraal, & Livingstone, 2012; Kraal, Popovic, & Kirk, 2009; Liou, Tang, Yeh, & Tsai, 2011; National Academies of Sciences, Engineering, and Medicine, 2011). Lastly, passenger emotion, satisfaction and anxiety towards airports have also been studied as psychological attributes (Bogicevic et al., 2016; Fodness & Murray, 2007; Jeon & Kim, 2012).

2.3.1. Passenger Experience

The complexity of processes in airport buildings can cause challenging airport experiences for the passengers. Activities in an airport that a passenger performs are crucial to obtain an objective framework for evaluation of passenger experience (Kirk et al., 2012). In this connection, passenger experience is measured by satisfaction in line with place, time, and interactions with others (Harrison, 2015) (See Figure 8). For instance, generally passengers expect to wait for a short time in the queue to impose their processing activities effectively. There are important factors that need be considered to better understand the complete passenger experience (Kirk, 2013). Accordingly, to consider where the experience begins is important, because it can be even starting from planning a trip before buying tickets or from entering the airport. Kraal et al. (2009) divide airport passenger activities into two: (1) processing activities and (2) discretionary activities (Kraal et al., 2009). Processing activities are related to activities that a passenger needs to perform to board their flight (Livingstone et al., 2012). It includes check-in, filling out required paperwork, security controls, identity checkpoint and boarding the plane (Kraal et al., 2009). Discretionary activities include leisure time (Rowley & Slack, 1999), in which passengers perform them during non-processing times (Popovic et al., 2009). In this connection, previous studies mainly considered passenger experience after their entrance to the airport buildings, in which planning a trip process or preparing for a trip before arriving at the airport have not been covered that much in passenger experience studies (Airport Council International, 2008; Cave, Blackler, Popociv, & Kraal, 2013; Consumer Protection Group, 2009; Kazda & Caves, 2009; Myant & Abraham, 2009). Figure 8 illustrates that experience.

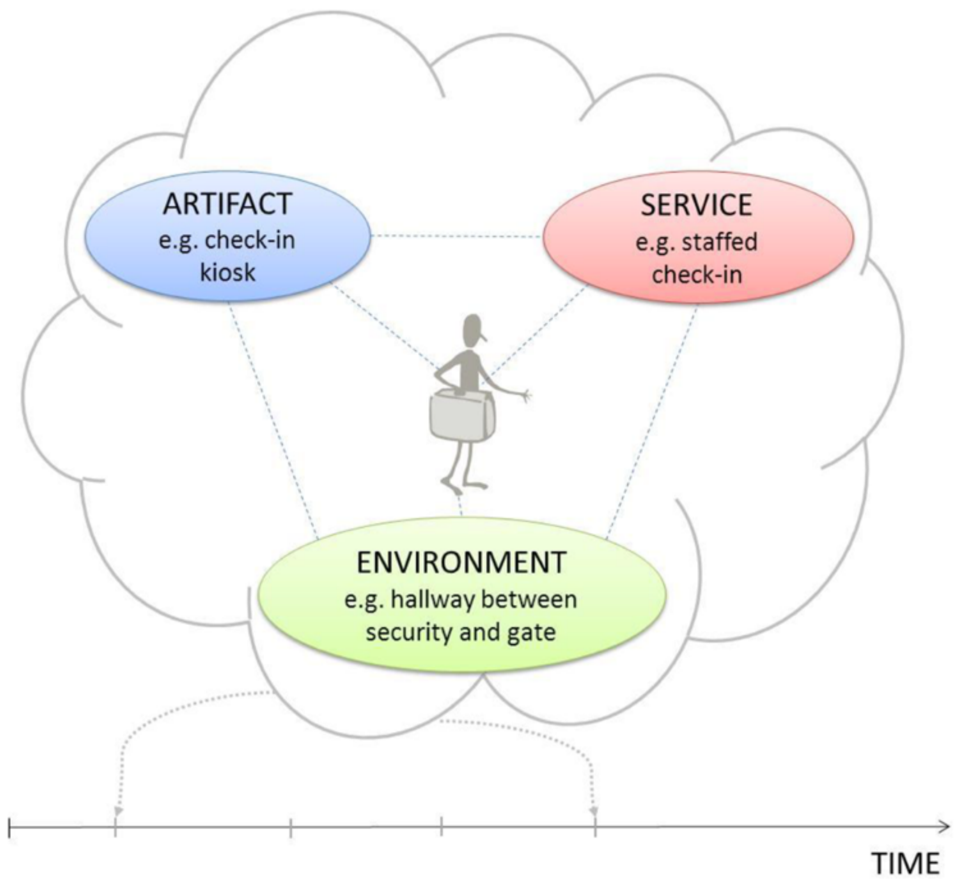

Figure 8. Factors affecting the passenger experience (Harrison, Popovic, Kraal, & Kleinschmidt, 2012:2).

There are different components for passenger experience in terms of departures or arrivals (Kirk, 2013), or either for domestic and international flights. Popovic et al. (2010) have emphasized different components of Australian international airport experience both for departures and arrivals (See Figure 9). In addition to study of Popovic et al. (2010), Cave et al. (2013) have also considered departing components with respect to landside and airside division. Accordingly, landside processing activities include: (1) arrive at airport, (2) check-in, (3) security, and customs, and airside activities include: (1) waiting area and (2) boarding (See Figure 10). However, in Turkey, different from other counties, there are two-security controls during landside processing activities. First security control is just after arriving at the airport, and second security control is similar to other airport experiences in other countries. Therefore, international and domestic passenger experiences at airports in Turkey can be seen in Figure 11. For example, an exemplary domestic flight work flow in a Turkish airport is as follows, a passenger enters the airport (processing), goes through the first security control (processing), probably takes a sandwich/coffee (discretionary), uses the seating area for eating/drinking and/or resting facilities (discretionary), proceeds to check-in (processing), uses the restrooms (discretionary), goes through the second security control (processing), uses the waiting areas (discretionary) and then boards to her/his flight (processing). In this connection, according to the studies, in terms of spending time in airports for passengers, 36% of the airport activities consist of processing activities and 64% of them are formed by discretionary activities (Kirk et al., 2012; Underhill, 2008).

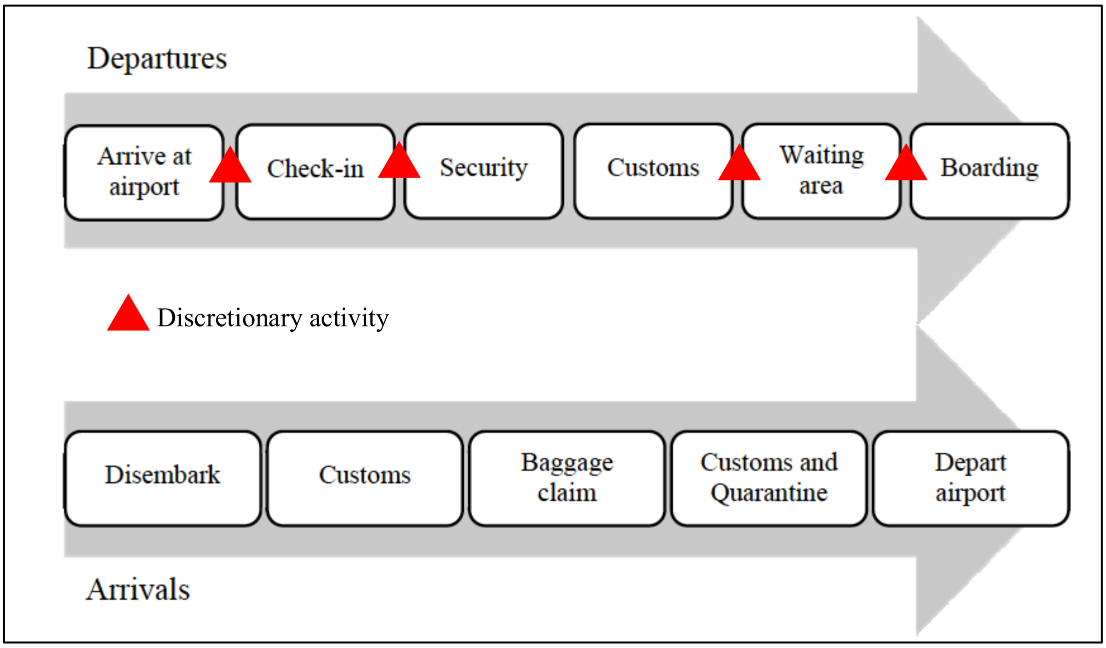

Figure 9. Passenger experience in airports for departures and arrivals (Adapted from Popovic et al., 2010).

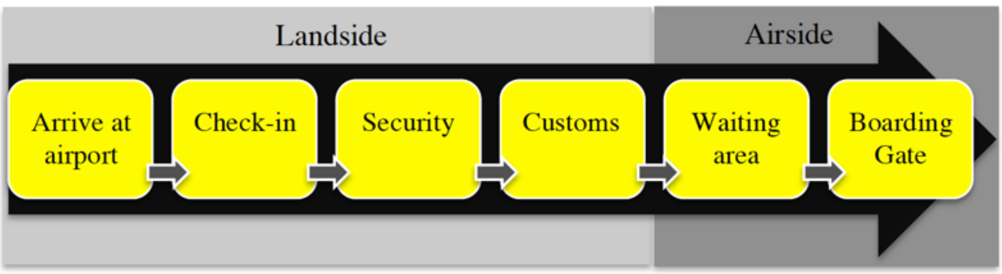

Figure 10. Processing activities of departing passengers in line with landside and airside division (Cave et al., 2013:2).

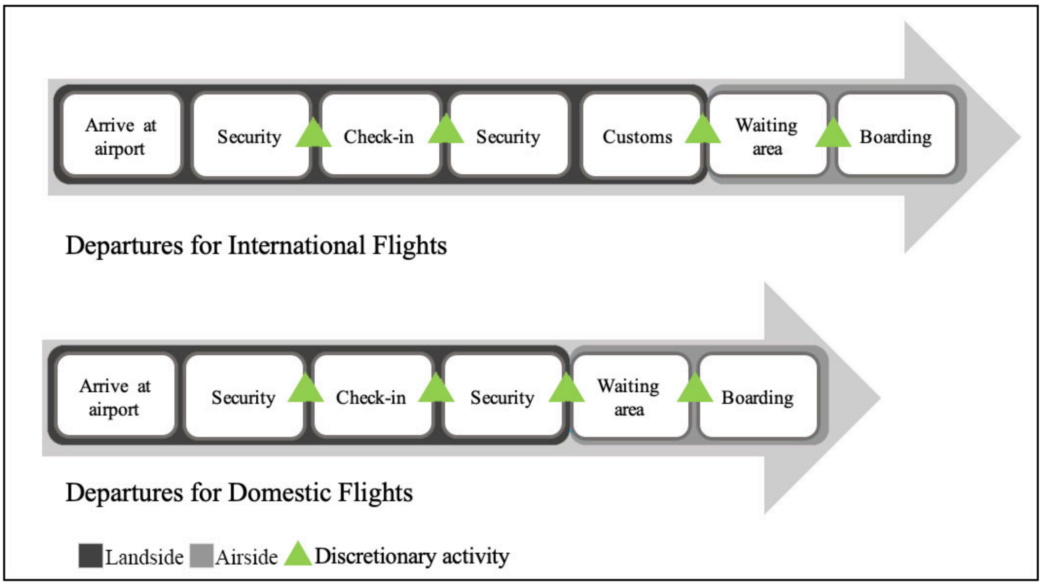

Figure 11. Passenger experience for airports in Turkey during international and domestic flights (Adapted from Popovic et al., 2010).

Moreover, complexity of processes in airport buildings are crucial, because airports tend to be confusing, uncomfortable and stressful environments for passengers (Underhill, 2008). Although airport designers studied a lot on designing based on passenger experience, they do not really have a passenger oriented design approach (Harrison, 2015). The reason is that airport buildings are designed as a result of the collaboration among airport owners, architectural firm(s) and individual airlines (Harrison, 2015), so that they generally ignore the major stakeholders in the airports (Neufville & Odoni, 2003). However, airports must satisfy the needs of the different stakeholders (Popovic et al., 2010) including government bodies, airport staff, retailers, airport owners, airlines and passengers (Harrison et al., 2012). Accordingly, despite the importance of passenger experience for airport design (Popovic et al., 2010), it has not been deeply analyzed and integrated in a structured manner into the design process (Zidarova & Zografos, 2011).

2.3.2. Elderly Travelers at Airports

Along with the globally increasing elderly population and growing interest towards active ageing, a considerable increase in the amount of the elderly travelers has been observed in the recent years (Forest, Brihier, & Verny, 2013). As a results of improved quality of life, controlled chronic diseases and financial stability after retirement; (Baker, Brink, Lipschitz, & Marcolongo, 2016; Cooper, 2006; Suh & Flaherty, 2019) age is not a barrier for traveling any more than any time in the past (Suh & Flaherty, 2019). Concordantly, the proportion of elderly traveler is expected to increase as a result of better economic and educational level (National Academies of Sciences, Engineering, and Medicine, 2014).

Elderly travelers mainly have been travelling since they were young, and they do not see the age factors as any kind of constraint for traveling (Ramos-Sesma, Mora, & Ramos-Rincon, 2018). However, as a result of normal ageing process, a general reduction is expected in the way of physical (e.g. vision loss, hearing loss, reduced mobility) (Ahacic et al., 2000; Lin et al., 2013), cognitive, physiological and sensory capacities (Silva, Souza, Gomes, Figueiredo, & Menegon, 2015). Therefore, elderly travelers could have both physical (wayfinding, orientation etc.) and psychological (getting lost, fear, etc.) difficulties during their airport experiences (Bauer, 2012; Eperon & Chappuis, 2015; Wong & Simons, 2012; Lee et al., 2017). Therefore, these kinds of difficulties may cause confusion and anxiety for elderly population especially when they are trying to adapt to new situations and unfamiliar environments (Burkholder, Joines, Cunningham-Hill & Xu, 2010; Eperon & Chappuis, 2015).

According to Burghouwt, Wit and Bruggen (2006), the three greatest challenges for the elderly in airports are: (1) walking, (2) waiting, and (3) wayfinding. Firstly, there is an increase in the number of large-scale airports designed with long walking distances, which become an important challenge for elderly people in terms of their abilities. Therefore, in order to shorten the long walking distances; moving sidewalks, electric carts, automatic people movers and sufficient amount of resting areas are important design considerations for airports. Also use of escalators and elevators are important to accommodate vertical circulation for them (Burghouwt et al., 2006; Silva et al., 2015). Secondly, not only elderly people but also all passengers need to wait during processing activities such as check-in, security or boarding. In particular, elderly passengers need to rest while they are waiting. Accordingly, increasing the number of appropriate seating elements would be an important solution to ease the processing activities for elderly people (Wolfe, 2003). Lastly, navigating within unfamiliar environments is very challenging especially for elderly travelers. In this connection, improving wayfinding facilities (e.g. signage systems, technological services and helping staff) could be helpful for the airport experience of elderly travelers (Burghouwt et al., 2006).

Moreover, National Academies of Sciences, Engineering, and Medicine (2014) has considered wayfinding, fatigue, technology and equipment simultaneously and analyzed passenger sequence with reference to the three following key spaces: (1) entrance to security, (2) from security to gates, and (3) from arrival gates to terminal exit. These key spaces play significant role on landside experience. Moreover, the main challenges at the landside are also: *check-in area wayfinding, fatigue, coping with technology* and *security control* (National Academies of Sciences, Engineering, and Medicine, 2014). Since elderly people have more difficulties to understand the meaning of signs, to perceive colors and small prints (Silva et al., 2015), placing staffed information station close to the front door, providing two-dimensional "You Are Here" maps and using easy to understand signs for the signage system would be very helpful for them (National Academies of Sciences, Engineering, and Medicine, 2014). In addition to wayfinding, technological devices such as self-service check-in kiosks can be challenging for elderly people. Touchscreen familiarity and understanding displayed information due to the size, color and brightness of the screen can cause constraints (Silva et al., 2015). So, providing assistant staff near the self check-in areas can help elderly people having difficulties. Besides, while standing in the queue for an overcrowded check-in area, elderly people can be extremely tired. In this sense, having sufficient amount of comfortable seating elements near the check-in area would ease the check-in process (Wolfe, 2003). Also, using automatic lifted bag well at the check-in counter would really assist the physical limitations of elderly people. Lastly, elderly travelers are also faced with problems during security controls. Wolfe (2003) lists these problems as waiting in queue, removing personal items like clothing, placing on and taking off baggage for screening conveyor belt and walking through body scanners. Since it can be a very stressful process for elderly people, dedicated lanes for the elderly, enlarged recomposing lounges and screens showing the screening process can be important efforts to accommodate elderly people (National Academies of Sciences, Engineering, and Medicine, 2014). To sum up, considering all the passenger usability experiences and challenges for elderly people, better precautions can be taken beforehand regarding the limitations of elderly travelers.

2.4. Emphatic Design: Simulated Physical Aging

Due to the growth in elderly population, the need for insight into elderly experiences with goods, services, products and environments is emerging. However, many designers may not be aware of the challenges that elderly people experience while using these environments or products (Lavallière et al., 2016). Designers generally say that they are designing for themselves with a designer-centered approach when creating new products, services, or environments (Coleman, Lebbon, & Myerson, 2003; Cooper, 1999). This means that user-product interaction mainly depends on their individual experiences as potential users (Popovic, 1999). At this point, there is a risk for eliminating variety in backgrounds, knowledge and capacities of the whole population through that self-observation (Cardoso & Clarkson, 2012). For instance, Morrow (2000) indicates that a wide range of people is excluded during the design process due to the homogeneity in the background of designers and also their insufficient analysis strategies. As a result, many everyday products and environments may cause frustration, difficulty or even dangerous interactions for wide range of users (Porter & Porter, 1999) including elderly people. Besides, Cardoso and Clarkson (2012) also emphasizes that another important reason for the lack of designer-user interaction, is the time and budget constraints in which designers do not be able to consult with end-users. That means constraints related to operation, material, time and budget during the design process may lead the designers to disregard to incorporate information for the users (Altay, 2014; Darses & Wolff, 2006). However, it is important for designers to be aware of the consequences of their design decisions in later stages of design process (Ritcher, Weber, Bojduj, &Bertel, 2010).

Accordingly, there is a gap between designers approach and the needs of elderly users even though the changes associated with the ageing process are well documented (Boot, Nichols, Rogers, & Fisk, 2012). Design for elderly population has been covered in many disciplines including gerontology, ergonomics, human factors, occupational theory and design (Gilbert & Rogers, 1999). Through the years, several design approaches have emerged to support elderly friendly products and environments such as universal design, inclusive design, transgenerational design and user-centered design (Demirbilek & Demirkan, 2004; Farage, Miller, Ajayi, & Hutchins, 2012; Vermeulen,et al., 2013; Woudhuysen, 1993). Empathic design is also one of these approaches as a new branch of user-centered design (Postma, Zwartkruis-Pelgrim, Daemen, & Du, 2012).

Among all approaches, empathic design is a design research approach that has been developed to build a creative understanding for users and their daily lives (Postma et al., 2012), as well as enables designers to feel for the users (Postma, Lauche, & Stappers, 2009). It focuses on everyday life experiences, individual desires, moods and emotions (Mattelmäki, Vaajakallio, & Koskinen, 2014). Over the years, empathic design has been a valuable response of design for user experience in the way of understanding users and their needs (Postma et al., 2012). There are four principles for this approach. These are: (1) balancing rationality and emotions (Dandavate., Sanders, & Stuart 1996), (2) making inferences about users and their possible futures through empathy, (3) involving users in the design process, and (4) having multi-disciplinary evaluators in the design team (Postma et al., 2012). According to the previous studies, during the design process, taking experts and users outside of the project context enable designers to develop empathy with end users, and it has been found very valuable, which gives the opportunity to develop greater insight and understanding and ensuring the usability of designed products and environments (Thomas & McDonagh, 2013). Therefore, empathic design can help the designers to notice different sets of users under different circumstances.

In the recent years, to close the gap between the designers and elderly users, an empathic tool has been developed in the form of age simulation suit (Lavallière et al., 2016). The concept of ageing simulation suit is relatively new and has been primarily used by the automotive industry. Automobile companies have created this suit to improve vehicle design for elderly drivers (Lavallière et al., 2016). Besides, age simulation suit has also been used for educational purposes in nursery studies, in the way of enabling students to experience challenges and needs of elderly people (Henry, Douglass, & Kostiwa, 2007; Lavallière et al., 2016; Watkins, Higham, Townley, & Gilfoyle, 2019). In these studies, this suit has been found very useful to increase empathy of nursery students towards elderly patients. Other related studies have generally considered only one part of the body such as feet (Eymard, Crawford, & Keller, 2010), spine (Tremayne, Burdett, & Utecht, 2011), and hands (Georgia Tech Research Institute, 2007). In the field of built environment, in 1973, Pastalan et al have conducted an experiment with PhD students of architecture. The students wore simulators, which limits age-related visual, hearing, respiratory, and tactile capacities. This tool was defined as a conceptual approach for an empathic model (Pastalan, Mautz, & Merrill, 1973). Moreover, Zijlstra et al. have evaluated the impact of age simulation suit on the performance of wayfinding in the hospital setting (Zijlstra, Hagedoorn, Krijnen, Schans, & Mobach, 2016). Nevertheless, despite these two studies, there are very rare researches related to age simulation suit in the field of built environment.

Moreover, age simulation suit offers people an opportunity to put themselves in ‘someone else’s shoes’ (Cardoso & Clarkson, 2012) to increase empathy that can result in better design of products, services and environments (Lavallière et al., 2016). With the help of this ageing simulation suit, even younger people can have opportunities to experience physical limitations of elderly people including vision, hearing, head mobility, joint stiffness, loss of strength, grip ability and coordination skills (Moll, n.d.). In order to simulate natural sensations of ageing, age simulation suits are generally composed of different modules. These are head module, torso module, arms modules and legs module (Groza, Sebesi, & Mandru, 2017) (See Figure 12). Head module includes vision module, hearing module and neck mobility device. Torso module comprises of a heavy vest that limits spine movement. Arms module simulates movement limitations of shoulder, elbow and wrist, as well as sensorial limitations of hands. Lastly, legs module restricts the hip, knee and ankle movement (Groza et al., 2017) (See Table 1).

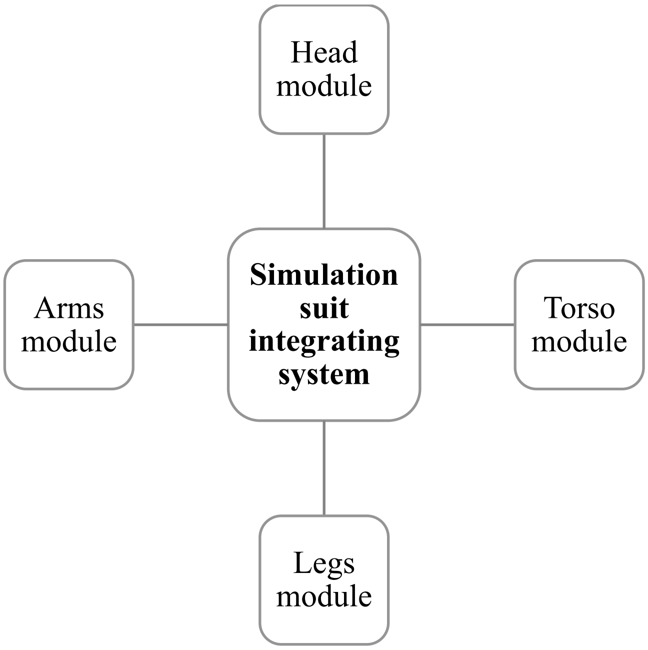

Figure 12. Major components of an age simulation suit (Groza et al., 2017).

Table 1. Torso modules and proposed technical solutions (Adapted from Groza et al., 2017).

Module	Physical Function	Technical Solution
Head	Vision	Special glass that simulate eye disease
	Hearing	Noise protection headset
	Neck mobility	Cervical collar
Torso	Spine movement	Vest with weight added, exoskeleton, backpack
Arms	Tactile Sense	Gloves, finger protections, tremor simulator
	Shoulder, elbow and	Orthosis with elastic systems, orthosis with
Legs	Hip, knee and ankle	Orthosis with elastic systems, orthosis with
	Foot movement	Overshoes, metallic plate, exoskeleton

Many academic institutions and companies have produced age simulation suits both for empathy training and occupational therapy (Lavallière et al., 2016): (1) *AGNES* (Age Gain Now Empathy System) designed by MIT Age Lab to simulate motor, visual, flexibility, dexterity and strength of a person around 75 years old (MIT Age Lab, 2019)(See Figure 13), (2) *Genworth R70i* by Applied Minds LLC for Genworth, where latest technologies are combined to create more realist feeling including computer controlled back and virtual reality helmet (Prindle, 2016)(See Figure 14) and; (3) *GERT* (GERontologic Test) produced by German company Produkt + Projekt Wolfgang Moll simulates sensomotoric skills in old age with 11 matched components that constitute age simulation head, age simulation torso, age simulation arms and age simulation legs (Moll, n.d.).

To sum up, although different approaches have been developed for simulated physical aging suit, its comprehensive integration to interior design process and usability research is not studied deeply, especially for complex built environments to create a better understanding of ageing process in these environments (Groza et al., 2018). Thus, this thesis aims to fill this gap in the design literature by exploring the effects of simulated physical ageing on a usability inspection method (heuristic evaluation) in airport environments.

Figure 13. AGNES suit. Retrieved from

https://www.nytimes.com/2011/02/06/business/06aging.html

Figure 14. Genworth R70i suit. Retrieved from

https://www.newsweek.com/2015/07/17/exclusive-new-super-suit-simulates-aging-millennials-338018.html

CHAPTER 3

METHODOLOGY

3.1. Research Questions and Hypotheses

In this study there are one main and two sub research questions:

RQ: Does simulated physical ageing positively influence heuristic evaluation in airport environments?

sub-RQ1: What are the usability problems for elderly people in an airport environment?

sub-RQ2: Does ageing simulation suit significantly enable evaluators to increase their empathy towards age-related physical impairments on airport activities?

To achieve the objectives of the study, following hypotheses are tested:

H1: There is a statistically significant difference in performance of heuristic evaluation while wearing an age simulation suit.

H2: Ageing simulation suit significantly increases perceived closeness towards elderly people.

H3: There is a statistically significant effect of wearing ageing simulation suit on difficulty in physical performance.

H4: There is a statistically significant correlation between airport usability and difficulty in physical performance.

H5. There is a statistically significant evaluator effect in finding usability problems in test sessions.

H6. Heuristic evaluation method significantly enhances better inspection of usability problems in airport environments.

3.2. Setting

To understand the usability problems of elderly travelers in airport environments, the data was collected in a newly constructed airport building in İstanbul, Turkey during the dates of 25st February and 28th February 2019 (See Figure 15). The administration of the airport did not allowed to mention the name that airport for the study. The airport is located in the north of central Istanbul, next to the Black Sea costs (Ma, 2019). It targets to be the largest airport in the world with a capacity of 200 million annual passengers and 3500 flights per day (Dirsehan, 2019; Koseoglu, Keskin, & Ozorhon, 2019). The airport includes 3 terminals, 6 runways with multiple buildings that are connected through walkways, sky-bridges, or tunnels (Koseoglu et al., 2019). Construction of the building was carried out in four phases and during the data collection, only the first phase of the airport was finalized with a terminal with its 90 million passenger capacity (IGA, 2018).

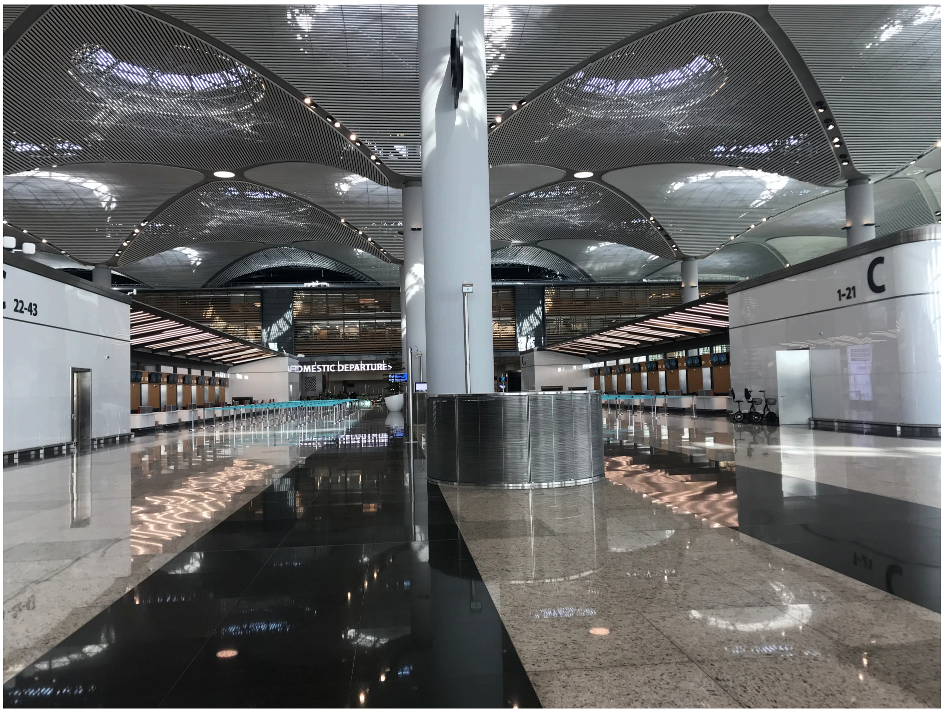

Figure 15. Airport environment where the study conducted (taken by the author, 2019).

The study was conducted on the landside of the domestic departures. That airport was selected because, as mentioned in the literature review by Eperon and Chappuis (2015), elderly people tend more to experience confusion and anxiety while adapting to new environments. Accordingly, collecting these data from a new airport environment can address the challenges of elderly travelers more. During the data collection, the operational activities in the airport were not totally started. Only very few flights were scheduled in a day. Therefore, the density of passengers was low and also some small construction work was still going on inside and outside of the airport. Figure 16 illustrates the plan of the selected airport building. Figure 17 illustrates the area where the study was conducted.

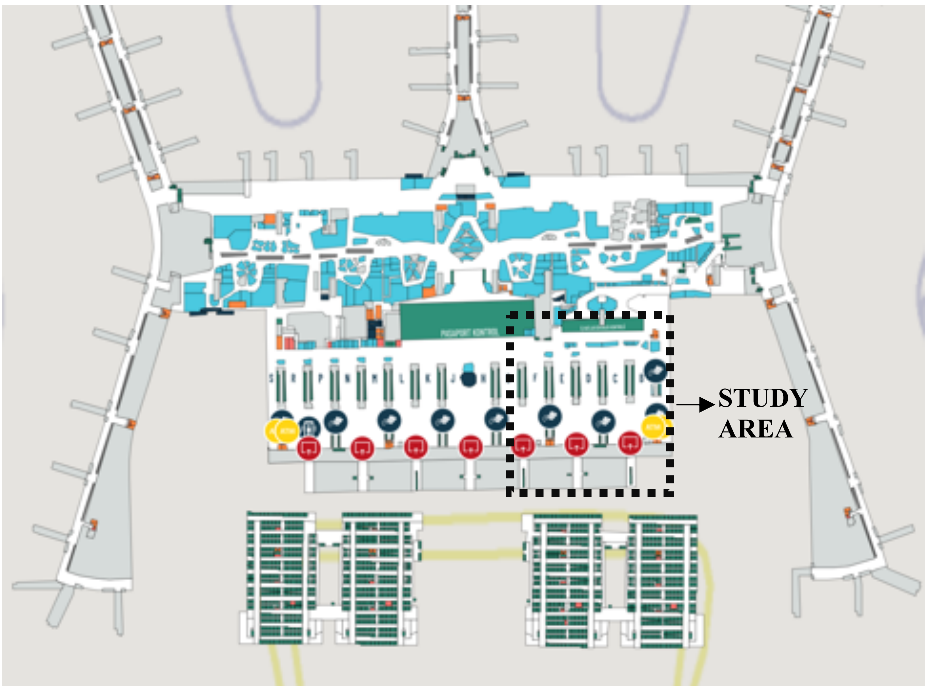

Figure 16. Map of the newly constructed airport. Retrieved from

https://www.istanbulhavalimani.com/en/passenger/airport-guide/airport-map

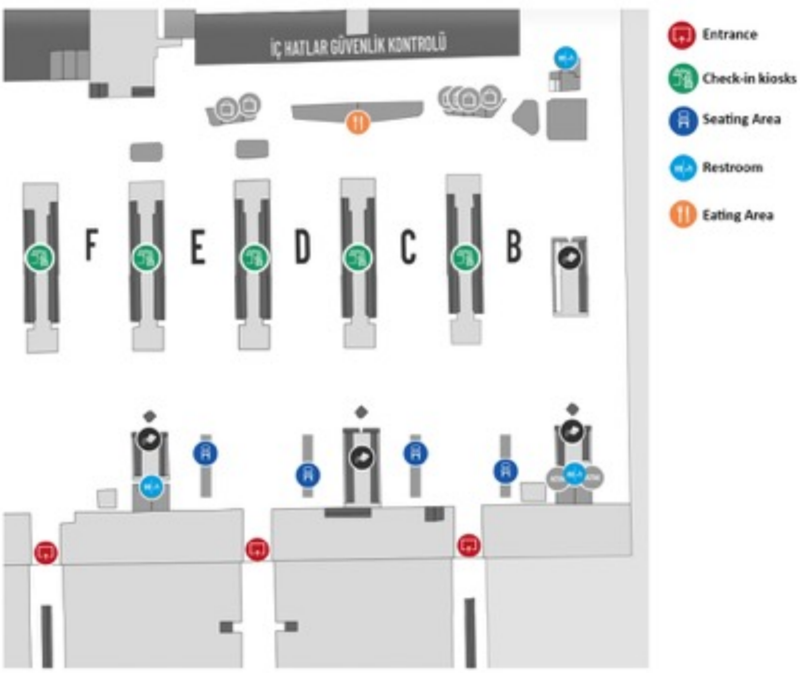

Figure 17. Area where the study was conducted. Retrieved from

https://www.istanbulhavalimani.com/en/passenger/airport-guide/airport-map

3.3. Participants

Referring to Nielsen's (1992) statement that usability evaluators were better than non-usability evaluators in conducting heuristics, this thesis chose eight evaluators with four architects and four interior architects. The eight evaluators were recruited by purposeful convenience sampling from the database of Chamber of Architects and Interior Architects in Ankara and İstanbul Branch. In order to find the evaluators who have necessary background for the study, firstly a database was formed within the architects and interior architects. The objectives and the procedure of the study were explained to those architects and interior architects by e-mail and they were invited to participate to the study. Inclusion criteria for the study were as follows: (i) having already universal design/disability/elderly knowledge; (ii) being worked professionally in various airport projects in practice, not being in the airport environment before where the data will be collected; (iii) being in a normal body mass index and not having any disability. Consequently, regarding the availability at a given time and willingness to participate to the study, the eight evaluators were determined regarding the inclusion criteria. Table 2 presents the sample's characteristics. The evaluators were adults aged between 29-49 years. Their mean age was 38,63 years old. Lastly, all the official permissions for each participant were taken from the airport administration and police headquarters before the data collection.

The study was approved by the Bilkent University Institutional Ethical Review Board. All the participants were asked to sign the informed consent, which stated the purposes of the study, their involvement, risks and emergency procedures. After they signed, they were enrolled in the study. They were also informed about the confidentiality of the study and their right to terminate their participation at any time.

Table 2. Descriptive statistics of the evaluators.

	Gender	Age	Profession	Professional Experience in Years
Evaluator 1	Male	49	Interior Architect	25
Evaluator 2	Male	41	Architect	15
Evaluator 3	Male	36	Architect	10
Evaluator 4	Male	33	Interior Architect	8
Evaluator 5	Male	29	Architect	6
Evaluator 6	Male	43	Interior Architect	20
Evaluator 7	Female	32	Interior Architect	8
Evaluator 8	Female	46	Architect	21

3.4. Procedure

The study is composed of four different sessions as: Session I (pre-test), Session II (test), Session III (post-test) and Session IV and five stages as: Stage 1 (extraction), Stage II (mapping usability), Stage III and Stage IV (adapted heuristic evaluation), and Stage V (model). Evaluators performed each setting individually and without any time lapse. Figure 18 illustrates the workflow diagram of the study.

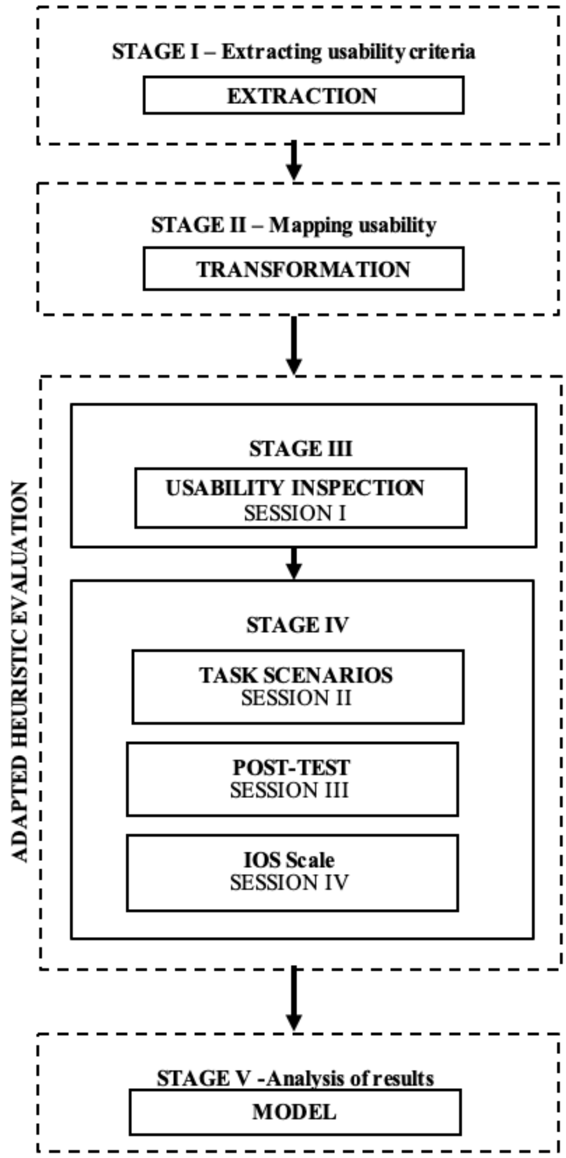

Figure 18. Workflow diagram of the study (drawn by the author, 2019).

Session I is composed of six open-ended questions that are related to building elements by Froyen (2012). For each evaluator, since it was their first time in that airport, before asking the questions, they were asked to do a movement tour of the building considering the use of elderly passengers. The tour lasted 10 minutes for each evaluator. Following the movement tour, six open-ended questions were asked and their answers were sound recorded. The open-ended questions were lasted approximately 10 minutes for each evaluator. (See Appendix B for open-ended questions). After finishing the open-ended questions, evaluators were asked to perform six task scenarios as part of Sessions II (See Appendix C for task scenarios). During this session, four of the evaluators wore GERT suit and four of them did not. However all of them carried a luggage consistent with real airport experience. After each task scenario, relevant heuristic principles and physical difficulty level of each task (considering elderly users) were asked in the form of five-point Likert scale ranging from 1 as totally disagree to 5 as totally agree for heuristic principles and 1 as very difficult to 5 as very easy for physical difficulty. There were 45 heuristic principles that were asked to the evaluators during Session II. The reliability of those 45 principles was confirmed by assessing reliability analysis (Cronbach's alpha=0.963). Session II were lasted around 40 minutes for each evaluator. In Session III, evaluators were asked to reconsider their pre-test statements with the same six open-ended questions in Session I (see Appendix D). Their answers were also sound recorded. Thereby, more detailed evaluations and further usability problems and suggestions were obtained. Lastly in Session IV, in order to measure the perceived closeness between evaluators and elderly people, one last question was asked in Inclusion of Other in the Self (IOS) Scale by Aron et al (Aron, Aron, & Smollan, 1992) (See Appendix E for the IOS scale test). IOS scale helps to understand the perception of the evaluators, i.e. how close they feel with elderly people. Figure 19 illustrates the test sessions of the study.

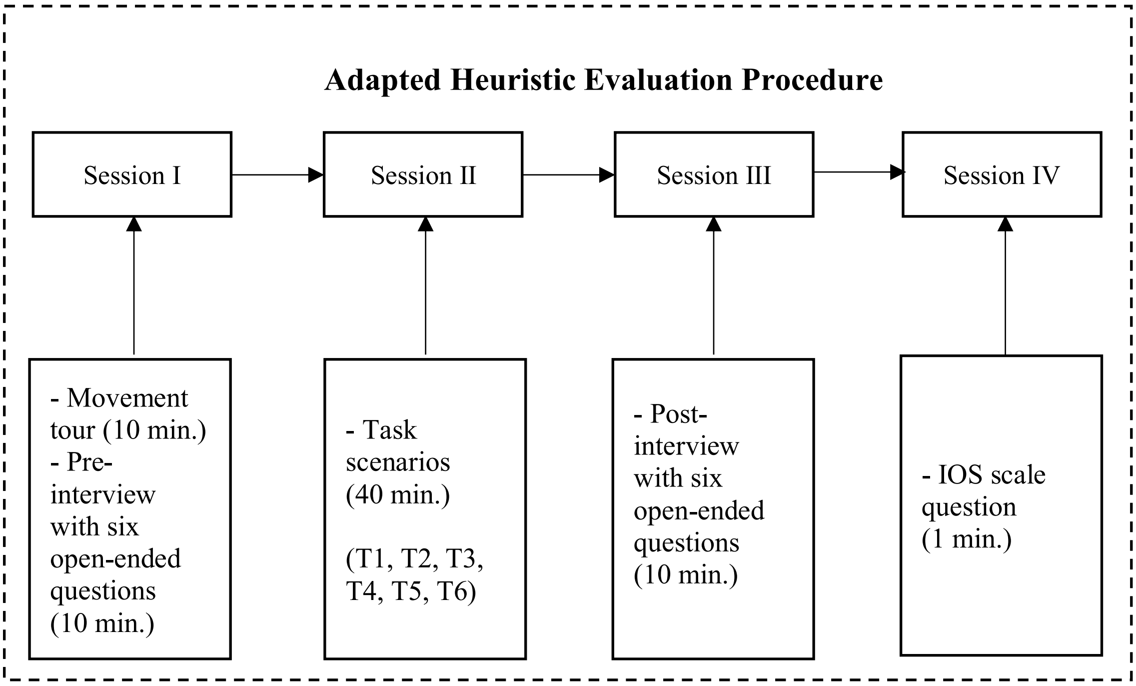

Figure 19. The structure of the adapted heuristic evaluation procedure applied in the airport environment (drawn by the author, 2019).

During the data collection, a car was rent in order to facilitate the transportation of the evaluators to the airport. All the evaluators were taken from their houses or offices and they were driven to the airport environment to collect the necessary data. The data was collected with 2 evaluators for each experiment day. In order to avoid any kind of biases, the evaluators performed the test sessions individually with the guidance of the author. During the data collection, the evaluators were not allowed to listen or observe to the other evaluator, who was performing the test sessions at that time. Accordingly, the other evaluators waited for their turns by drinking coffee at one of cafés at the domestic departure area of the airport. All sessions lasted about approximately 2 hours for each evaluators, in which almost 5 hours were spent in that airport environment per one experiment day. Lastly, after conducting all test sessions, the evaluators were driven back to their houses.

Figure 20. Evaluator #AA4 with GERT suit (taken by the author, 2019).

Figure 21. Evaluator #IA3 with GERT suit (taken by the author, 2019).

Figure 22. Evaluator #AA3 with GERT suit (taken by the author, 2019).

3.5. Instrumentation and Data Collection

The study has three instruments. These are : (1) open-ended questions in sessions I and III, (2) task scenarios in setting II and (3) GERT age simulation suit. All the open-ended questions in Session I and task scenarios in Session II have been grouped under six categories based on Huber Froyen's (2012) elements of built environments. These adapted elements include: (1) access: entrance to the building, (2) elements for horizontal circulation in a building, (3) elements for vertical circulation in a building, (4) facilities for rest, (5) sanitary facilities and (6) facilities for food and drinks.

Besides, as Quiñones, Rusu, & Rusu mentioned (2018), many existing heuristic studies are presented as an extension or adaptation of existing heuristics. Accordingly, to effectively evaluate a specific domain, several researchers have designed new sets of usability heuristics (Quiñones, et al., 2018). Likewise, this study proposed a new set of heuristics for an airport environment by extending age friendly principles by WHO (2007) and airport guidelines for the elderly by National Academies of Sciences, Engineering, and Medicine (2014). Table 3 illustrates these 16 heuristic principles that are constituted with respect to elderly use of airport environments.

Table 3. Incorporation of age friendly principles (WHO, 2007) and airport guidelines for elderly (National Academies of Sciences, Engineering, and Medicine, 2014) into the heuristics for the usability of airport environments.

Heuristic Number	Heuristic Description
H1	Adequate security checkpoint design to avoid long queues
H2	Easily accessible entrance from the public transportation
H3	Avoided use of slippery flooring
H4	Adequate placement to avoid long waking distance
H5	Use of high-contrast color combinations of font and/or graphics and background to ensure readability and perceptibility of the signage systems
H6	Use of simple icons on the signage systems
H7	Adequate placement of signage system
H8	Use of sufficient level of illumination
H9	Announcements can be easily heard and understood
H10	Adequate speed of escalator
H11	Use of visible elevator buttons
H12	Use of adequate amount of seating elements
H13	Comfortable seats are provided
H14	Adequate spacing between rows of seats
H15	Easy to use sanitary amenities (e.g. sink, water closets)
H16	Avoided use of heavy doors

3.5.1. Task Scenarios

A task-based heuristic evaluation process was conducted, in which evaluators were evaluating the usability with given heuristics and set of tasks. There were six task scenarios that we created in line with landside processing and discretionary activities (See Section 2.5.1.) and building elements suggested by Froyen (2012). Each task scenario compromised of 5 to 9 subtasks with reference to physical performance domains. The sub-tasks are listed in Appendix C. Table 4 lists motor and sensory assessment domains. Motor assessment domains include: (1) *strength*, capacity of a muscle to produce force, (2) *balance*, ability to orient body in a space and to maintain an upright posture, (3) *locomotion*, moving body from one place to another (Reuben et al., 2013) and (4) *endurance,* ability to keep doing something difficult or painful (Cambridge Dictionary, n.d.). Sensory assessment domains include: (1) *vision*, ability to see and (2) *audition*, ability to hear.

Table 4. Adapted domains for physical performance test instruments from different consensus groups (Reuben et al., 2013).

	Domain
Motor Assessment	Strength Balance Locomotion Endurance
Sensory Assessment	Vision Audition

Each subtask is concerned with relevant physical assessment domain to judge the usability of that building element based on elderly-friendly environment criteria. The first task is passing through the domestic entrance by taking off and putting on your jacket for the security control. Second task is finding the related check-in desk (for an imaginary flight) by carrying a luggage. Third task is using the vertical circulation elements. Forth task is finding and using the seating elements by performing stand to sit and sit to stand positions. Fifth task is finding and using the restrooms (by opening door, pretending to use restroom cabins and sanitary amenities). Lastly, sixth task is finding and going to a proper facility for food/drink and ordering a food. Table 5 illustrates which physical performance domains are associated with which task.

Table 5. Task scenarios associated with physical performance domains.

Task	**Domain**
T1: Passing through the domestic entrance by taking off and putting on your jacket for the security control.	Upper body strength, balance, vision, audition
T2: Finding the related check-in desk (from imaginary flight) by carrying a luggage.	Lower body strength, upper body strength, balance, locomotion, endurance, vision, audition
T3: Using the vertical circulation elements.	Lower body strength, balance, locomotion, endurance, vision, audition
T4: Finding and using the seating elements by performing stand to sit and sit to stand positions.	Lower body strength, balance, endurance, audition
T5: Finding and using the restrooms (by opening door, pretending to use restroom cabins and sanitary amenities).	Lower body strength, upper body strength, balance, locomotion, endurance, vision, audition
T6: Finding and going to a proper facility for food/drink and ordering a food.	Lower body strength, balance, locomotion, endurance, vision, audition

3.5.2. GERT Age Simulation Suit

GERT (GERontologic Test) is produced by German company Produkt + Projekt Wolfgang Moll. It enables to experience physical limitations of elderly people even for younger people with respect to vision, audition, mobility, balance, grip ability and strength. Moll emphasizes that by GERT walking and grip ability can be simulated very close to reality (Moll, n.d.). Accordingly, it gives an opportunity to have a better understanding of elderly people's behaviors. See Figure 23. Although GERT suit is intended to simulate the physical limitation of ageing process, it is also possible to simulate the cognitive limitations (e.g., dementia) or sensation of pain (back pain, knee pain) by additional accessories of GERT suit that can be purchased from Produkt + Projekt Wolfgang Moll company (Moll, n.d.).

Figure 23. GERT Age Simulation Suit. Retrieved from http://www.age-simulation-suit.com

The suit consists of four separate main components including: (1) age simulation head, (2) age simulation torso, (3) age simulation legs and (4) age simulation arms. See Figure 24. Age simulation head includes *special goggles* that cause changed color perception, grainy blurring, glare sensitivity and narrowed visual perception, *hearing protection* that causes high-frequency hearing loss and *cervical collar* that restricts head mobility (Moll, n.d.). Age simulation torso is comprised of a heavy west that causes bending of the spine, postural weakness, mobility restrictions and decreased balance. Age simulation arms include elbow wraps that reduces joint mobility, weight cuffs that reduces strength and coordination and special gloves that restricts hand mobility, grip ability and tactile perception. Lastly, age simulation legs are comprised of knee wraps that restrict joint mobility and weight cuffs that cause reduced strength, changed coordination and unsteady gait (Moll, n.d.). The purchase of this 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 24. Components of GERT Age Simulation Suit. Retrieved from http://www.age-simulation-suit.com/download/Age_simulation_suit.pdf

CHAPTER 4

RESULTS

The results of the study were analyzed both qualitatively and quantitatively. The data obtained from open-ended questionnaires in Session I and Session III were analyzed qualitatively. The Likert scale questions in Session II and Session IV were analyzed quantitively.

4.1. Qualitative Findings

As mentioned previously, the responses of the participants during Session I and Session III were audio recorded. 16 audio records in total were collected at the end of these sessions. These audio records were analyzed by inductive content analysis that embodies open coding, creating categories and abstraction (Elo & Kyngas, 2007). In this regard, each audio record was listened through several times to enable content familiarization. As indicated by Elo and Kyngas (2007), data from audio records were transcribed verbatim in the form of notes and headings as a process of open coding. The written text was read again and headings were obtained as much as possible to describe all aspects that had been mentioned by the evaluators (Burnard, 1991). Following these, main categories were revealed considering the six building elements: (1) access: entrance to the building, (2) elements for horizontal circulation in a building, (3) elements for vertical circulation in a building, (4) facilities for rest, (5) sanitary facilities and (6) facilities for food and drinks. Then, generic categories were freely generated by grouping the data under the main categories (Burnard, 1991). All these processes of content analysis were performed for Session I and Session III separately.

Session I

Considering *'access: entrance to the building'*, all evaluators stated that wayfinding while entering the building was easy with the help of signage systems. They mentioned that even if the passengers come to the airport by public transportation or by private car, they could easily find their ways. On the other hand, access by public transportation was found challenging as a result of insufficient number of public transit and inadequate placement of bus stops. Lastly, different than the other evaluators, evaluator #AA4 found two additional usability problems, that were related to the vertical circulation and insufficiency in the signage system. That evaluator stated:

> *"I cannot see variety of vertical circulation elements for the entrance except elevators and moving ramp. These elements can be useful in terms of physical limitation for wide range of people. However, these are all electrically driven elements. What if some technical problems occur? How the passengers will enter the airport?"*

For *'elements for horizontal circulation in a building'*, seven evaluators highlighted the problems caused by the long walking distances. This problem was due to the scale of the airport building compared to other airports in the world. Considering the scale of the airport, there were insufficient amount of seating elements, which were discussed by four evaluators. As mentioned in the literature review, moving sidewalks, automatic people movers and sufficient amount of seating areas should have been implemented to the airport environment in order to shorten the long walking distances (Burghouwt et al., 2006; Silva et al., 2015). Another four evaluators also addressed the inadequate placement and scale of the flight information systems. Considering the expected passenger flow of that airport, their scale were too small and their locations were a quite far from the security checkpoints. Two evaluators suggested to improve signage system for better wayfinding. Besides, despite the huge scale of the airport two evaluators who were both architects claimed that check-in kiosks were placed successfully. Evaluator #AA4 also gave examples from his/her previous airport project that he/she had worked while embracing horizontal circulation.

> *Walking distances are too long. Even a young passenger can get tired and get stressed while performing their airport activities. Although I can see special assistance vehicles, during busy periods, their number will not be sufficient to help the passengers who may need special assistance (#AA1).*

> *Flight information systems are too small to be seen from the crowd. For instance, in Esenboğa Airport project, we designed huge, free standing and visible flight information screens that can be seen from distances (#AA4).*

Considering *'elements for vertical circulation in a building'*, all evaluators mentioned that it was very difficult to approach to vertical circulation elements including escalator and elevator, since they were not clearly visible and located improperly. Only one escalator and one elevator were placed in to the domestic arrivals area. They were behind the ticket sales offices in which they were totally invisible for the passengers.

For '*facilities for rest'*, six evaluators mentioned that there was a crucial need of more seating elements. An increased number of seating units would make the environment more attractive and comfortable to walk the long distances considering the huge scale of the airport. Therefore, the passengers could sit down to rest when they got tired.

Considering *'sanitary facilities',* seven evaluators reported that the design of the restrooms were successful considering their amounts, placements and interior design. However, evaluator #IA4 mentioned that some passengers could have difficulties while finding the restrooms. It was because the restrooms were located behind the security checkpoints in which after the security control the passengers orient to the opposite direction of the airport building.

Lastly for '*facilities for food and drinks',* four evaluators stated that due to the food/drink facilities were located just before the second security control, their locations caused non-legibility. Besides six evaluators took attention to long walking distances for food and drink facilities as a result of their placements.

> *I wish to observe more homogeneous placement of food and drink facilities. What if I don't want to pass by second security control immediately (#IA4)?*

Considering all these expressions of the evaluators, an abstraction of Session I were formulated. Accordingly, main categories, and their related generic and sub-categories were grouped. Figure 25 illustrates the abstraction process of Session I.

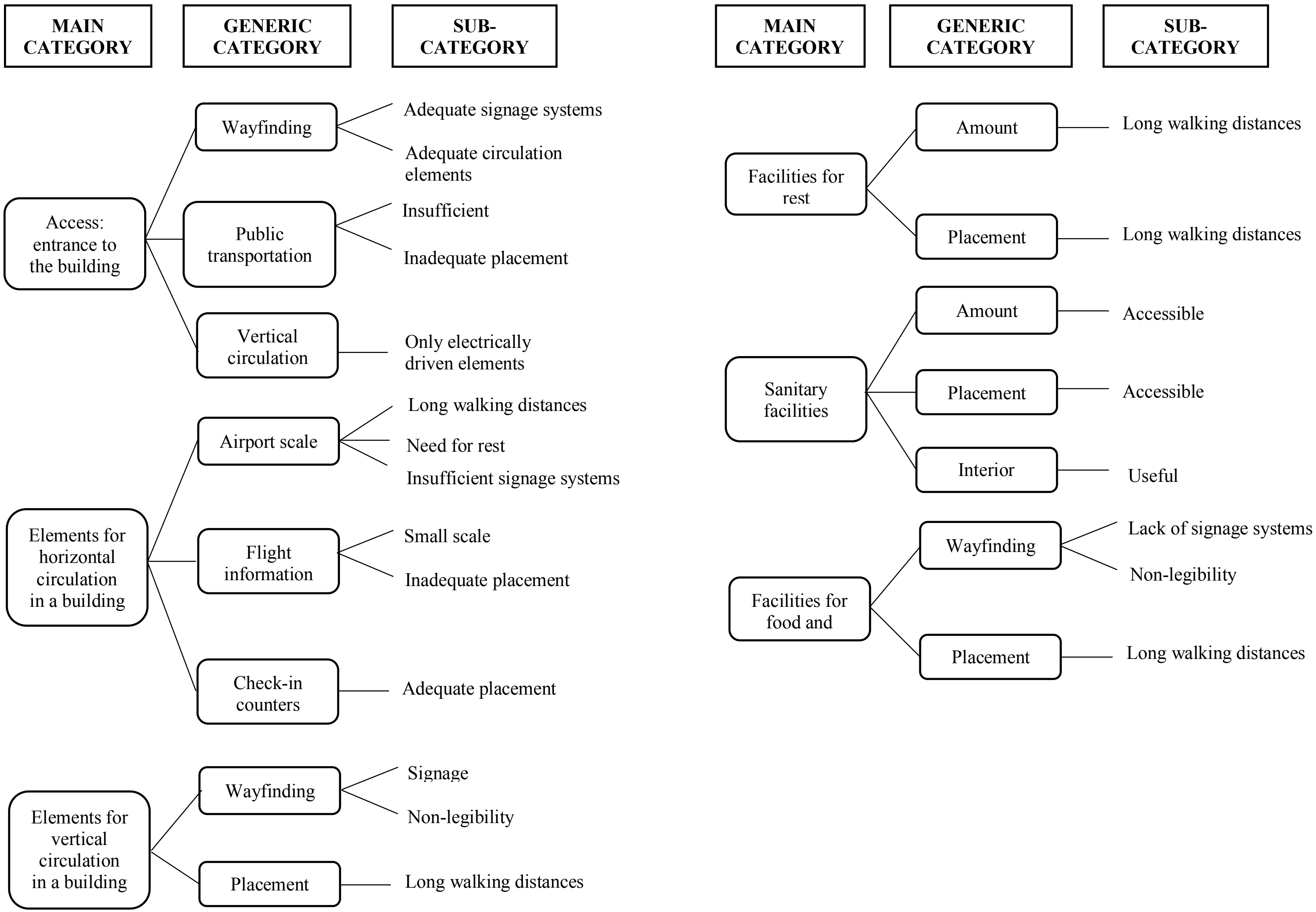

Figure 25. Abstraction process of Session I (drawn by the author, 2019).

Session III

Considering *'access: entrance to the building'*, all evaluators mentioned that access from public transportation was a challenging task to enter the airport. The reason was that public transportation stops were located at the basement floor, so passengers needed to use vertical circulation elements in order to arrive domestic departure area, which was located on the ground floor. The problems regarding the legibility of signage systems were also reported by the same evaluators in this session. It was because of the insufficient amount of signage systems from parking areas to domestic entrance doors.

For *'elements for horizontal circulation in a building'*, all evaluators stated that long walking distances could be the most significant usability problem for that airport. Also, they all stated that considering the scale and the passenger circulation of that airport, there should be definitely more number of seating elements. Four evaluators who were three interior architects and one architect also suggested that some seating areas could be designed nearby the check-in counters. They mentioned that because the seating areas were located near to the entrance doors and restrooms, and they were no seating elements near check-in counters. Consistent with Session I, signage systems and small flight information screens were also found to be an issue in terms of legibility, nevertheless for Session III, more evaluators (five evaluators for signage systems and six evaluators for flight information screens) took attention to flight information screens. In addition to the findings of Session I, all evaluators added loud announcement systems and five evaluators mentioned slipperiness of the floor as usability problems.

Even though I like the layout of the check-in kiosks, considering the waiting period for the queue, I think there should be some seating area nearby check-in kiosks (#IA3).

For '*elements for vertical circulation in a building'*, seven evaluators mentioned the non-legibility and other seven evaluators stated improper placement of the escalators and elevators. They explained that there was only one elevator and one escalator in the domestic departure area. Considering the huge scale of the airport, these numbers were unacceptable, and they caused long walking distances. Besides, they also stated that there were no sufficient signage systems that could direct the passengers. Moreover, all evaluators, who wore GERT suit, were concerned a lot about the high speed of escalators as well as slippery floor of the vertical circulation elements.

Considering *'facilities for rest'*, consistent with Session I, placement and number of seating elements were reported by all evaluators. Considering the expected passenger flow of that airport, the number of seating elements was very insufficient. Especially, evaluators with GERT suit discussed more the importance of seating elements. Six of them also emphasized the ergonomic dimensions of the seating elements and suggested that they could be more comfortable considering the long waiting periods in airports. It was because only one type of seating elements was designed with a polyurethane material for the domestic arrival area.

These seating units may look nice in terms of usability, but sometimes people need more comfort in airports if they need to sit there for long hours (#AA3).

Considering *'sanitary facilities'*, all evaluators, who did not wear GERT suit, found no usability problems at the restrooms. On the contrary, they were stated the success of the design of their placements, numbers and amenities. On the other hand, evaluators with GERT suits indicated that the placement, signage systems, sanitary amenities, slippery floor and understanding announcements could be problematic for elderly users.

At first, I found the placement of the restrooms successful. However, after I wore this suit, the distances became longer for me. Accordingly, walking through the restrooms also became challenging for my body (#IA4).

For *'facilities for food and drinks'*, all evaluators stated that the placement of food and drinks facilities were a little bit far away. They indicated their preference for a more homogenous placement of these facilities consistent with their statements in Session I. Moreover, proper signage systems were also lacking to orient the passengers to those food and drinks facilities. Besides, evaluators with GERT suit found acoustical problems related with hearing flight announcements. It was difficult to understand clearly those announcements at that area because of the background noise. Furthermore, they stated that considering the passenger circulation of the airport, the number of seating elements at food and drink facilities was also found insufficient.

Similar to Session I, based on the evaluators' responses, an abstraction process of Session III was formulated. Figure 26 illustrates this abstraction. Even though the abstraction in Figure 26 has similarities with Figure 25, additional generic and sub-categories can be seen where more usability problems were reported during Session III.

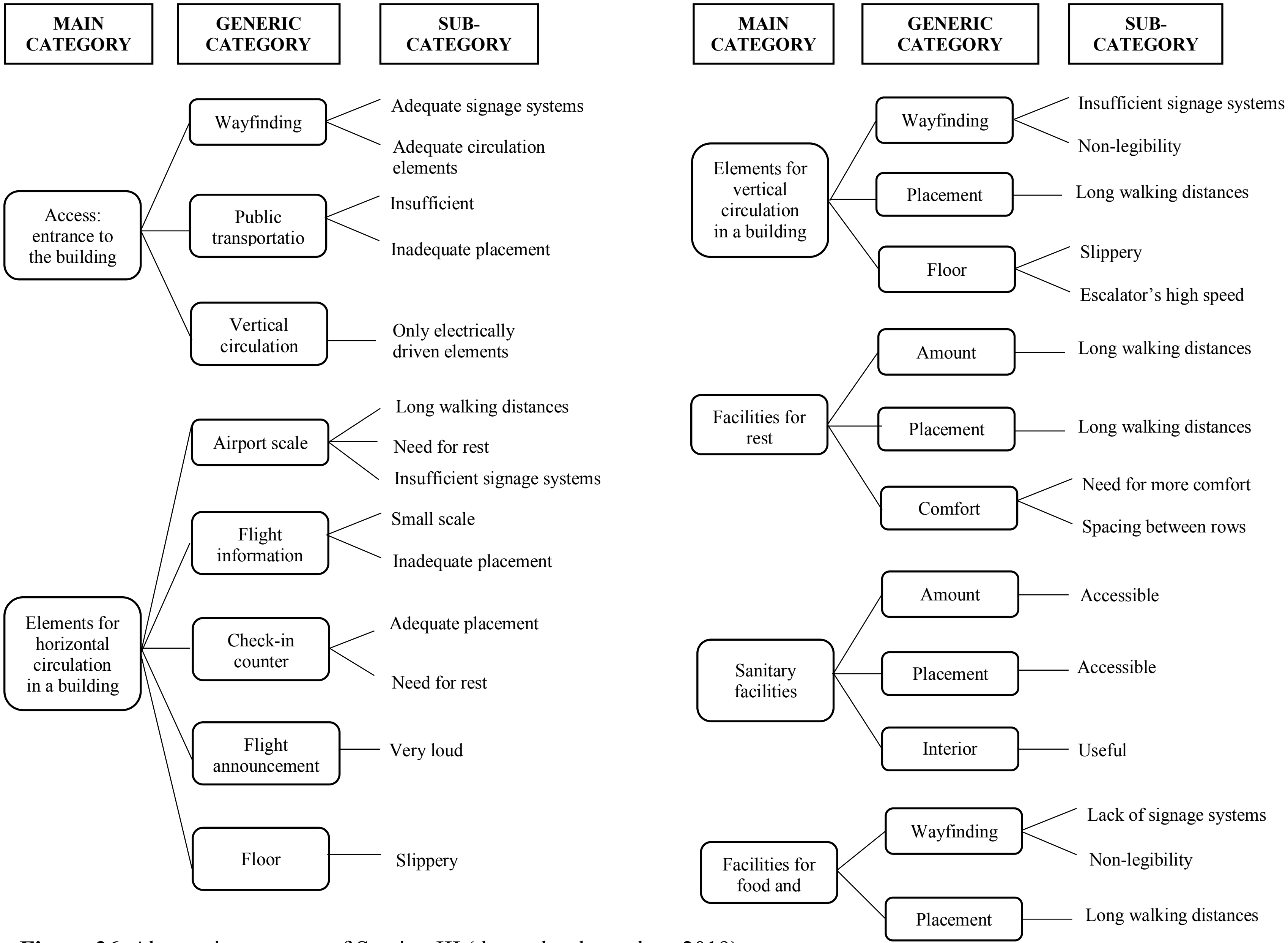

Figure 26. Abstraction process of Session III (drawn by the author, 2019).

4.2. Quantitative Findings

All quantitative data analyses were done by IBM SPSS Statistics 24 software. Quantitative findings were analyzed under three categories: (1) descriptive statistics, (2) simulation findings and (3) heuristic findings. The statistical calculations, descriptive analysis, t-test, correlation matrices and two-way ANOVA test were used for obtaining the results.

4.2.1 Descriptive Statistics

As mentioned previously, there were eight evaluators in total. Four evaluators were architects and the other four evaluators were interior architects. The majority (75%) of the study evaluators were male. Their age range was between 29 and 49 years, with a mean age of 38.83 years. The evaluators were professionally working in practice for at least six years. The professional experience of the evaluators was minimum 6 years and maximum 25 years, with a mean experience of 14.13 years. Although the evaluators had been selected randomly, as seen in the descriptive results, the evaluators had matching age, profession, professional experience and body mass index. Thereby, all possible outcomes that could direct the results differently due the diversities of the evaluators had been prevented in advance to obtain more reliable results.

4.2.2. Simulation Findings

In order to explore the impact of GERT suit on heuristic evaluation method, independent t-test analyses were used. In order to test Hypothesis 1 (H1), 'There is a statistically significant difference in performance of heuristic evaluation while wearing an age simulation suit', the mean differences of usability agreement levels in the session II were compared regarding the group with GERT suit and the group without GERT suit for Session II. Accordingly, two independent t-tests were conducted to analyze the difference of wearing GERT suit (1) on the overall six task scenarios and (2) on each task scenario individually. Figure 27 illustrates mean values for overall task scenarios. Regarding the usability agreement, the overall mean value of responses belonging to the group without GERT suit is higher (4.2600) than the overall mean values of the group with GERT suit (3.2750). This means that the usability performance of the building elements of the airport environment was found better without GERT suit, whereas evaluators without GERT suit drew less attention to possible usability problems for elderly travelers. Besides, the result of the independent t-test for overall six task scenarios also showed that there was a statistically significant difference between the two groups (F=.870, t=7.934, p=.000, at the 0.05 level).

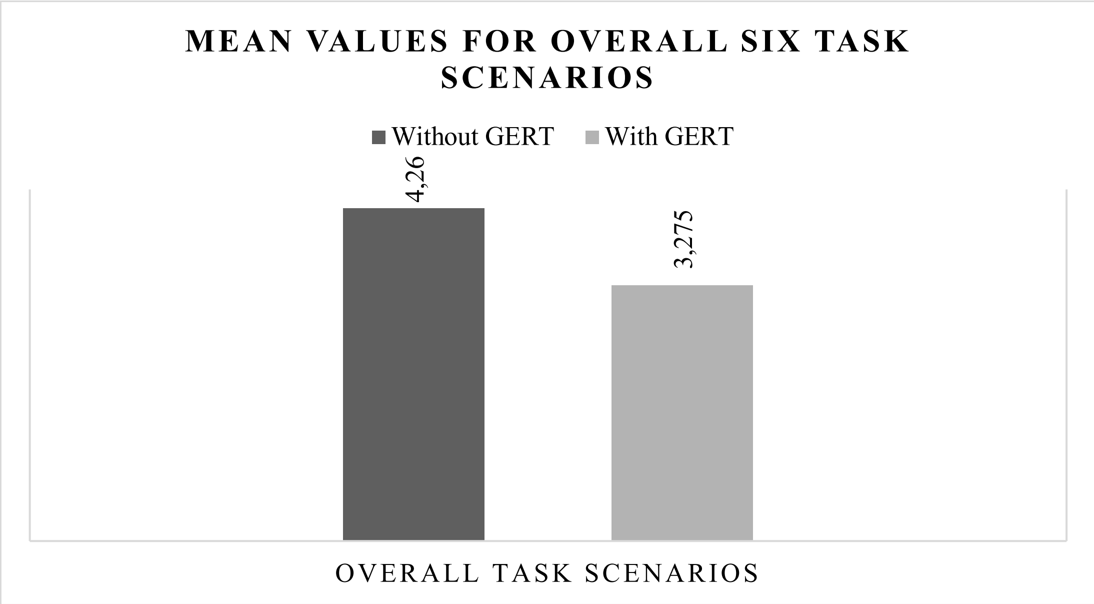

Figure 27. Mean values for overall six task scenarios.

Likewise, the study also found statically significant mean difference for each task scenario (at the 0.05 level) (See Figure 28 for mean values for each task scenario and Table 6 for independent t test statistics). At this point, consistent with the Hypothesis 1 (H1), GERT suit enhanced better performance of heuristic evaluation in terms of finding more usability problems for all six task scenarios in Session II.

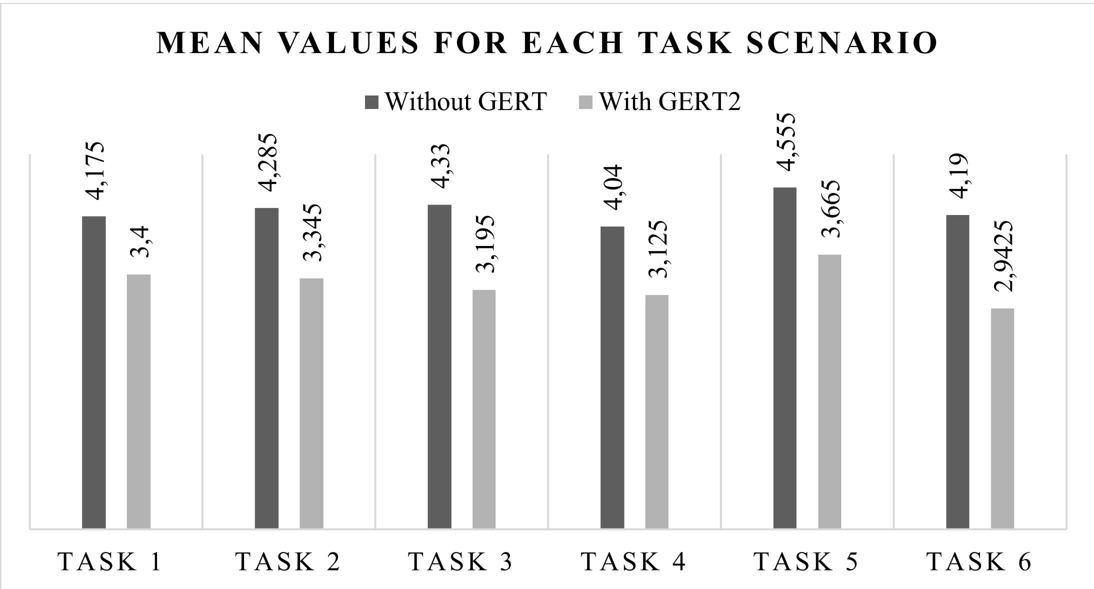

Figure 28. Mean values for each task scenario (T1, T2, T3, T4, T5, T6).

Table 6. Independent Sample T Test for each task scenario.

		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**
Task 1	**Equal variances assumed**	.860	.390	5.007	6	.002	.77500	.15478
	Equal variances not assumed			5.007	5.014	.004	.77500	.15478
Task 2	**Equal variances assumed**	2.862	.142	5.655	6	.001	.94000	.16623
	Equal variances not assumed			5.655	3.881	.005	.94000	.16623
Task 3	**Equal variances assumed**	3.884	.096	5.175	6	.002	1.13500	.21934
	Equal variances not assumed			5.175	3.262	.011	1.13500	.21934
Task 4	**Equal variances assumed**	.436	.533	5.164	6	.002	.91500	.17718
	Equal variances not assumed			5.164	5.497	.003	.91500	.17718
Task 5	**Equal variances assumed**	1.704	.240	3.575	6	.012	.89000	.24896
	Equal variances not assumed			3.575	4.192	.022	.89000	.24896
Task 6	**Equal variances assumed**	.974	.362	8.621	6	.000	1.24750	.14471
	Equal variances not assumed			8.621	5.284	.000	1.24750	.14471

Moreover, another independent t-test was also conducted in order to measure the differences between the groups with respect to perceived closeness of the evaluators towards elderly people. As mentioned in the methodology chapter, perceived closeness was measured by Inclusion of Other in the Self (IOS) Scale by Aron et al (1992). According to the results, there was a significant mean difference between the groups (p=0.07, at the 0.05 level, See Figure 29 and Table 7). It was shown that the group with GERT suit experienced higher perceived closeness towards elderly people. So, Hypothesis 2 (H2), 'Ageing simulation suit significantly enhances increasing perceived closeness towards elderly people', was also supported. Therefore, GERT suit significantly enhanced perceived closeness towards elderly people that can result in better inspection of usability problems with respect to elderly users.

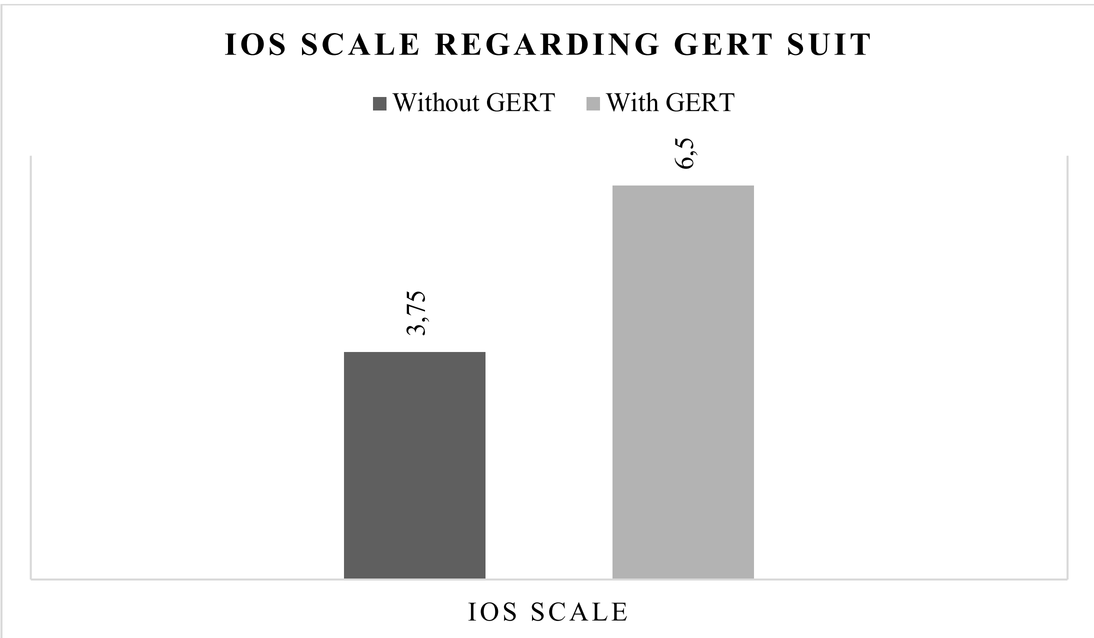

Figure 29. Means values for inclusion of other in the self (IOS) scale.

Table 7. Independent Samples Test 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 Scale	**Equal variances assumed**	1.000	.356	-3.973	6	.007	-2.750	.692
	Equal variances not assumed			-3.973	4.210	.015	-2.750	.692

The last independent t-test was conducted to measure the impact of GERT suit on physical performance difficulty of each task, in which Hypotheses 3 (H3), 'There is a statistically significant effect of wearing ageing simulation suit on difficulty in physical performance', was tested. Accordingly, considering the physical performance difficulty responses of the participants, statistical mean differences were found for Task 1, Task 2, Task 3, Task 4 and Task 6 by conducting independent t-test ($p1=.032$, $p2=0.03$, $p3=.020$, $p4= .017$, $p6= .040$, at the 0.05 level, See Table 8 and Figure 30). However, for Task 5 a statistical mean difference was not found significantly ($p=134$, at the 0.05 level, See Table 8 and Figure 30). It is because the building element (sanitary facilities) in Task 5 was found the most usable building element in terms of use of elderly people (See section 4.2.3 for more detailed information). This means evaluators with GERT suit did not experience many physical difficulties while performing Task 5, whereas their physical performance difficulty evaluations were affected accordingly.

Table 8. Independent Samples Test for physical performance difficulty.

		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
Task 1	Equal variances assumed	2.455	.168	2.777	6	.032	1.500	.540
	Equal variances not assumed			2.777	4.523	.044	1.500	.540
Task 2	Equal variances assumed	3.000	.134	4.899	6	.003	2.000	.408
	Equal variances not assumed			4.899	3.000	.016	2.000	.408
Task 3	Equal variances assumed	1.800	.228	3.130	6	.020	1.750	.559
	Equal variances not assumed			3.130	4.412	.031	1.750	.559
Task 4	Equal variances assumed	1.000	.356	3.273	6	.017	1.250	.382
	Equal variances not assumed			3.273	5.880	.017	1.250	.382
Task 5	Equal variances assumed	.	.	1.732	6	.134	.500	.289
	Equal variances not assumed			1.732	3.000	.182	.500	.289
Task 6	Equal variances assumed	.158	.705	2.611	6	.040	1.250	.479
	Equal variances not assumed			2.611	4.973	.048	1.250	.479

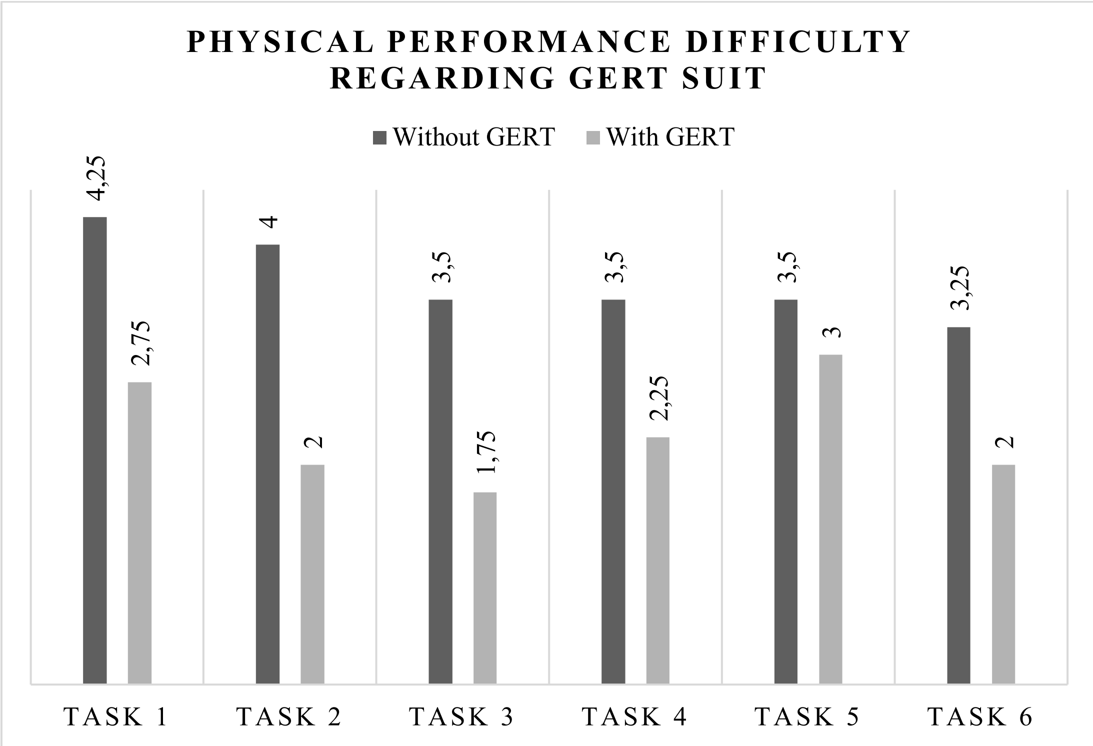

Figure 30. Mean values for physical performance difficulty.

Lastly, Pearson correlation analysis was used to identify the correlations between usability evaluation and physical performance difficulty. The relationships between variables are stated as correlation coefficients. For instance, 0.9 to 1.00 indicates very strong correlation between variables whereas 0.2-0.4 indicates low correlation (Argyrous, 2011). Table 9 illustrates the values of correlation. Regarding the GERT suit as a physical limitation instrument, the thesis analyzed how physical difficulty was related with the usability evaluation. According to the result of the Pearson correlation, there was a statistically significant relationship between usability evaluation and physical performance difficulty. Pearson correlation coefficient is .702, where a positive, strong, high and marked association existed (See Table 10). Therefore, as stated in Hypothesis 4 (H4), 'There is a statistically significant correlation between airport usability and difficulty in physical performance', it is possible to state that in this thesis, physical performance difficulty was highly associated with usability evaluation (p=.000, at the 0.05 significance level, See Table 10). Such a correlation pointed out that GERT suit is crucial and has a significant benefit on usability detection. When the physical capacity decreases, the ability of a person to perform certain task reduces. Accordingly, possible usability problems occur while performing difficult tasks. Therefore, by testing H4, it was possible to examine how the usability evaluation of evaluators were affected by the physical difficulty of given tasks in Session II.

Table 9. Values of correlation (Argyrous, 2011).

Range	**Relative Strength**
0	No relationship
0-0.2	Very weak relationship
0.2-04	Weak, low association
0.4-0.7	Moderate association
0.7-0.9	Strong, high, marked association
0.9-1.0	Very high, very strong relationship
1.0	Perfect association

Table 10. Correlation between usability evaluation and physical difficulty.

		Usability	Physical Difficulty
	Pearson Correlation	1	.702
Usability Evaluation	**Sig. (2-tailed)**		.000
	N	48	48
	Pearson Correlation	.702	1
Physical Difficulty	**Sig. (2-tailed)**	.000	
	N	48	48

4.2.3. Heuristic Findings

During all test sessions, the evaluators in total had detected 47 usability problems. Table 11 illustrates a detailed distribution matrix of reported usability problems for Session I, Session II and Session III. It shows which evaluators found which usability problem during which session regarding GERT suit and their professions.

Table 11. Reported usability problems during Session I, Session II and Session III.

Problems reported by all evaluators	without GERT												with GERT											
	IA1			AAI			IA2			AA2			IA3			IA4			AA3			AA4		
	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3
1. Access: entrance to the building																								
1. Use of vertical circulation																						■		■
2. Access from public transportation		■	■		■	■	■	■	■		■	■		■	■		■	■		■	■	■	■	■
3. Not enough signage systems																						■		■
4. Hard to read signage systems																	■	■						
2. Elements for horizontal circulation																								
5. Long walking distances		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
6. Limited number of seating elements		■	■			■	■	■	■	■	■	■	■	■	■		■	■		■	■	■	■	■
7. Lack of seating elements near check-in counters			■							■		■						■				■		■
8. Inadequate placement of check-in counters		■	■											■	■		■	■		■	■	■	■	■
9. Inadequate placement of flight information screens		■	■									■	■	■	■	■	■	■	■	■	■	■	■	■
10. Small flight information screens			■									■	■		■	■		■	■		■	■		■
11. Not enough signage systems	■				■	■		■	■							■	■	■	■	■	■		■	■
12. Inadequate placement of signage systems	■															■	■	■	■	■	■		■	■
13.Very loud announcement systems		■	■		■	■		■	■		■	■		■	■		■	■		■	■		■	■
14. Hard to read signage systems	■																■	■						
15. Slipperiness of the floor								■	■		■	■		■	■					■	■			■
3. Elements for virtical circulation																								
16. Non-legibility of the escalator inside of the building	■		■	■			■		■	■		■	■		■	■		■	■		■	■		■
17. Non-legibility of the elevators inside of the building	■		■	■			■		■	■		■	■		■	■		■	■		■	■		■
18. Inadequate placement of elevators	■	■	■	■				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
19. Inadequate placement of escalators	■	■	■	■				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
20. Cause long walking distances	■		■	■	■	■	■	■	■		■	■		■	■	■	■	■	■	■	■	■	■	■
21. Unsafe escalator due to its high													■		■				■		■	■		■
22. High-speed of the escalator														■	■		■	■		■	■		■	■
23. Limited number of escalator			■			■			■			■			■	■		■	■		■			
24. Limited number of elevators			■			■			■			■			■	■		■	■		■			
25. Slipperiness of the escalator floor																	■	■		■	■		■	■
26. Slipperiness of the elevator floor																	■	■		■	■		■	■
27. Inadequate placement of signage systems		■	■		■	■		■	■		■	■		■	■		■	■		■	■		■	■
28. Difficult to understand signage systems																	■	■						
29. Difficult to understand announcements														■	■		■	■		■	■		■	■
4. Facilities for rest																								
30. Limited number of seating elements		■	■				■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
31. Inadequate placement of seating elements	■		■				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
32. Cause long walking distances										■	■	■	■		■	■		■				■		■
33. Non-legibility of seating elements	■		■	■	■	■	■		■							■		■						
34. Uncomfortable seating elements	■		■		■	■								■	■		■	■		■	■			
35. Anadequate spacing between rows of the seats								■	■								■	■			■			
5. Sanitary Facilities																								
36. Non-legibility of restrooms																■		■						
37. Inadequate placement of restrooms														■	■					■	■		■	■
38. Slipperiness of the floor														■	■					■	■			
39. Inadequate placement of signage systems																				■	■			
40. Hard to use sanitary amenities											■	■		■	■		■	■		■	■			
41. Hard to understand announcements														■	■			■		■	■		■	■
6. Facilities for food and drinks																								
42. Inadequate placement of food/drink facilities		■	■	■	■	■		■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■
43. Cause long walking distances		■	■	■	■	■		■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■
44. Non-legibility of food/drink facilities			■			■	■		■			■			■	■		■	■		■	■		■
45. Lack of signage systems		■	■		■	■		■	■		■	■		■	■		■	■		■	■		■	■
46. Difficult to understand announcements														■	■			■		■	■		■	■
47. Limited number seating elements														■	■		■	■		■	■		■	■
	11	13	24	9	11	15	10	15	22	12	16	24	14	23	33	20	28	40	18	30	38	22	25	35
TOTAL = 47	**48**			**35**			**47**			**52**			**70**			**88**			**76**			**82**		

E: Evaluator, S1: Session 1, S2: Session 2, S3: Session 3, ■ Reported usability problem, IA: Interior Architect, AA: Architect

According to the frequency of each reported usability problem, elements for horizontal circulation and elements for vertical circulation were reported as the least useful building elements for the airport environment. As Figure 31 illustrates, sanitary facilities and entrance to the building was found the most useful building elements for elderly passengers. Besides, long walking distances, limited number of seating elements, inadequate placements of building elements including horizontal circulation, vertical circulation, seating elements and food/drink facilities were the most reported usability problems.

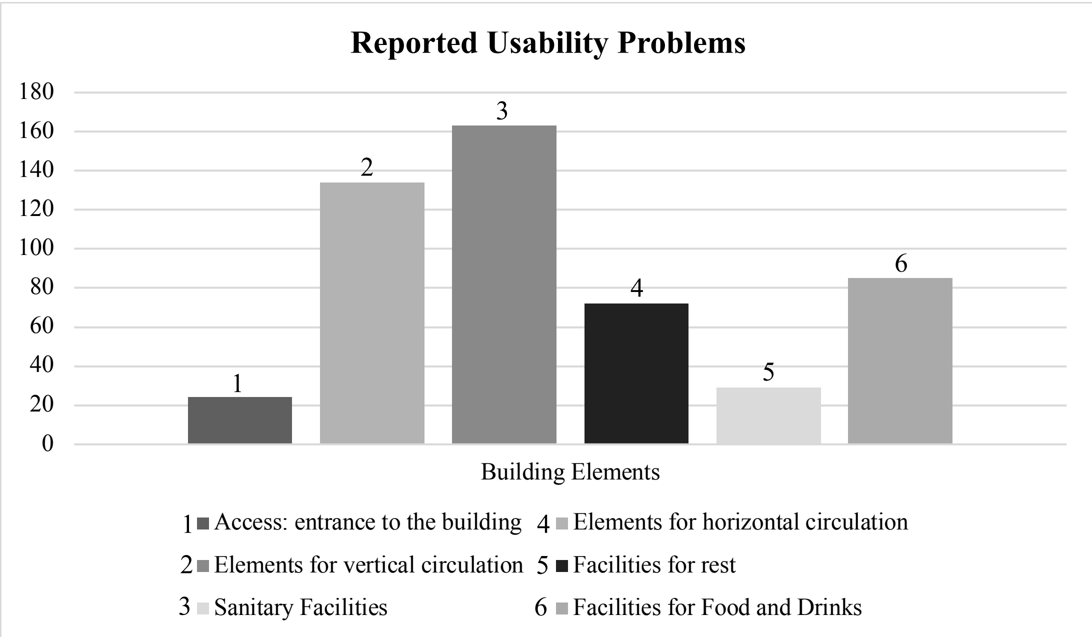

Figure 31. Reported usability problems regarding building elements.

Moreover, in order to analyze the effect of profession and test sessions on the performance of usability evaluation, a two-way ANOVA test was conducted. According to test results, a statistically significant effect was found with respect to test sessions (p=.000, at the 0.05 significance level, See Table 12). 116 usability problems were found in Session I, 161 usability problems were found in Session II and 231 usability problems were found in Session III as shown in Table 13. Thereby, fewer usability problems were found in Session I, i.e., including non-legibility of seating elements, inadequate placement of signage systems, small flight information screens, and unsafe escalator. The reasons for finding less number of problems in Session I could be as follows: evaluators were familiar with that airport environment for only 10 minutes, and they had not performed any passenger activities yet. However, most of the usability problems were found in Session II and Session III, i.e., access from public transport, long walking distances, limited number and inadequate placement of seating elements, non-legibility and inadequate placement of vertical circulation elements, and inadequate placement of food/drink facilities. The reason for finding more usability problems in Session II compared to Session I could be that task scenarios and GERT suit have encouraged the evaluators to interact within the airport environment more, to experience barriers, risk factors and unusable design features of the airport.

On the other hand, a statistical significant evaluator effect in terms of professions on the performance of usability evaluation was not found as a result of two-way ANOVA test ($p= 0.93$, at the 0.05 significance level, See Table 12). Therefore, Hypothesis 5 (H5) was rejected. In total, interior architects found 253 usability problems and architects found 255 usability problems as shown in Table 13. Consistent with the statement of the evaluators, evaluators did not have too distinctive focuses during test sessions. They mainly embraced the usability of the airport environment in similar tendencies. Accordingly, as statistical results were demonstrated, evaluator effect was not observed between interior architects and architects for this study.

Table 12. Two-way ANOVA test results for the effect of profession and test sessions on the performance of usability evaluation.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	19847.048[a]	5	3969.409	87.160	.000
Intercept	251987.524	1	251987.524	5533.100	.000
Profession	128.884	1	128.884	2.830	.093
Session	19672.315	2	9836.158	215.981	.000
Profession * Session	172.725	2	86.362	1.896	.151
Error	22862.000	502	45.542		
Total	359110.000	508			
Corrected Total	42709.047	507			

a. R Squared = .465 (Adjusted R Squared = .459)

Table 13. Reported usability problems regarding test sessions and professions.

		Number Usability Problem
Test Session	**Session 1**	116
	Session 2	161
	Session 3	231
Profession	**Interior Architect**	253
	Architect	255

Lastly, in order to test Hypotheses 6 (H6), ‘Heuristic evaluation method significantly enhanced better inspection of usability problems in airport environments’, a paired sample t-test was conducted. Accordingly, we wanted to compare the pre-test statements of the evaluators and their post-test evaluations. As a result of the paired sample t-test, a statistically significant difference was found between Session I and Session III considering the number of reported usability problems, consistent with H6 (p=.000, at the 0.05 significance level, See Table 14).

Table 14. Paired samples test for Session I and Session III difference.

			%95 Confidence Interval of the Difference				
		Std. Error Mean	**Lower**	**Upper**	**t**	**df**	**Sig. (2-tailed)**
Pair 1	Session 1-Session 3	1.742	-18.493	-10.257	-8.253	7	.000

4.3. Discussion

The study analyzed obtained data both qualitatively and quantitatively. According to the comparison of qualitative results obtained during Session I with the results obtained in Session II and III, it is possible to say that evaluators could not experience all the usability aspects of the airport environment. As mentioned before, participants had been in this airport for the first time. As a result, in order to evaluate the airport environment in a more comprehensive way, they needed time whereas Session II helped them in this manner. Task scenarios and heuristic questions during Session II enabled them to consider that airport environment in a detailed manner. Consistent with the literature, GERT suit gave them the opportunity to make empathy and experience the physical limitations of elderly people (Moll, n.d.) in a real airport environment by performing real task scenarios. Accordingly, this emphatic experience provided them a new perspective for elicitation of usability issues of the airport environment. During Session III, evaluators mentioned more usability problems even though the same open-ended questions of Session I were asked. To give an example, in Session I, six of the evaluators did not take attention to public transportation problems. However, during Session III, all evaluators reported access from public transportation as a difficult task to enter the building. Accordingly, it can be said that experiences of evaluators in Session II allowed them to be aware of more usability issues.

Moreover, during Session III, it was possible to observe the significant impact of GERT suit towards perception of the evaluators. This means, evaluators with GERT suit stated additional usability problems for almost every building elements. As mentioned in the literature review, the reason is that GERT suit enabled the evaluators to experience physical limitations of elderly people including vision, hearing, head mobility, joint stiffness, loss of strength, grip ability and coordination skills (Moll, n.d.), and the evaluators were able to put themselves in 'elderly user's shoes' by increasing empathy. Hereby, the previously mentioned gap between designers' approach and the needs of elderly users (Boot et al., 2012) became closer with this empathic tool that can encourage better designed airport environments for elderly passengers for future projects.

Considering the quantitative analysis, consistent with qualitative results, GERT suit was found significantly effective for the usability inspection process of an airport environment. Besides, in line with the previous studies, quantitative results also showed that GERT suit enabled increased level of perceived closeness and physical performance difficulty during Session II, whereas evaluators were able to report more usability problems for Session II and Session III. In other words, since the most crucial feature of GERT suit is the way that it makes physical restrictions for the human body, combining these restriction with real task scenarios in a real airport environment enabled the evaluators: (1) to create empathy towards elderly people with respect to their airport activities, (2) to critically analyze the airport architectural features in accommodating elderly passengers and (3) to understand the needs of elderly people to take necessary precautions and to apply for future architectural projects. Lastly, this study aimed to see an evaluator effect in terms of the profession of the evaluators. However, quantitative results showed that there was not a significant evaluator effect, in which interior architects and architects reported similar number of usability problems in the total of Session I, Session II and Session III.

The quantitative findings also showed that the least usable building elements in the airport were ‘elements for horizontal circulation’ and ‘elements for vertical circulation’. In accordance with the evaluators’ expressions, this result was mainly because of the long walking distances of the airport. Therefore, evaluators mentioned that diminishing the distances between the building elements could provide more supportive airport environment for elderly passengers by extinguishing physical barriers and by diminishing stress level and tiredness of the elderly passengers.

On the other hand, despite its significant contribution to this study, GERT suit only simulated the elderly body with respect to sensory and motor capabilities. In other words, only physical capabilities were restricted while wearing that suit. However, as a result of normal ageing process not only physical capabilities decrease but also cognitive capabilities reduce as well. This means, our study only considered physical limitations of elderly people, since the participants of the study were divided into two groups with respect to evaluators who wore GERT suit and evaluators who did not wear GERT suit. In this manner, in order to conduct a more reliable study in terms of elderly limitations, including real elderly people to the study as a third value of that focus group would be more beneficial to also analyze the impact of cognitive restrictions of elderly people in airport usability. Thereby, within the third group, the reliability of GERT suit during heuristic evaluation could also be measured by making comparisons of GERT suit with real elderly users. Moreover, as mentioned in the literature review, since the ageing is not a homogeneous process, there are early elderly (60 to 74 years) and late elderly (75 years and more) people (MacKinlay, 2007; Multani & Verma, 2007; Orimo et al., 2006). However, the producer of GERT suit does not emphasize any specific age range for the suit. Accordingly, the result may vary and be different in terms of performance and capabilities of real elderly people. During the experiment procedure, the reason that the evaluators were adults who had physical and cognitive capabilities, they were much more able to deal with physical challenges that caused from GERT suit. However, the thesis believes that the real elderly people may experience more difficulties while performing the task scenarios.

Furthermore, during the experiment procedure, the evaluators in the study had no real flight tickets and therefore no time-pressure for catching the flight and boarding. Therefore, they performed the task scenarios without any rush. Thus, it is expected that passengers with real flight tickets are more likely to feel stressed because of the risk of missing the flight. At this point, time constraints would impact the performance of the evaluators during the task scenarios in which their usability evaluations may be affected from. Moreover, while collecting the data in the airport environment, the operational activities were not totally started and only five-six flights were scheduled in a day. However, according to expected numbers, 3500 flights per day will be operated in that airport (Dirsehan, 2019; Koseoglu et al.,2019). Accordingly, during the busiest period of that airport environment, task performances and usability evaluations of the evaluators could be different from this study. It is because, during the data collection of this study, the building elements were much more visible, accessible and understandable due to the lack of real passengers.

Finally, as discussed in the literature review, heuristic evaluation is a rule of thumb method that can be easily adapted into other research studies (Quiñones & Rusu, 2017). As discussed previously, only %3 of the existing heuristic studies are related to the usability studies in architectural design context (Hermawati & Lawson, 2016) and there are no tools available to evaluate the usability of a built environment (Fink et al., 2010). In this connection, this study is a pioneer study, which could be also adapted into other architectural typologies to evaluate their usability even by regarding elderly people or not. Therefore, this study can close an important gap in order to promote the usability of built environment not only for elderly friendly built environments but also to support new conceptual design considerations for future architectural projects. A proposed study model for establishing simulation based space heuristics is seen in Figure 32.

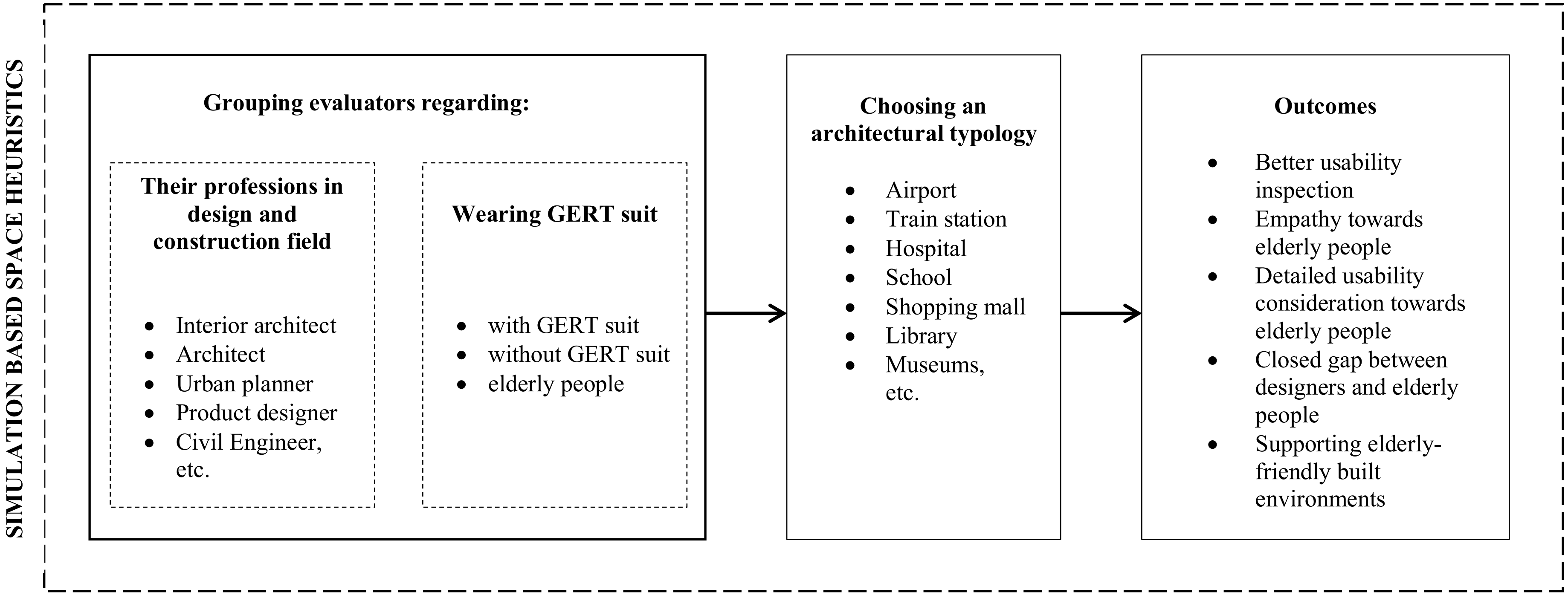

Figure 32. Proposed model for establishing simulation based space heuristics (drawn by the author, 2019).

CHAPTER 5

CONCLUSION

This study is a pioneering study considering the two following aspects: (1) for the first time, the study used GERT suit in an airport environment and (2) the study evaluated usability of an airport environment by heuristic evaluation method combined with emphatic design. Accordingly, this study suggested a new empathic methodology with simulated physical ageing combined with heuristic evaluation in order to close the gap between designers and elderly users. Findings of the study indicated that GERT suit significantly enhanced better perception of usability problems in an airport environment regarding elderly needs and demands. By restricting physical capabilities, evaluators increased their empathy towards elderly passengers in an airport environment whereas more usability issues were took attention of the evaluators.

The findings also showed that the level of perceived closeness and the physical performance difficulty both increased while wearing GERT suit. In other words, having physical challenges while performing task scenarios enabled the evaluators to increase their empathy towards elderly people, which resulted in the better inspection of usability problems.

The findings on evaluator effect showed that there was not a significant difference between the usability inspection performance of interior architect and architects. As mentioned by the evaluators, this can be due to similar working areas of interior architects and architects in architectural offices. Accordingly, in order to observe that evaluator effect with respect to profession, future studies can include more professions from construction and design field. For instance, like the study of Afacan and Erbuğ (2009), the profession group can include interior architect, architect and urban planner. Also in addition to their considerations, product designer or civil engineer can also be included in profession group to enlarge the perspectives of the evaluators. Moreover, as mentioned in the discussion part, the other limitation of the study was the way in which cognitive capacities of elderly people were not taken into consideration. In this regard, since this study dealt with the needs of elderly people in airport environments, utilizing the perspective of real elderly people would improve the reliability of the study.

As a result, considering these limitations, the suggested study model for future studies includes two new approaches to embrace the usability of built environment with more detailed considerations. These are: (1) including more professions from design and construction field to observe evaluator effect and (2) forming the focus group with three values including group with GERT suit, group without GERT suit and group of elderly people.

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APPENDIX A

THE APPROVED ETHICS FORMS BY THE BILKENT UNIVERSITY ETHICS COMMITTEE

Bilkent Üniversitesi
Akademik İşler Rektör Yardımcılığı

Tarih : 7 Ocak 2019

Gönderilen : İrem Yumuşak

Tez Danışmanı : Yasemin Afacan

Gönderen : Fatma Taşkın
İnsan Araştırmaları Etik Kurulu Başkanı

Konu : *"Heuristic Evaluation ..."* çalışması etik kurul onayı

Üniversitemiz İnsan Araştırmaları Etik Kurulu, 7 Ocak 2019 tarihli görüşme sonucu, *"Heuristic Evaluation through Simulated Physical Ageing to Improve Airport Usability for Elderly (Havaalanlarında ki Yaşlılara Yönelik Kullanım Problemlerinin Fiziksel Yaşlı Simülasyonu Aracılığıyla Analizi)"* 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.

Etik Kurul Üyeleri:

Ünvan / İsim	**Bölüm / Uzmanlık**	**İmza**
1. Doç.Dr. Fatma Taşkın	İktisat	
2. Prof.Dr. Erdal Onar	Hukuk	
3. Prof.Dr. Haldun Özaktaş	Elektrik ve Elektronik Müh.	
4. Doç.Dr. Işık Yuluğ	Moleküler Biyoloji ve Genetik	
5. Yrd.Doç.Dr. Gül Günaydın	Psikoloji	
Yd.1.Doç.Dr. Çiğdem Gündüz Demir	Bilgisayar Mühendisliği	(yedek üye)
Yd.2. Yrd.Doç.Dr. A.Barış Özbilen	Hukuk	(yedek üye)

Kurul karar/toplantı No: 2019_01_07_02

Bilkent Üniversitesi, 06800 Bilkent, Ankara • Telefon: (312) 290 12 13 • (312) 290 12 14 • Faks: (312) 266 41 52

(Form Student_EN*)

Ethics form for graduate and undergraduate students - human participants

Note - group projects fill in one copy with all your names on it. Consult your project supervisor for advice before filling in the form.

Your name(s): İrem Yumuşak **Project Supervisor: Assoc. Prof. Yasemin Afacan**

A. Write your name(s) and that of your supervisor above.
B. Read section 2 that your supervisor will have to sign. Make sure that you cover all these issues in section 1. Discuss what you are going to put on the form with your project supervisor.
C. Sign the form and get your project supervisor to complete section 2 and sign the form.

1. Project Outline (to be completed by student(s))

(i) Full Title of Project:

Heuristic Evaluation through Simulated Physical Ageing to Improve Airport Usability for Elderly

(ii) Aims of project:

This study aims to explore the usability problems for elderly people in an airport environment by using heuristic evaluation method through simulated physical ageing.

(iii) What will the participants have to do? (brief outline of procedure; please draw attention to any manipulation that could possibly be judged as deception; *for survey work, a copy of the survey should be attached to this form*):

The participants will voluntarily participate the study. There will be eight participants. There are three different settings (Setting I, Setting II, Setting III) that will be conducted in an airport environment. Before the settings are started, brief explanation about the study and how participant's contribution will affect the study will be explained. In the Setting I, there is a questionnaire that will be asked during a movement tour of an airport environment. The questionnaire consists of six open-ended questions and is about the usability of that airport. The voices of the participants will be recorded during the questionnaire in order to analyse their answers qualitatively. In the Setting II, there are task scenarios to be performed by the participants in the same airport environment. Four participants will be wearing an age simulation suit and other four participants will not be wearing an age simulation suit during these task performances. After each task scenario, six heuristic questions about airport usability will be asked to the participants in a Likert Scale from 1 to 5. Moreover, difficulty level of each task will also be asked to the participants in a Likert Scale 1 to 5. The data obtained from the Setting II will be analysed statistically by using IBM SPSS Software. Setting III, is a questionnaire for the usability of the same airport environment that consist of similar open-ended questions to Setting I. However, in the Setting III, participants will be asked to reconsider their Setting I statements after their task performances in the Setting II. Their voices will be again recorded during the questionnaire in order to analyse their answers qualitatively. Lastly, as personal data, age, sex, profession, smoking status and physical exercise status will be asked to the participants. There will not be any discussion about life style or personal information of the participants. Moreover, all personal information of participants supplied during the research will be held in confidence in the researchers' database and accessed only by the study staff. The names of the participants will be coded into the numbers. So the personal information will not be shared in any medium.

(iv) What sort of people will the participants be and how will they be recruited? In the case of children state age range. (*Any participant who has not lived through his/her 18th birthday is considered to be a child!*)

All of the participants are between the age of 25 to 45. They will be in normal body mass index. Also, participants will be the professionals who works in architecture, design or construction field.

*If you are testing children or other vulnerable individuals, state whether all applicants have CRB** clearance* _____

* Adapted from *www.york.ac.uk/depts/psych/www/research/ethics/HumanProjForm.doc*

1

YA. Y.

(v) **What sort stimuli or materials will your participants be exposed to? Tick the appropriate boxes and then explain the form that they take in the space below, please draw attention to any content that could conceivably upset your participants). Questionnaires[x]; Pictures[ ]; Sounds [ ]; Words[x]; Caffeine[ ]; Alcohol[ ]; Other[x].**

Other: Age Simulation Suit
This simulation suit is about 15 kilograms. Therefore, participants who will wear that suit can get tired after the given task scenarios at Setting II.

Criminal Records Bureau – Please attach relevant clearance documentation.

YA · Y.

(vi) Consent Informed consent must be obtained for all participants before they take part in your project. The form should clearly state what they will be doing, drawing attention to anything they could conceivably object to subsequently. It should be in language that the person signing it will understand. It should also state that they can withdraw from the study at any time and the measures you are taking to ensure the confidentiality of data. If children are recruited from schools you will require the permission of the head teacher, and of parents. Children over 14 years should also sign an individual consent form themselves. When testing children you will also need Criminal Records Bureau clearance. Testing to be carried out in any institution (prison, hospital, etc.) will require permission from the appropriate authority. (Please include documentation for such permission.)

Who will you seek permission from?

Participants own permission will be obtained. They are all older than 18 years old.

Please attach the consent form you will use. Write the "brief description of study" in the words that you will use to inform the participants here.

The participants will voluntarily participate the study. There will be eight participants. There are three different settings (Setting I, Setting II, Setting III) that will be conducted in an airport environment. Before the settings are started, brief explanation about the study and how participant's contribution will affect the study will be explained. In the Setting I, there is a questionnaire that will be asked during a movement tour of an airport environment. The questionnaire consists of six open-ended questions and is about the usability of that airport. The voices of the participants will be recorded during the questionnaire in order to analyse their answers qualitatively. In the Setting II, there are task scenarios to be performed by the participants in the same airport environment. Four participants will be wearing an age simulation suit and other four participants will not be wearing an age simulation suit during these task performances. After each task scenario, six heuristic questions about airport usability will be asked to the participants in a Likert Scale from 1 to 5. Moreover, difficulty level of each task will also be asked to the participants in a Likert Scale 1 to 5. The data obtained from the Setting II will be analysed statistically by using IBM SPSS Software. Setting III, is a questionnaire for the usability of the same airport environment that consist of similar open-ended questions to Setting I. However, in the Setting III, participants will be asked to reconsider their Setting I statements after their task performances in the Setting II. Their voices will be again recorded during the questionnaire in order to analyse their answers qualitatively. Lastly, as personal data, age, sex, profession, smoking status and physical exercise status will be asked to the participants. There will not be any discussion about life style or personal information of the participants. Moreover, all personal information of participants supplied during the research will be held in confidence in the researchers' database and accessed only by the study staff. The names of the participants will be coded into the numbers. So the personal information will not be shared in any medium.

(vii) Debriefing - how and when will participants be informed about the experiment, and what information you intend to provide? If there is any chance that a participant will be 'upset' by taking part in the experiment what measures will you take to mitigate this?

Each participant who takes part in the questionnaires and task scenarios will be asked to sign a consent form to satisfy ethical procedures (See attached consent form). Before conducting the settings, a brief explanation will be also given as to how data from their responses will be used.

(viii) What procedures will you follow in order to guarantee the confidentiality of participants' data? Personal data (name, addresses etc.) should only be stored if absolutely necessary and then only in such a way that they cannot be associated with the participant's experimental data.

Each participant, who takes part in the in the questionnaires and task scenarios, will be asked to sign a consent form to satisfy ethical procedures (See attached consent form). All personal information of participants supplied during the research will be held in confidence in the researchers' database and accessed only by the study staff. The names of the participants will be coded into the numbers.

YA-Y.

In the information consent form there is a statement which is signed by the graduate student and the supervisor that "we confirm that the confidentiality and anonymity will be maintained and the participant will not be identified from any publications".

(vii) Give brief details of other special issues the ethics committee should be aware of.

-

(viii) Tick any of the following that apply to your project

[x] it uses Bilkent facilities;
[ ] it uses stimuli designed to be emotive or aversive;
[ ] it requires participants to ingest substances (e.g., alcohol);
[ ] it require participants to give information of a personal nature;
[ ] it involves children or other vulnerable individuals;
[ ] it could put you or someone else at risk of injury.

YA·Y.

Student's signature: ....İrem Yumuşak.................. date: ....20/12/2018.......
(all students must sign if this is a group project, please initial all other pages)

The signatures here signify that researchers will conform to the accepted ethical principles endorsed by relevant professional bodies, in particular to

Declaration of Helsinki (WMA):
http://www.wma.net/en/30publications/10policies/b3/index.html

Ethical Principles of Psychologists and Code of Conduct (APA):
http://www.apa.org/ethics/code2002.html

Ethical Standards for Research with Children (SCRD):
http://www.srcd.org/about-us/ethical-standards-research

2. Supervisor's assessment (supervisor to complete - circle yes or no)

Yes/No - I confirm that I have secured the resources required by this project, including any workshop time, equipment, or space that are additional to those already allocated to me.

Yes/No - The design of this study ensures that the dignity, welfare and safety of the participants will be ensured and that if children or other vulnerable individuals are involved they will be afforded the necessary protection.

Yes/No - All statutory, legislative and other formal requirements of the research have been addressed (e.g., permissions, police checks)

Yes/No - I am confident that the participants will be provided with all necessary information before the study, in the consent form, and after the study in debriefing.

Yes/No - I am confident the participant's confidentiality will be preserved.

Yes/No - I confirm that students involved have sufficient professional competency for this project.

Yes/No - I consider that the risks involved to the student, the participants and any third party are insignificant and carry no special supervisory considerations. If you circle "no" please attach an explanatory note.

No/Yes - I would like the ethics committee to give this proposal particular attention. (Please state why below)

Supervisor's signature: ...... Assoc. Prof.Dr. Yasemin Afacan....... date: ....20/12/2018.......

Please e-mail an electronic version of this word processed form (without signatures) along with other application material to the committee to start the evaluation process. Paper copies of all application material, (properly signed where indicated, and initialed on all other pages) should be sent after possible modifications suggested by the committee are finalized.

Bilkent University does not allow the use of students of research investigators as participants. Students who have the potential of being graded by the investigators during or following the semester(s) in which the study is being carried out should not participate in the study. Students may not receive any credit for any university course, with the exception of the GE250/GE251 courses, for their participation. The GE250 and GE251 (Collegiate Activities I and II) courses include an optional activity which encompasses volunteering as a participant in a research project.

5

YA · İY.

(Form Staff_EN*)

Staff Application Form for Experiments with Human Participants

(A separate application form must be completed for each experiment and staff member.)

Please check one: ___ ***I need a formal approval letter for an external agency (TÜBİTAK, etc.)***

_X_ ***An internal communication letter informing me of the approval will be sufficient***

1. Name of applicant (graduate students should indicate their supervisors)

Graduate Student: İrem Yumuşak; Supervisor: Assoc. Prof. Dr. Yasemin Afacan

2. Funder of grant/studentship if any:

Turkish Science Academy, Young Scientist Award Program (BAGEP 2017)

3. Full title of experiment/project

Heuristic Evaluation through Simulated Physical Ageing to Improve Airport Usability for Elderly

4. When do you wish to start data collection: _______01.01.2019_________

5. Aims of project:

This study aims to explore the usability problems for elderly people in an airport environment by using heuristic evaluation method through simulated physical ageing.

6. What will the participants have to do? (Provide a brief outline of procedure, *for survey work, a copy of the survey should be attached to this form.*) Please indicate if the participants may be exposed to stimuli which may upset them:

The participants will voluntarily participate the study. There will be eight participants. There are three different settings (Setting I, Setting II, Setting III) that will be conducted in an airport environment. Before the settings are started, brief explanation about the study and how participant's contribution will affect the study will be explained. In the Setting I, there is a questionnaire that will be asked during a movement tour of an airport environment. The questionnaire consists of six open-ended questions and is about the usability of that airport. The voices of the participants will be recorded during the questionnaire in order to analyse their answers qualitatively. In the Setting II, there are task scenarios to be performed by the participants in the same airport environment. Four participants will be wearing an age simulation suit and other four participants will not be wearing an age simulation suit during these task performances. After each task scenario, six heuristic questions about airport usability will be asked to the participants in a Likert Scale from 1 to 5. Moreover, difficulty level of each task will also be asked to the participants in a Likert Scale 1 to 5. The data obtained from the Setting II will be analysed statistically by using IBM SPSS Software. Setting III, is a questionnaire for the usability of the same airport environment that consist of similar open-ended questions to Setting I. However, in the Setting III, participants will be asked to reconsider their Setting I statements after their task performances in the Setting II. Their voices will be again recorded during the questionnaire in order to analyse their answers qualitatively. Lastly, as personal data, age, sex, profession, smoking status and physical exercise status will be asked to the participants. There will not be any discussion about life style or personal information of the participants. Moreover, all personal information of participants supplied during the research will be held in confidence in the researchers' database and accessed only by the study staff. The names of the participants will be coded into the numbers. So the personal information will not be shared in any medium.

7. What sort of people will the participants be and how will they be recruited? In the case of children state age range. (*Any participant who has not lived through his/her 18th birthday is considered to be a child!*)

All of the participants are between the age of 25 to 45. They will be in normal body mass index. Also, participants will be the professionals who works in architecture, design or construction field.

* Adapted from *www.york.ac.uk/depts/psych/www/research/ethics/StaffPGEthicsForm.doc*

YA. YA.

I have CRB[**] clearance yes / no

8. Arrangements for consent and debriefing (attach information sheet and consent form)

Each participant is informed about the study briefly. Each participant who takes part in the questionnaires and task scenarios will be asked to sign a consent form to satisfy ethical procedures (See attached consent form). Before conducting the settings, a brief explanation will be also given as to how data from their responses will be used.

9. How will you guarantee confidentiality of participants?

In the information consent form there is a statement, which is signed by the participants "we confirm that the confidentiality and anonymity will be maintained and the participant will not be identified from any publications". Moreover, all personal information of participants supplied during the research will be held in confidence in the researchers' database and accessed only by the study staff. The names of the participants will be coded into the numbers.

[**] Criminal Records Bureau – clearance is required for non-university personnel, including students, for experiments involving children. Please attach relevant documentation.

YA. Y.

10. Please e-mail an electronic version of this word processed form (without signatures) along with other application material to the committee to start the evaluation process. Paper copies of all application material, (properly signed where indicated, and initialed on all other pages) should be sent after possible modifications suggested by the committee are finalized.

Signature(s):

Person carrying out the work

Graduate Student: İrem Yumuşak

Supervisor, grant holder, or Principal investigator: I am satisfied that that the procedures adopted will ensure the dignity, welfare and safety of all participants in this work.

Supervisor: Assoc. Prof. Yasemin Afacan

The signature above signifies that researchers will conform to the accepted ethical principles endorsed by relevant professional bodies, in particular to

Declaration of Helsinki (WMA):
http://www.wma.net/en/30publications/10policies/b3/index.html

Ethical Principles of Psychologists and Code of Conduct (APA):
http://www.apa.org/ethics/code2002.html

Ethical Standards for Research with Children (SCRD):
http://www.srcd.org/about-us/ethical-standards-research

Bilkent University does not allow the use of students of research investigators as participants. Students who have the potential of being graded by the investigators during or following the semester(s) in which the study is being carried out should not participate in the study. Students may not receive any credit for any university course, with the exception of the GE250/GE251 courses, for their participation. The GE250 and GE251 (Collegiate Activities I and II) courses include an optional activity which encompasses volunteering as a participant in a research project.

Bilkent Üniversitesi Bilgilendirilmiş Onay Formu

Formu okuduktan sonra lütfen boşlukları dikkatlice doldurunuz.

1	**Katılımcının İsim ve Soy İsimi:**	______________________
2	**Acil bir durum için katılımcı yakını iletişim bilgileri (adres, e-mail, telefon numarası).**	______________________

Araştırma Başlığı:
Havaalanlarında ki Yaşlılara Yönelik Kullanım Problemlerinin Fiziksel Yaşlı Simülasyonu Aracılığıyla Analizi

Çalışmanın Amacı, Metodu ve Öngörülen Yararları: Bu çalışmanın amacı, havaalanı mekanlarındaki yaşlılara yönelik kullanım problemlerini, fiziksel yaşlı simülasyonu yardımıyla gözlemlemektir. Tüm katılımcılar gönüllü olarak çalışmaya destek sağlayacaktır. Toplamda sekiz katılımcı bulunacaktır. Kullanım problemlerinin analizi için üç ayrı bölümden oluşan (Bölüm I, Bölüm II, Bölüm III) bir çalışma hazırlanmıştır. Bu bölümlerle ilgili tüm çalışmalar aynı havaalanı ortamında gerçekleşecektir. Bölümler başlamadan önce çalışmanın amacı, anketin çalışmaya katkısı tüm gönüllü katılımcılara anlatılacaktır. Bölüm I' de, havaalanı kullanım problemleriyle ilgili altı açık uçlu sorunun sorulduğu bir anket bulunmaktadır. Bölüm I' deki tüm sorular, katılımcıların havaalanında gerçekleştirdiği fiziksel bir tur sırasında sorulacak ve verdikleri cevaplar sesli bir şekilde kayıt edilecektir. Bölüm II' de katılımcılara havaalanı ortamında senaryo bazlı görevler verilecektir. Bu görevler sırasında dört katılımcı yaşlı simülasyon kıyafeti giyerken, dört katılımcı ise giymeyecektir. Her görev sonunda katılımcılara, 1 den 5 e kadar sıralanmış Likert ölçeğinde, havaalanı kullanım analizine yönelik sorular sorulacaktır. Ayrıca her görevin zorluk derecesi de yine 1 den 5 kadar sıralanmış Likert ölçeğinde değerlendirilecektir. Bölüm III' de, havaalanına yönelik Bölüm I' de ki sorulara benzer açık uçlu sorular sorulacaktır. Ancak bu noktada, katılımcılardan Bölüm I' de verdikleri cevapları Bölüm II' de ki deneyimlerinden sonra tekrardan gözden geçirmeleri ve bu sorulara yeniden cevap vermeleri istenecektir. Katılımcıların açık uçlu sorulara verdikleri cevaplar sesli bir şekilde kayıt edilecektir. Çalışma sırasında katılımcılardan; cinsiyet, yaş, meslek, sigara kullanma durumu ve spor yapma durumu kişisel bilgi olarak paylaşmaları istenecektir. Tüm sorular ve senaryo bazlı görevler literatür taraması sonucunda bu çalışmaya uyarlanmıştır. Ön görülen herhangi rahatsız edici bir durum veya sağlık riski bulunmamaktadır. Çalışma boyunca elde edilen tüm veriler nicel ve nitel araştırma yöntemleri kullanılarak analiz edilecek. Ulaşılan tüm sonuçlarla, havaalanlarında ki yaşlılara yönelik kullanım problemleri elde edilecektir ve daha yaşlı dostu çevreler oluşturulmasına katkı sağlanacaktır. Katılımcıların tüm kişisel bilgileri saklı kalacaktır ve hiçbir mecrada yayınlanmayacaktır. Katılımcı isimleri yayınlanmayacak, isimler numaralar ile kodlanacaktır.

A Bölümü

A1	Çalışmanın herhangi bir bölümünde katılımcı çalışmanın bir parçası olmak istemediğine karar verip, çalışmayı herhangi bir açıklama yapmak zorunda olmadan bırakabilir. Ayrıca çalışma yürütücüsü katılımcının çalışmaya devam etmemesi gerektiğini düşünerek katılımcıyı çalışmanın dışında tutma kararı alabilir.
A2	Katılımcının çalışmaya katılımını sonlandırma kararı alması çalışmanın doğasını, çalışma ekibini ve çalışma ekibinin Bilkent Üniversitesi ile olan ilişkisini şimdi veya gelecekte etkilemez.
A3	Katılımcıların tüm kişisel bilgileri saklı kalacaktır ve hiçbir mecrada yayınlanmayacaktır. Katılımcı isimleri yayınlanmayacak, isimler numaralar ile kodlanacaktır.
A4	Tüm sağlık bilgileri ve kişisel bilgiler sadece çalışma yürütücüsünün veri tabanında saklanacak ve sadece çalıma yürütücüsü tarafından erişilebilecektir. Özel bilgiler hiçbir mecrada paylaşılmayacaktır.
A5	Katılımcı paylaşımları çalışma bünyesinde akademik amaçla yayınlanabilir ancak bu yayınlar katılımcıların kişisel bilgilerini içeremez. Tüm kişisel bilgiler gizli tutulacaktır.
A6	Katılımcılar 25 -45 yaş aralığındaki bireyler olacaklardır. Her katılımcı normal vücut kitle indeksine sahip olacaklardır. Katılımcılar mimarlık, tasarım veya inşaat alanlarında profesyonel olarak çalışıyor olacaktır.

B Bölümü (İmzalar)

B1 Katılımcı

Ben ______________________

Bu projenin doğasını anladım ve gönüllü olarak katılmayı kabul ediyorum. Aşağıdaki imzam onayımın belgesidir.

İmza: **Tarih:**

B2 Araştırmacı

Ben **İrem Yumuşak**

Katılımcıya araştırmanın amacını, metodunu ve beklediğim yararlarını açıkladım ve elde edeceğim bilgilerin mahremiyetini koruyacağım.

İmza: **Tarih:**

APPENDIX B

OPEN-ENDED QUESTIONNAIRE IN SESSION I

Katılımcı No:
Yaş: **Cinsiyet:** K / E **Sigara Kullanımı:** Var / Yok **Spor Düzeni:** *hiç* **1 2 3 4 5** *sıkça* **Meslek:**

Havaalanlarında Yaşlılara Yönelik Kullanım Problemlerinin Fiziksel Yaşlı Simülasyonu Aracılığıyla Analizi

BÖLÜM I (Açık Uçlu Sorular)

1. Yaşlıların fiziksel performansını göz önünde bulundurarak, havaalanının ana girişlerini mimari açıdan değerlendirir misiniz?
   Notlar:

2. Yaşlıların fiziksel performansını göz önünde bulundurarak, havaalanının yatay sirkülasyon düzenini mimari açıdan değerlendirir misiniz?
   Notlar:

3. Yaşlıların fiziksel performansını göz önünde bulundurarak, havaalanının dikey sirkülasyon düzenini mimari açıdan değerlendirir misiniz?
   Notlar:

4. Yaşlıların fiziksel performansını göz önünde bulundurarak, havaalanında ki oturma elemanlarını ve oturma düzenini mimari açıdan değerlendirir misiniz?
Notlar:

5. Yaşlıların fiziksel performansını göz önünde bulundurarak , havaalanında ki lavaboları mimari açıdan (konumlandırılması ve iç mimari elemanlarıyla) değerlendirir misiniz?
Notlar:

6. Yaşlıların fiziksel performansını göz önünde bulundurarak , havaalanında ki yeme-içme olanaklarını mimari açıdan (konumlandırılması ve iç mimari elemanlarıyla) değerlendirir misiniz?
Notlar:

APPENDIX C

TASK SCENARIOS, HEURISTIC QUESTIONS AND PHYSICAL DIFFICULTY LEVEL IN SESSION II

BÖLÜM II – SEZGİSEL DEĞERLENDİRME

Katılımcı no:

Bina Elemanı	Görev Senaryoları		Höristik No.	Höristik Tanım	Höristik Değerlendirme (Mekan Performansı) (1: kesinlikle katılmıyorum, 3: nötr, 5: kesinlikle katılıyorum)	Yorumlar	Zorluk (Fiziksel Perf.) (1: çok zor, 5: çok kolay)
(1)Erişim: Binaya Giriş	Senaryo 1 (S1)	İç hatlar giriş kapısını kullanarak güvenlik kontrolünden geçmek (ceketinizi çıkartarak ve giyerek)	H1	Elverişli bir güvenlik kontrol alanı tasarımıyla uzun kuyruklar önlenmiştir	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐
			H2	Toplu taşıma araçlarından kolaylıkla ulaşılabilir bir giriş sağlanmıştır	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H5	Yer/yön işaretleri ve bilgi levhaları/ekranlarında, yüksek kontrastlı renk kombinasyonları kullanılarak okunmaları ve algılanmaları kolaylaştırılmıştır (binanın dışından itibaren)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H6	Yer/yön işaretleri ve bilgi levhaları/ekranlarında, basit-anlamlı simgeler ve yalın (havaalanı jargonu dışında) bir dil kullanılmıştır (binanın dışından itibaren)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H9	Anonslar kolaylıkla duyulabilir ve anlaşılabilir şekildedir	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
(2)Yatay Sirkülasyon Elemanları	Senaryo 2 (S2)	İlgili check-in kontuarını bavul taşıyarak bulmak (hayali bir uçuş için)	H3	Kaygan zemin kullanımından kaçınılmıştır	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐
			H4	Bina elemanlarının (check-in kontuarı, bilgi ekranları vs.) uygun konumlandırılması sonucunda uzun yürüme mesafeleri önlenmiştir	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H5	Yer/yön işaretleri ve bilgi levhaları/ekranlarında, yüksek kontrastlı renk kombinasyonları kullanılarak okunmaları ve algılanmaları kolaylaştırılmıştır	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H6	Yer/yön işaretleri ve bilgi levhaları/ekranlarında, basit-anlamlı simgeler ve yalın (havaalanı jargonu dışında) bir dil kullanılmıştır	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H7	Yer/yön işaretleri ve bilgi levhaları/ekranları elverişli noktalarda konumlandırılmıştır	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H8	Yeterli bir aydınlatma seviyesi kullanılmıştır	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H9	Anonslar kolaylıkla duyulabilir ve anlaşılabilir şekildedir	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H12	Yeterli miktarda oturma elemanı bulunmaktadır (senaryo sırasından yorulma durumunda)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		

1

Bina Elemanı	Görev Senaryoları		Höristik No.	Höristik Tanım	Höristik Değerlendirme (Mekan Performansı) (1: kesinlikle katılmıyorum, 3: nötr, 5: kesinlikle katılıyorum)	Yorumlar	Zorluk (Fiziksel Perf.) (1: çok zor, 5: çok kolay)
(3) Dikey Sirkülasyon Elemanları	Senaryo 3 (S3)	Dikey sirkülasyon elemanlarını kullanmak (yürüyen merdiven, asansör, merdiven)	H3	Kaygan zemin kullanımından kaçınılmıştır	1☐ 2☐ 3☐ 4☐ 5☐		1☐ 2☐ 3☐ 4☐ 5☐
			H4	Bina elemanlarının (dikey sirkülasyon elemanları) uygun konumlandırılması sonucunda uzun yürüme mesafeleri önlenmiştir	1☐ 2☐ 3☐ 4☐ 5☐		
			H5	Yer/yön işaretleri ve bilgi levhaları/ekranlarında, yüksek kontrastlı renk kombinasyonları kullanılarak okunmaları ve algılanmaları kolaylaştırılmıştır (dikey sirkülasyon işaretleri)	1☐ 2☐ 3☐ 4☐ 5☐		
			H6	Yer/yön işaretleri ve bilgi levhaları/ekranlarında , basit-anlamlı simgeler ve yalın (havaalanı jargonu dışında) bir dil kullanılmıştır (dikey sirkülasyon işaretleri)	1☐ 2☐ 3☐ 4☐ 5☐		
			H7	Yer/yön işaretleri ve bilgi levhaları/ekranları elverişli noktalarda konumlandırılmıştır (dikey sirkülasyon işaretleri)	1☐ 2☐ 3☐ 4☐ 5☐		
			H8	Yeterli bir aydınlatma seviyesi kullanılmıştır (yürüyen merdiven, asansör ve merdiven için)	1☐ 2☐ 3☐ 4☐ 5☐		
			H9	Anonslar kolaylıkla duyulabilir ve anlaşılabilir şekildedir (yürüyen merdiven, asansör ve merdiven için)	1☐ 2☐ 3☐ 4☐ 5☐		
			H10	Yürüyen merdivenler elverişli bir hızdadır	1☐ 2☐ 3☐ 4☐ 5☐		
			H11	Kolaylıkla görünür asansör tuşları kullanılmıştır	1☐ 2☐ 3☐ 4☐ 5☐		
(4)Dinlenme (oturma) Elemanları	Senaryo 4 (S4)	Uygun bir oturma elemanı bulmak ve kullanmak (oturup kalkma pozisyonlarını deneyerek)	H4	Bina elemanlarının (oturma elemanlarının) uygun konumlandırılması sonucunda uzun yürüme mesafeleri önlenmiştir	1☐ 2☐ 3☐ 4☐ 5☐		1☐ 2☐ 3☐ 4☐ 5☐
			H8	Yeterli bir aydınlatma seviyesi kullanılmıştır	1☐ 2☐ 3☐ 4☐ 5☐		
			H9	Anonslar kolaylıkla duyulabilir ve anlaşılabilir şekildedir (oturma elemanlarından)	1☐ 2☐ 3☐ 4☐ 5☐		
			H12	Yeterli miktarda oturma elemanı bulunmaktadır	1☐ 2☐ 3☐ 4☐ 5☐		
			H13	Konforlu oturma elemanları kullanılmıştır	1☐ 2☐ 3☐ 4☐ 5☐		
			H14	Oturma elemanları arasında yeterli bir mesafe bulunmaktadır	1☐ 2☐ 3☐ 4☐ 5☐		

2

Bina Elemanı	Görev Senaryoları		Höristik No.	Höristik Tanım	Höristik Değerlendirme (Mekan Performansı) (1: kesinlikle katılmıyorum, 3: nötr, 5: kesinlikle katılıyorum)	Yorumlar	Zorluk (Fiziksel Perf.) (1: çok zor, 5: çok kolay)
(5)Tuvaletler	Senaryo 5 (S5)	Uygun bir tuvalet bulup kullanmak (kapıyı açmak, kabinleri ve lavaboyu kullanmak)	H3	Kaygan zemin kullanımından kaçınılmıştır	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐
			H4	Bina elemanlarının (tuvaletlerin) uygun konumlandırılması sonucunda uzun yürüme mesafeleri önlenmiştir	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H5	Yer/yön işaretleri ve bilgi levhaları/ekranlarında, yüksek kontrastlı renk kombinasyonları kullanılarak okunmaları ve algılanmaları kolaylaştırılmıştır (tuvalet işaretleri)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H6	Yer/yön işaretleri ve bilgi levhaları/ekranlarında , basit-anlamlı simgeler ve yalın (havaalanı jargonu dışında) bir dil kullanılmıştır (tuvalet işaretleri için)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H7	Yer/yön işaretleri ve bilgi levhaları/ekranları elverişli noktalarda konumlandırılmıştır (tuvalet işaretleri için)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H8	Yeterli bir aydınlatma seviyesi kullanılmıştır	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H9	Anonslar kolaylıkla duyulabilir ve anlaşılabilir şekildedir (tuvaletlerden)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H15	Kolay kullanıma sahip tuvalet elemanları (klozet, lavabo vs.) bulunmaktadır	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H16	Ağır kapı kullanımından kaçınılmıştır	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
(6)Yeme-İçme	Senaryo 6 (S6)	Uygun bir yeme-içme yeri bulmak ve oraya giderek yemek siparişi vermek	H4	Bina elemanlarının (yeme-içme yeri) uygun konumlandırılması sonucunda uzun yürüme mesafeleri önlenmiştir	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐
			H5	Yer/yön işaretleri ve bilgi levhaları/ekranlarında, yüksek kontrastlı renk kombinasyonları kullanılarak okunmaları ve algılanmaları kolaylaştırılmıştır (yeme-içme yeri işaretleri ve menü)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H6	Yer/yön işaretleri ve bilgi levhaları/ekranlarında , basit-anlamlı simgeler ve yalın (havaalanı jargonu dışında) bir dil kullanılmıştır (yeme-içme yeri işaretleri ve menü)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H7	Yer/yön işaretleri ve bilgi levhaları/ekranları elverişli noktalarda konumlandırılmıştır (yeme-içme yeri işaretleri)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H8	Yeterli bir aydınlatma seviyesi kullanılmıştır	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		

			H9	Anonslar kolaylıkla duyulabilir ve anlaşılabilir şekildedir (yeme-içme yerlerinden)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H12	Yeterli miktarda oturma elemanı bulunmaktadır	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		
			H13	Konforlu oturma elemanları kullanılmıştır	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐		

4

APPENDIX D

OPEN-ENDED QUESTIONNAIRE IN SESSION III

Katılımcı No:

Havaalanlarında Yaşlılara Yönelik Kullanım Problemlerinin Fiziksel Yaşlı Simülasyonu Aracılığıyla Analizi

BÖLÜM III (Açık Uçlu Sorular)

1. Bölüm II' deki deneyimizden sonra; yaşlıların fiziksel performansını göz önünde bulundurarak, havaalanının ana girişlerini mimari açıdan tekrardan değerlendirir misiniz?
   Notlar:

2. Bölüm II' deki deneyimizden sonra; yaşlıların fiziksel performansını göz önünde bulundurarak, havaalanının yatay sirkülasyon düzenini mimari açıdan tekrardan değerlendirir misiniz?
   Notlar:

3. Bölüm II' deki deneyimizden sonra; yaşlıların fiziksel performansını göz önünde bulundurarak, havaalanının dikey sirkülasyon düzenini mimari açıdan tekrardan değerlendirir misiniz?
   Notlar:

4. Bölüm II' deki deneyimizden sonra, yaşlıların fiziksel performansını göz önünde bulundurarak; havaalanında ki oturma elemanlarını ve oturma düzenini mimari açıdan tekrardan değerlendirir misiniz?
Notlar:

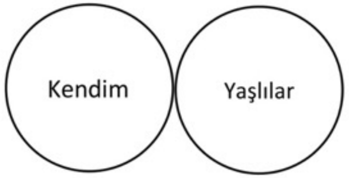
5. Bölüm II' deki deneyimizden sonra; yaşlıların fiziksel performansını göz önünde bulundurarak, havaalanında ki lavaboları mimari açıdan (konumlandırılması ve iç mimari elemanlarıyla) tekrardan değerlendirir misiniz?
Notlar:

6. Bölüm II' deki deneyimizden sonra, yaşlıların fiziksel performansını göz önünde bulundurarak, havaalanında ki yeme-içme olanaklarını mimari açıdan (konumlandırılması ve iç mimari elemanlarıyla) tekrardan değerlendirir misiniz?
Notlar:

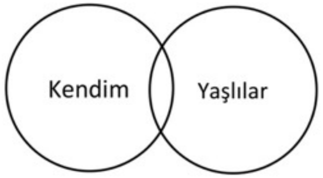
APPENDIX E

IOS SCALE QUESTION IN SESSION IV

Her üç bölümde ki performansınızı ve yanıtlarınızı düşündüğünüzde, kendinizi yaşlı kullanıcıların yerine ne kadar koyduğunuzu ve düşünüyorsunuz?



1



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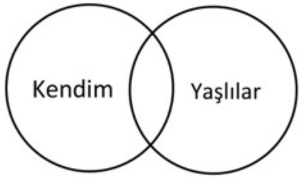

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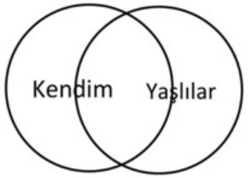

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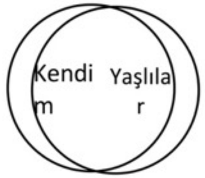

7

Katılımcı No:

APPENDIX F

PHOTOGRAPHS OF THE AIRPORT ENVIRONMENT

Figure F.1. Domestic entrance area outside of the building (taken by the author, 2019).

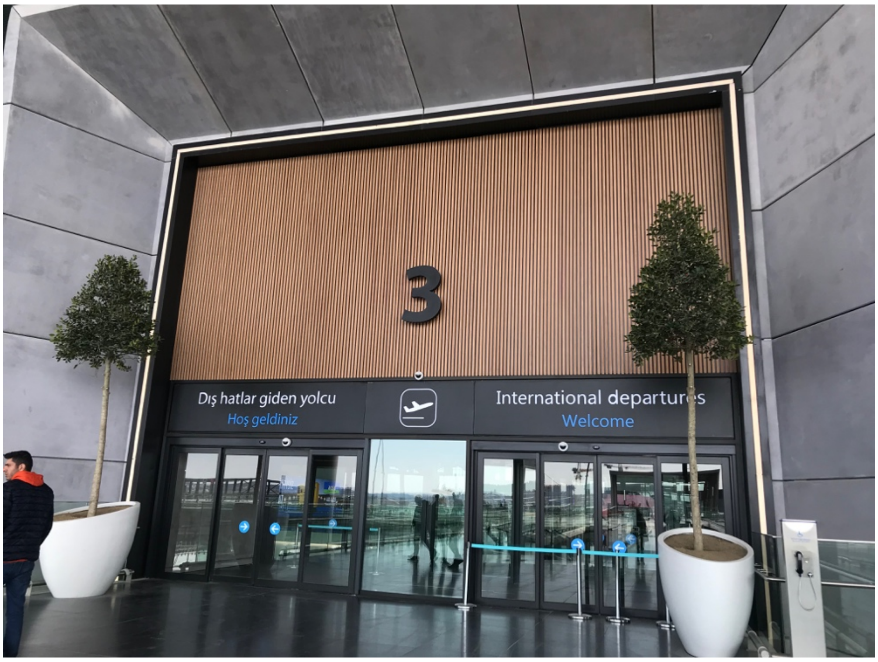

Figure F.2. Domestic entrance area outside of the building (taken by the author, 2019).

Figure F.3. Check-in counters in domestic arrivals (taken by the author, 2019).

Figure F.4. Flight information screens right after security check points (taken by the author, 2019).

Figure F.5. Escalator (taken by the author, 2019).

Figure F.5. Elevators (taken by the author, 2019).

Figure F.6. Eating area (taken by the author, 2019).

Figure F.7. Seating area (taken by the author, 2019).

Figure F.8. Seating area (taken by the author, 2019).

Figure F.9. Restroom cabins (taken by the author, 2019).

Figure F.10. Wash basins in restrooms (taken by the author, 2019).

Figure F.11. Signage system (taken by the author, 2019).

Figure F.12. Signage system (taken by the author, 2019).